Design of a Nature-based Health Intervention:
Self-guided Forest Bathing for Public Gardens

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Abstract

A growing body of evidence demonstrates that nature experiences are beneficial to human health and well-being. However, individuals are spending less time in natural environments, due to rapid urbanization and shifting lifestyle patterns, and there is an increase in mental illness. Design professionals and health providers are helping to address these issues through nature-based interventions (NBIs) which are programs or environmental designs that engage people in nature-based experiences in order to improve health and well-being.

The overarching goal for this project is to help leverage public gardens to improve public health. In part one of the project, I screened an expert-curated list of 27 NBIs to identify programs that fit three design criteria: 1) free for participants, 2) low-cost to implement, and 3) scalable in the context of public gardens. In the second part, I surveyed the websites of 33 public gardens in the Puget Sound region of Washington State to see which NBIs they offered. This provided a snapshot of existing programming of public gardens in the region. In part three, I designed a self-guided forest bathing (Shinrin-yoku) NBI for public gardens by synthesizing forest bathing protocols in academic studies and adhering to the above design criteria. The program consists of the following components: 1) a flyer that public gardens can use to advertise the forest bathing activity to visitors, 2) a web page hosted on the University of Washington Botanic Gardens website (https://botanicgardens.uw.edu/washington-park-arboretum/activities/forest-bathing/), 3) the forest bathing activity itself, available as audio and printable instructions, and 4) an optional online questionnaire.

This project suggests that public gardens are uniquely positioned to improve public health and it demonstrates a method for designing an NBI that is tied to current research and that can be equitably distributed to the public via a wide variety of green care entities. By incorporating more health-promoting, nature-based programs into their mission, public gardens might broaden society's notion of what a garden is for.

Introduction

1.1. Urbanization, nature deficit, and mental health

In 1950, 30 percent of the world's population lived in urban areas. By 2018, about 55 percent lived in urban areas. As we continue into the 21st century, human populations around the world continue to move from rural to urban areas (United Nations Department of Economic and Social Affairs. World Urbanization Prospects., 2018). In the US, people spend an average of 90% of their time indoors, indicating a further reduction of exposure to natural environments (Klepeis et al., 2001). Richard Louv wrote about Nature Deficit Disorder to describe the generalized societal phenomenon of people growing up with progressively less personal connection to the outdoors (Louv, 2008).

The trend of people spending less time in nature coincides with increased attention to mental illness. The World Health Organization (WHO) has identified improving mental health as a global priority (Motion for your mind, 2019). Compromised mental health often decreases productivity in the workforce and is predicted to result in an estimated loss of $16 trillion in the global economy between 2010-2030 (Bloom, 2011). Finding low-cost and effective treatment options for mental health is important to ease the pressure on healthcare resources.

1.2. Nature and health

An expanding body of research demonstrates and brings nuance to the health and well-being effects of nature experiences. Numerous reviews have shown a relationship between exposure to greenspace and improved human health measures (Bowler et al., 2010; Capaldi A. et al., 2014; Haluza et al., 2014; James et al., 2015; Seymour, 2016). Three prominent theories have attempted to explain this relationship, though they may not be mutually exclusive. First, Attention Restoration Theory (ART) emphasizes the role of nature in relieving mental fatigue (Kaplan, 1989; Kaplan, 1995; Kaplan & Berman, 2010). Second, Stress Reduction Theory (SRT) emphasizes the role of nature in relieving physiological stress (Ulrich et al., 1991). Third, the Biophilia Hypothesis proposes that humans experience health benefits from nature exposure because of an innate connection with living things, as this trait helped humans survive and pass on their genes (Kellert & Wilson, 1993; Wilson, 2019). One key feature of nature experiences is

that their health benefits are highly interrelated. For example, walking in an urban greenspace provides not only exposure to the elements of nature, but also the co-benefits of physical activity and social cohesion (Konijnendijk et al., 2013). Multiple mechanisms have been hypothesized for the salutary effects of nature experiences (e.g. psychological pathways, enhanced immune function, physical activity, social contact, and improved air quality) and there is a unanimous call among authors for more research that demonstrates the causal pathways for these benefits (Frumkin et al., 2017). One study looks at 21 different pathways with the goal of narrowing down the human health benefit of nature to a central pathway (Kuo, 2015). Regardless of the challenge of demonstrating mechanisms that drive the relationship, health practitioners are beginning to view nature-contact as a useful and low-cost intervention to address a variety of health issues, especially in the context of urbanization and mental health (Ibes et al., 2018).

1.3. Nature-based Health Interventions (NBIs)

Nature-based health interventions (NBIs) are defined as programs, activities, and/or environmental designs that engage people in nature-based experiences to improve health and well-being (Shanahan et al., 2019). Among the different approaches to address declining mental health, in addition to traditional drugs and psychological therapies, policy makers and healthcare professionals are increasingly promoting the use of NBIs (Bragg & Atkins, 2016; Kondo et al., 2020; Lovell et al., 2018). However, there remains a lack of consensus around the terminology and frameworks for using NBIs, and this lack of consensus poses a challenge for health providers because it limits how likely interventions are coordinated with the providers. In an effort to optimize the understanding and use of different health-benefitting nature experiences, researchers have labeled, classified, and evaluated different types of NBIs. For example, one study, that focused on NBIs in institutional and organizational settings, categorized interventions into three types: garden and horticulture-based therapies, animal-assisted therapies, and care farming (Moeller et al., 2018). Another study reviewed NBIs in the workplace and grouped NBIs into three different types: green exercise, nature savoring, and green office space (Gritzka et al., 2020). For this project, I rely on a study that generated a list of well known NBI types and classified these by a number of qualities, such as their target beneficiaries and intended outcomes (Shanahan et al., 2019) (Table 1). One of the NBIs classified in their taxonomy, forest bathing, is the focus of this project.

Table 1: NBIs that use alterations to environments and NBIs that use programs and activities (adapted from Shanahan et al., 2019)

Nature-based Health Interventions (NBIs)
NBIs that use alterations to the environment:
1. Provision of gardens in hospitals or residential care homes (sometimes referred to as healing gardens).
2. Provision of nature within rooms in healing environments.
3. Indoor plants in workplace or other non-healing indoor environment such as shopping centers.
4. Increase provision of public urban parks and gardens.
5. Improvement of urban public parks and gardens.
6. Provision of walking or bike paths, or other shared use paths/trails.
7. Streetscape enhancement/green corridors along streets.
8. Community gardens/allotments.
9. Greening childcare or school grounds.
10. Outdoor gym equipment.
11. Provision of accessible natural environments.
NBIs that use programs and activities:
12. Green/nature/park/garden prescriptions.
13. Care-farming or farm therapy, including horticulture and animal-assisted therapy.
14. Residential retreats.
15. Wilderness therapy.
16. Wilderness programs.
17. Ecotherapy.
18. Pet therapy or pet-assisted therapy.
19. Forest bathing.
20. Green gyms or environmental volunteering.
21. Outdoor exercise groups.
22. Nature play/wild play.
23. Forest schools/outdoor classrooms/learning environment.
24. Children's kitchen gardens.
25. Outdoor education schemes.
26. Promotion and facilitation campaigns.
27. Blue gym.

1.4. Background of Forest Bathing (Shinrin-yoku)

Forest bathing is a category of NBIs classified by researchers and was defined as the "practice of spending time in forest settings, often with emphasis on attention to breathing and other meditative techniques" (Shanahan et al., 2019). During the 1980s, the practice of forest bathing, or Shinrin-yoku, emerged as a pivotal feature of public health in Japan. As the Japanese government looked for cost-effective ways to ease the hyper-stressful work culture, they promoted Shinrin-yoku, which literally translates to "taking in the atmosphere of the forest." The name was coined by the Japanese forestry department but the practice itself, of immersing oneself in nature by mindfully using all five senses, is intertwined in the nature-focused traditions of Shintoism and Buddhism in Japan.

Since the 1980s, a growing body of research has linked experiences in forests and forest-like environments to improved physiological and psychological health metrics (Hansen et al., 2017; Song et al., 2013; Wen et al., 2019). Forest bathing continues to gather attention as a health promotion method, regardless of a lack of consensus about the most important mechanisms for this benefit.

One challenge when developing an evidenced-based forest bathing intervention is that no established protocol for the activity exists. However, common conditions emerge from the forest bathing studies, especially when considering what forest bathing is *not*. For example, participants are not instructed to seek out a destination, so forest bathing is not a fitness-oriented hike. There is an emphasis on silence, with groups of participants usually directed to not speak with each other, so forest bathing is an alternative to verbal socializing. There is an emphasis on abstaining from the use of personal devices (phones, computers, etc.), so participants direct their eyes and other senses on the forest stimulus itself. Generally, participants are instructed to sit, stand, or walk for a minimum exposure time of 15 minutes in a forest-like environment.

1.5. Urban greenspace

Urban greenspace is broadly defined as areas with predominant vegetation, whether naturally occurring or man-made spaces (Taylor & Hochuli, 2017). This could include grasslands, parks, woodlands, street trees, etc. Urban greenspace has received attention in recent

years for providing valuable ecosystem services to people living in urban areas (Bratman et al., 2019; Song et al., 2014). Urban greenspace in general is a strong location for designing and implementing NBIs, in contrast to more remote forms of nature, because of its proximity to where many people live. This mitigates the barrier of access associated with the more rural nature experience. Another potential advantage of building more NBIs in urban greenspace is that they are a liminal space between urban and wilderness, where urban city dwellers can experience outdoor environments, yet be near conveniences such as public transportation, parking lots, and public restrooms. This allows people, who may not have the time or resources to visit remote natural areas, to engage in shorter, more frequent nature experiences.

Public gardens are a subset of urban greenspace and are defined as follows by the The *American Public Gardens Association:*

> *A public garden is an institution that maintains collections of plants for the purposes of public education and enjoyment, in addition to research, conservation, and higher learning. It must be open to the public and the garden's resources and accommodations must be made to all visitors. Public gardens are staffed by professionals trained in their given areas of expertise and maintain active plant records systems.*
>
> (What is a Public Garden? | American Public Gardens Association)

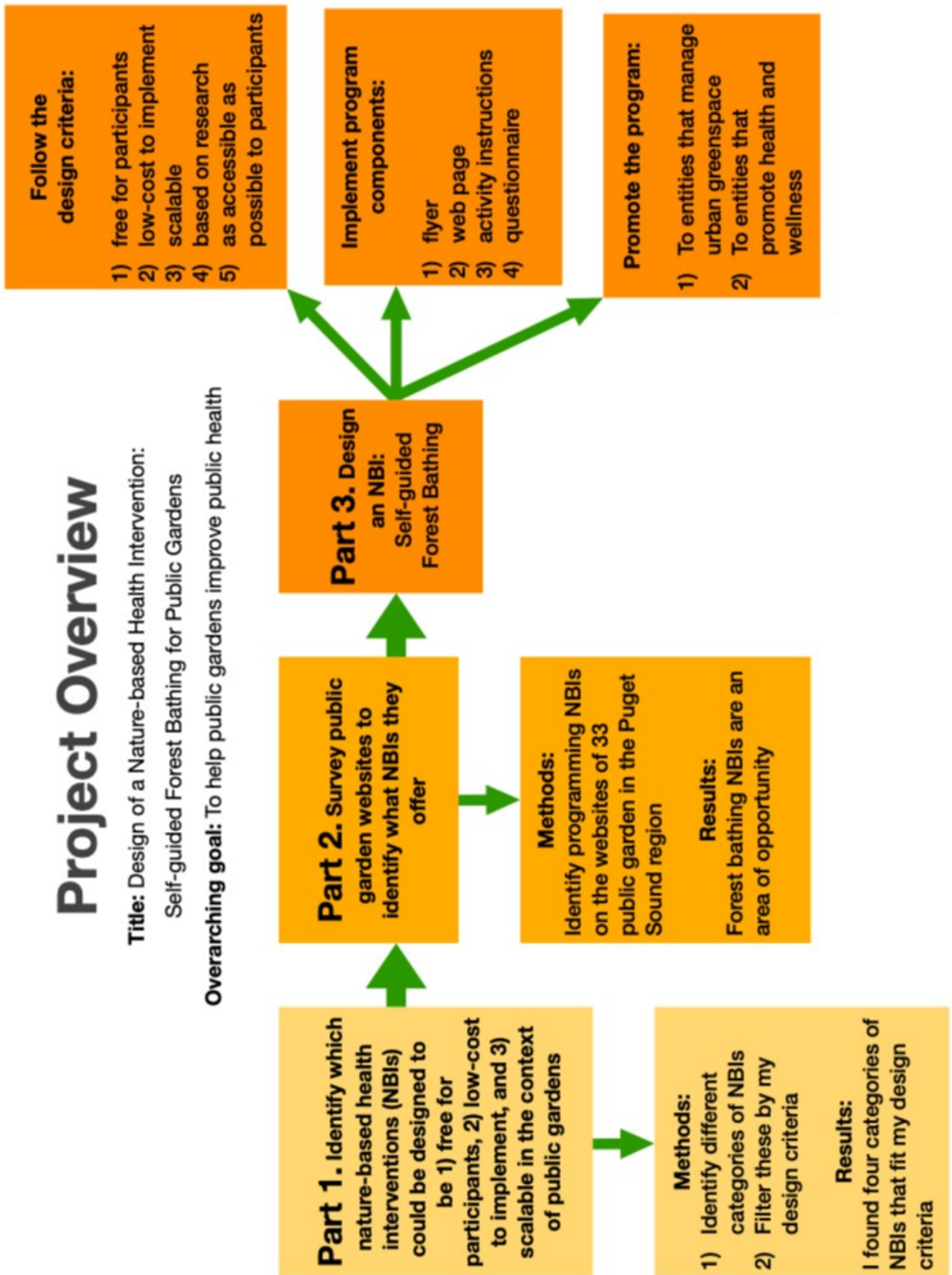
Some garden-type entities that fall within the above definition are excluded from my investigation of NBIs at public gardens. These entities include city/county/state/federal parks, cemeteries, zoological gardens, sculpture gardens, college and university campuses, historic homes, and natural areas. I focused on 33 public gardens made up of botanical gardens, arboreta, conservatories, privately owned gardens, and other entities. While far from a thorough investigation of NBIs represented in all of urban greenspace, my investigation provides a sense of context for the NBI that I implemented at the University of Washington Botanic Gardens (UWBG). It also highlights potential areas of opportunity for future program development in public gardens.

1.6. Research Goals

This project has three main parts (Figure 1). In part one, my goal was to identify which NBIs could meet the following criteria: 1) free for participants, 2) low-cost to implement, and 3)

scalable in the context of public gardens. In the second part, my goal was to survey the websites of public gardens in the Puget Sound region to identify what NBIs they offer. Lastly, I design, implement, and promote an NBI, based on forest bathing, that meets the above design criteria. The higher order goal of this project is to help leverage public gardens to improve public health.

Figure 1: Project overview



Methods

In this section I first provide the rationale for my three design criteria, then I explain the methods for addressing each part of the project: 1) identify NBIs that meet the design criteria, 2) survey public garden websites to identify which NBIs are currently offered in the Puget Sound region, and 3) design an NBI based on forest bathing.

2.1. Design criteria

To establish the design criteria, I considered a several challenges of implementing a successful NBI in public gardens, namely low participant engagement, low program adoption by public gardens, and a limited reach of a program. Then I applied constraints, the design criteria, that would enable a program to more easily overcome each of these challenges.

2.1.1. Free to participants:

Early on in the project I recognized the challenge of participant engagement and adherence in an intervention program (Kondo et al., 2020). From the perspective of the urban city dweller, there may be a variety of costs associated with accessing an NBI at a public garden, both monetary and otherwise. These costs include participation fees, possible garden admission fees, parking fees, the expense of transportation to and from the public garden, the opportunity cost of spending the time engaged in the NBI, the attentional and social demands of some NBIs, and other unforeseen costs. I wanted to remove at least one of these barrier, so I maintained that the NBI needed to have zero monetary fees required to participate. So if a garden visitor was at the public garden at the correct time, they could participate for no monetary cost.

2.1.2. Low-cost to implement:

Next, from the perspective of entities that own and operate public gardens, the cost of program implementation (including ongoing maintenance) poses a significant barrier. Therefore, an intervention with nominal expenses will be more likely to be adopted by gardens. Rather than specifying that a program be completely free, I allowed for a small cost to be incurred, mainly for the display of laminated, paper signs. I estimated this to be $50 per year (in 2020), allowing for multiple signs to be printed and posted at multiple locations by garden staff. Gardens promote programs and activities via their website and social media, but I wanted to allow for an

inexpensive physical sign, because I thought this could be key for walk-in garden visitors who are not connected with a garden's online platforms.

One issue with the "low-cost to implement" criteria is that some programs fall in this category only after a startup cost of program development. For example, creating outdoor education material for children, requires an initial investment of curriculum development and/or curation, after which it can be offered freely to public gardens and their visitors for almost no further cost. I included programs that could be developed in this manner, but I excluded from this criteria, programs that depend on volunteers or skilled facilitators. While there are high-quality opportunities for NBIs that utilize community volunteer elements (e.g. volunteer gardening groups), I left them out of this study due to the cost of coordinating and managing the volunteers. Similarly, I excluded "Green/nature/park/garden prescriptions" from this list because, while it may be free to the public garden when a health provider directs their patients to walk through their landscape every week, there is an initial promotion and networking cost that may be beyond the scope of many public gardens.

2.1.3. Scalable:

Scalability refers to both the ability for an intervention to be implemented in many locations, thus increasing the maximum reach of the program, and also the possibility for additional components and modifications applied to the basic program structure. This opens the possibility of public gardens with different budgets, organizational structures, staffing, and landscapes to innovate and develop a program that works well for them.

An important aspect of this constraint, is that the NBI would have to be designed to be non- place-specific, in other words, it would need to work effectively in all public gardens in the Puget Sound region. One issue with this design criteria is that public gardens themselves have little incentive to design and implement NBIs that are not place-specific. I hypothesize that third party organizations or individuals, who are incentivized to improve public health and well-being, could successfully promote and implement many NBI programs in public gardens, especially when there is low-cost to implement the program and the program fills an unmet niche in a garden's current set of amenities.

2.1.4. How this design criteria applies to an NBI based on forest bathing:

With the goal of designing a program based on forest bathing that meets the design criteria, I ruled out certain program components found in other forest bathing NBIs. I eliminated in-person, guided versions of a program, because of the expense of coordinating and hiring qualified forest bathing and/or nature therapy guides. Some programs designate forest bathing trails and even install forest bathing "invitations" on signs along trails, but I excluded these components because they require gardens to install and maintain such features. The Association of Nature and Forest Therapy (ANFT), an international organization that trains and certifies guides, also certifies forest bathing paths and green spaces (*Association of Nature and Forest Therapy Guides and Programs*, n.d.). An ANFT Trail Consultant works with land managers to make recommendations on trails that have certain qualities related to accessibility, safety, biodiversity, natural features, and management. This helps promote forest bathing and contextualizes a trail in a wider network of forest bathing trails, but as of 2020, the certification process for a single trail costs $1,000. In contrast, the forest bathing program that I designed is intended to be a low-cost, accessible amenity that can be easily adopted by land managers.

2.2. Identifying NBIs that meet the design criteria

To sift through a selection of possible interventions, I relied on a study that curated a set of 27 NBIs through a Delphi expert elicitation process, using 19 experts from seven countries (Shanahan et al., 2019). These interventions are implemented in a variety of physical environments and are aimed at 1) preventing chronic health conditions, 2) promoting general well-being, 3) and/or treating specific physical, mental or social health, and well-being issues. The NBIs in this list were grouped into two broad types: 1) those that aim to alter the environment to promote nature experiences (e.g. installation of walking paths, streetscape enhancement, installation of indoor plants in work places, etc.) and 2) those that use programs or activities to promote nature experiences (e.g. outdoor exercise programs, wilderness therapy, outdoor education schemes, etc.) (Table 1). This taxonomy of NBIs is not meant to be comprehensive. It was intended as a tool for practitioners to more effectively select NBIs that address particular needs and contexts. As such, my project builds off of their work.

I applied my design criteria to the 27 NBIs. This immediately ruled out the first 11 NBIs, which required some aspect of altering environments (e.g. installing street trees, installing walking paths, etc.) (Table1). These are neither low-cost nor scalable across many locations. So my assessment then focused on the 16 NBIs that used programs or activities (Table 2). These NBIs are aimed at different target beneficiaries (i.e. age groups, disabilities, etc.) and have different intervention goals, but I focused on program descriptions, deciding if a version of the NBI could be developed in such a way that it could be free to the public, low-cost to implement, and scalable in the context of public gardens.

Table 2: Information about NBIs that use programs and activities (adapted from Shanahan et al., 2019)

Intervention	Description	Intervention Goals (i.e. Health Outcome)	Target Beneficiaries
12. Green/nature/ park/garden prescriptions.	Doctors (or other professionals) 'prescribe' or refer patients/clients to outdoor activities (often walks).	Increase exercise and the associated benefits, stress reduction, reduce blood pressure, improve healing times, reduce depression, increase resilience and other mental health benefits. Some are targeted towards children for purposes such as prevention or treatment of obesity, cancer and diabetes. Some also target quality of life, well-being and social support.	Individual patients or groups with a range of conditions.
13. Care–farming or farm therapy, including horticulture and animal–assisted therapy.	Therapeutic use of commercial farms and agricultural landscapes as a base for promoting mental and physical health, through normal farming activity or horticulture.	Mental health promotion and to reduce distress in people with dementia. Reduce social isolation.	Youth at risk; youth with special needs (e.g., autism); cancer survivors; mental disorders; people with lost functionality; people recovering from serious illness.
14. Residential retreats.	Multi–modal therapies delivered in a removed natural setting.	Holistic well-being: physical, but primarily psychological (coping), social, spiritual.	Patients with chronic conditions such as cancer or cardiovascular disease.
15. Wilderness therapy.	Structured nature–based activities and programmes in 'wilder' environments for 'at risk' groups or those recuperating or in recovery	Address social and psychological issues through a range of pathways, including by facilitating positive human–nature interactions, building self–esteem and fostering social connections.	People with severe mental health issues; youth at risk of involvement in crime; individuals who are imprisoned or on probation from crime; ex–offenders; victims of crime; children with ADHD; those living with or recovering from a range of mental and physical conditions; people with post–traumatic stress disorder.
16. Wilderness	Programmes designed to	Personal growth, social skills.	Often youth, but also

Intervention	Description	Intervention Goals (i.e. Health Outcome)	Target Beneficiaries
programmes.	challenge participants in natural environments.		targeting any interested people and groups.
17. Ecotherapy.	Treatment modalities that include the natural world in relationships of mutual healing and growth, and as such are a form of applied ecopsychology.	Positive effects on psychological well-being, fitness and self–reported health.	People with symptoms of stress, or other mental health and well-being issues.
18. Pet therapy, or pet–assisted therapy.	Use of pets, especially in hospitals to benefit patients.	Psychological well-being; social well-being.	Hospital inpatients; other vulnerable groups.
19. Forest bathing.	Practice of spending time in forest settings, often with emphasis on attention to breathing and other meditative techniques	Improved physical and mental well-being.	People referred to the program or voluntary participation.
20. Green gyms or environmental volunteering.	Active work in an outdoor environment, often with a focused conservation outcome.	Provide diverse benefits including physical activity, mental well-being, social connection/(re)integration.	People referred to the program or voluntary participation.
21. Outdoor exercise groups.	Groups with the specific aim of exercising in nature (most commonly walking) for health benefits.	Improve physical, psychological, social and spiritual well-being, including better cardio–vascular health, psychological well-being.	Local interested residents, or people referred to the program with a specific health condition, or voluntary participation.
22. Nature play/wild play.	Structured programmes designed to facilitate children's play in natural environments.	Enhance child health and development through provision of social programmes and physical environments that promote varied play opportunities, improved attention and learning, physical activity, mental health.	Children (general).
23. Forest Schools/outdoor classrooms/learning environment.	Programme of education in the outdoors (rather than about the outdoors). Typically children spend a period of their schooling (ranging from	Provide alternative (and sometimes improved) learning environment, increase physical activity and the associated benefits.	Typically children, but has been used with adults and people with special needs.

Intervention	Description	Intervention Goals (i.e. Health Outcome)	Target Beneficiaries
	a couple of hours a week to all their time) undertaking outdoor activities. Forest school is both a pedagogy and a physical entity, with the use often being interchanged.		
24. Children's kitchen gardens.	Gardens in schools and kindergartens to encourage engagement in growing one's own food and to increase access to fruit and vegetables	Improve nutrition, social connections and psychological benefits (e.g., confidence, team work skills), physical activity, educational outcomes, school–based quality of life.	Children in childcare, nurseries and schools.
25. Outdoor education schemes.	Schemes designed to introduce children/adults to nature with the purpose of altering their knowledge about, attitudes toward and contact with nature.	Increase confidence to use natural environments for physical activity and recreation and promote the health and well-being benefits associated with this and increased nature exposure.	Largely children, but also aimed at adults from vulnerable groups (e.g., rehabilitation) and others.
26. Promotion and facilitation campaigns.	Promotional campaigns (e.g., via media) to highlight and encourage engagement with natural environments and potential health benefits.	Increase awareness, engagement, use and experience of natural environments.	General population, but often targeted at specific groups such as different age groups.
27. Blue gym.	Water– or shoreline–based activities.	Improve mental well-being.	General population.

2.3. The NBIs currently offered at public gardens in the Puget Sound region

Next, I examined the context of UWBG in terms of other geographically proximate public gardens. I limited this area to the Puget Sound region, including King, Kitsap, Pierce, and Snohomish Counties, population 4.2 million with a population growth of 500,000 in the last ten years (*Region adding 188 people a day | Puget Sound Regional Council*, n.d.). I intended to capture a snapshot of public garden programs in the region and to learn from the NBIs that these gardens offered.

In order to compile this selection of public gardens, I Google searched the key phrase "Puget Sound gardens." This resulted in several websites that list regional public gardens; I focused on three sites that seemed to capture many gardens in the area:

1. https://pugetsoundgardens.org/
2. https://www.gardenconservancy.org/preservation/northwest-network
3. http://southsoundgardens.com/index.php

These websites featured 33 gardens (Table 3: List of public gardens; Figure 2: Map of public gardens of the Puget Sound region). However, this does not represent a comprehensive list of public gardens in the region, as defined by the American Public Garden Association above. One main distinction of these public gardens is that they are usually entities where the main features are the gardens themselves rather than something else. For example, zoos, cemeteries and university campuses may have elaborate landscapes and gardens but their primary focus is not the greenspace itself. Additionally, in order to contain the scope of this project, I decided to omit greenspace that is operated solely by a jurisdiction (i.e. public parks or state parks).

I browsed the website of each garden and recorded any of the previously defined 16 NBIs offered (Table 2). I also noted any site content (e.g. links, articles, handouts, self-guided tours, courses, videos, audio clips, etc.) that would directly inform a site user about the health and well-being benefits of nature-contact. I noted what each garden offered on its website, if anything, and included the location in the website where the information was located.

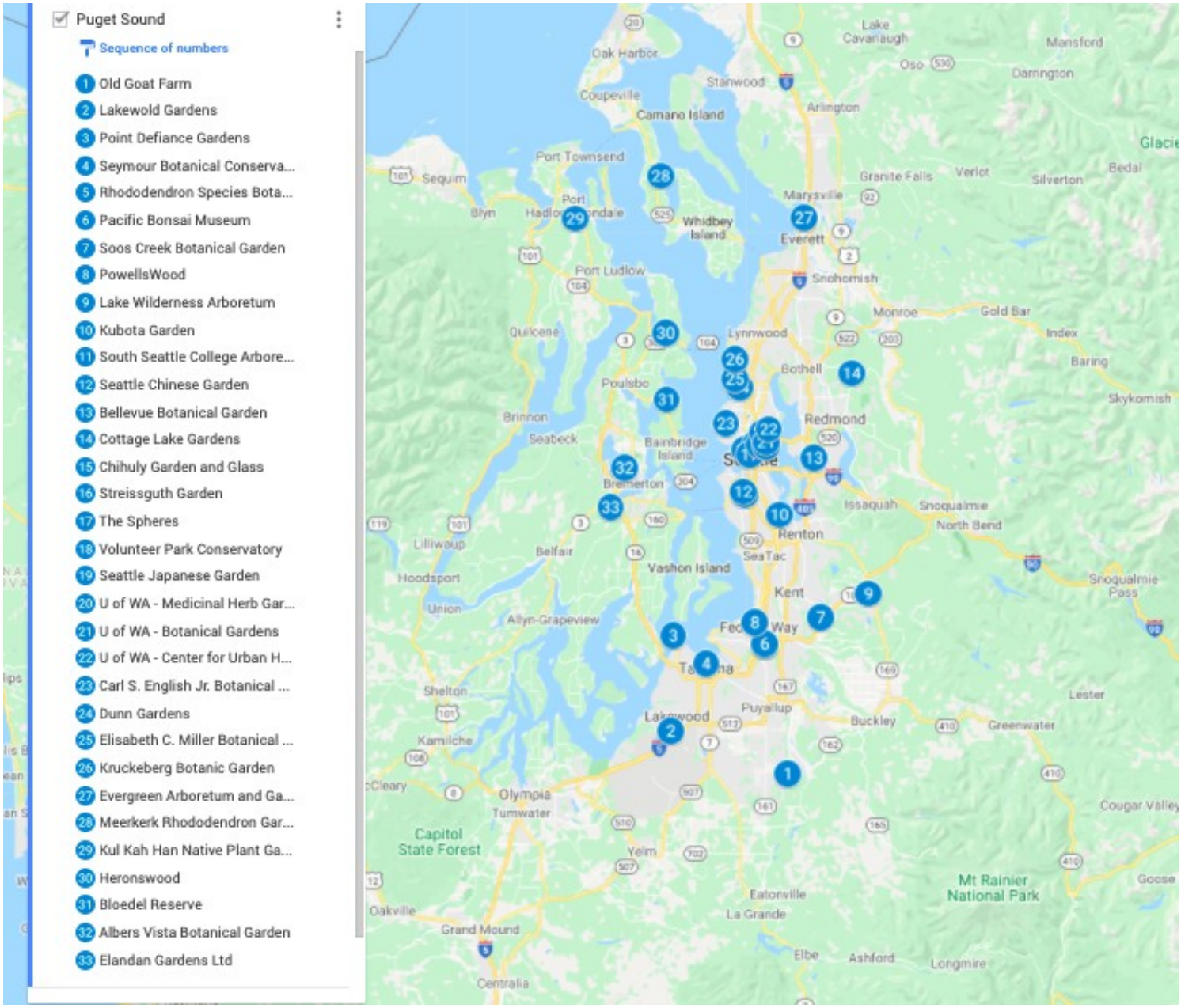
I was interested in whether and how public gardens are translating the growing body of nature and health literature into programs or resources for their public, but it is important to note

that this website search was done in 2020 when most or all in-person programming was not taking place due to safety precautions related to the COVID-19 pandemic. People were not allowed to socially gather, so this prevented public gardens from hosting any in-person programming. Therefore, this may have affected my findings if gardens temporarily deleted NBI programming content from their website rather than leaving them up with a “cancelled until further notice” signifier.

Table 3: List of public gardens of the Puget Sound region

Public Garden	Website
Albers Vista Gardens	http://www.albersvistagardens.org/
Bellevue Botanical Garden	https://bellevuebotanical.org/
Bloedel Reserve	https://bloedelreserve.org/
Carl S. English Jr. Botanical Garden	http://www.ballardlocks.org/carl-s-english-garden.html
Chihuly Garden and Glass	https://www.chihulygardenandglass.com/
Cottage Lake Gardens	http://cottagelakegardens.com/
Dunn Gardens	https://dunngardens.org/
Elandan Gardens Ltd	http://www.elandangardens.com
Elisabeth Carey Miller Botanical Garden	https://www.millergarden.org/
Evergreen Arboretum and Gardens	http://www.evergreenarboretum.com
Far Reaches Farm	https://www.farreachesfarm.com/
Good Shepherd Center	https://historicseattle.org/project/good-shepherd/
Heronswood	https://heronswoodgarden.org/
Kruckeberg Botanic Garden	https://www.kruckeberg.org/
Kubota Garden	https://kubotagarden.org/index.html
Kul Kah Han Native Plant Garden at HJ Carroll Park	https://nativeplantgarden.org
Lake Wilderness Arboretum	https://www.lakewildernessarboretum.org/gardens/perennial-garden/old-garden-roses/
Lakewold Gardens	https://lakewoldgardens.org/
Meerkerk Gardens	https://www.meerkerkgardens.org/
Old Goat Farm	https://www.oldgoatfarm.com/
Powellswood	https://powellswood.org/
Rhododendron Species Botanical Garden	https://rhodygarden.org/
Seattle Chinese Garden	http://seattlechinesegarden.org/
Seattle Japanese Garden	https://www.seattlejapanesegarden.org/
Seattle Sensory Garden	https://www.seattleparksfoundation.org/project/seattle-sensory-garden/
Soos Creek Botanical Garden and Heritage Center	http://www.sooscreekbotanicalgarden.org/
Streissguth Gardens	http://streissguthgardens.com/
The Highline SeaTac Botanical Garden	https://highlinegarden.org/
The Spheres	https://www.seattlespheres.com/
University of Washington Botanic Gardens	https://botanicgardens.uw.edu/
U of WA - Medicinal Herb Garden	http://www.uwmedicinalherbgarden.org
W.W. Seymour Botanical Conservatory	https://www.metroparkstacoma.org/plants-exhibits-conservatory/
Waterfront Seattle	https://waterfrontparkseattle.org/

Figure 2: Map of the public gardens of the Puget Sound region (King, Kitsap, Pierce, and Snohomish Counties)



2.4. Forest Bathing Program Components

This section describes the background and methods for each component of the forest bathing program: the flyer, the web page, the activity instructions, and the program evaluation (Figure 4).

2.4.1. Flyer

To advertise this activity to garden visitors at public gardens, I designed a flyer that is available on the web page and can be printed and posted at any location. It should be printed on an 8.5"x11" piece of paper and posted at visible locations at the garden (e.g. at information boards, visitors centers, information kiosks, etc.) (Figure 3). The printing and maintenance of the physical flyers is the minimum expense for a public garden that wants to adopt the forest bathing amenity. Additionally, this flyer can work well in any location where green care entities and land managers want to promote the resource.

Figure 3: Example of an informational kiosk at a public garden

2.4.2. Web page

The flyer directs people to a web page hosted on the UWBG website. I designed the web page on this site, rather than creating a new website, because I had already planned to first implement the program at UWBG. There may be an advantage here, in that affiliation with UWBG could give an unfamiliar program more credibility and exposure with potential participants. However, there may be a disadvantage if other public gardens (or other entities in urban greenspace) do not want to affiliate with UWBG if, for example, they are a garden that

wants to avoid exposing themselves to competition for public attention and resources. Regardless of the unknowns here, tying this program to UWBG is an example of how the program can be added to a public garden's list of amenities with little or no disruption to their current budget and staffing. So, this approach of piloting and hosting an NBI program could be replicated in gardens elsewhere.

2.4.3. Forest bathing activity instructions

To create a handout of the activity instructions, I employed an iterative design process, first writing and designing from guiding principles, then soliciting feedback from a group of "experts," then repeating. This group consisted of two forest bathing guides, a few grad students from the School of Social Work at University of Washington (UW), and a handful of nature and health researchers and practitioners in the Environment and Well-being Lab at UW. My guiding principles focused on synthesizing basic protocols from forest bathing studies and writing instructions that succinctly explain the "how to" of the activity. I wanted the instructions to be legible and to use as few words as possible. They needed to be visually appealing and to be written in language that was easy to understand but not overly prescriptive. Many forest bathing "invitations" are place specific, but I wanted to write instructions that are general enough to be used in a wide variety of greenspace settings and seasons. Lastly, I wanted to create an arc of an experience with a beginning, middle, and end.

Similar to the visual instructions, the audio instructions are designed to be a succinct guide to the practice of forest bathing, effective for participants in a variety of greenspace environments, and conducive to both the beginner and repeat participant. I worked with Michael Stein-Ross, a certified forest bathing guide, who wrote and narrated these instructions.

2.4.4. Program evaluation

In the design process of any NBI, there should be a plan to evaluate the intervention along some metrics of success. I recognized a distinction between 1) the evaluation of interventions designed and implemented by nature and health researchers for the purpose of testing a hypothesis with a controlled experiment and 2) the evaluation of interventions designed and implemented by nature and health practitioners (e.g. city planners, landscape designers, public health officials, community organizers, etc.) for the purpose of improving population

health. These two intervention types sometimes overlap, but are usually distinct. This forest bathing program, which falls in the second group, can be viewed as a simple platform where future research could gather data on how participants respond to the intervention.

I used Google Forms to create a questionnaire that participants can easily find on the web page. From the point of view of the public gardens, I focused on what is probably the most important question for whether or not to offer an amenity: To what extent does this amenity add value to this public garden? I expected that few people will fill out an optional questionnaire about an optional program, so I limited the number of questions and focused on general impressions about the activity.

Results

3.1. Identifying NBIs that meet the design criteria

There were 16 NBI categories that promote nature experience through programs and activities in contrast to the 11 NBI categories that promote nature experience through environmental alterations (Shanahan et al., 2019) (Table 1). In general, the process of reviewing taxonomies of NBIs is a useful place to begin for entities that want to develop and/or implement more nature and health programming. I ignored the 11 NBIs that use environmental alterations because none of these meet my 'low-cost' criteria. I then applied each of the three design criteria to the 16 NBI categories that use programs and activities (Table 2). I considered if a version of each NBI could conceivably be designed within the bounds of each design criteria. Four of these NBIs met zero of the inclusion criteria (care-farming/horticulture therapy, residential retreats, wilderness therapy, and wilderness programs (See Table 2 for descriptions of all 16 NBIs)). If NBIs did not qualify in this filtering process, this does not mean that they could not be developed into successful programs for public gardens, only that they can not be implemented under my design constraints.

I identified four NBI categories that could meet all three inclusion criteria AND they could conceivably exist in the context of many public gardens (indicated in bold, with an X in each column of Table 4). This short list includes 1) forest bathing, 2) outdoor exercise groups, 3) outdoor education schemes, and 4) promotion and facilitation campaigns. This filtering process suggests that program versions of each of these four NBI categories could be offered for free and

implemented in any location. For example, an “outdoor education scheme” NBI, when designed under this set of criteria, might be a collection of children’s nature-based scavenger hunts with themes to work well in a wide variety of public gardens (Example themes: pollinators, weather patterns, birding, botany, hydrology, soil science, etc.). If such a program was designed and promoted to a public gardens, then some gardens may adopt the program, thereby adding a “lens” that garden visitors could use to experience the landscape.

A common feature of the four NBI categories that meet my design criteria is that they are information based, and each version of a program would provide a unique “lens,” via online tools or physical signs or handouts, that could augment and enrich how a participant interacts with an outdoor space. For the purpose of this project, I proceed with developing a program based on forest bathing (See Section 3.3).

Table 4: NBIs that could possibly meet each design criteria; X=Yes, possibly

NBI	Low-cost to implement	Free for participants	Scalable to public gardens
Green/nature/park/ garden prescriptions.		X	X
Care-farming or farm therapy, including horticulture and animal-assisted therapy.			
Residential retreats.			
Wilderness therapy.			
Wilderness programs.			
Ecotherapy.			X
Pet therapy or pet-assisted therapy.		X	
Forest bathing.	**X**	**X**	**X**
Green gyms or environmental volunteering.		X	X
Outdoor exercise groups.	**X**	**X**	**X**
Nature play/wild play.		X	X
Forest schools/outdoor classrooms/learning environment.			X
Children's kitchen gardens.		X	
Outdoor education schemes.	**X**	**X**	**X**
Promotion and facilitation campaigns.	**X**	**X**	**X**
Blue gym.		X	

3.2. The NBIs currently offered at public gardens

My survey of NBIs on public garden websites helped provide context for this project. In summary, I found six of 16 NBIs offered at 15 of 33 public gardens. This included programming that I labeled as 1) Ecotherapy, 2) Forest Bathing, 3) Environmental Volunteering, 4) Forest Schools/outdoor classrooms/learning environment, 5) Outdoor education schemes, and 6) Promotion and facilitation campaigns (Table 5). In regards to the NBIs that met my design criteria, I identified that a version of forest bathing was offered at three public gardens, outdoor exercise groups were offered at zero gardens, outdoor education schemes were offered at eight gardens, and promotion and facilitation campaigns were offered at three gardens (Table 6). For each NBI category, there are multiple versions of programs that were designed and implemented. Studying these existing programs could be useful for public gardens to learn from each other and to find niche program opportunities.

Notably in my results, there were 18 of the 33 public gardens that did not display any programming NBIs on their websites. There are a few possible reasons for this: there are currently barriers for public gardens to implement more NBI programs (e.g. a lack of funding), a lack of incentives to offer programs and activities to garden visitors (e.g. because they fail to directly generate revenue and/or they are outside of the organizational mission), my method of browsing websites overlooks existing programs (e.g. because they are only promoted on social media or the physical locations), and/or public gardens have removed programs from websites due to the Covid-19 pandemic (my survey was conducted in 2020). While far from conclusive findings, the general lack of visible NBI programming at public gardens justifies creating more programs that are low-cost to implement and that adds value to these entities. It should be easier for public gardens to curate a variety of meaningful nature experiences for their visitors.

Focusing on the forest bathing NBIs, I only found two types of forest bathing programs offered by the public gardens in my survey. The first type relied on a contracted facilitator (i.e. mental health workers or forest bathing guides) to lead a scheduled session. These sessions require visitors to arrive at the session at the prescribed time and location and to pay a fee for the service. The second type of forest bathing program, which was only offered at one public garden (“Strolls for Well-being” at Bloedel Reserve), was more involved in that participants followed a twelve week program and shared their experience with other participants and with a trained

facilitator. Participants were instructed to follow along handouts that supplemented weekly, self-guided nature walks through the gardens. This was offered through a fee-based seasonal admission process until the summer of 2020, when due to COVID-19, an alternative program called “Strolls at Home” was offered on their website. This version of the program provided 12 handouts for 12 weeks for free to anyone who accessed the materials online. This version directed participants to interact with nature anywhere, not only at Bloedel Reserve.

Table 5: NBIs that use programs and activities, found on public garden websites

Public Garden	Eco-therapy	Forest bathing	Green gyms of environmental volunteering	Outdoor education schemes	Promotion and facilitation campaigns	Nature & health resources and links
Albers Vista Gardens				X		
Bellevue Botanical Garden		X	X	X		
Bloedel Reserve	X	X				X
Dunn Gardens			X			
Elisabeth Carey Miller Botanical Garden				X		
Evergreen Arboretum and Gardens			X			
Kruckeberg Botanic Garden						X
Kubota Garden				X		X
Kul Kah Han Native Plant Garden at HJ Carroll Park			X	X		
Lakewold Gardens					X	
Rhododendron Species Botanical Garden			X	X		
Seattle Japanese Garden			X			
The Spheres					X	X
University of Washington Botanic Gardens		X	X	X	X	X
W. W. Seymour Botanical Conservatory				X		

Table 6: NBIs that meet the three design criteria and gardens that offer them

NBIs that could possibly meet the 3 design criteria:	Names of public gardens that offer a version of this NBI
Forest bathing:	• Bellevue Botanical Garden • Bloedel Reserve • University of Washington Botanic Gardens
Outdoor education schemes:	• Albers Vista Gardens • Bellevue Botanical Garden • Elisabeth Carey Miller Botanical Garden • Kubota Garden • Kul Kah Han Native Plant Garden at HJ Carroll Park • Rhododendron Species Botanical Garden • University of Washington Botanic Gardens • W.W. Seymour Botanical Conservatory
Promotion and facilitation campaigns:	• Lakewold Gardens • The Spheres • University of Washington Botanic Gardens
Outdoor exercise groups:	• N/A

3.3. Forest Bathing Program Components

In this section, I provide more context behind designing a self-guided forest bathing program and then I explain the four basic program components.

3.3.1. Context for designing a self-guided, forest bathing NBI

I designed an NBI based on forest bathing for a few reasons. I considered that a version of a forest bathing NBI could meet my design criteria and I thought this type of amenity would add value to public gardens. I had not found in the scientific literature any forest bathing interventions that were completely self-guided (i.e. with no personnel on-site to instruct participants), but I thought the activity itself was simple enough that it could work well as a self-guided activity. This was key to ensuring that the program stayed free, because it avoids incurring the on-going cost of coordinating and/or hiring forest bathing guides to facilitate the activity for participants. My effort to complete this project represents a program startup cost, however once the first version is completed, other gardens can implement and improve their own versions of the program with relatively small adjustments.

Nature-savoring concepts and rituals exist in cultures around the world, each celebrating a tradition of interacting with nature to promote mental and physical benefits. For example, the concept of waldeinsamkeit in Germany, translated as ‘forest loneliness,’ carries the cultural notion that going into the woods promotes tranquility. While many traditions could help introduce urban city dwellers to the benefits of nature experiences, the Japanese tradition of Shinrin-yoku is unique among the nature-savoring traditions. This is because there is now a substantial body of literature that indicates how the practice is associated with health and well-being (Hansen et al., 2017; Song et al., 2016; Wen et al., 2019).

Despite the increasing presence of forest bathing in the scientific literature and grey literature in recent years, I found only three gardens in the region that indicated on their websites that they host forest bathing type experiences for their visitors. I viewed this relative absence of programming as an area for potential innovation.

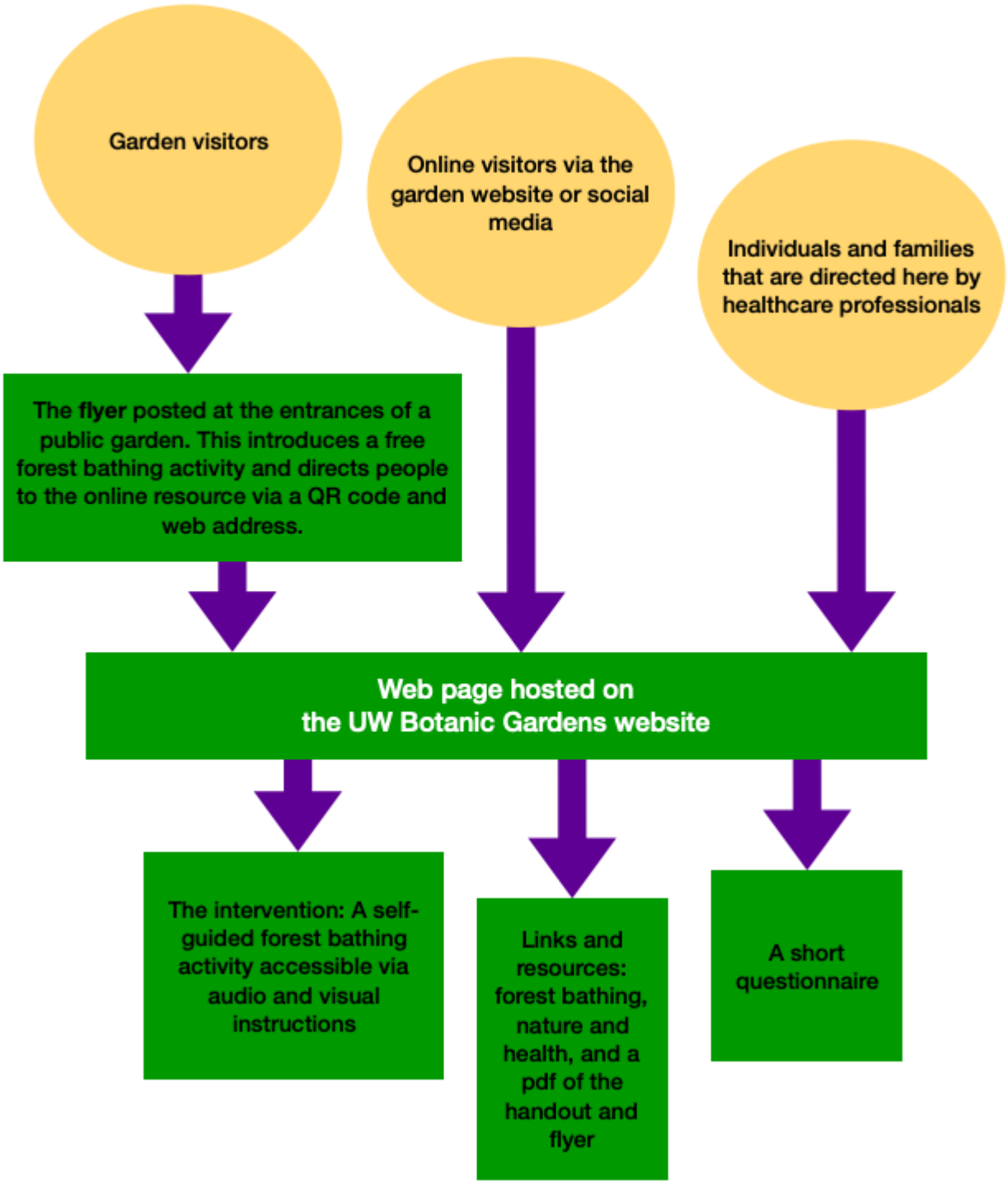
In contrast to the two types of forest bathing programs in my survey (one type that was a fee-based, guided, 90-minute session and the other that was a free, self-guided, 12-week program), I designed a forest bathing program that is free for participants, self-guided, and

particularly short and accessible. Many forest bathing studies demonstrated physiological and psychological health benefits after as little as a 15-minutes interventions (Hansen et al., 2017; Song et al., 2016; Wen et al., 2019), so I considered this as the minimum amount of time for the activity.

Slowing down to practice forest bathing can feel awkward and uncomfortable for individuals who are accustomed to fast-paced, high-stimulus environments, so I wanted to make the behavior as easy as possible for a beginner. A benefit of a shorter nature-savoring activity is that it is more likely to be frequently repeated than longer, 90-minute, guided sessions. Short and frequent forest bathing could supplement longer, more in-depth, nature experiences. Furthermore, studies have indicated the benefits of short amounts of time in park-like settings (Yuen & Jenkins, 2020) as well as the benefit of increased 'visit frequency' to greenspace (Shanahan et al., 2016; White et al., 2017, 2019). I wanted it to be simple enough that someone could learn the basic skills then return to it frequently, such as on the way home from work or on a lunch break. The instructions are intended to be simple enough that, after a few sessions with the handout or audio guide, an individual could memorize the activity and engage in the practice regularly.

The program is designed for participants to practice on there own or in groups. I hypothesized that the audience for a forest bathing NBI at a public garden might come from three potential directions: 1) garden visitors who physically visit the garden, 2) online visitors via the garden's website and social media, and 3) individuals and families that are directed to the garden by health care professionals (Figure 4). This third group is aspirational, as the program would have to be established before it became a green prescription activity for health providers to direct their patients.

Figure 4: How people access the self-guided, forest bathing NBI



3.3.2. Flyer

The flyer represents the minimum materials required to connect visitors to the activity. The flyer is designed to direct interested garden visitors to the audio/visual forest bathing activity instructions on the web page via a QR code (abbreviated from Quick Response code) (Figure 5). The content of the flyer includes a 1) brief description of what the activity is, 2) what a participant can expect to gain from engagement in the activity, and 3) how to access the activity, the QR code and web page URL. The QR code is a matrix barcode that someone with a smart phone with web access can use to link to a website, in this case the web page with the activity instructions. The flyer allows an individual to access the activity instructions on their own if they are carrying a smart phone with data, however, a public garden can circumvent this barrier by posting or printing out copies of the activity instructions from the website. Offering the physical activity instructions to the garden visitors is preferable to relying on the flyer, though I note this as an additional option, because it increases the cost of offering the amenity (i.e. printing out copies of the activity instructions and relying on garden staff to refill the copies and make them available).

Figure 5: The flyer

3.3.3. Web page

The web page is hosted on the UWBG website and offers three different components. The first is the forest bathing activity instructions (Figure 6). The second is an optional Google Forms questionnaire (Table 7). The third component is a list of additional resources related to forest bathing and nature and health. The page went live on February 7, 2021 and can be found at: https://botanicgardens.uw.edu/washington-park-arboretum/activities/forest/

3.3.4. Activity instructions

The activity instructions are available on the web page in English and in two formats: 1) visual instructions in the form of a handout (Figure 6) and 2) audio instructions. The audio was written and narrated by certified forest bathing guide, Michael Stein-Ross, of Cascadia Forest Therapy (Audio clip: https://depts.washington.edu/uwbg/media/forest_bathing_audio.m4a). The audio is ten-minutes long and the narrator invites participants to periodically pause the recording to direct attention to the environment. Both versions of the instructions are designed to be effective in a variety of greenspace environments and user-friendly for the forest bathing beginner and the repeat participant.

For the purpose of building a clear and concise forest bathing activity, I drew upon common protocols in the literature to inform design guidelines for the setting, the time period in the setting, the state of the participants' attention, and notably what a participant is not doing (i.e. not hiking to a destination, not distracted on a phone or on other devices, not distracted with talking, and not moving quickly). One frequently occurring protocol is that participants are instructed to direct their attention to the natural environment. Building on this, I include the "savor" instruction to invite participant to slow down, and hold their attention with the stimulus in their environment. The psychological act of savoring a positive event, sometimes referred to as capitalizing or amplifying, is also associated with feeling more positive emotions (Bryant, 1989; Langston, 1994; Moskowitz et al., 2012; Smith & Bryant, 2016).

Figure 6: The handout (aka visual activity instructions)

3.3.5. Program evaluation

Participants have access to an optional questionnaire, through a link on the web page, that directs them to a three question Google Forms questionnaire (Table 7). The purpose of the questionnaire is to gather general impressions about the user experience of the program. This information will be helpful for improving the program design. The questionnaire is available on the program web page and is located at: https://docs.google.com/forms/d/e/1FAIpQLSfgD-tsB9Ys0_3mXNikbf_BdoysLwef_OmNQVs37WiYPvrvkQ/viewform

After the first six weeks of the questionnaire being live, there were zero responses. This suggests that the questionnaire could be improved to make it more enticing for participants to fill out. It could also suggest that not many people are actually using the resource to engage in a forest bathing activity. Lastly, it could suggest that not many people will fill out an optional question of this kind. Generally, this model of collecting feedback from participants may need further attention and improvement.

Table 7: Content of online questionnaire

Questionnaire content:	
1	“How did you like the forest bathing activity?” (five-point Likert-scale question)
2	“Please tell us what you thought about the forest bathing activity.” (text box question)
3	“How did you find out about the forest bathing activity?” (text box question)

3.4. Promoting the forest bathing NBI to public gardens and other organizations

At the beginning of March 2021, I promoted the self-guided forest bathing resource in an email to the public gardens on my list. I suggested that they can link the web page on their website if it is a good fit for offering to their garden visitors. After two weeks, I heard back from six gardens who said they are interested in sharing the resource with their visitors and one of the gardens (Kruckeberg Botanic Garden) has linked it on their site.

I reached out to a group of organizations with the same offer, focusing on organizations that manage green space or that provide mental health resources to people. I shared the program,

at the beginning of March, 2021, to the following entities: The Whole U, Puget Sound Public Gardens (an online resource), Washington Trails Association, The American Public Garden Association, and The UW Counseling Center. So far, I have heard back from the first two organizations; The Whole U has agreed to promote the event to UW faculty and staff in April 2021 and Puget Sound Public Gardens has linked the web page under their "On-going Events." The positive reception from a small number of entities in these first weeks is suggestive that the program could add value to public gardens and their visitors.

Discussion

4.1. Public gardens for public health

By exploring what programs are currently offered at public gardens around the Puget Sound, I showed that some gardens present many more NBI programs than others and, in general, promoting NBI programs on their website is outside the focus of most of these gardens. This indicates an opportunity. Public gardens that embrace the project of improving public health, enrich their community ties, connect with a wider audience, and help to justify their role in society. One of the biggest challenges of many public gardens is staying open, which is related to attendance and demonstrating value to funders. Offering nature experiences as a path to health and well-being may be important to many funders. Some public gardens are already expanding in this direction with programs and activities that emphasizes health benefits of nature experiences. For example, Bloedel Reserve includes "Nature and Well-being" as one of their guiding principles and offers the "Strolls for Well-being" program to support this mission. Similarly, Kruckeberg Botanic Garden promotes meaningful nature experiences by offering online resources about nature and wellness, community science, outdoor education, horticulture, and more.

4.2. One-size-fits-all NBIs

I identified four NBI categories that could be further developed into programs under the design criteria (Table 8), and I propose classifying such as programs as "one-size-fits-all NBIs" because they have the unique characteristics of being non-place-specific– they can be offered at many different locations in a given region. Furthermore, they are more equitable by being free for participants and low-cost for any entity to offer to their public. I propose that high-quality versions of these four NBI categories could be designed, curated, and promoted to gardens. These programs might be designed and curated by organizations committed to public health or any entity that wants to enrich the user experience of landscapes.

A central priority for public gardens is the on-going maintenance and development of their physical space, so a lack of NBI programs is not surprising. Those that are currently offered at public gardens, are usually place-specific and rarely designed to be shared with other entities. Public gardens themselves are not incentivized to develop programming that can draw visitors

and funders to other locations. Public gardens often lack the resources to provide value-promoting programs. Meanwhile, third party practitioners (organizations and individuals committed to improving public health) struggle to find homes for low-cost, high-leverage health interventions. This coordination problem can be overcome when practitioners design "one-size-fits-all NBIs" and promote them to public gardens and entities that manage urban greenspace. These programs help gardens establish relevance, engage their local communities, and attract funders.

I advocate for more such programs that are open-sourced, so they can be adjusted to suit the needs of different public gardens. Such programs could be designed to be regionally specific, seasonally specific, modified for different age groups and target beneficiaries, and offered in multiple languages. Within the "forest bathing" NBI category, there could be nature-savoring programs designed for different age groups, designed for indoor use, modified for different seasons, designed specifically for large groups, designed with a writing/journaling component, with a photography component, designed to incorporate social media, etc. In the "outdoor exercise" NBI category, there could be programs that feature garden walking challenges, self-guided qigong, speed-walkers scavenger hunts, walk-and-talk-with-a-friend campaigns, etc. Similarly, in the other categories of one-size-fits-all NBIs, there could be a variety of online content designed and promoted specifically for visitors of public gardens.

Future research could investigate solutions to more efficiently 1) introduce public gardens to one-size-fits-all NBI programs and 2) introduce practitioners (entities that can design and promote NBIs) to public gardens. The best resource that I found to address these challenges is the Library and Media Center database on the American Public Garden Association. This resource is especially for helpful for public garden management to learn what other gardens are doing in terms of garden management, education and science, plant curation and conservation, facilities and operations, public engagement, horticulture, etc. Yet, it is not currently set up to filter for public garden programs that can be implemented in many locations, it does not use the framework of NBIs, and it currently lacks many examples of public garden programs.

4.3. NBIs in urban greenspace

For organizations that are interested in offering more nature-based health amenities, the framework of NBIs used in this project is a valuable starting place (Shanahan et al., 2019). Due to the limited scope of this project, I focused on only 33 public gardens in the Puget Sound region, but other organizations that facilitate interactions between people and greenspace are likely to also find this framework useful. Public park departments, which usually have restrictive budgets and a focus on equity and public health, may be interested in one-size-fits-all NBIs. Self-guided forest bathing, and other such NBIs, could be useful for green belts, zoos, university campuses, K-12 schools, nursing homes, hospitals, tourism companies, etc. Nature-based programs could be leveraged by universities to address mental health related illness in student populations. Companies could leverage NBIs to reduce employee burnout. Additionally, NBI programs could be promoted by entities that offer health and wellness resources (e.g. health care providers, counselors, mindfulness organizations, etc.).

Table 8: Information about the four NBIs that meet all three design criteria (adapted from Shanahan et al., 2019)

Intervention	Description	Implemented for the Prevention (P) or Treatment (T) of Illness	Intervention Goals (i.e. Health Outcome)	Target Beneficiaries
Forest bathing.	Practice of spending time in forest settings, often with emphasis on attention to breathing and other meditative techniques	P/T	Improved physical and mental well-being.	People referred to the program or voluntary participation.
Outdoor exercise groups.	Groups with the specific aim of exercising in nature (most commonly walking) for health benefits.	P/T	Improve physical, psychological, social and spiritual well-being, including better cardio–vascular health, psychological well-being.	Local interested residents, or people referred to the program with a specific health condition, or voluntary participation.
Outdoor education schemes.	Schemes designed to introduce children/adults to nature with the purpose of altering their knowledge about, attitudes toward and contact with nature.	P	Increase confidence to use natural environments for physical activity and recreation and promote the health and well-being benefits associated with this and increased nature exposure.	Largely children, but also aimed at adults from vulnerable groups (e.g., rehabilitation) and others.
Promotion and facilitation campaigns.	Promotional campaigns (e.g., via media) to highlight and encourage engagement with natural environments and potential health benefits.	P	Increase awareness, engagement, use and experience of natural environments.	General population, but often targeted at specific groups such as different age groups.

4.4. Recommendations for public gardens offering self-guided forest bathing

This project shows how a forest bathing program can be modeled after the protocols of forest bathing studies that demonstrate positive health and well-being outcomes. Basic program components (i.e. the flyer, website, instructions, and evaluation) can be designed to reduce barriers to its use–both to participants by being free, and to gardens by being low-cost to implement. To maximize the potential reach of interventions, they can be designed and implemented to be easily scaled up and adopted by other gardens.

If a public garden wants to build upon the basic program components, they could improve their on-site infrastructure to be more conducive to self-guided forest bathing. First, their facility should be regularly maintained to be safe and accessible to the public. Second, there should be areas for walking and/or sitting near trees or areas with ample biodiversity. Third, they can help advertise the program to visitors online and at their physical locations, offering handouts of the instructions in addition to posting the flyer.

Public garden can designate existing trails or garden rooms that are conducive to forest bathing, where the space itself invites people to slow down and notice sensory inputs. Or, these trails and garden rooms can be designed and installed especially for nature-savoring activities. Ideally, these will be walking paths and garden areas with the less traffic noise and fewer pedestrian traffic. The paths can be quite short, say 50 yards, since the focus is not on moving quickly or reaching a distant destination. Benches can be installed in locations that feel safe, yet provide a sense of refuge.

For urban public gardens, the sounds of the city frequently dominate the sounds of the garden. Water features can be installed to help reduce the impact of traffic noise. Garden management can further reduce distracting noises by establishing protocols for the use of loud maintenance equipment and investing in quieter equipment.

There are other strategies for building on the basic program component. Gardens could post short videos to promote forest bathing at their location. A designated forest bathing trail could feature techniques (aka invitations) posted on signs along the trail (e.g. “Can you walk slowly and notice what is in motion around you.”). Materials could be offered in multiple languages. Local forest bathing or nature therapy guides could be invited to host monthly events in the space. There could be staff facilitated events (e.g. “Forest Bathing Fridays” or “Four

Seasons Forest Bathing"), complete with post-activity refreshments. Guided and self-guided sessions can close with participants drinking tea featuring plants found at the garden.

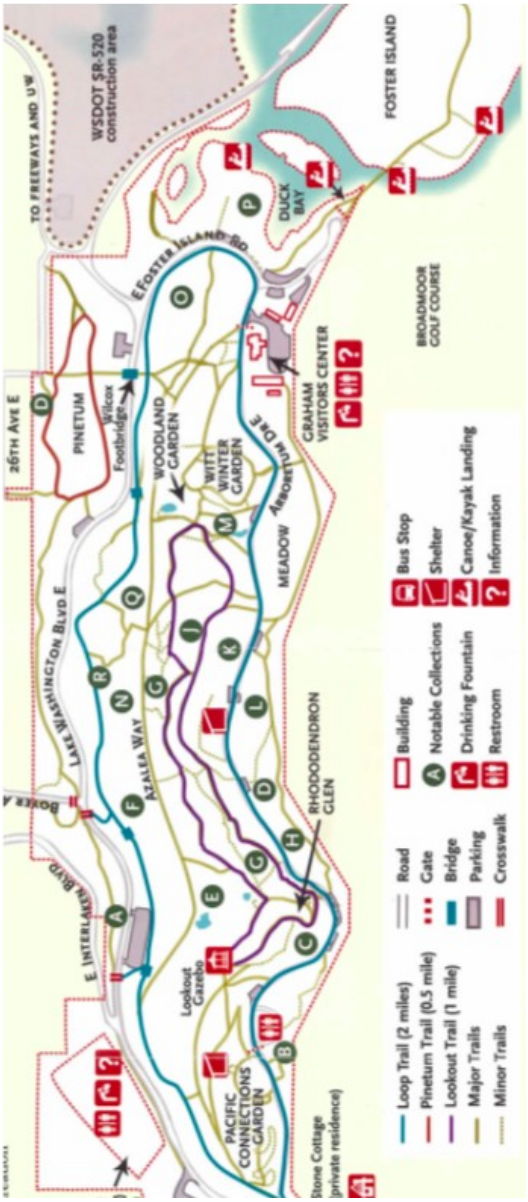
If a group of people participates in the activity together, they can be encouraged to share their observations and experiences with each other after the prescribed session. This strengthens social co-benefits of the experience and helps integrate positive experiences. One researcher suggested a whiteboard could be displayed for garden visitors to write down what they savored in the garden that day. The forest bathing activity could be used to enrich existing volunteer programs. For example, beginning a volunteer session with a short, silent forest bathing activity could deepen the overall experience for some participants.

4.5. Forest bathing locations at UWBG

At UW Botanic Gardens, there are many locations that are conducive to self-guided forest bathing. These are locations where individuals or small groups can experience forest-like conditions with relatively less distractions compared to surrounding areas. My general recommendation is for people to find any location that is pleasing to them, where they feel surrounded by nature and can sit or walk comfortably in the space. Ideally, someone can return often to their chosen forest bathing sit spots and walking trails. At the Center for Urban Horticulture location of UWBG, I recommend the Yestler Swamp boardwalk or the Loop Trail in the Union Bay Natural Area (Figure 7). There are places to sit comfortably (mostly benches, but sometimes at the base of trees) along both of these trails. The ornamental display gardens around the buildings are also useful for nature savoring, especially when not too crowded with visitors. At the Washington Park Arboretum location of UWBG, I recommend trails with fewer pedestrian commuters and ample trees and biodiversity, such as the Lookout Trail or the side trails on Foster Island (Figure 8). Garden rooms such as the Witt Winter Garden or the Pacific Connection Garden are excellent locations, as are many other short sections of trails or trail benches.

Figure 7: Map of the Center for Urban Horticulture at UWBG
https://botanicgardens.uw.edu/center-for-urban-horticulture/visit/maps-trails/

Figure 8: Map of the Washington Park Arboretum at UWBG
https://botanicgardens.uw.edu/washington-park-arboretum/visit/maps-trails/



4.6. Limitations

In order to stay within my desired design criteria, I had to make a number of compromises in this version of a forest bathing program. One issue is that participants need to have a smart phone with data and English language reading ability to access the activity instructions. This is a drawback because of the likely distraction and attentional-pull of smart phones, away from the elements of nature. One solution is for gardens to print and offer copies of the activity instructions. More could be done to evaluate and improve the accessibility of the program components and to provide alternative versions and translations to more effectively reach different populations.

Public gardens may overlook how adopting a forest bathing program into their current set of garden amenities fits into their existing priorities related to education, interpretation, and building relationships with their community. This project shows how NBIs can be incorporated into existing sets of garden amenities for very little cost, yet an unfamiliar program risks low adoption by public gardens. The goal of improving health outcomes of garden visitors may be outside the current priorities of many public gardens.

A challenge with a forest bathing NBI relates to issues with the terminology. When a forest bathing activity is offered in park-like settings, with heavily managed landscapes, it may diminish the perceived value and conservation of more wild, species-rich forests. However, the term “forest” is already used in this diminished sense, for example, in urban forestry where residential landscapes and street trees are ingredients of the urban forest canopy. Additionally, the forest bathing literature has demonstrated the activity to be an effective intervention in a variety of *forest-like* setting such as urban parks and botanical gardens. Nonetheless, if public gardens do not identify as offering forests or forest-like conditions to their visitors, I suggest they rename the program something like “Nature-based Mindfulness”, “Mindfulness in Nature”, or “Nature Savoring.” These, to me, are the next-best names for this particular program.

More work could be done to develop useful language for describing an alternative to a hike, where the goal is not a physical destination, but rather the gentle holding of one’s attention in the natural environment. People are familiar with “going on a hike” or “a walk in the woods,” but these descriptions are missing the contemplative, appreciative, slow-moving aspects of forest

bathing. Other terms in the literature for forest bathing-related activates include: nature therapy, forest therapy, ecotherapy, nature-based mindfulness, and mind-body interventions.

In addition to the need for more consensus around terminology, NBIs must be known and marketed to healthcare providers, so that they consider incorporating a variety of nature-based activities into their green prescriptions for patients. The framework of NBIs is slow to catch on, even as opportunities abound for green prescriptions in many urban areas (Van den Berg, 2017).

There are limitations that should be considered when promoting any activity based on the nature and health literature. The current literature seems to demonstrate that many people experience positive health and well-being outcomes, but individuals respond differently to nature experiences due to the host of complex and interrelated variables.

It is beyond the scope of this project to gather evidence for the health and well-being effects associated with this forest bathing activity. The goal of this program is not to promote a panacea, but to suggest that forest bathing is a set of behaviors that can be practiced, and if it proves helpful to a participant, they can continue to use it for their ongoing health and mental hygiene. The nature and health literature continues to trend toward the benefits of forest bathing on short-term outcomes, but more research needs to evaluate long-term health impacts (Hansen et al., 2017; Gritzka et al., 2020). A limitation of forest bathing studies is their inability to attribute the physical and psychological effects solely on the environment compared to other factors such as the behaviors and preconceptions that the participant brings to the environment. For example, many studies do not measure the participant's sense of "nature connectedness" which may affect their perceived benefit from the experience.

Lastly, the current NBIs offered at public gardens and the current nature and health literature are expected to change and develop over time. There are drawbacks to focusing solely on the web content of public gardens when searching for their garden amenities. Some gardens websites may not reflect their total NBI offerings. And notably, the research for this project was undertaken in 2020 during the COVID-19 pandemic which may have influenced the programs and web content of public gardens.

4.7. Future research

This project provides a simple structure for future studies to potentially reach a high volume of participants in a forest bathing intervention, however the scope of this project does not include measuring health outcomes. Future research could gather data on how the activity affects the well-being of participants by providing an option for participants to fill out a pre and post intervention POMS (Profile of Mood States) questionnaire (Park et al., 2009). The project would benefit from a combination of quantitative and qualitative measures directed at the attitudes, beliefs, and perceptions of garden visitors, including measuring the level of interest that garden visitors have in engaging in the activity itself. The project would benefit from measuring the level of interest that public gardens have in adopting and promoting the program. Future studies could collect data through online questionnaires, paper surveys, and/or mobile EEG devices, etc. The emergence of mobile technology that measures brain activity (EEG devices) shows promise for collecting data on effects of people engaged in outdoor activities (Aspinall et al., 2015).

Conclusion

This project highlights opportunities for designing NBIs in public gardens as a cost-effective and equitable approach to addressing public health. My approach was to create a simple forest bathing NBI that could become an integral part of any public garden, in any location. This process demonstrates how there are opportunities to build NBIs into the existing programming and organizational structures of a public garden with minimal disruption to the status quo of the space and staffing. Urban populations are spending less time in natural environments, so it is important to expand the map of meaningful, health-promoting activities in urban greenspace.

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