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Features of Healing Gardens and their Importance for Restoration

Master thesis
submitted by
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Abstract

Although the presence of nature, in such forms as park land, open space and greenery, have a positive effect on humans who are statistically ever more stressed at their workplace, not all green spaces seem to conform to this understanding. These natural spaces have rather to be designed purposely in order to be restorative. Motivated by research about healing gardens, a self experiment was conducted in the botanical garden of Zurich, along with expert interviews and a literature research to find specific restorative features in gardens. In the self experiment two garden sites were compared using the revised attentional network task (ANT-R) in terms of their restorative effects, and slight differences were found between the two sites. In the expert interviews and the literature research, nine aspects of features of a garden that have a restorative effect could be found. Finally it is proposed that through application of those aspects of features, a garden, as well as other environments, can be consciously designed to be more restorative.

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Introduction

According to the Bundesamt für Statistik (BFS) in 2017, 21% of the working inhabitants of Switzerland were prone to regularly suffer from stress at the working place (Bundesamt für Statistik, 2019). Stress is seen as one of the precursors of many different types of illnesses, such as cardiovascular disease and burnout (Bundesamt für Statistik, 2019, Ehlert, 2016). It is furthermore even seen as a factor that might promote an earlier occurrence of age-related diseases (Epel et al., 2004). In scientific literature it is commonly acknowledged that green spaces, including parks and gardens, are able to reduce stress and support health (Hartig, Evans, Jamner, Davis, and Gärling, 2003). For example, view into the green out of a window shortens the stay in a hospital after surgery (Ulrich, 1984), walking in a forest increases the activity of the immune system (Li et al., 2008), and spending time in a healing garden reduces blood pressure (Taheri and Shabani, 2016).

Green spaces are especially needed in the context of work and working places in the cities, but also around hospitals and other health facilities, to provide possibilities for stress alleviation and restoration (Kaplan, 1993). Certainly, much more can be done to transform our cities into healthy and supportive environments not just for humans but also for other organisms (Hunter and Hunter, 2008). The better we understand the restorative effects of green spaces, the more we can use this knowledge to create a healthy environment. The design of green spaces matters. Simply adding more green does not seem to be sufficient (Lindemann-Matthies and Matthies, 2018). The way green spaces are perceived is highly dependent on the context and the restorative effect of green areas therefore varies (Herzog, Maguire, and Nebel, 2002). For example, White et al. (2010) have shown that the occurrence of water has a positive influence on the perceived restoration in both natural and urban environments; and tended forests increase the positive and decrease the negative affect better than wild forests (Martens, Gutscher, and Bauer, 2011).

Overall, the information about the restorative effect of specific designs and features of green spaces is scattered and especially in Switzerland little research has been conducted on this issue.

This master thesis therefore contributes to the investigation of restorative effects of specific features and elements of green spaces. The focus lies on parks and gardens, especially on healing gardens as they have been created intentionally for restoration (Marcus and Sachs, 2014) and the following research questions are investigated:

1. **What specific features of green spaces (gardens) have a positive restorative effect on humans?**
2. **Do specific sites within the same garden differ in terms of their restorative effect?**

The following hypotheses can be derived from the aforementioned:

- There are definable features of a garden that have a restorative effect. Consequentially, through application of these features, a garden can be consciously designed to be more restorative.
- The different areas and places within a garden can differ considerably in terms of their restorative effects.

To answer the first research question expert interviews and literature analysis is used. For the second research question a self-experiment is performed. In the interview section, several experts whose work is either directly or indirectly related to the restorative effects of gardens and healing gardens are interviewed in order to arrive at a better understanding of the vast array of specific restorative features. In the literature analysis, the focus lies on healing gardens with the aim of extracting a list of features that support restoration. With the self-experiment, the restorative effect of two different sites in the same garden is investigated by measuring directed attention (see below) after a stressful trip to the sites through the city centre during morning rush hour. Moreover, a specific list of restorative features is expected to be discovered, namely features that can only be found by being physically exposed to the situation and by talking with people that work inside a garden. Since fully objective investigations about the complex systems of restorative environments and its mechanisms prove to be difficult to achieve, the author attempts to combine subjectivity and objectivity by choosing this form of experiment.

Terminology

Green spaces is used as a general term for gardens, parks, forests, and meadows. The term *nature* is largely avoided in this study because it is very generic and hard to grasp. As an example nature is defined by Oxford University Press (2019) as: "The phenomena of the physical world collectively, including plants, animals, the landscape, and other features and products of the earth, as opposed to humans or human creations." (Oxford University Press, 2019, Definition of nature). It is very difficult to draw a line between what is human-made and what is not, and, furthermore, it is not obvious why humans should be separated from nature (for discussions see, e.g., Wohlwill (1983)).

Gardens can be defined in various ways and conforming to the Oxford University Press (2019), parks can be seen as large gardens. A garden is: "A piece of ground adjoining a house, in which grass, flowers, and shrubs may be grown" (Oxford University Press, 2019, Definition of garden). In another definition by Drosdowski (1989, p. 560) gardens are defined as a confined land for planting vegetables, fruits, flowers or similar things. Finally, it is important to highlight a garden's role in expressing a specific understanding of nature in the context of a certain culture (Henning, 1980).

Healing gardens are defined as gardens that are specifically designed for therapeutic or beneficial effects on the majority of its users (Ulrich, 1999). The term *healing garden* is typically used in connection with healthcare facilities, where the healing aspect is key.

In this thesis, we talk about *restoration* and largely avoid the generic term *healing*. Restoration typically describes an important aspect of returning to a former, healthier condition (Oxford University Press, 2019). For example, if suffering from an illness it means to return to a healthy state, or if stressed it means to return to a more relaxed state. The latter is essential to prevent illnesses (Epel et al., 2004).

Measuring restoration

One standard attempt used to measure restoration involves an indirect approach by surveying test subjects, with, e.g., the perceived restorative scale (PRS) (Herzog et al., 2002; Van den Berg, Jorgensen, and Wilson, 2014; Korpela and Hartig, 1996). These surveys reveal a higher perceived restoration from stress and negative mood in natural than in urban settings, a higher perceived restoration when the four factors of the attention restoration theory (ART) are present (see below), and a connection of restorative places and favourite places (Herzog et al., 2002; Van den Berg et al., 2014; Korpela and Hartig, 1996). Such surveys make sense regarding the psychological aspect of restoration from stress and individual differences in the preferred settings for stress alleviation. A similar subjective assessment is done by recording the mood change after exposure to, e.g., stress and different environments (Van den Berg et al., 2014). Typically after induced stress negative mood was stronger and more complete restored after contact with natural settings than urban settings and the restorative state increased after contact with green spaces (Van den Berg et al., 2014). A more objective approach to measure restoration is via the measurement of directed attention (Kaplan and Kaplan, 1989), based on the attention restoration theory (ART) of Kaplan and Talbot (1983) and Kaplan (1995).

Attention restoration theory (ART) states that four factors are involved in making a place restorative (Kaplan and Talbot, 1983). First, being away; meaning being away from some aspects of everyday environment, physically as well as mentally (Kaplan, 1995). Second, fascination; there should be things that hold the attention in a non-invasive effortless fashion, giving way to many opportunities to think about other things (Kaplan, 1995). Third, extent; a felt width, also historic artefacts can lead to the sense of a larger world (Kaplan, 1995). And fourth, compatibility; one should be able to do what one pleases in the environment (Kaplan, 1995). The main focus of this theory lies on directed attention, which is a renamed concept, taken from the concept of voluntary attention suggested by William James (1892) (as cited in Kaplan and Kaplan, 1989). Voluntary attention is needed when something is not very interesting and does not draw the attention effortlessly, as opposed to the involuntary attention which does not need any effort; the attention is automatically

drawn by interesting occurrences (James, 1892). Directed attention takes a lot of energy because focusing on something needs the inhibition of all other stimuli which tend to draw attention (Kaplan and Kaplan, 1989). Therefore, the better the restoration, i.e., the less stressed and the more relaxed somebody is, the more accurate and faster the directed attention and the resulting action becomes. This is why the measurement of directed attention is taken as an indirect measurement for restoration.

Directed attention is very important for our daily life and can cause severe consequences if it is fatigued (Kaplan and Kaplan, 1989). Many studies are using directed attention for measuring restoration (of attention). Directed attention is typically measured with the attention network task (ANT) from Fan, McCandliss, Sommer, Raz, and Posner (2002). From the results of the ANT the flanker conflict can be calculated which is high when directed attention is low and low when directed attention is high (Berman, Jonides, and Kaplan, 2008). An increase of the flanker conflict thereby implements that one is not able to inhibit irrelevant excitations properly anymore which in long term also influences the functioning in a society. Fatigue of directed attention can be linked to lower self control (Vohs et al., 2008). As an example of using the ANT, in their experiment, Berman et al. (2008) showed pictures to the participants of nature and urban environments for ten minutes and participants had to rate them (Berman et al., 2008). Before and after they made the rating they had to fill out the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and conducted the ANT (Berman et al., 2008). The PANAS scales the mood and was used to investigate a possible correlation of mood and cognitive functioning (Berman et al., 2008).The self experiment in this thesis will utilize both, the PANAS and a revised version of the ANT.

Methods

Three different methods were used to answer the research questions about specific features of a garden that have a positive and restorative effect on humans. The expert interviews and healing garden literature search was done for investigating features in a garden that help make a stay more restorative. For examining the effect of available features on restoration of attention and mood, two sites in the same garden were compared with a self experiment.

Expert Interviews

To collect information on restorative features of gardens, four experts were interviewed, Dr. Nicole Bauer, Iréne Kuhn, Stefan Müller, and Annemarie Spring. They were chosen according to their connections to healing gardens and subsequently extended to restorative environments. More detailed information about the experts is given below.

Experts

Dr. Nicole Bauer is a research fellow at Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) in the group social sciences in landscape research. Her subject is restoration. She explores the connection between environments and the restoration of humans in it. The interview took place on the area of the WSL on June 15, 2019.

Iréne Kuhn is an activation specialist HF in the retirement home Gibeleich in Opfikon. The garden in the retirement home Gibeleich was remodelled between 2003 and 2005; it was documented in the "Schlussbericht; KTI-Projekt Nr. 6177.2FHS-ET (2003-2005); Therapeutische Gärten für Alterszentren; Ansätze zur Gestaltung und Nutzung von geriatrischen Aussenräumen" (Beck et al., 2005). The interview took place in the therapeutic garden of Gibeleich on August 8, 2019.

Stefan Müller is the head gardener of the Inselspital Bern and responsible for the entire outdoor area of the hospital. A work was published in 2005 about the Inselgärten, the gardens of the hospital, and how they can be improved according to the healing garden concept. This work was called "Die Umgestaltung der Inselgärten nach dem Konzept Healing Garden" (Gabriel et al., 2005). The interview took place in the garden of the Inselspital Bern on August 21, 2019.

Annemarie Spring is working in the Kartause Ittingen and offers guided tours. She has been working there for 16 years and started to make garden tours eight years ago. The Kartause Ittingen is famous for its rose gardens and attracts a lot of people especially in the blooming season of the roses. The Interview took place in the gardens of the Kartause Ittingen on August 28, 2019.

In-depth interview and interview guideline

The interview topic was about features or influences of the garden that they think have an effect on the human recovery quality when spending time in the garden. The interviews were in-depth interviews with a guideline. The used guidelines can be found in the appendix page 32 ff.. The interview was conducted fairly freely in order not to influence in some preferred direction of the interviewing person. All the interviewees were asked for their definition of a garden. Except from Dr. Nicole Bauer, all interviewees have made a guided tour through the garden they work in. The original transcript of the interviews is with the author and can be requested by email. In order to minimize the interviewers' impact on the statements of the interviewees, the interviewer tried not to make any judgmental statements or ask suggestive questions, as recommended by Dresing and Pehl (2018). The interviewer tried to just listen and to interrupt as little as possible the flow of speech of the interviewee. Furthermore specific questions were asked only in the end for having no impact on the majority of the answers.

Transcription of interviews and focused coding for analysis

All interviews were transcribed into High German, guided by the instruction given in the book of Dresing and Pehl (2018). It was transcribed according to the content-semantically transcription. Following the main guidelines: It is transcribed word for word, not phonetically or summarizing; dialects are being translated as accurately as possible, and if not possible just kept inside; words like „hm", „aha", „ja", „genau" by the interviewer are not being transcribed if not interrupting the talking person; breaks longer than three seconds are marked with (...); emotional nonverbal expressions are noted in brackets (Dresing and Pehl, 2018).

Focused coding was used to analyse the transcribed interviews (Saldaña, 2015). Every interview was read through and all the information relating to features of the garden, well-being and restoration were gathered. Out of this gathered information, keywords were extracted and arranged into preliminary categories. If they were not fitting, a new category was added. Those keywords were searched in the original text and statements were summarised per expert. Finally, the information was grouped into nine physical and qualitative categories (later in the text referred to as aspects), which summarize the features of a garden important for restoration.

Literature Research

Literature analysis based on the standard reference for healing gardens (Marcus & Sachs, 2014; a book with an evidence based approach towards features of a healing garden) as well as abstracts of relevant papers was used to complement and support the restorative aspects found through the analysis of the in-depth interviews. Disease specific features were excluded. Restorative features were extracted from the book and the abstracts and grouped, where possible, into the same

restorative aspects (categories) found through the interview analysis. All features were grouped and there was no need for an additional category.

For finding relevant papers the term "healing garden" was searched in Scopus and Web of Science in the article title, abstract and keywords. The results were retrieved on the 12. February 2019. The search gave 96 scores on the database Scopus and additional 17 on the database Web of Science. Of those 96 scores on Scopus 16 did not have an abstract and two were mentioned twice. They were excluded. Of the remaining 78 only 15 papers were found to contain relevant information and were included in the end for investigating the features and one additional from Web of Science. For the table about the benefits of healing gardens (Appendix, Table A 3) additional five papers were included from Scopus and one from Web of Science. In total 22 papers with focus on different participants were included in the literature research (Appendix, Figure A 1). The methods used by the authors of the investigated papers ranged from literature review, to single case studies of hospitals or care facilities, to interviews, to questionnaires, up to observations and behaviour analysis (Appendix Table A 3).

Self Experiment

In the self experiment conducted by the author, the main goal was to see whether there were differences in the restoration ability of different garden surroundings. The focus was directed to the restoration of attention and mood. Perception of the surrounding depends amongst other things on the elements in the garden. The focus of the researched question lies primarily on whether there are any locational differences in restoration at all.

Locations compared for their effect on restoration

The two places compared are located within the new Botanical Garden of the University of Zurich. They were chosen according to their perceived differences by the author. The first one is located on a hill in a typical Zurich forest with fixed benches and the second one at a pond with mobile chairs on a mowed meadow (Figure 1). The restoration at those places was measured via the restoration of attention, specifically via the revised attention network task (ANT-R) developed by Fan et al. (2009).

Revised attention network task (ANT-R) for measuring restoration of attention

The process of the ANT-R is as follows (see Fan et al., 2009, for more details): Participants are instructed to fixate on a cross. Next to the cross there is a rectangle to each side. Inside one of those rectangles five arrows appear often preceded by flashing of the rectangles. The flashing occurs on either one or both rectangles. As soon as the arrows appear, the participant has to indicate as fast as possible in which direction the arrow in the middle is pointing by pressing the respective key. The flanking arrows can be congruent or incongruent with the middle arrow. The reaction time of the congruent trials subtracted from the incongruent ones results in the flank conflict. The flanker

conflict is connected with the directed attention. If the flanker conflict is high the directed attention is low, and vice versa (cf. Berman et al., 2008). The test lasts approximately 30 minutes and consists of four sessions with three pauses in between (Fan et al., 2009).

Recording of feelings after arrival and after break for perceiving the environment

The feelings and impressions were recorded in a journal and using the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) for measuring the mood, to see whether the different sites have an influence on it. The PANAS consists of 20 adjectives and one has to rate them on a 5-point Likert scale. Ten of those adjectives concern measuring positive affect: enthusiastic, interested, determined, excited, inspired, alert, active, strong, proud, and attentive. And ten of those adjectives for negative affect: scared, afraid, upset, distressed, jittery, nervous, ashamed, guilty, irritable, and hostile (Watson et al., 1988). The results can vary between a minimum of 10, meaning every adjective is rated as not true or very slightly true, and a maximum of 50, meaning every adjective is rated as extremely true.

Data analysis

The software used for the ANT-R and the PANAS was Inquisit 5 (2018) retrieved from https://www.millisecond.com. All the calculations have been made with R (www.r-project.org/). Especially descriptive analysis was made, because statistical tests need to have independence of the measurement points which is not given in a self experiment. Plotting, calculating variables (like f.e. flanker conflict), and calculating means was performed with R.

Experimental design

The experiment took place on Mondays, Tuesdays, Thursdays and Fridays with alternating sites (Figure 1). This form was repeated until there were 21 repetitions per site. The idea was to always have a counter part of the other site in the same time difference and with similar conditions.

Description of self experiment

The self experiment started by taking the tram to the destination Hegibachplatz at 7:48 in the morning. The tram ride took approximately 30 minutes. In the tram the author made notes of the sleep (hours and quality), breakfast, weather (according to the internet), equipment, program of the day, motivation, stress, tiredness, and special occurrences. From Hegibachplatz the author walked to the Botanical Garden and to the site of the day (Figure 2). Upon arrival the first impression of the site was noted, then the laptop with a little "tent" protecting it against the rain and blocking the sun was set up and the PANAS followed by the ANT-R was conducted (Figure 3). After each test a 15-minute break was taken, during which the surroundings were observed sitting on a bench or chair. Ten minutes should already be enough according to Berman et al. (2008), but just to be safe 15 minutes

were chosen. After those 15 minutes (an alarm was set), the "tent" was repositioned again and the PANAS followed by the ANT-R was repeated (Figure 1). After finishing or sometimes in between some thoughts and occurrences during the test or break were noted.

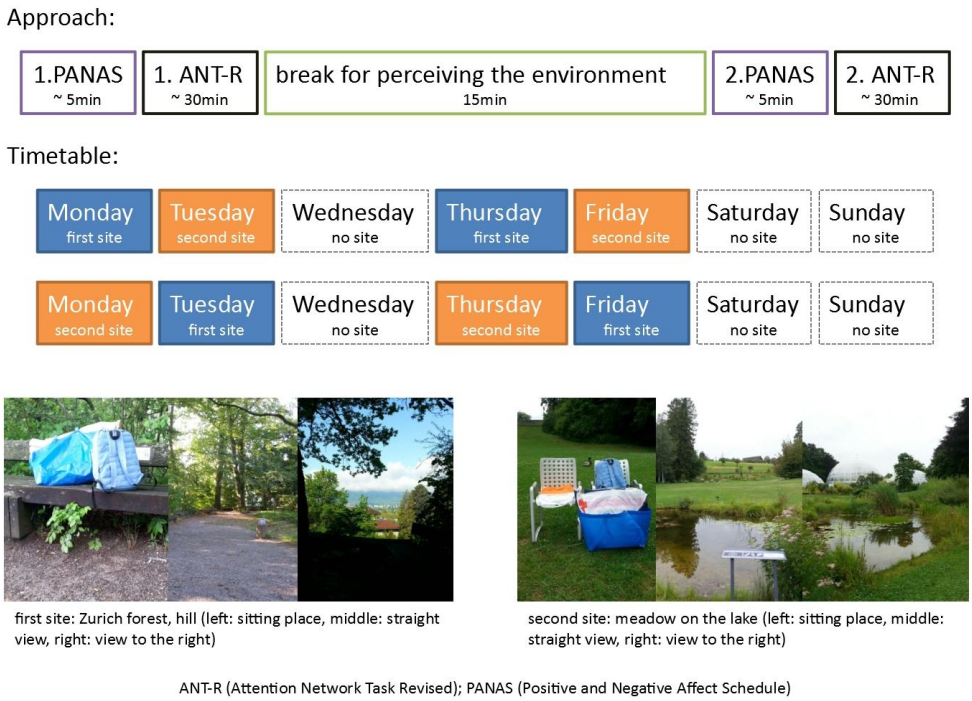

Fig. 1. Structure of the self experiment. Photographs by Carmen Allemann.

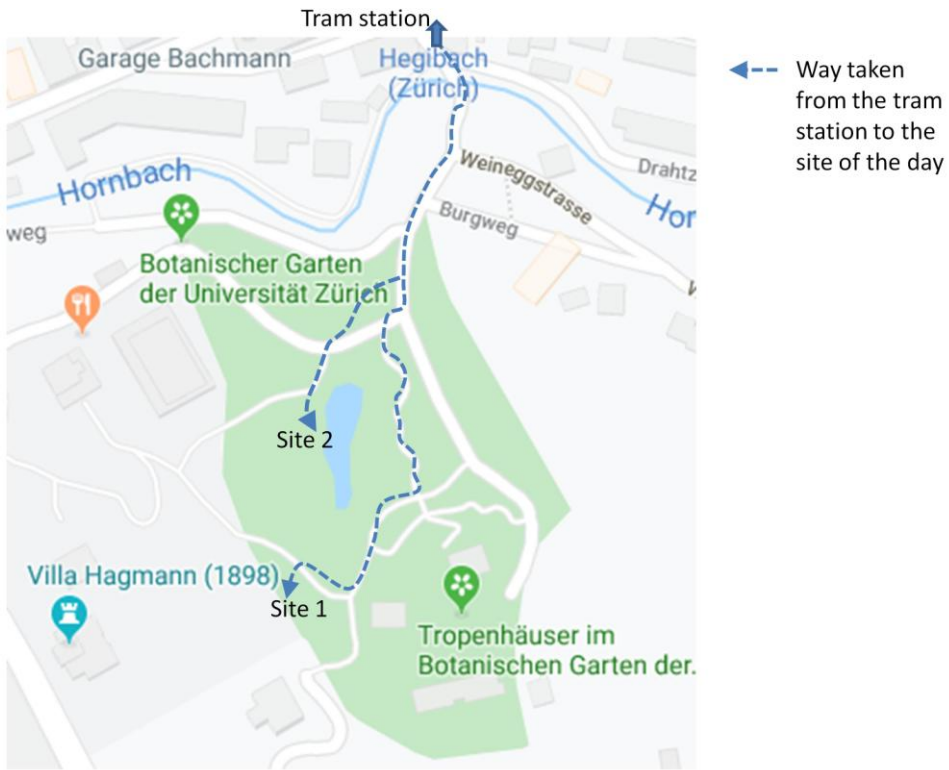

Fig. 2. Way taken from Hegibachplatz to the site of the day. Site 1 on a hill in the forest and site 2 on a meadow near a pond. Google. [new Botanical Garden Zurich, Switzerland, with surrounding]. Retrieved on 11.04.19, from https://www.google.ch/maps/@47.3588156,8.5598223,17z

Fig. 3. The author conducting the ANT-R with the so called "tent" at the pond site (left) and at the hill site (right). Photographs by Carmen Allemann.

Pilot studies

Before opting for the applied method, four pilot projects were conducted. In the first pilot project the author took a one-hour walk through both the new and old Botanical Garden of the University of Zurich and took notes of everything that she consciously registered. The second pilot project took place in the new Botanical Garden and consisted of conducting a free recall test with two different kinds of breaks; one looking into the garden without focus and the other focussing on one plant. The third pilot project used the ANT-R and also a stress test and was conducted in the new Botanical Garden again, with seven repetition from Monday to Sunday (from May 5 to May 10, 2019). And the last pilot project was conducted in the same way as the finally used one only without the "tent" and only eight repetitions (from May 13 to May 24). In this last pilot project the reaction time slightly increased, so there seemed to be no learning effect, as was suspected after the third pilot project (see Appendix, Figure A 2 and Figure A 3). The two sites showed slight differences in the reaction times. This kind of design seemed to work.

Results

Expert Interviews

Definitions of a garden and restoration by interviewees

A typical garden described by Dr. N. Bauer has a lawn, a vegetable and a flower bed and shrubs and similar things. It is also a kitchen garden, not only with blooming and beautiful plants, but also vegetables and fruit trees. She does not think of the WSL area as a simple garden. (Dr. N. Bauer, personal communication, July 15, 2019)

For Ms. Kuhn, a garden is an experiential oasis and a heaven of tranquillity. One can observe how things grow, prosper and change. A garden can spark memories. A garden is defined by its name, therefore a park is not the same. A garden is something that can be used, like the kitchen garden and it is something close and personal. Everyone has their own way of thinking about it (I. Kuhn, personal communication, August 8, 2019).

For Mr. Müller a garden is something man-made, not purely natural. It should primarily satisfy humans as opposed to nature. The hospital area would fit the definition of a garden, size is not important (S. Müller, personal communication, August 21, 2019).

A garden is described by Ms. Spring as being very broad. Gardens can appear in different forms with different purposes: There are gardens for beauty, joy, harvest, or a mix of all. Today a garden is luxury. It is only fully perceived when working within or with it. Living beings such as worms, insects, birds and plants, especially trees and also weeds all belong into a garden. The Kartause Ittingen consists of many gardens, not just one (A. Spring, personal communication, August 28, 2019).

When it comes to Dr. Nicole Bauer's definition of restoration, she describes restoration as renewal of resources which were fatigued or exhausted over the daily routine. Restoration is mostly about the ability to concentrate. When we concentrate we have to suppress everything else which requires a lot of energy. After a while, this leads to a digression of the attention paid to other things. Recovery research primarily deals with the recovery of this concentration ability, so that people can do their daily work (Dr. N. Bauer, personal communication, July 15, 2019).

Restorative aspects of a garden

Nine physical and qualitative aspects of a garden, summarizing multiple features mentioned during the interviews, were found to have an influence on the restoration ability of a garden (Figure 4). The three physical aspects are: Water, Plants and Ecosystems, and Infrastructure. The six qualitative aspects are: Aesthetic, Preference, Settings, Use, History, and Experience. Keywords and

features summarized in these comprehensive categories are shown in Table 1 and Appendix Table A 1 and Table A 2.

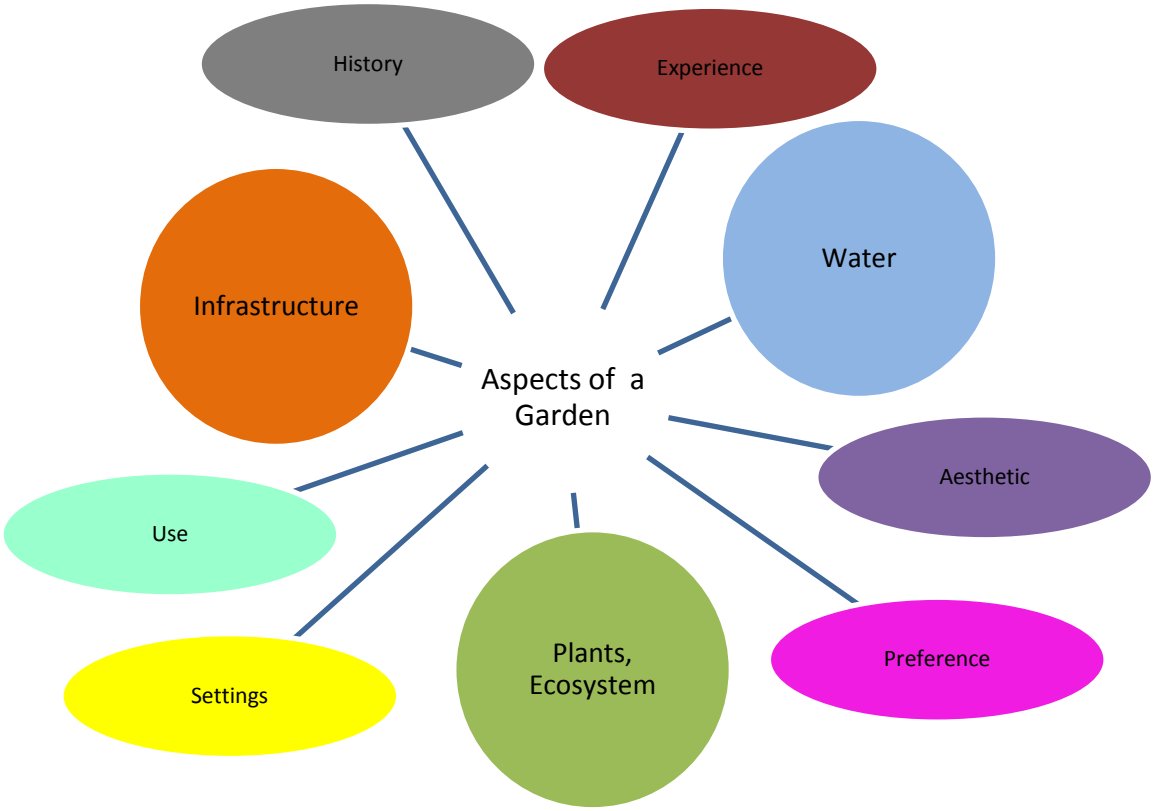

Fig. 4. Physical (circle) and qualitative (oval) aspects of a garden found to be important for restoration. Each aspect summarizes a multitude of features mentioned during the interviews. The colours in this figure match the colours in Table 1, Table 2, Table A 1 - Table A4.

Table 1 and Table 2 provide the definitions of the physical and qualitative aspects as well as the related keywords. One example (quotation) of a description of features is given each. For more examples and how they were organized see Appendix Table A 1 and Table A 2.

Table 1. Definition of the three physical aspects of a restorative garden.

Physical aspects	Definition	Keywords	Example (description of features)
Water	Water itself or things related to it (like fish and water plants).	Wasser, Teich, Bach, Weiher, Brunnen, Fischbehälter, Fisch, ertrinken, Seerose	"*Und besonders find ich dann eben auch die Seerosen dass es mit den Farben dass es unterschiedliche Farben gibt und dass das Wasser sich spiegelt, die Bäume sich im Wasser spiegeln und so Reflexionen gibt, das find ich einfach interessant* [...] " (Dr. N. Bauer, personal communication, July 15, 2019)

Physical aspects	Definition	Keywords	Example (description of features)
Plants, Ecosystem	The collective group of elements like all stages of plants, soil, stones, raised beds, fire, animals, and ecosystems.	Pflanzen, Natur, Wald, naturnah, Hochbeet, Grün, Holz, Feuer, Bäume, Gartenarbeit, Ökosystem, Asthaufen, Schottergarten, Ruderalfläche, wild, Erde, Samen, Kompost, Stein, Vegetation, erdet, Tier, Insekten, Schmetterlinge, Eidechsen, Vogel, Biene, Leben, Igel, Blindschleiche, Fisch, Wurm, Enten, Schaf, Esel	" [...]*aber glaub die Leute ziehts schon eher irgendwohin wo es noch ein bisschen Grün hat*." (S. Müller, personal communication, August 21, 2019)
Infrastructure	Infrastructural elements such as seating, trash bins, or paths.	Infrastruktur, sitz (Sitzmöglichkeiten, etc.), hinzusetzen, Wege, möblieren, Möbel, Tisch, Stuhl, Liegen, Bank, Abfall, Vernetzung, Toilette, Stange	*"[] die Idee ist, dass die Möblierung immer mobil ist []"* (S. Müller, personal communication, August 21, 2019)

Table 2. Definition of the six qualitative aspects of a restorative garden.

Qualitative aspects	Definition	Keywords	Example (description of features)
Aesthetic	Things that are visually pleasing or displeasing to the human eye.	Ästhetik, artenreich, (bio-)divers, Kunstwerk, Künstler, Konturen, vielfältig, gepflegt, Farben, blüht, blühen, Beton, Showgarten, Kontrast, Blumen, Reflexionen, Spiegelungen, visuell, attraktiv, schön, deko, Blätter	"[...] *und mehr und mehr sind dann auch Kunstwerk darin hinein gekommen und das ist ja etwas, also manchmal siehts einfach lustig aus, aber man tut es zum Schmücken hinein oder.*" (A. Spring, personal communication, August 28, 2019)
Preference	People's personal taste and tendencies.	Vorlieben, Präferenz	*"[] ich denke mal wichtig ist, sind die Vorlieben []"*(Dr. N. Bauer, personal communication, July 15, 2019)
Setting	Geographic location and rough design. Also included are the conditions of the surroundings.	Grösse, weiter weg, abgerückt, Fläche, Nischen, Gestaltung, Sichtschutz, Zonierung, Zone, öffentlich, , Funktion, geschützt, privat, Distanz, organisiert, kleinere Einheiten, ~Areal, Raum, viele Gärten, Platz, umgrenzt, eingefriedet, verschiedene Gärten, Licht, Schatten, dunkel, sonnig, schattig, hell, Lärm, Flugzeug, bau, heiss, Verdichtung, Aussicht, Wetter	*"Ich würde sagen ein Garten hängt nicht so sehr von der Grösse ab []"* (A. Spring, personal communication, August 28, 2019)

Qualitative aspects	Definition	Keywords	Example (description of features)
Use	The reasons why people (do not) go into a garden.	Zeit, kurz, Wissen, Produkt, Geld, Platz, selten, mehr nutzen, Pocket-Park, belebt, Signaletik, Flyer, Sinn, lehren, lernen, Image, Arbeit, raus gehen, frische Luft, draussen, schauen, Wetter, anschreiben, Eingang	*"[] ganz viel auf die grüne Wiese gesetzt und das wird ja häufig nicht wirklich genutzt, []"* (Dr. N. Bauer, personal communication, July 15, 2019)
History	Chronological and historical aspects to a garden.	Geschichte, historisch, Alter, alt, Epoche, barock, geschichtlich, biographisch, früher, -zeiten, jährig	*"Hier noch der älteste Baum auf dem Areal, der ist knapp 200 jährig. Eine wunderschöne Blutbuche."* (S. Müller, personal communication, August 21, 2019)
Experience	Resources that are provided by the garden and possibilities of using it.	Harmonie, Kommunikation, Respekt, Kräuter, Essblüten, Luxus, Gewürz, Nutz-, Flanier-, Macht, Konfitüre, essen, riechen, trainieren, ernten, Leidenschaft, Wissen, Kreislauf, Erfahrung, Arbeitsplatz, Tee, Restaurant, Duft, Bier, spazieren, durchgehen	*"[] dann zu verschiedenen Teemischungen und Heilkräutermischungen und wir machen zum Beispiel hier ja auch Kräutersalz-workshops []"* (A. Spring, personal communication, August 28, 2019)

W*ater* was seen by all interviewees who mentioned it as an especially important element for restoration. But, Ms Spring had concerns for using it, she described it as luxury and problematic in times of drinking water shortage.

Plants and ecosystems were seen as important too. Vast plant diversity was said to have calming and healing abilities. Stone gardens without plants were seen as no good by two of the interviewees, as well as lawns which are mowed a lot and not used to sit or play. Ecosystem features like soil or habitats for animals are positive. Most of the interviewees mentioned animals a lot. They pointed them out during the interview and talked about their habitats and features that keep the animals in the garden. Insects and birds were mentioned in particular.

Infrastructure mostly refers to furniture. To have benches and chairs in the right place was seen as important. Sometimes the design of a path was also touched upon.

A*esthetics*, mostly expressed as beautiful, was often mentioned in connection with flowers, trees, animals or bushes. Most interviewees mentioned a high biodiversity, blooming plants and different colours to be aesthetic.

Preference was perceived by two interviewees as important for restoration. According to them a preferred place is also a restorative place, but preference is not the same for every person, that is why possibilities to choose should be given to garden users. Mobile chairs, different garden rooms, and different kinds of plants are examples for applying the aspect of preference.

Settings should provide some privacy, some protection, enough space to move, easy access, and elements to engage with. For providing extent a garden does not have to be very large but the design can make it feel bigger, e.g. by making different zones inside the garden or building niches. In order to provide easy access it was suggested to arrange many small gardens near the users, yet also not too near to achieve some feeling of being away. Conditions should be altered to provide shade especially from trees, and hide disturbing noises. Some interviewees mentioned the dependency of the usage of a garden on the weather.

Dr. Nicole Bauer underlined that it is important for a garden to be *used* (Personal communication, July 15, 2019). Different ways of using a garden were mentioned, like taking a stroll, eating inside, harvest, having aperitifs, smoking, learning, and working. To get more people to use a garden zonings were suggested again in order to meet the taste of as many people as possible. Nature trails can be introduced as a feature that attracts more people to the garden.

The *history* of some features can trigger fascination. In this regard the age of certain features, mostly trees, and the memories they evoke were mentioned. Many gardens are maintained and designed to preserve history.

Experience of a garden: Today it is important to consider activities that people like to be able to do in a garden. As an example, the experts mentioned that many people like to eat, walk, harvest, or study in the garden.

Literature Research

Typical features of a garden for restoration extracted from literature were grouped in the same way as the aspects found in the expert interviews. The results support the three physical aspects: water, plants and ecosystems, and infrastructure. The qualitative aspects supported by the literature are: Aesthetic, Preference, Settings, Use, and Experience (Appendix Table A 1 and Table A 2). History was not mentioned in the examined literature as feature of a restorative garden.

Restorative effects found in literature about healing gardens are reduced blood pressure, heart rate, depression, and stress in the context of veterans suffering from PTSD (Sherman, Varni, and Malcarne, 2005; Taheri and Shabani, 2016). They further provide emotional restoration (Reeve, Nieberler-Walker, and Desha, 2017), and improve well-being on one hand for children and on the other hand for people with dementia (McCormick, 2017; Gonzalez and Kirkevold, 2014). Some further benefits are listed in the appendix (Table A 5).

Self Experiment

Below the results of the main experiment including general reaction time, flanker conflict, mood change, irregularities, and personal experiences are presented.

General reaction time

The main experiment was conducted 42 times. Figure 8 illustrates the mean reaction time obtained from measurements with the ANT-R. In Figure 8 the measure on July 29 deviates from the other measures with 629.08 ms mean reaction time. Following Data without this outlier day and its counterpart day are also looked at. The reaction time between the first and the second ANT-R increased in both sites. This means the reaction became slower from the first to the second ANT-R (Table 3).

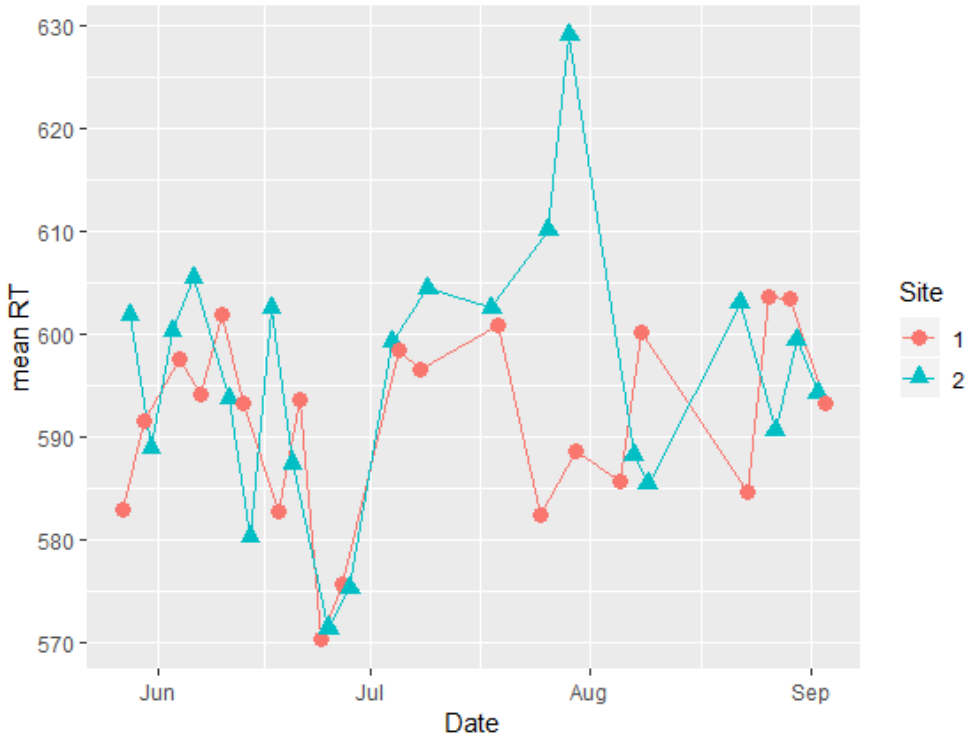

Fig. 5 This figure shows the results, mean reaction time, of all 42 days of the main experiment. Red and a circle is the hill site in a forest. Blue and a triangle is the site on a meadow at a pond.

Table 3. Data from the main experiment with the general reaction times. If the difference is negative, this means the reaction time increased from the first to the second ANT-R (needed more time).

Mean reaction time					
First ANT-R		Second ANT-R		Differences first minus second ANT-R	
Hill site (Site 1)	Pond site (Site 2)	Hill site (Site 1)	Pond site (Site 2)	Hill site (Site 1)	Pond site (Site 2)
590.58 ms		596.81ms		-6.23 ms	
587.64 ms	593.53 ms	595.37 ms	598.25 ms	-7.73 ms	-4.72 ms
589.76 ms [1]		596.13 ms [1]		-6.38 ms [1]	
588.00 ms [1]	591.51 ms [1]	595.31 ms [1]	596.95 ms [1]	-7.31 ms [1]	-5.44 ms [1]

[1] ***mean reaction times without an outlier (29.07.19 and 30.07.19)***

ANT-R: Attention Network Task Revised

Flanker conflict

Figure 6 depicts the flanker conflict. A decrease of the flanker conflict over time can be seen. A high flanker conflict means that the person conducting the attention task had problems with inhibiting the distracting incongruence of the flankers. The flanker conflict decreased at the hill site and increased at the pond site. Figure 7 shows this difference of the first to the second measure. A positive value means the first flanker conflict was higher than the second, viz. the flanker conflict did decrease. A negative value means the second flanker conflict was higher than the first, viz. the flanker conflict did increase. That is the directed attention increased at the hill site, but not at the pond site (Table 4).

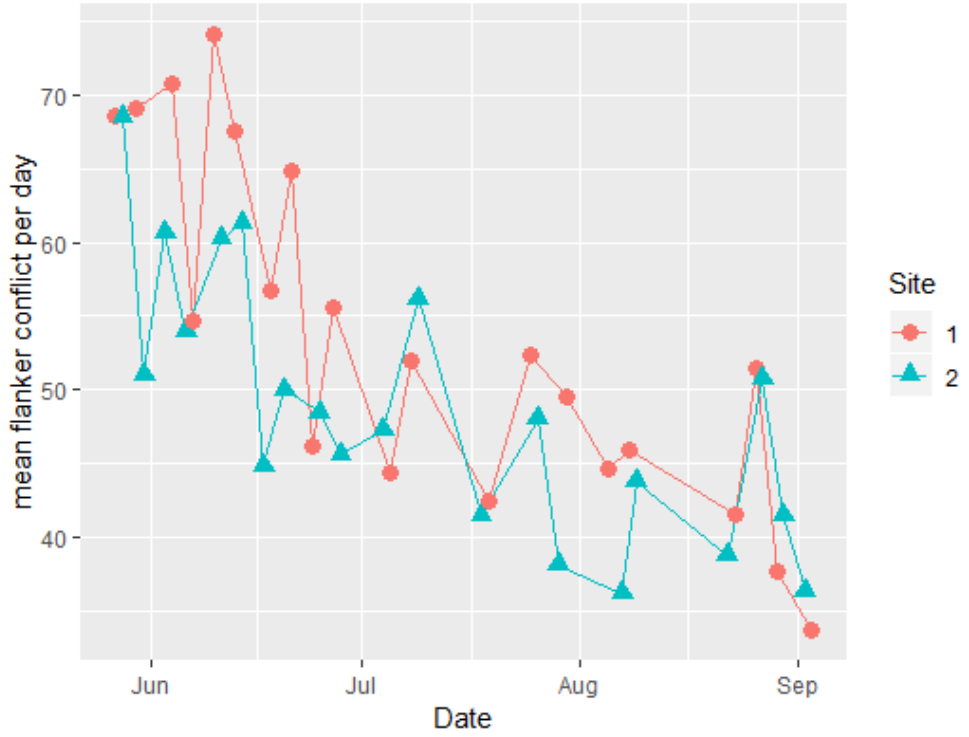

Fig. 6. Mean flanker conflict per day which is related to directed attention, with 42 days/repetitions.

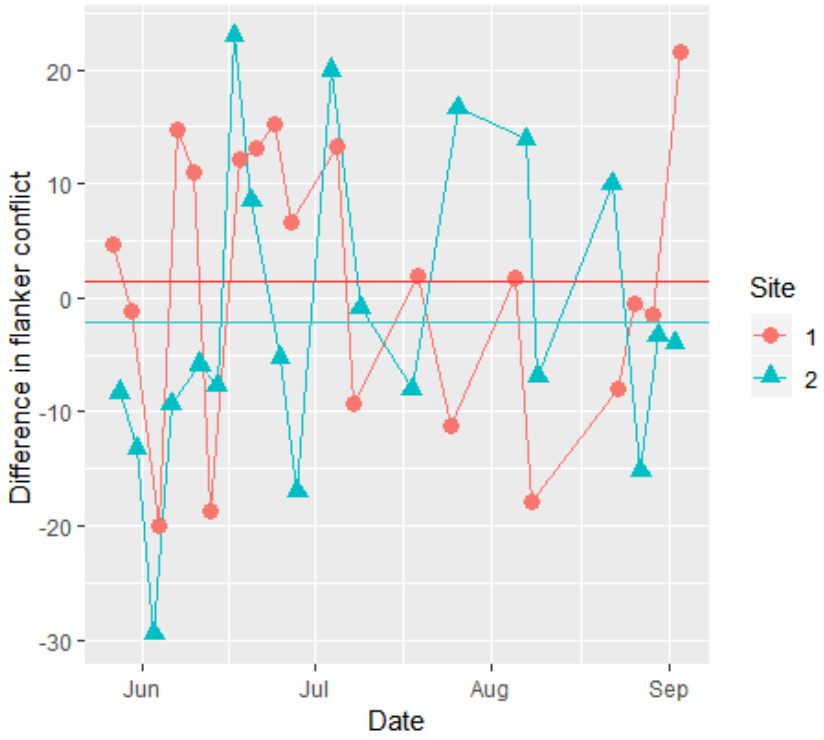

Fig. 7. Difference in flanker conflict calculated by subtracting the second flanker conflict after the break, from the baseline flanker conflict. The outlier of the 29.07.2019 and the according day of the other site were excluded here. The lines indicate the mean of each site. Site 1: Hill site; Site 2: Pond site

Table 4. Difference of the flanker conflict between the first and second ANT-R. Negative number means an increase of flanker conflict from first to second ANT-R. Positive number means that the flanker conflict decreased from the first to the second ANT-R.

Mean reaction time (flanker conflict)					
First ANT-R		Second ANT-R		Differences first minus second ANT-R	
Hill site (Site 1)	Pond site (Site 2)	Hill site (Site 1)	Pond site (Site 2)	Hill site (Site 1)	Pond site (Site 2)
50.75 ms		51.46 ms		-0.71 ms	
53.87 ms	47.63 ms	53.12 ms	49.79 ms	0.75 ms	-2.17 ms
51.29 ms [1]		51.65 ms [1]		-0.36 ms [1]	
54.39 ms [1]	48.18 ms [1]	53 ms [1]	50.23 ms [1]	1.39 ms [1]	- 2.12 ms [1]

[1] ***mean reaction times without an outlier (29.07.19 and 30.07.19)***
ANT-R: Attention Network Task Revised

Mood change

The difference in mood between the first and the second PANAS showed a slight decrease in positivity at the hill site, and an increase at the pond site. The negative affect decreased at both sites (Table 5).

Table 5 Positive and Negative Affect Schedule (PANAS) results, with 10 being the minimum and 50 the maximum. To the difference in mood: A positive number of the positive affect means that the second PANAS was less positive than the first and a positive Number of the negative affect means negativity decreased from the first to the second PANAS.

Positive Affect (PA)				Negative Affect (NA)				Difference in mood first - second PANAS			
First PANAS		Second PANAS		First PANAS		Second PANAS		Positive Affect (PA)		Negative Affect (NA)	
Site 1	Site 2	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
22.12		21.53		14.38		12.57		0.33		1.82	
22.59	21.66	21	22.07	14.21	14.55	12.41	12.72	1.59	-0.41	1.8	1.83

Site 1 = hill site, Site 2 = pond site

Irregularities with the experiment

Experiments that have been pair wise excluded and the reason why: On July, 2 experiment spoiled by heavy raining; on July, 11, July, 16, and July, 22, computer crashed in the second ANT-R after 208, 286, and 210 trials; August, 2 due to illness; August, 11 until August, field course took place. Some days the author felt ill: on July 8, July 9, July 25, July 29, and August 26. The experiment on August 6 was due to heavy raining shifted to Wednesday August, 7. On July, 26 the experiment at the pond site was shifted into the shadow of nearby trees due to too much heat.

Personal experiences in the garden

While conducting the self experiment many things were perceived as positive, neutral, or negative. Perceived in a positive way were (1) the wild animals like birds, squirrels, ducks, frogs, and snakes, (2) private atmosphere, (3) having shade. Some observations were that some people jogged up to the hill site to exercise, school classes stayed more in the open, and chairs on the meadow were often rearranged. Perceived in a negative way were (1) the noise of engines, (2) animals like mosquitoes, (3) being exposed, (4) too hot or cold temperature, (4) the way to the garden through the whole city and from the tram stop past a construction site. More detailed results of journal entries are left out.

Discussion

Features of Gardens with Restorative Effects

With the expert interviews the hypothesis, that there are tangible features that make an environment more restorative could be supported. Many features were repeatedly mentioned in all interviews to have a positive impact on the well being of the garden users. The literature research supports the aspects of features that were found in the expert interviews (Appendix, Table A 3 and Table A 4). These features are linked with measurable effects such as reduced blood pressure, reduced stress and improved well-being (Sherman et al., 2005;Taheri and Shabani, 2016; McCormick, 2017; Gonzalez and Kirkevold, 2014).

In the paper "What makes a garden a healing garden?" Stigsdotter and Grahn (2002) offer three different hypotheses to explain the healing effect of gardens: (1) the design and contents of the garden, (2) the activity carried out in the garden or (3) both, design and activity in combination (Stigsdotter and Grahn, 2002). The relevant aspects for restoration found in this study support the third hypothesis that suggests both, design together with activities as important for restoration.

Three categories of restorative features are tangible and described as the physical aspects: *Water; Plants and Ecosystems; Infrastructure.* The other six are qualitative aspects and describe how to implement the three physical aspects: *Aesthetics; Preference; Setting; Use; History; Experience*. Following all nine groups are described and discussed.

Physical aspects

The most prominent aspect which all agreed on was *Plants and Ecosystems*. In the literature a plants to hardscape ratio of 7:3 is proposed, hardscape meaning concrete or stones amongst other things (Marcus and Sachs, 2014). In the expert interviews plants were mentioned as restorative features of a garden mostly when they are native, easy to maintain, biodiverse, providing privacy, bloom over the whole year, spark fascination, provide shade, and are part of a natural *ecosystem*. Native plants are i.a. important for having a sense of place (Marcus and Sachs, 2014). The literature further adds different heights, offering sensory experience, and looking healthy (Marcus and Sachs, 2014). Those characteristics are also listed in the qualitative aspects of a restorative garden. Animals, as part of the ecosystem, are mentioned in the interviews and in the literature to give a place a sense of harmony, thus a garden should have features that consider their natural habitats (Marcus and Sachs, 2014). Animals are also mentioned to facilitate using a garden (Weerasuriya, Henderson-Wilson, and Townsend, 2018). Wildlife habitats should be provided as to allow for a rich, multisensory experience (Marcus and Sachs, 2014). In the self experiment the occurrence of animals were seen as fascinating and a welcome change. The positive influence of plants on restoration has

been demonstrated also in literature beyond healing gardens many times (Kaplan, 1995; Kaplan and Talbot, 1983; Hartig et al., 2003; Herzog et al., 2002).

Another very prominent restorative feature next to plants is *water*. It is seen as restorative by most interviewees as well as in the literature (Naderi and Shin, 2008; Weerasuriya et al., 2018; Marcus and Sachs, 2014). Marcus and Sachs (2014) give specific recommendations on how water should be incorporated into a garden to be most restorative, e.g., in the form of engaging more than one sense, producing sounds that are calming. In the literature water is also seen as a facilitator for using a garden (Marcus and Sachs, 2014; Weerasuriya et al., 2018). In a study outside of the healing garden literature pictures containing water, in urban and natural sites, were rated higher in the perceived restorativeness (White et al., 2010).

Concerning *infrastructure*, several interviewees highlighted having furniture as especially important. In the literature especially comfortable furniture is mentioned as well as considering the designing of paths, e.g. to minimize glare, offering variety of experiences (Marcus and Sachs, 2014; Pasha and Shepley, 2013).

Qualitative aspects

When it comes to the aspect of *aesthetics*, the most important factor in the literature as well as in the interviews is biodiversity (Marcus and Sachs, 2014). In the expert interviews blooming flowers and green are seen as aesthetic and improving the well-being of the garden users. Outside the literature of healing garden Ulrich (1983) points out that culture very likely plays a role in aesthetic preference.

As to *preference*, there is a connection between places that are preferred and places that are restorative (N. Bauer, personal communication, July 15, 2019). Preference for features is sometimes used to find features for restorative gardens (Rodiek and Fried, 2005). Preference and restoration are linked together also according to Van den Berg, Koole, and Van der Wulp (2003). There is a study however that found that they are not always the same (Martens et al., 2011). Outside of the healing garden literature complexity is given as a factor that is preferred when occurring in moderate levels (Ulrich, 1983).

Another important factor is the *setting* of a garden. It seems to be important for people to be able to retreat. It is therefore recommended to design a garden in a way that visitors will not feel observed (Marcus and Sachs, 2014). In a case study about nurses a significant preference for privacy among staff was found (Naderi and Shin, 2008). Different kinds of zonings are highly recommended by Mr Müller (Personal communication, August 21, 2019). According to the literature, visitors seem to prefer having a variety of possibilities to spend their time in the garden (Marcus, 2007). Some examples: Different seating possibilities (sun or shade), places to be alone or with others, open or closed view, different walking routes (Marcus, 2007). Different garden rooms are also mentioned by

Berggren-Bärring and Grahn (1995a) to be more attractive and draw more people into for example a park than having just one garden room (as cited in Stigsdotter and Grahn, 2002). It is important to provide subspaces to satisfy different purposes (Marcus and Sachs, 2014; Lau, Gou, and Liu, 2014). Another aspect mentioned in the interviews and being noticed in the self experiment was the importance of having shade for being able to stay inside the garden for a longer time. Ms Spring (Personal communication, August 28, 2019) stated that the shadow of a tree is very different from that of a awning. Akbari, Pomerantz, and Taha (2001) show in their paper the importance of trees especially in urban areas for providing shade and regulating the microclimate. Regarding the external conditions of a garden, there are some factors concerning the surrounding of a garden that have to be considered, such as high buildings and noises from nearby streets (Marcus and Sachs, 2014). Weather and temperature also belong in this category. Shelter and dry seats are important to have in the case of a rainy day (Marcus and Sachs, 2014). Some plants require specific conditions, i.e. temperature and moisture in order to be healthy (Marcus and Sachs, 2014). The size of a garden seems not to be important, there are possibilities to also make a small garden restorative (Marcus and Sachs, 2014). The garden should provide privacy and a contrast to the indoor (Marcus and Sachs, 2014).

When it comes to the element of *use*, gardens need to deliver in certain aspects as to become attractive for people to actually enter it. Naturally, availability as mentioned in the interviews, is an important factor in motivating people to use a garden. This means a garden has to be nearby and easily accessible. Smaller gardens in close range (Dr. N. Bauer, personal communication, July 15, 2019) and making people aware of the existing gardens (Marcus, and Sachs, 2014; Whitehouse et al., 2001) are suggested as solutions. Some authors mention barriers that prevent easy visitation of a garden in studies revolving around gardens in health care facilities (Weerasuriya et al., 2018; Kearney and Winterbottom, 2006; Pasha, 2013). In the self experiment the long way to the garden was perceived as a strain. Outside the healing garden literature Björk et al. (2008) found that little access of green spaces goes in hand with lower neighbourhood satisfaction and lower physical activity.

In the expert interviews the *history* of the garden or its elements were also often mentioned in connection with a restorative garden. Old plants were especially seen as positive. In the healing garden literature history is not mentioned. Two interviewees mentioned the historical background of certain elements. Historical features can give an environment more extent; a factor that helps making an environment more restorative according to the ART (Kaplan, 1995).

In the category *experience*, the mentioned points concern what people actually do in the garden. Also included are material as well as immaterial resources that visitors can take away from it. Naturally, a garden should be designed for example in a way that enables liked activities not only by

single persons, but also in groups in order to enable social contact (Marcus and Sachs, 2014). A garden should provide possibilities to do exercises or have sensory experiences, also for people with limited mobility (Marcus and Sachs, 2014). According to ART compatibility is important in an environment for being restorative, that means people have to be able to do what they prefer (Kaplan, 1995). Therefore it is important to know what experiences garden users seek and what activities they like to perform inside the garden.

Restorative Effect of Different Sites in the Same Garden

The underlying hypothesis in the self experiment is that gardens can considerably differ in terms of their restorative effects.

Looking at the flanker conflict, the results from the self experiment suggest that the hill site was better in restoring directed attention than was the pond site. This could be due to the presence of the forest or the enclosed location, which are both linked. The pond site had the disadvantage of not having shade and being not protected from the wind and weather, which might have led to weariness.

Looking at the mood, the negativity decreased in both sites, and just in the hill site the positivity decreased a little. This is in accordance with the literature where the presence of water led to greater improvement of the mood (Barton and Pretty, 2010). Nevertheless the results have to be looked at with caution, because when starting the experiment the mood, especially the positive affect, were not similar. The positive affect at the hill site was noteworthy higher than at the pond site, this might have influenced the results.

The two sites both had typical features that support restoration, like water and plants, and maybe the effect of restorative elements would have been bigger when one site had only few restorative features while the other had multiple ones.

In the self experiment a tendency towards a better cognitive restoration of attention in the hill site was found and a tendency towards an improvement of positive affect at the pond site. This leads to the assumption that different places seem to support different restoration. It seems that there is a difference even inside a garden between different places, but an experiment with more people is needed to confirm this.

Advantage and disadvantage of a self experiment

Conducting a self experiments has some advantages. A self experiment can lead to a deeper understanding of the topic, can reveal possible difficulties and problems early on, and spark new ideas for new ways of approaching the research. Considering its usefulness in getting a practical understanding of a topic, it is recommended as a pre-study to a following larger study

There are also some disadvantages of the self experiment approach. Results cannot be generalized. The subject doing the research knows everything about the background of the test and could unconsciously manipulate the research in a favoured direction. All the data is connected, being repeatedly conducted by the same person. Hence no statistical test can be applied.

In hindsight the author would not conduct the self experiment in the same way, see also limitations. However one advantage of the chosen approach was diving into the topic pragmatically and scouting possible pitfalls that might lead into a blind alley further down the line. Also, it provides a method that enables a very direct access to the topic, namely nature and its effect on oneself. Accordingly, with this approach the author had the opportunity to experience first-hand some restorative features that came up in the literature and in the expert interviews like the fascination for wild animals, and the comfort of privacy and shades as well as noises of engines, mosquitoes, being exposed, and extreme temperature at the other hand were experienced in a negative way.

Limitations and Improvements

Expert interviews

Only four experts were interviewed. It would be interesting to investigate in different related fields and interview experts of all kinds of directions. The nine restorative aspects are only a possible solution with the according interviews and the literature – there are many other possible ways of illustrating those features, and there are many ways of going deeper into detail with those features.

Literature research

In the literature search only papers found in Scopus under the term "healing garden" were included, but there are many papers from other fields as well investigating the restorative effects of environments. There is a lot of additional literature, especially about restoration ability of plants, e.g. indoor plants, in other research fields (f.e. Lindemann-Matthies and Matthies, 2018; Bringlismark, Hartig, and Patil, 2009).

Since healing gardens (Heilgärten) are rarely mentioned in Switzerland under this name, there should be made more investigations about other names such as therapeutic gardens (Therapiegärten), restorative environments, sanatorium or health gardens (Gesundheitsgärten), and also more insight about the already applied methods of making a place more restorative, the underlying ideas and ways of building such places.

Self experiment

The self experiment had some design challenges. Both sites showed a slowing down in the general reaction time from the first to the second ANT-R. It was mentioned in the paper of Fan et al. (2009) that the revised version of the ANT has an increased attentional demand compared to the first

developed ANT. This leads to the assumption that doing the ANT-R fatigued the attention more than could be regained in a 15 minutes break. The break might have also been too short for showing the influence of the environment on its ability to restore directed attention. This was also suggested by Dr. Nicole Bauer (personal communication, July 15, 2019). A pre-study focusing on the length of the break would be appropriate, if considering a similar experiment again.

The learning effect of the mean reaction time stopped before starting the main experiment, but the learning effect of the flanker conflict did not. The flanker conflict got smaller and smaller with time, which implements that with the ANT-R, the flanker conflict is learnable. The learning effects of the flanker conflict was not investigated before because an incorrect flanker conflict was calculated in the beginning. It would be interesting to see how the learning curve behaved with a large number of participants.

It would have been advantageous to conduct a longer comparison between a downtown site and a natural site to control for major disruptive factors.

The focus on the ANT-R while conducting it seems very high so that the environment cannot be taken in consciously. Only things like fresh air, temperature, weather, or noise can have an influence while performing the ANT-R and those are often rather distractions than anything else. On this account it is suggested to conduct the ANT-R inside a building rather than at the site. The advantage of being inside is also that a very rainy day can be included into the results as well. The way from each of the sites to the room where the ANT-R is conducted should be equally long, and the room should always look the same for it is as well an environment which can influence the results.

The two compared sites both had major restorative features, water and forest. A bigger difference is expected when looking at sites that differ more in the availability of restorative features. It would have been also very interesting to just manipulate one feature of the site and to compare them.

The mood was only measured with the PANAS which is not very sensitive, a different measurement of the mood and also a long-time measurement of the mood would have been of advantage.

To sum up, some possible ways to improve the conducted self experiment would be taking longer breaks in between the two ANT-R to perceive the environment, adding a control site next to the two compared sites, choosing garden sites that are more different from each other respecting insights from the literature about healing gardens more, conducting the ANT-R inside a building and not directly on site, and using different methods for measuring the mood.

Implications for Further Research

Ms Spring mentioned that the effect of a garden needs time (personal communication, August 28, 2019). Longitudinal studies therefore seem important to investigate beneficial effects of

gardens. Many health issues of today like excessive stress or depression are long-term problems. Hence it would be very interesting to conduct longitudinal studies about effects in the garden, as done by Kaplan and Talbot (1983) in their wilderness study, where students spent between 9-14 days in the wilderness before assessing their experiences back in the city again. They made clear that it had a longer impact than just the stay itself.

Furthermore due to the multi-layered mechanisms of how gardens and especially healing gardens seem to work, it is important to investigate more in sociocultural influences on the perceived restorativeness of an environment. Also, surveys about the use of gardens and their perceived benefits should be conducted more often, to consider and investigate on people who regularly use natural environments. It seems that a place is perceived differently when it was often visited, e.g., in childhood (Thompson, Aspinall, and Montarzino, 2008).

A method that would be interesting to look at is embodied science. It is a relatively new field seeing the brain in conjunction with its environment (Hardy-Valée and Payette, 2008). This shows the importance of a harmonious surrounding.

Conclusion

This thesis illustrates that there are specific aspects which make a garden more restorative. There are physical aspects (Water; Plants and Ecosystems; Infrastructure) and qualitative aspects (Aesthetics; Preference; Setting; Use; History; Experience) describing how to implement those physical aspects. The major finding is that there are specific features proven to help restoration which are more specific than simply being natural. With designing urban environments in a more restorative manner, the health costs can be reduced, social contact can be promoted and working environments can be made more supportive to the needs of humans.

These found categories of features can be used as support for designing urban environments, like parks and gardens. They are suitable to provide restoration inside a city (see also White et al., 2010). In order to get as many people as possible to use restorative environments those green spaces should be nearby, easily accessible, and designed after the recommendations from the healing garden literature (Marcus and Sachs, 2014).

The expert interviews and also the literature analysis lead to the insight that there is a lot of knowledge already out there but it is not as easily accessible because especially in the field of restoration, results are spread over a variety of scientific disciplines and known with different names.

In the self experiment slight difference between two sites inside the same garden were found. The site with a pond was better in restoring the mood, while the site inside a forest was better in restoring the attention. This results are interesting but have to be looked at with caution because the base measures were not the same in the two sites and the experiment was only

conducted by one person. Nevertheless with the experiment the author learned how important shadow can be, and that the attitude towards the site can have an influence on the performance in the mood. On the other side that there might be a difference also inside a garden in terms of its restoration dependent on the features present and that the attention network task is a cumbersome but interesting tool to measure directed attention.

For making a self experiment it needs a lot of patience, ability to observe one's own behaviour, and one needs to be honest. Because self experiments are not normally done in science, many self doubts have to be endured. Although the results from the self experiment have to be interpreted cautiously, the method itself undoubtedly qualifies as a powerful tool to immerse oneself in a topic. It is an interesting way to see the transition between subjectivity and objectivity and qualitative and quantitative measurement. For a larger more quantitative study this can prove to be essential, both, for the design of the study as well as the interpretation of the results in a meaningful way.

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Appendix

Expert Interviews

Guidelines

Frau Bauer:

1. Was bedeutet für Sie Erholung?/Was verstehen Sie unter Erholung?/Was kommt Ihnen spontan in den Sinn, wenn Sie an Erholung denken?
2. Gibt es eine beste Methode zur Messung von Erholung?
   - Welche wäre das? Selbsteinschätzung oder haben Sie eine 'objektivere' Art gefunden?
   - Ist Erholung überhaupt objektiv?
3. Was macht für Sie einen erholsamen Ort aus?
   - wichtigste Charakteristiken?
   - was nicht? (Was sehen Sie als nicht erholsam?
   - Formen/Architektur
4. Gärten
   - Definition?
   - Glauben Sie, dass es spezifische Charakteristiken eines Gartens gibt, welche diesen erholsamer machen?
   - Auf was kommt es an, dass ein Garten erholsam ist?
5. Was zeichnet diesen Ort (hier) aus?
   - Dieser Ort hier, wäre dies für Sie/die Menschen ein erholsamer Ort?
   - Garten?
   - Was verändern? Was nicht?
   - Erholsame Aspekte?
6. Einzelne Aspekte, die einen Ort gleich "besser" machen oder "schlechter"?
   - diesen Ort hier?
   - was ist speziell?
7. Was wäre der grösste Erfolg, welchen Sie mit ihrer Forschung erreichen könnten?
8. ZUSATZ Keine Natur vs. Wildnis
   - Studie: gepflegte Orte besser
9. ZUSATZ soziale Kontakte wichtiger Aspekt von (Gemeinschafts-) Gärten
   - einiges dazu erforscht , was denken Sie?
10. ZUSATZ Hauptnutzung des Ortes relevant?/Nutzer (Gesundheit, Alter etc.) relevant?
11. ZUSATZ Natürliche Umwelt jetzt besser genutzt? (Seit 2010)
    - Veränderung seit 2010 (Anspielung auf eine Aussage eines von ihr geschriebenen Papers)

12. ZUSATZ Geringer Profit führt zu weniger Interesse der Wirtschaft an Grünen Flächen/Gärten?
13. ZUSATZ Wieso denken Sie werden Dinge nicht umgesetzt obwohl Sie erholsamer wären?

Frau Kuhn:

1. Was ist für Sie ein Garten?
   - Definition?
   - Abgrenzung was nicht?
2. Was finden Sie gut an diesem Garten/Ort hier?
   - Was würden Sie ändern? Weshalb?
   - Was sollte ein Therapiegarten/Heilgarten enthalten um gut (heilsam, erholsam) zu sein?
3. Wie nutzen Sie den Garten heute?
   - Was kommt besonders gut an?
   - Welche Elemente sind (besonders) beliebt?
   - Von wem wird der Garten v.a. genutzt? Mitarbeiter? Bewohner?
   - Wird der Garten überhaupt noch genutzt?
4. Welche Charakteristiken machen einen guten (Heil-)Garten aus?/Was muss in einem Garten sein um erholsam zu sein?
   - Elemente, Formen
5. Was haben Sie das Gefühl bewirkt ein/der Garten?
   - Woran könnte das liegen?
6. Was verstehen Sie unter Erholung, Heilung etc.?
7. Haben Sie den alten Garten noch gekannt?
   - Was denken Sie war der grösste Gewinn der Umgestaltung? (Tablet mit Bildern)
   -Was fehlt noch immer?
8. Denken Sie Präferenz ist gut für die Erholung/Erhaltung/Gesundheit? Oder nicht immer?
   - Bsp. geschwungene Wege, unebene Flächen etc.
9. Können Sie mir ein bisschen über sich erzählen?
   - Ausbildung (Jahre), Zeit bei Gibeleich
10. Wollen Sie gerne anonym bleiben?
    - auch Arbeitsort?
11. Darf ich alle Daten verwenden? Soll ich ihnen Passagen vor der Abgabe der Arbeit zusenden?

Herr Müller:

1. Was ist für Sie ein Garten?
   - Abgrenzung

2. Rundgang (Gedanken zu den einzelnen Gartenräumen)
   - Wie wird der Garten genutzt?
   - Von wem wird der Garten v.a. genutzt?/Was wissen Sie über die NutzerInnen des Gartens?
3. Was ist speziell/besonders an diesen Gärten? (hier Inselspital)
   - Charakteristiken?
   - Verbesserungen?
   - Was ist schon sehr wirkungsvoll?
   - Was finden Sie gut an diesen Gärten hier?
4. Was zeichnet generell gute (heilsame, erholsame) Gärten aus?
   - Welche Elemente befinden sich in einem solchen 'perfekten' Garten? (Mal ohne Nachteile der Erhaltung etc.)
5. Weshalb wurde dieser Garten/Gärten gebaut/erstellt?
   - Was war ausschlaggebend?
6. Was haben Sie alles verändert, seit sie hierherkamen?
7. Schlussfragen:
   - Wie lange arbeiten Sie schon hier?
   - Wie lange generell als Gärtner?
   - (Was dazu bewegt?)
   - Darf ich alles verwenden?
   - Gerne Anonymisiert?
8. ZUSATZ Die Arbeit: Die Umgestaltung der Inselgärten nach dem Konzept Healing Garden formulierte Wünsche, denken Sie da hat sich einiges getan seit 2003 bzw. 2005?
   - mehr Sitzmöglichkeiten
   - mehr Schatten
   - Bocciabahn
   - Essensstand im Sommer
   - Themenweg
9. ZUSATZ Was, nach ihrem Gefühl, bewirkt der Garten?
10. ZUSATZ Ziel ihrer Arbeit?
11. ZUSATZ Man sagt, es ist schwierig sich an seinem Arbeitsort zu erholen, empfinden sie dies auch so?
12. ZUSATZ Kennen Sie andere 'Heilgärten' in der Schweiz?

Frau Spring:

1. Was ist für Sie ein Garten?
   - Was verstehen Sie unter einem Heilgarten?

2. Wer nutzt die Gärten vor allem?
3. Rundgang: Was finden Sie besonders schön/erholsam?
   - Was würden Sie verändern und weshalb?
4. Was ist speziell/besonders an diesen Gärten?
   - Charakteristiken?
5. Was, nach ihrem Gefühl, bewirkt der Garten?
6. Was zeichnet generell gute Gärten aus?
   - Welche Elemente befinden sich in einem solchen 'perfekten' Garten?
7. Was ist das Ziel Ihrer Arbeit?
   - Weshalb sind Gärten auch auf dem Land wichtig?
8. Weshalb wurden diese Gärten erstellt?/Was war Ausschlag gebend?
9. Finanziell keine Probleme die Gärten zu erhalten?
10. Wie lange arbeiten Sie schon hier?
11. Was hat Sie dazu bewogen?
12. Darf ich alle gesammelten Daten verwenden?
13. Wollen Sie gerne anonym bleiben?/Darf ich Ihren Namen verwenden?

Tables of statements of the interviewees

Table A 1. Statements of interviewee organized in nine aspects, here showing the three physical aspects.

Physical Aspects	Dr. Nicole Bauer	Ms. Kuhn	Mr. Müller	Ms. Spring
Water	Good for restoration (central element)		Having a calming effect	Very desirable (makes a garden restorative)
	Has aesthetic features		There is a desire to use water in the design of a garden	Luxury, wonderful and a dream of many people
	According to a study: The more the better (together with green)			Requirement number one in earlier days to settle down
			Less attractive with protection grid in it	Because of increasing drinking water shortage nearly a forbidden luxury
Plants, Ecosystem	Nature has ability to attract attention, keep concentration without effort	Nature and green have calming effects	Nature good for switching off for a short time	Green as calming, flowers as inspiring
	Nature and green spaces are especially good for restoration		Were seen as positive: mixed plants and shrubbery areas, native plants, trees for spending shadows, trees	Trees, grass, flowers, vegetables, stone piles and woodpiles are seen as healing aspects of a garden

Physical Aspects	Dr. Nicole Bauer	Ms. Kuhn	Mr. Müller	Ms. Spring
	Preference for trees, shrubbery , and meadows (with high grass seen as beautiful)		and meadows as privacy blinds	Trees are very important, no matter what size
	According to study: The more the better (together with water)		Seen as wonderful were old trees, ever-changing array of flowers and their arranging, greening of walls, nature as contrast to the building	Many plants and their features are seen as beautiful and leading to respect
	Study shows working with soil changes the micro biome of humans	People like to work with soil and look into the green	Garden of the Inselspital Bern as green lung and other worldly	Engaging with soil, (spontaneous) plants, and trees for getting into soul of gardens
	Working in a garden leads to deviation of rumination (study)		Demand of indoor green	Medicinal plants in the garden lead to fascination
	Character of it is important	Uses raised beds to work with old people	Value of green space is not measurable	Shadow of a tree is different (than f.e. Awning)
			Giving habitats to wildlife (f.e. Wood piles, trees)	Giving habitats to wildlife (f.e. stone piles, old wood piles)
				Compost for maintaining the circuit of life
	Simple green meadows are often not used		Seen as negative were invasive plants, monocultures, trees when taking the view, and gravel gardens with a fleece beneath	Stone gardens without plants as deserts and not leading into the soul of a garden
		Mentioned wild bees, butterflies, and birds	Mentioned insects (butterflies), hedgehogs, lizards, sheep, donkeys, birds, and ducks	Mentioned fish, duck, horses, birds, panther, sheep, insects (butterflies, wild bees), worms, lizards, blindworms, and hedgehogs
		Flowers for insects and wild bee houses	Branch piles for hedgehogs to overwinter, stone garden with many lizards	Provide habitats for animals (like stone and wood piles) and leave them things to eat, this leads to a restorative garden

Physical Aspects	Dr. Nicole Bauer	Ms. Kuhn	Mr. Müller	Ms. Spring
		Birds in a aviary are seen as nice	Bird boxes for giving experience to people	Have grazing sheep, birds getting the fruits of the rose hip
		For harmony should have animals (biodiversity)	Feels better when there is a diversity (of butterflies etc.)	Mentioned animals as care takers
		Old people like to observe animals like butterflies	Biodiverse shrub mix cultures lead to more life (insects ecosystems)	Had in the past fish tanks for fresh fish
		People remember that there were more butterflies and bees in the past	No ducks anymore since protection grid, it is a pity	Engaging with i.a. Animals leads to the discovery of the soul of a garden, one gets respect for the life in it
			Have sheep because animals are mentioned in the healing garden concept	If harvesting it is good to have a fence against big vermin
Infrastructure	With little room many people make a sitting place	Sitting outside makes people relax and they like it	Want as much furniture as possible	Two places where she can sit forever
	Bench with tree in the back is seen as protected		A bench even on concrete is still better than staying inside	Furniture is very important
			Mobile chairs onto mowed grass	Art work with many benches (from Jenny Holzer)
			Seating stairs above a stream	
	Ways designed according to users, but green can stay the same		Soft curved ways (english garden style)	Path through the grape yard
			Likes to make a nature trail (label trees and ecosystems)	Labyrinth
			Mowed out ways and places (not visible from outside)	
			New path made into the garden (make garden more vivid)	
			Garden as a connection to other places around	
	Raised beds good for old people (for garden work)	Pole used for exercise and getting better	Bird boxes have been hung up	Toilet rooms are available (Carthusian monks had theirs in the garden)

Physical Aspects	Dr. Nicole Bauer	Ms. Kuhn	Mr. Müller	Ms. Spring
		footing	Nature is always finding a way (include into design)	Compost would be nice for recycling garden waste, closing circuits
			Too much time is spent with emptying trash bins (but is needed)	

Table A 2. Statements of interviewee organized in nine aspects, here showing the six qualitative aspects.

Qualitative Aspects	Dr. Nicole Bauer	Ms. Kuhn	Mr. Müller	Ms. Spring
Aesthetic	Water lilies, diversity, manifoldness of plants, and blooming plants are seen as aesthetic	(old) people enjoy looking at flowers (brings back memories)	Blooming plants as attractive, ever-changing array of flowers as uplifting	Blooming of plants as important, beautiful, and as attraction (especially (historic) roses)
	Water is seen as aesthetic with its ability to mirror and reflect	Old people like strong colors and outlines	Contrast to hospital environment as attractive and improving well-being	There are gardens only for beauty and joy
	Beautiful: Meadows with high grass, trees and shrubbery	Biodiversity as important for getting a good harmony	Liked: Stone garden with high biodiversity (also set as a goal) Beautiful: color and diversity	Wilderness as beautiful but not a garden
			Certain plants/trees as beautiful	(old) plants (parts)/trees as beautiful
				Many roses are planted because of their attractiveness
			Decoration of buildings and trees and art is mentioned in different ways (also art made of plants)	Decoration as beautiful (art as decoration, plant art, dried plants etc.)
			Meadow with cut out paths as appealing	Caterpillars and butterflies as wonderful
			A show garden with medicinal plants was mentioned	Water as a dream and fire as beautiful
	If people do not use the garden aesthetic does not matter	For old people too many flowers is confusing	Usability (f.e. Having shadow) before beauty	In earlier days more looked for functionality not beauty
	Concrete effects us negatively	Having around only concrete quickly	Concrete as not restorative	Concrete over as negative

Qualitative Aspects	Dr. Nicole Bauer	Ms. Kuhn	Mr. Müller	Ms. Spring
	Ambient noise can decrease the beauty of a garden	becomes boring	Letting things get wild seen as problem	Withered plants as not nice forlooking at
			Protection grid as not looking nice	
			Aesthetic can need a lot of money (f.e. Ever-changing array of flowers)	
Preference	Liking of something is important			Important what one likes
	Preference studies assume that liking is linked to recovery (forest study does not support that)			
	Preference lies on manifold living areas with trees, shrubs, and high grass (meadow)			
Setting	Place should be bright (especially in forests)	Old people are very sensitive to temperature and the weather	Shadows shifts (use mobile chairs) -> shadows as positive	Used shadows during the tour -> shadows as positive
	Noise of airplanes and construction sites as negative	Not liked: noise of airplanes	Lack of shadow leads to extreme heat in summer	Dependent on nice weather
	Agglomeration leads to problematic decrease of green places			Too hot locations led to diseases for Roses
	A garden should have a certain expanse	Gibeleich has three different private 'gardens	Zoning as important, three different garden types in one garden seen as positive	Ittingen has many gardens not one big one
	Places should not be completely alien to us and have some distance to home (being moved away)			One shows with a garden, that one has space
		Having lot of space to move is seen as positive	Garden is not defined by its size	Garden is not dependent on size
	having half-private places (having houses with yards)		Privacy screens/protections against views (high grass, hedges), niches and zonings	Walls, sight protections change a garden into a protected site

Qualitative Aspects	Dr. Nicole Bauer	Ms. Kuhn	Mr. Müller	Ms. Spring
	Likes bench better when there is a tree in the back (protection)		are important and liked	
	Knowledge about place might be important to like it	Raised beds are good if having little space (or if people are not able to work on the ground)	Building habitats for animals is seen as positive (f.e. Stone garden with plants)	habitats for animals (like stone and wood piles) and leave them things to eat (not harvest everything right away), leads also to a restorative garden
	Important to know who is using the garden			
	Effort should be small to use green places (many green places are not used)		Good to have places where trees can stay for a long time and become old	Labyrinth as interesting garden element
	Should be designed to fit daily habits, but, should not remind of own everyday life		Contrast of ever-changing array of flower and ruderal area is liked	Criterion of a garden is to engage with the place/space
		Public way through garden seen as disadvantage	Big areas of lawn (without reason) or concrete seen as negative	Gardens for benefit (vegetable gardens) often look meager (time of Carthusians)
			Redesign is very expensive, needs official support	
Use	Nurseries gardens are not about restoration but about doing something meaningful	Observing as important for humans	Many people eat in the garden	Is used for aperitifs (festivities)
		Just being outside is seen as good	People who smoke want to go outside for a short time (near the entrance)	The criterion is that one engages with the space there is
		St. John's wort was used more often in the past	Nature trail (labeling the trees and some ecosystems), so people can learn a little while outside	Many healing herbs were used in the past
			Gardens at the entrance are bearer of the image	Garden is bearer of the image
				Offers work places
	Place with no direct function is liked	Selling products made of things of the garden is seen as good	Zonings for different preferences and different ways of use	Needs experience and knowledge till a garden is as one likes it (can benefit)

Qualitative Aspects	Dr. Nicole Bauer	Ms. Kuhn	Mr. Müller	Ms. Spring
	Visiting green spaces should be no big effort		Made flyers for the new opening of the park	Labyrinth as symbol of life
	Normally no money needed to spend time in the green		Mixed plantations are easy to maintain (cut once a year)	
	Cortisol level should not be too high			
	Working with the garden leads to reduced rumination (study)	Garden as haven of tranquility		Used to show that one has money, knowledge and space
	To spend even 20 minutes in a pocket-park is restorative	Being outside for sensing the season, fresh air, communication seen as good		
	View of own garden can be a confrontation with unfinished work	Harvesting needs a lot of time	People stay on the hospital ground for very short times (other places for restoration) (garden more for staff and visitors)	Influence of a garden needs time
	Many green places are rarely used, could be used more often		Many do not want to invest time for maintaining the garden	
			Signing of the area is difficult	
History			Old trees are seen as wonderful and make a big impression on people	Old trees and shrubs as beautiful and fantastic
			Water basin from 1890	Old wood piles are important for some animals
	Working in a garden can bring memories back to older people	Flowers and diversity brings back memories to older people	Ever-changing array of flowers was more popular in the past, especially old people like it	Proud to have the oldest wood reservoir (of canton Thurgau)
	We react positive to nature (vegetation and water) because of our human history	People in retirement homes were in better shape in the past	History is very important in the 'Insel'gardens (care guidelines, designs from different epochs)	Historic incidences influence a garden design
			Depending on epochs garden design is different	

Qualitative Aspects	Dr. Nicole Bauer	Ms. Kuhn	Mr. Müller	Ms. Spring
		St. John's wort was used more often in the past	Care is sometimes more complex when leaving things as in the past	Many healing herbs were used in the past
			In the past areas were filled with same plants, today interested in biodiverse places	Gardens of our ancestors have been meagre, harvest was the most important
Experience	Walk through the garden instead of eating a sandwich in front of the computer	Smelling things from the garden	Care for gardens as a passion	Smell and look at roses
		Some people eat in the restaurant with connection to the garden	Many people like to eat in the garden	Gardens can offer work place
		Take a stroll through the garden is liked	Show garden for learning (medicinal plants f.e.)	Can show the garden in guided tours (transfer of knowledge)
		Working with and exercising in the garden (as a change)		Gardens to engage with
	Kitchen garden for harvest not only for looking beautiful	For harvesting vegetable, fruits, herbs etc. And preserve them		Plant herbs for tea, fragrant sacs, cosmetic, or medicine
		Making flower bunches		Can eat a lot from the garden (needs time to realize sometimes)
		Biodiversity as important for getting a good harmony		Provide food and shelter for wild animals
		Providing material for working with older people		

Literature Research

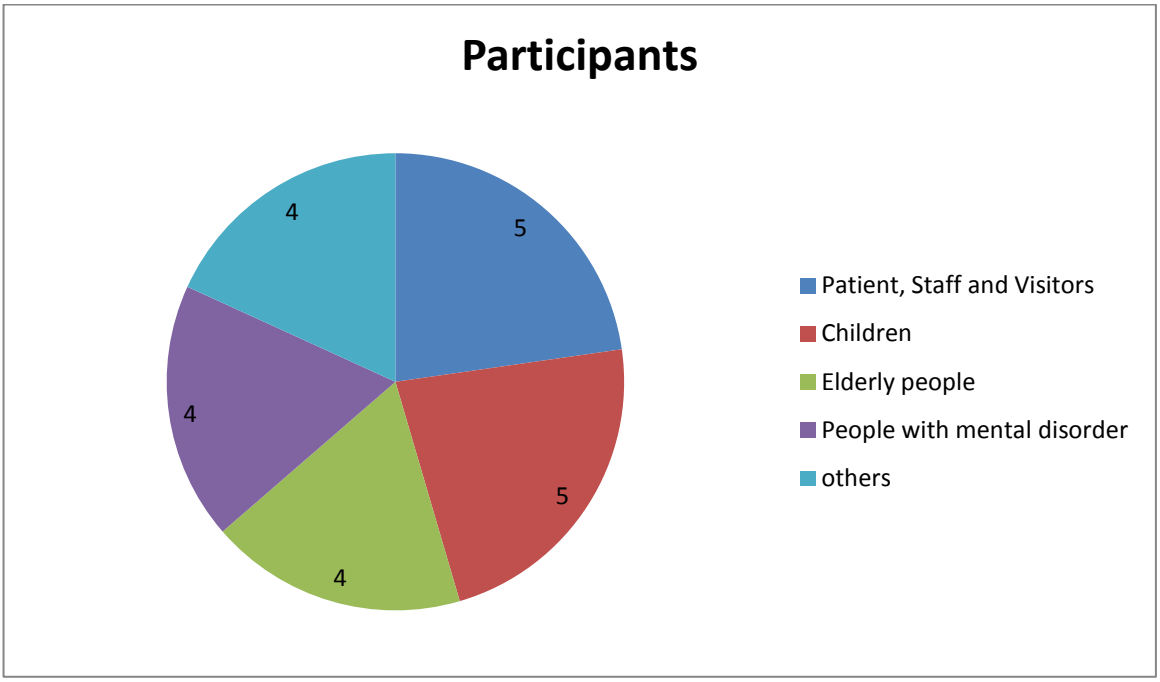

Fig. A 1. Participants of the included papers. The number inside the chart indicates the number of papers.

Table A 3. Investigated papers showing the participants, name of the paper, and the used method.

Participants	Paper	Method
Patient, Staff, and Visitors	Weerasuriya, R., Henderson-Wilson, C., Townsend, M. **Accessing Green Spaces Within a Healthcare Setting: A Mixed Studies Review of Barriers and Facilitators** (2019) *Health Environments Research and Design Journal*, *12(3), 119-140.*	Literature review
	Cervinka, R., Röderer, K., Hämmerle, I. **Evaluation of hospital gardens and implications for design: Benefits from environmental psychology for architecture and landscape planning** (2014) *Journal of Architectural and Planning Research*, 31 (1), pp. 43-56.	Online questionnaire (rating)
	Pasha, S. **Barriers to garden visitation in children's hospitals** (2013) *Health Environments Research and Design Journal*, 6 (4), pp. 76-96.	Site visits and questionnaires
	Pouya, S., & Demirel, Ö. **The Physical Attributes of Healing Garden for A Century Old Healthcare Premises** (2017) *Anadolu Üniversitesi Sanat ve Tasarım Dergisi, 7(1), 150-167.*	Case studies
	Ibrahim, F., Harun, W. M. W., Samad, M. H. A., & Kamaruddin, W. N. W. S. W. **The Physical Attributes of Healing Garden for A Century Old Healthcare Premises.** (2015) *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies, 6(2), 47-59.*	Case studies
Children	McCormick, R. **Does Access to Green Space Impact the Mental Well-being of Children: A Systematic Review** (2017) *Journal of Pediatric Nursing*, 37, pp. 3-7.	Literature review
	Reeve, A., Nieberler-Walker, K., Desha, C. **Healing gardens in children's hospitals: Reflections on benefits, preferences and design from visitors' books** (2017) *Urban Forestry and Urban Greening*, 26, pp. 48-56.	Case study

Participants	Paper	Method
	Pasha, S., Shepley, M.M. **Research note: Physical activity in pediatric healing gardens** (2013) *Landscape and Urban Planning*, 118, pp. 53-58.	Research note
	Sherman, S.A., Varni, J.W., Ulrich, R.S., Malcarne, V.L. **Post-occupancy evaluation of healing gardens in a pediatric cancer center** (2005) *Landscape and Urban Planning*, 73 (2-3), pp. 167-183.	Post-occupancy evaluation
	Whitehouse, S., Varni, J.W., Seid, M., Cooper-Marcus, C., Ensberg, M.J., Jacobs, J.R., Mehlenbeck, R.S. **Evaluating a children's hospital garden environment: Utilization and consumer satisfaction** (2001) *Journal of Environmental Psychology*, 21 (3), pp. 301-314.	Post-occupancy evaluation, behavioural observation, surveys, and interviews
Elderly People	Kearney, A.R., Winterbottom, D. **Nearby nature and long-term care facility residents: Benefits and design recommendations** (2006) *Journal of Housing for the Elderly, 19(3-4), 7-28.*	Interview
	Senes, G., Fumagalli, N., Crippa, R., Bolchini, F. **Nursing homes: Engaging patients and staff in healing garden design through focus group interviews** (2012) *Neuropsychological Trends*, 12 (1), pp. 135-146.	Focus group interviews
	Collins, C.C., O'Callaghan, A.M. **Healing gardens for assisted living: An interdisciplinary approach to health education** (2007) *Journal of Extension*, 45 (6).	Expert collaboration
	Rodiek, S.D., Fried, J.T. **Access to the outdoors: Using photographic comparison to assess preferences of assisted living residents** (2005) *Landscape and Urban Planning*, 73 (2-3), pp. 184-199.	Focus groups, written questionnaires, comparison of photographs
People with mental disorder	Paraskevopoulou, A.T., Kamperi, E., Demiris, N., Economou, M., Theleritis, C., Kitsonas, M., Papageorgiou, C. **The impact of seasonal colour change in planting on patients with psychotic disorders using biosensors** (2018) *Urban Forestry and Urban Greening*, 36, pp. 50-56.	Behaviour analysis, questionnaire
	Pommier, R., Pringuey, D., Pringuey-Criou, F., Boulon, Y., Boyer, S., Massoubre, C. **A qualitative study of healing garden experience. An exploratory study in adult psychiatry [Approche qualitative de l'éprouvé au Jardin de Soins. Une étude exploratoire en Psychiatrie de l'Adulte]** (2018) *Annales Medico-Psychologiques*, 176 (2), pp. 150-156.	Qualitative study of experience
	Taheri, S., Shabani, A. **Conceptual and practical principles in designing healing gardens for veterans with PTSD with a focus on reducing stress- A narrative review** (2016) *Journal of Military Medicine*, 18 (3), pp. 230-241.	Narrative review
	Gonzalez, M.T., Kirkevold, M. **Benefits of sensory garden and horticultural activities in dementia care: A modified scoping review** (2014) *Journal of Clinical Nursing*, 23 (19-20), pp. 2698-2715.	Literature review
Students	Lau, S.S.Y., Gou, Z., Liu, Y. **Healthy campus by open space design: Approaches and guidelines** (2014) *Frontiers of Architectural Research*, 3 (4), pp. 452-467.	Literature review and case study

Participants	Paper	Method
Nurses	Naderi, J.R., Shin, W.H. **Humane design for hospital landscapes: a case study in landscape architecture of a healing garden for nurses.** (2008) *HERD*, 2 (1), pp. 82-119.	Literature review, site analysis, in-depth survey
Physiotherapist	Siriphanich, S., Wachiratrungsalid, P., Tepwongsirirat, P., Chaipivaporn, N. **Landscape element application guidelines for physical therapy exercise** (2016) *Acta Horticulturae*, 1121, pp. 69-78.	Interview, observation, and questionnaire
Mixed unknown	Arslan, M., Kalaylioglu, Z., Ekren, E. **Use of medicinal and aromatic plants in therapeutic gardens** (2018) *Indian Journal of Pharmaceutical Education and Research*, 52 (4), pp. S151-S154.	Literature review

Table A 4. Physical aspects that are recommended for a healing garden, arranged according to the aspects of the expert interviews, but without the ones specific for certain illnesses. The numbers in brackets refer to literature, which is listed below the table.

Physical aspects	Mentioned in abstract of literature research 'healing garden' in Scopus (12.02.2019)	Mentioned in "Therapeutic landscapes: An Evidence based Approach To Designing Healing Gardens And Restorative Outdoor Spaces." (Marcus and Sachs, 2014)
Water	Symbolic creek and sacred spring were arranged (67)	Water should engage more than one sense
	Water features as facilitators for garden use (11)	Seating should be located near the water
		Sound should have a calming or soothing effect (and can be used to drown unpleasant urban noises)
		Should be attractive at all times of the year (including when it is empty)
		Interactive potential of water should be considered (positive and negative)
Plants, Ecosystem	Trees with seasonal colour change (3)	Provide rich, multisensory experience (wildlife habitats, seasonal variety)
	Aromatic plants (5)	Use plants from local ecosystems, native plants can provide people with a sense of place
	Various plant textures (24)	Beautiful, healthy plants are uplifting
	More green is liked (51)	Provide a ration of approx. 7:3 plants to hardscape (concrete, stones etc.)
	Preferences for contact with nature (among staff) (67)	Plant characteristics that are liked: provide place of respite; address all of the senses; inviting interactions
	Changed garden (from an exposed, dry gulley ravine) into a green, fertile oasis (67)	Plant placement: confidentiality and privacy; availability and proximity for seating; attractive destinations; places to linger and semiprivate spaces; areas for activities

Physical aspects	Mentioned in abstract of literature research 'healing garden' in Scopus (12.02.2019)	Mentioned in "Therapeutic landscapes: An Evidence based Approach To Designing Healing Gardens And Restorative Outdoor Spaces." (Marcus and Sachs, 2014)
	Suggestion for improvement, include more trees and greenery into the garden (91)	Basic requirements for plant growth: water; soil; sunlight
	Flora, foliage, and lawn as facilitators for garden use (11)	Physical and visual access to nature
	Nature as one of six relevant factors for design (44)	If there are tall building structures, use big trees, that reduce the scale
		Recommend plants with different height
		Planting that offers "fascination" and sensory engagement
		Create subspaces with plants
		Maximize the use of low-maintenance and resilient plants
		Make mounted or sloped beds for visibility also when seated
		Avoid toxic and allergenic and nuisance plants
		Not enough maintained gardens are not liked
		Sickly and dying plants are likely to evoke a strong negative reaction
	Animal life as facilitator for garden use (11)	Provide rich, multisensory experience (wildlife habitats, seasonal variety)
Infrastructure	Recommendation of users to add more interactive things for kids to do (91)	Pathways – Variety of experiences – Curvilinear (wheelchair) – Flat primary pathways with passing areas – Flat and smooth entryway – Minimize extreme contrasts of dark and light on the ground – Raised edges (for no outwash of plantings and navigation) – Minimize glare on all path surfaces Adequately illuminated but without shining into adjoining rooms
	Comfortable seats, for longer stays in the garden (46)	Easy to operate doors into the garden

Physical aspects	Mentioned in abstract of literature research 'healing garden' in Scopus (12.02.2019)	Mentioned in "Therapeutic landscapes: An Evidence based Approach To Designing Healing Gardens And Restorative Outdoor Spaces." (Marcus and Sachs, 2014)
	Private table-and-chair places for 1-2 people (67)	Frequent and adequate resting spots
	Added contemplative paths and garden benches (67)	Seating possibilities (comfortable, mobile, majority should have backs and arms, not retain excessive heat or cold, not produce glare)
		Tables for lunch or do paperwork (for individuals and groups)
		Fixed furniture should have a wall or plantings behind the back
		Especially entrance should have comfortable furniture
		Provide storage for maintenance equipment of garden
		Provide trash and recycling bins
		Lights that do not dazzle people
		Fun or whimsical features
		Should look for safety

Note. (3) Paraskevopoulou, A.T., Kamperi, E., Demiris, N., Economou, M., Theleritis, C., Kitsonas, M., Papageorgiou, C.
The impact of seasonal colour change in planting on patients with psychotic disorders using biosensors
(2018) *Urban Forestry and Urban Greening*, 36, pp. 50-56.

(5) Arslan, M., Kalaylioglu, Z., Ekren, E.
Use of medicinal and aromatic plants in therapeutic gardens
(2018) *Indian Journal of Pharmaceutical Education and Research*, 52 (4), pp. S151-S154.

(11) Weerasuriya, R., Henderson-Wilson, C., Townsend, M.
Accessing Green Spaces Within a Healthcare Setting: A Mixed Studies Review of Barriers and Facilitators
(2018) *Health Environments Research and Design Journal*, . Article in Press.

(24) Siriphanich, S., Wachiratrungsalid, P., Tepwongsirirat, P., Chaipivaporn, N.
Landscape element application guidelines for physical therapy exercise
(2016) *Acta Horticulturae*, 1121, pp. 69-78.

(44) Cervinka, R., Röderer, K., Hämmerle, I.
Evaluation of hospital gardens and implications for design: Benefits from environmental psychology for architecture and landscape planning
(2014) *Journal of Architectural and Planning Research*, 31 (1), pp. 43-56.

(46) Pasha, S., Shepley, M.M.
Research note: Physical activity in pediatric healing gardens
(2013) *Landscape and Urban Planning*, 118, pp. 53-58.

(51) Kearney, A.R., Winterbottom, D.
Nearby nature and long-term care facility residents: Benefits and design recommendations
(2006) *Journal of Housing for the Elderly, 19(3-4), 7-28.*

(67) Naderi, J.R., Shin, W.H.
Humane design for hospital landscapes: a case study in landscape architecture of a healing garden for nurses.

(2008) *HERD*, 2 (1), pp. 82-119.

(91) Whitehouse, S., Varni, J.W., Seid, M., Cooper-Marcus, C., Ensberg, M.J., Jacobs, J.R., Mehlenbeck, R.S.
Evaluating a children's hospital garden environment: Utilization and consumer satisfaction
(2001) *Journal of Environmental Psychology*, 21 (3), pp. 301-314.

Table A 5. Qualitative aspects that are recommended for a healing garden, arranged according to the aspects of the expert interviews, but without the ones specific for certain illnesses. The numbers in brackets refer to literature, which is listed below the table.

Qualitative aspects	Mentioned in abstract of literature research 'healing garden' in Scopus (12.02.2019)	Mentioned in "Therapeutic landscapes: An Evidence based Approach To Designing Healing Gardens And Restorative Outdoor Spaces." (Marcus and Sachs, 2014)
Aesthetic	Views, diverse textures, heights, and shapes as facilitators for garden use (11)	Aesthetic lights
		Attractive view from the main garden entrance (legible layout)
		Biodiversity as an important factor of healing gardens
Preference	Safety as prime consideration (for therapeutic garden design) (24)	No strong smells (f.e. Food exhaust)
	Users of a garden liked to be involved in the decision process (55)	
	Contact with nature and privacy were preferred by staff (67)	
	Preference was used to find features (79)	
	A garden as connection between mind, body, and personal preference (24)	
Setting	Shade for longer stays in the garden (46)	Sufficient shade and sunny places
	Shade, sun, rain, fresh air, and wind as facilitators for garden use (11)	Should be sited in a quiet location
	Diverse open spaces to satisfy different purposes (36)	Create subspaces with different qualities
	Private areas (67)	With limited size, the ratio of height of buildings is critical to width of open space
		Analyzing of microclimate site conditions important
		Min. 6 hours of sunlight
		Primary garden should provide shelter (wind etc.), have a cover at the main entrance
		Serve as contrast to clinical indoor setting
		Sense of physical enclosure (if not enclosed by buildings should have fence or hedge)

Qualitative aspects	Mentioned in abstract of literature research 'healing garden' in Scopus (12.02.2019)	Mentioned in "Therapeutic landscapes: An Evidence based Approach To Designing Healing Gardens And Restorative Outdoor Spaces." (Marcus and Sachs, 2014)
		Privacy inside the garden (no windows to see whole garden)
		Easily monitored by staff
		Smoking must be prohibited in garden areas
Use	Wide variety of exercises (24)	Design building for garden to be visible from main public spaces
	Dissatisfaction with quality of seats led staff to use the garden less (52)	Inclusive culture
	Poor shade led visitors to use the garden less, but quality of seats did not (52)	People inside should be able to enjoy too (window view), but also have privacy
	Educate people with gardening (for people who are institutionalized) (69)	Education – Plant labels with information – Other interpretive material (garden plan f.e.) – Features that can be moved, manipulated or changed – Opportuninies for children to explore and play – Visitor book, garden journal – Possibility to observe wildlife
	Specific design, because users mostly have only a short exposure time (67)	Adequate way finding to and within the garden
	Majority of family members did not know about existence of the garden (91)	
	Accessibility often a problem (W5)	
History	-	-
Experience	Support of relationship with others (8)	Design for social support
		Areas and outlets for exercise
		Sensory experience also for people in a wheelchair or on a gurney

Note. (8) Pommier, R., Pringuey, D., Pringuey-Criou, F., Boulon, Y., Boyer, S., Massoubre, C.
A qualitative study of healing garden experience. An exploratory study in adult psychiatry [Approche qualitative de l'éprouvé au Jardin de Soins. Une étude exploratoire en Psychiatrie de l'Adulte]
(2018) *Annales Medico-Psychologiques*, 176 (2), pp. 150-156.

(11) Weerasuriya, R., Henderson-Wilson, C., Townsend, M.
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(2018) *Health Environments Research and Design Journal*, . Article in Press.

(24) Siriphanich, S., Wachiratrungsalid, P., Tepwongsirirat, P., Chaipivaporn, N.
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(2016) *Acta Horticulturae*, 1121, pp. 69-78.

(36) Lau, S.S.Y., Gou, Z., Liu, Y.
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(46) Pasha, S., Shepley, M.M.
Research note: Physical activity in pediatric healing gardens
(2013) *Landscape and Urban Planning*, 118, pp. 53-58.

(52) Pasha, S.
Barriers to garden visitation in children's hospitals
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(55) Senes, G., Fumagalli, N., Crippa, R., Bolchini, F.
Nursing homes: Engaging patients and staff in healing garden design through focus group interviews
(2012) *Neuropsychological Trends*, 12 (1), pp. 135-146.

(67) Naderi, J.R., Shin, W.H.
Humane design for hospital landscapes: a case study in landscape architecture of a healing garden for nurses.
(2008) *HERD*, 2 (1), pp. 82-119.

(69) Collins, C.C., O'Callaghan, A.M.
Healing gardens for assisted living: An interdisciplinary approach to health education
(2007) *Journal of Extension*, 45 (6).

(79) Rodiek, S.D., Fried, J.T.
Access to the outdoors: Using photographic comparison to assess preferences of assisted living residents
(2005) *Landscape and Urban Planning*, 73 (2-3), pp. 184-199.

(91) Whitehouse, S., Varni, J.W., Seid, M., Cooper-Marcus, C., Ensberg, M.J., Jacobs, J.R., Mehlenbeck, R.S.
Evaluating a children's hospital garden environment: Utilization and consumer satisfaction
(2001) *Journal of Environmental Psychology*, 21 (3), pp. 301-314.

(W5) Ibrahim, F., Harun, W. M. W., Samad, M. H. A., & Kamaruddin, W. N. W. S. W. (2015).
The Physical Attributes of Healing Garden for A Century Old Healthcare Premises.
International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies, 6(2), 47-59.

Table A 6. Benefits of a healing garden, mentioned in the literature found in Scopus with the term "healing garden". The numbers in the brackets belong to the literature farther down.

Benefits of healing, therapeutic or horticultural gardens	Mentioned in abstract of literature research 'healing garden' in Scopus (12.02.2019)
Physical	(Veterans with PTSD) Reducing blood pressure and heart rate (21)
	(People with dementia) improvement of sleep pattern and functional level (37)
	Providing ecological profits and ecosystem services (W3)
Mental	Impression to get back on the feet, different perceived relation with caregivers, resumption of the power to act, and the recognition of the importance of the support from others (8)
	(Access to green space for children) improved mental well-being, overall health, cognitive development, promotes attention restoration, memory, competence etc. (17)
	Emotional respite (to visitors) (18)
	(Veterans with PTSD) reducing stress and depression (21)
	(People with dementia) improvement of well-being (37)
	(Patient, visitors, and staff in a pediatric cancer centre) lower emotional distress and pain (78)
	(Patients, families, and staff in children's hospital) Perceived garden as restoring and healing, and use was accompanied by increased consumer satisfaction (91)

Note. (8) Pommier, R., Pringuey, D., Pringuey-Criou, F., Boulon, Y., Boyer, S., Massoubre, C.
A qualitative study of healing garden experience. An exploratory study in adult psychiatry [Approche qualitative de l'éprouvé au Jardin de Soins. Une étude exploratoire en Psychiatrie de l'Adulte]

(2018) *Annales Medico-Psychologiques*, 176 (2), pp. 150-156.

(17) McCormick, R.
Does Access to Green Space Impact the Mental Well-being of Children: A Systematic Review
(2017) *Journal of Pediatric Nursing*, 37, pp. 3-7.

(18) Reeve, A., Nieberler-Walker, K., Desha, C.
Healing gardens in children's hospitals: Reflections on benefits, preferences and design from visitors' books
(2017) *Urban Forestry and Urban Greening*, 26, pp. 48-56.

(21) Taheri, S., Shabani, A.
Conceptual and practical principles in designing healing gardens for veterans with PTSD with a focus on reducing stress- A narrative review
(2016) *Journal of Military Medicine*, 18 (3), pp. 230-241.

(37) Gonzalez, M.T., Kirkevold, M.
Benefits of sensory garden and horticultural activities in dementia care: A modified scoping review
(2014) *Journal of Clinical Nursing*, 23 (19-20), pp. 2698-2715.

(78) Sherman, S.A., Varni, J.W., Ulrich, R.S., Malcarne, V.L.
Post-occupancy evaluation of healing gardens in a pediatric cancer center
(2005) *Landscape and Urban Planning*, 73 (2-3), pp. 167-183.

(91) Whitehouse, S., Varni, J.W., Seid, M., Cooper-Marcus, C., Ensberg, M.J., Jacobs, J.R., Mehlenbeck, R.S.
Evaluating a children's hospital garden environment: Utilization and consumer satisfaction
(2001) *Journal of Environmental Psychology*, 21 (3), pp. 301-314.

(W3) Pouya, S., & Demirel, Ö. (2017).
Hospital Rooftop Garden.
Anadolu Üniversitesi Sanat ve Tasarım Dergisi, 7(1), 150-167.

Self experiment

Pilot project

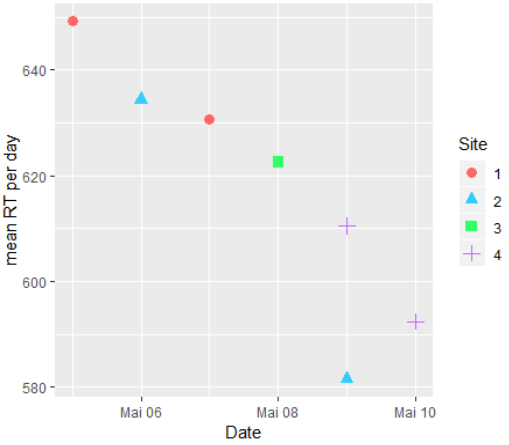


Fig. A 2. First pilot experiment conducting the ANT-R. RT: reaction time. Site 1: hill site, site 2: pond site, site 3: kitchen site, site 4: home site

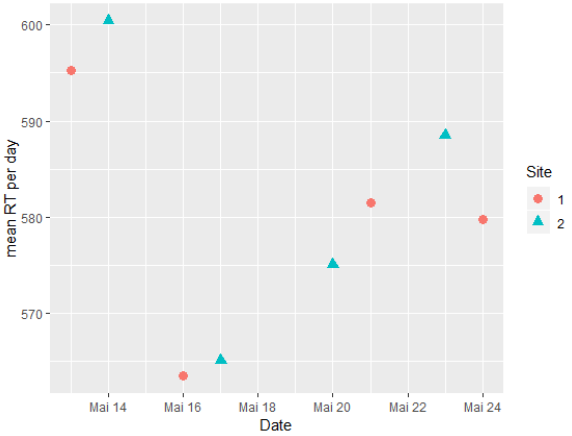


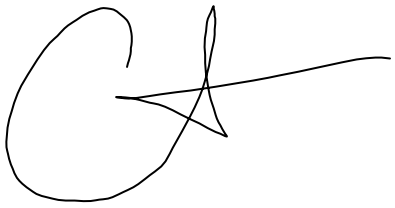
Fig. A 3. Pilot project which directly preceded the main experiment. It is conducted without a protection "tent", which is the only difference to the main experiment. Site 1: hill site; Site 2: pond site; RT = reaction time

Declaration of Originality

I hereby declare that the thesis with title

Features of Healing Gardens and their Importance for Restoration

has been composed by myself independently and only with the aid referred to in Bibliography and that no means other than those declared were used.
In every single case, I have marked parts that were taken out of published or unpublished work, either verbatim or in a paraphrased manner, as such through a quotation.
This thesis has not been handed in or published before in the same or similar form. A review of the work for plagiarism using appropriate software may be made.



Zurich, 17.01.2020

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