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'Designing a wellbeing garden' a systematic review of design recommendations

Bethany Harries^a , Lauriane Suyin Chalmin-Pui^{b,c}, Birgitta Gatersleben^a, Alistair Griffiths^c and Eleanor Ratcliffe^a

^aFaculty of Health and Medical Sciences, University of Surrey, Guildford, UK; ^bDepartment of Landscape Architecture, University of Sheffield, Sheffield, UK; ^cScience Team, Royal Horticultural Society, RHS Garden Wisley, UK

ABSTRACT

Evidence demonstrates the benefits of gardens for promoting wellbeing. Some gardens are now being designed specifically to promote wellbeing; however, there are currently no evidence-based guidelines or recommendations available for designers to support such endeavours. The present study undertakes a systematic review of garden design literature to: (1) identify the defining characteristics of a garden that promotes wellbeing in non-clinical populations; and (2) summarize existing evaluations of garden designs into recommendations that can promote wellbeing. Online databases were used to identify papers published before October 2022, from which 17 publications were reviewed. This review was conducted following PRISMA and framework for scoping reviews. *Results:* The defining characteristics of wellbeing gardens centred around six design aspects: accessibility, wayfinding, fostering serenity, multisensory planting, spatial organization, and cultural artefacts. From these, recommendations were developed for garden designers to create wellbeing gardens.

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Introduction

Gardens as health promotion

Having access to a garden has been associated with better subjective health and wellbeing (de Bell et al. 2020). Ulrich (1999) proposed that gardens help reduce stress as they provide a valuable space for social connection, sense of control, movement, and positive distraction. For example, one RCT study

CONTACT Bethany Harries  bh00535@surrey.ac.uk  Faculty of Health and Medical Sciences, University of Surrey, Guildford, UK

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exposed participants to a sensory garden for 30 min a week. Results showed that participants in the experimental group experienced significantly improved stress, productivity, and wellbeing compared to a waiting list control group (Souter-Brown, Hinckson, & Duncan 2021). Chalmin-Pui et al. (2021) found that including ornamental planting to front gardens improved self-reported stress and healthy diurnal cortisol patterns over a 3-month period, showing that even small gardens have potential to improve wellbeing. More recently, a health survey was conducted with older adults during the COVID-19 lockdown indicated that those who spent more time in the garden reported greater wellbeing and physical health (Corley et al. 2021). Apart from private gardens, visiting public gardens has also been shown to benefit wellbeing and help reduce blood pressure, perceived stress, and improve mood (Kohlleppel, Bradley, and Jacob 2002; Bennett 1995; Owen 1994). It is important to note that wellbeing can be defined in different ways. This review is concerned with wellbeing as a positive psychological outcome from spending time in gardens. Within existing literature on nature and wellbeing, the concept most often refers to aspects associated with the psychological quality of an individual's life including one's experience of happiness (MacKerron and Mourato 2013; McMahan 2018), positive over negative affect (Richardson et al. 2016; Ballew and Omoto 2018) and particularly in relation to alleviating stress and mental fatigue (Marselle et al. 2021; Berto 2014). As such, the term wellbeing as used in this review refers to the experience of happiness, positive emotions, reduced stress and mental fatigue. Whilst there is a clear evidence base supporting the use of gardens as a potential health promotion tool, there is still a big gap between evidenced-based research and garden design recommendations. Specifically, it is still not known how best to optimize the design of gardens to promote wellbeing.

The need for evidenced-based design

Research on natural landscapes such as woodlands and parks suggest that some aspects of the environment can cause distress (Gatersleben and Andrews 2013), and whilst most gardens do not include threatening elements such as overgrown woodlands (Milligan and Bingley 2007), gardens that are impractical and poorly designed might not be considered to promote wellbeing. For example, there might well be intentionally designed gardens where the potential to support wellbeing is not maximized due to poor design decisions. With little structured guidance, there is an increased risk of 'wellbeing gardens' being created without evidence-based design, limiting opportunities for people to access the abovementioned benefits that a well-designed garden could provide.

Evidence suggests that just having some exposure to natural scenery can have benefits (Hartig et al. 2014) and to this extent, all gardens could support wellbeing. However, distinguishing the specific aspects of garden design that can promote wellbeing could support better garden design and maximize these benefits. The design of a garden will of course vary greatly depending on the climate, location, and the intended user group.

Whilst there are some suggestions based on theory as to what experiential factors can support restoration from stress and cognitive fatigue, there is little evidence to suggest what specific environmental features best promote wellbeing within the garden context. For example, in the Attention Restoration Theory (ART), Kaplan and Kaplan (1989) suggest that for an environment to be restorative it must facilitate specific experiences. This includes fascination that captures effortless attention, a sense of being away, extent with scope for exploration, and compatibility with what the person wants to do. Additionally, Ulrich (1983) suggested that the environment should contain specific factors for it to aid stress reduction. These include complexity, water, structure (focal points, symmetry, depth), deflected vistas (curving pathways), even ground surface, and lack of threat. Whilst these theoretical recommendations can provide some support for factors of natural landscapes that may promote restoration, there is little support for specific environmental design features that evokes these theoretical factors. If gardens are to be used as a health promotion tool, it is important to distinguish the specific characteristics that allow them to function as spaces that promote wellbeing.

Designing gardens to promote wellbeing

Evidence-based health design is becoming increasingly important, and research in landscape architecture is aiming to develop tools to help guide garden designers in the development and evaluation of their gardens. Currently, there is an evidence-based health design process and accompanying post-occupancy evaluation tool to guide designers (Stigsdotter and Sidenius 2020). The tool recommends designers first get to know the needs of the population the garden is intended for and combine them with the best practice guidelines available. They should then develop a clear design criterion before designing the garden itself. Finally, a post-occupancy evaluation should be conducted to examine the effectiveness of the garden and address any issues in the design. Whilst this is important for providing best practice guidelines for landscape architects, it does not provide guidelines for garden designers on general planning, design aspects, or features that could be included in gardens to support the wellbeing of users. For example, whether there are specific types of plants that benefit wellbeing or specific ratios of greenery to paving or types of paving that might be more

beneficial. The creation of spaces with different features (sunny, shady, enclosed, or open) can all have a significant impact on perceptions of and reactions to the garden space (Marcus and Sachs 2013). Assessing the specific needs of populations and designing gardens with these varying needs in mind is beneficial, but what is the current evidence for the benefits of specific design features to maximize wellbeing outcomes for users? This is a question we aim to address in this review.

Developing design recommendations for wellbeing gardens

There is currently one known systematic review exploring design recommendations for gardens, which is based on healthcare settings for clinical populations (Shukor, Stigsdotter, and Nilsson 2012). In this review, some key design recommendations were found to be important in hospital gardens. This included providing views of the garden from inside, easy and accessible paths, a variety of different spaces and seating, use of multi-sensory and native plants that attract biodiversity, water features, and playful elements. Similarly, the garden audit tool by Cooper Marcus and Barnes (2010) was developed from studies of over 70 healthcare facilities and identifies six key design recommendations for hospital gardens. These include an accessible location and easy entry to the garden, garden layout and pathways, a variety of seating, multisensory planting, signage, and maintenance. Whilst this work is important, it is over a decade old and very specific to hospital gardens and clinical populations. Considering the evidence that gardens can provide stress reduction (Ulrich 1984) and cognitive restoration from everyday activities (Kaplan and Kaplan 1989), it is important to understand how wellbeing gardens designed for a wider population can promote such wellbeing benefits. As such, this review aims to exclude gardens designed for specific clinical populations.

There are currently no structured design guidelines for garden designers to develop and create gardens that promote wellbeing among the wider population. Systematically mapping the garden design recommendations in this area could help inform both garden design and evidence-based health design. Thus, this review aims to evaluate and collate the existing perspectives and evaluations in garden design literature to summarize current knowledge into garden design recommendations that promote wellbeing. In this review the term 'healing', 'restorative' or 'therapeutic' garden means a place that has been designed or is used in a way that promotes a sense of well-being.

Method

Search strategy

This systematic review was conducted following PRISMA (Page, Moher, and McKenzie 2022) and the guidance framework outlined by JBI (Peters et al. 2015).

A literature search was conducted in March 2022. Keywords were: ‘therapy garden’ OR ‘healing garden’ OR ‘restorative garden’ AND ‘design guideline’ OR ‘design recommendations’ OR ‘design considerations’ OR ‘post occupancy evaluation’ ([Appendix 1 in Supplementary material](#)). These search terms were selected because they are based on dominant discourse within the literature and a previous similar systematic review by Shukor, Stigsdotter, and Nilsson (2012). The terms ‘Garden design’ OR Garden AND wellbeing, ‘Wellbeing Garden’, ‘Sensory Garden’ and ‘Greenspace’ were also tested. However, the term ‘Garden design’ OR Garden AND wellbeing yielded mostly results of research exploring wellbeing benefits obtained from spending time in gardens, not discussing design specifically. The term ‘wellbeing garden’ did not return any results. The term ‘sensory garden’ only yielded results of gardens designed specifically for neurological disabilities, and therefore was not appropriate for the focus of this review. Finally, the terms ‘greenspace’ mostly related to urban planning and not garden design guidelines.

The selected search terms were combined using Boolean operators ([Appendix 1 in Supplementary material](#)). These terms were used in advanced search in three major databases: PubMed, Science Direct and Scopus. To check for other systematic reviews, a search was conducted in Prospero, however no results were identified. No restrictions were set on publication date. The oldest study included was published in 1996; the most recent publication date was 2019.

Study selection and screening

1. The literature had to focus on the design aspects of therapeutic, healing, or restorative gardens and had to be specifically related to design recommendations, guidelines, considerations, or post occupancy evaluations.
2. Peer-reviewed literature, case studies, qualitative interviews and triangulation methods from post occupancy evaluations were included in the review. Qualitative findings focussing on beneficial design features were deemed important as they are based on lived experience and practical knowledge (Shukor, Stigsdotter, and Nilsson 2012).
3. Only literature from English language sources was included in the search.

PRISMA flow diagram was used for study selection. A total of 135 studies were identified from the initial database search and a further 14 from reference lists. In total 149 studies were identified. This was reduced to 141 papers after duplicates were removed. The screening of titles and abstracts excluded 120 records for reasons mentioned above. This left 17 articles

appropriate for inclusion and data extraction for this scoping review as shown in the PRISMA flow diagram (Figure 1).

Of the exported studies, titles and abstracts were screened and irrelevant studies excluded. Reasons included: (1) full books and book chapters, hospital gardens with a focus on specific clinical populations or long-term conditions, or children/paediatric; (2) Sensory gardens developed specifically for special needs; (3) Gardens for care homes focussing on dementia or geriatrics; (4) Studies focussing solely on horticulture therapy interventions or well-being effects from exposure to gardens and not garden design; (5) virtual reality, interior design or architecture studies and studies completely irrelevant to garden design (biology, medical, ecology/biodiversity). This left 21 articles to be reviewed with full text reading. Of these, four were removed for reasons including: (1) no discussion of garden design, descriptive paper on developing a garden; and (2) focussing garden design on special needs and the evaluation of an evidenced based health design (EBHDL) tool with no discussion of actual design features or elements. Further sources were searched for and included from the reference lists of other identified studies ($n = 14$). Studies that provided a clear evaluation of garden design for health

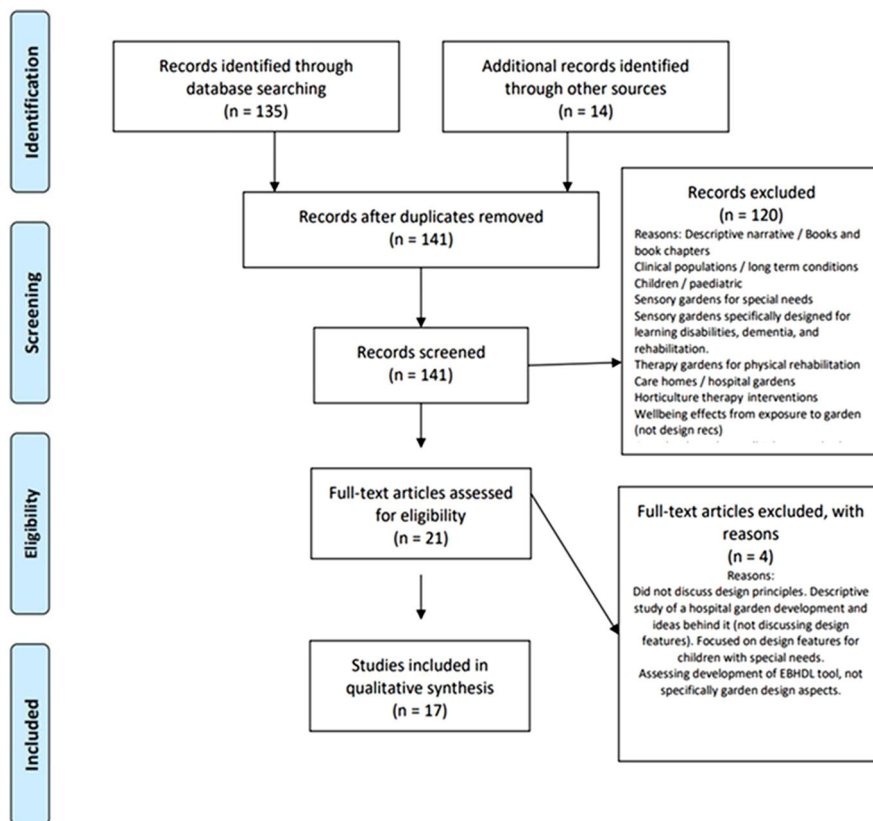


Figure 1. PRISMA diagram of study selection.

and wellbeing were put forward for data extraction and quality assessment ([Appendix 2 in Supplementary material](#)).

Data extraction and quality assessment

The following information was extracted from 17 eligible studies: authors and publication date; research aims; garden and participant characteristics; methods and analysis used; outcomes and results or summary of recommendations ([Appendix 3 in Supplementary material](#)).

Quality assessment identified the main strengths and limitations of each study using the mixed methods appraisal tool (MMAT; Hong et al. 2018). The MMAT is used to assess methodological quality and appraise research evidence of systematic mixed studies reviews. The MMAT has been shown to meet conventional standards for validity and reliability (Hong et al. 2018). Overall, the studies met the quality assessment criteria ([Appendix 4 in Supplementary material](#)).

Results

The selected studies were conducted in a range of countries: USA, UK, Sweden, Germany, and Latvia. The type of garden evaluated varies across the studies. Specifically, four focussed on gardens in community and green-spaces (Hussein 2010; Worden and Moore 2004; Lau, Gou, and Liu 2014; Peschardt 2014). Three focussed on hospital gardens but not for specific clinical populations (Bengtsson and Grahn 2014; Lygum et al. 2019; Naderi and Shin 2008) and four were focussed on gardens developed specifically for therapeutic purposes such as aiding recovery from stress and burnout (Stigsdotter and Grahn 2003; Stigsdotter 2015; Shahrad 2013; Sidenius et al. 2017). Finally, six of the studies collated research and literature to develop and describe important garden characteristics for promoting health and wellbeing (Erickson 2012; Eckerling 1996; Balode 2013; Douglas, Lennon, and Scott 2017; Shackell and Walter 2012; Vapaa 2002). The methodology across the studies varied with a majority using mixed-method approaches, including post occupancy evaluations, space analysis, behavioural observations, participant surveys, qualitative interviews, case studies and literature reviews.

Study review

Findings and recommendations from the 17 studies reviewed were examined following the PRISMA guidance framework (Page, Moher, and McKenzie 2022). To identify key themes and sub themes of garden design characteristics that promote health and wellbeing, data charting was carried out as stated in the JBI guidance framework for data extraction (Peters et al. 2015).

Table 1. Key themes and subthemes including number of citations in reviewed literature.

Key theme	Sub-themes	Number of citations
Accessibility	Location of garden.	14
	Pathways are clear/accessible.	11
	Variety of seating.	8
Wayfinding	Easy to navigate.	4
	Give sense of direction/encourage exploration.	4
	Signage (to encourage exploration and engagement).	3
	Pathways link to all areas.	2
Fostering Serenity	Provide positive sounds (water/windchimes).	11
	Peaceful/quiet.	3
Variety of Planting	Multisensory planting.	11
	Pollinator friendly plants.	10
	Seasonal interest.	6
	Hardy, Non-toxic/non-allergenic.	3
Spatial Organization	Enclosed space, safe, secluded, private.	16
	Spaces for social meetings/activities.	11
	Creation of rooms.	8
	Open spaces allowing views.	7
	Sunny and shady spaces.	7
Cultural Artefacts	Focal point (fountains, cultural artefacts).	4
	Historical.	2
	Spiritual symbolism.	2

The results were synthesized by identifying patterns and grouping into common themes and sub themes (Terry et al. 2017). Data extracted from the full-text articles included specific garden characteristics such as planting, paving, seating, and other design features (Appendix 5 in Supplementary material). In total six key garden design aspects were found to be consistent within the studies reviewed (Table 1).

The first design aspect identified was accessibility. Fourteen of the reviewed studies described the importance of the garden being accessible. This included the actual location of the garden being easy for people to find and access ($n = 14$). Bengtsson and Grahn (2014, 883) suggest ‘the garden should be easy to locate and access from indoors and should also provide a sense of familiarity’. Eleven of the studies described the need for pathways to be made with a suitable surface so that it is clear and accessible ($n = 11$). Balode (2013, 116) suggested ‘paths should be wide enough for two people and made of suitable surface’. Finally, there must be a variety of seating that is suitable for different users and provide the opportunity to sit in different areas of the garden ($n = 8$), this allows people the freedom and choice to use the garden how they want. Eckerling (1996, 22) suggested ‘variety of seating that is adaptable to sun and shaded areas is the basic foundations for any successful healing garden’.

The second design aspect identified in the literature was wayfinding. This includes signage placed around the garden either providing direction or identifying plants ($n = 3$). This was thought to be important to encourage exploration and engagement. Worden and Moore (2004, 137) recommended that ‘signage should be used to encourage interaction’. It was recommended that the layout of the garden must be easy to navigate as this encourages

engagement ($n=4$). The pathways should link to all areas of the garden and not just come to dead ends ($n=2$) and they should provide a sense of direction and encourage exploration ($n=4$). According to Bengtsson and Grahn (2014, 884) 'Paving and layout should aid understanding and orientation. Paths should not have dead ends and allow exploration of all areas'.

The third design aspect identified was fostering serenity. Eleven of the studies discussed creating a peaceful space by using sounds such as water features, wind chimes, grasses or plants that rustle in the breeze, and by encouraging birds and other pleasant wildlife with bird houses or feeders and pollinator-friendly plants ($n=11$). Vapaa (2002, 27) suggested 'promote reflection and self-awareness in the garden with use of quiet spaces to provide a feeling of relief for garden users by introducing sound with use of water and chimes and nature'.

The fourth design aspect identified was variety of planting. Thirteen of the studies discussed the importance of using planting to create interest, evoke the senses and encourage nature. Multisensory planting was discussed as providing different colours, scents, textures, and edible plants ($n=11$). The use of wild and local flora was thought to be important for creating a connection to place and encouraging local wildlife and biodiversity ($n=11$). Vapaa (2002, 27) recommended 'encourage wildlife (birds, butterflies, small animals, etc.) in the garden with planting. Reinforce the cycle of life through plants which provide seasonal change'. The importance of planting for seasonal interest was mentioned as it is important that the garden is pleasing and encourages users even in the winter months ($n=6$). As Eckerling (1996, 23) suggested use of 'multisensory planting that engages throughout the seasons'. Finally, some studies also mentioned that it is important to avoid toxic and allergenic plants and instead use hardy planting that can be touched and explored ($n=3$), 'non-toxic hardy plants should be used to encourage interaction' (Worden and Moore 2004, 136).

The fifth design aspect identified was spatial organization. Sixteen of the studies highlighted the importance of creating different spaces around the garden. This can be done with the creation of different 'rooms' using trees, climbers, grasses, walls, and fencing ($n=8$). Naderi and Shin (2008, 117) suggested 'plant trees and shrubs along paths and around seating to block views from surrounding windows'. There should be open spaces providing views ($n=7$), and enclosed spaces providing a sense of safety, seclusion, and privacy ($n=15$). Naderi and Shin (2008, 117) suggested 'organize private nooks along the way to allow observation of passers-by while ensuring privacy of use'. There should be spaces that allow for social gatherings of different sizes and activities ($n=11$). Lygum et al. (2019, 163) found that 'private spaces that allow both individual seclusion and social connection was viewed as important'. Also, important to include is a mixture of sunny and

shady spaces for people to choose where they would like to spend time ($n = 7$).

The sixth design aspect identified was cultural artefacts. Seven of the studies mentioned aspects that provided people with a sense of connection to the garden. This included historical ($n = 2$), 'a historical place facilitating fascination with the course of time' (Shahrad 2013, 11). Spiritual symbolism ($n = 2$), 'create or frame views of the sacred qualities of the adjacent chapel' (Naderi and Shin 2008, 118). Finally, use of focal points such as fountains, sculptures, and cultural artefacts ($n = 4$) 'use of cultural aspects to inspire fascination' (Bengtsson and Grahn 2014, 885).

Discussion

In total, 17 papers were deemed appropriate and reviewed. Six key design recommendations were identified including accessibility, wayfinding, fostering serenity, variety of planting, spatial organization, and cultural artefacts. These recommendations will now be discussed using current theories and evidence in relation to garden design considerations. Table 2 outlines the identified key design aspects along with ideas and recommendations for achieving this. The table outlines the priority level for each aspect based on the available evidence reviewed along with the quality and quantity of citations to highlight both strengths and gaps in research.

Accessibility

Accessibility was discussed in 14 of the studies. This included the actual location of the garden and ensuring that it is easy for people (of different abilities) to find and access. Having a perfectly designed restorative garden is of no use if nobody knows it exists and cannot access it. Stigsdotter (2015) suggests 'affordances and compatibility need to be flexible; all areas of the garden need to be accessible, there must be opportunity for a range of activities'. This is a concept touched upon in compatibility within ART, suggesting that a restorative environment should be compatible with what the individual wants or needs to do (Kaplan and Kaplan 1989). There is some evidence to support this: one study found environmental compatibility to be a significant predictor of perceived restoration (Herzog et al. 2003). The concept of accessibility is also mentioned to be important in the design of hospital gardens as evidence suggests that hospital gardens that are not easy to find or access are simply not used (Marcus and Sachs 2013; Shukor, Stigsdotter, and Nilsson 2012).

To enhance accessibility, designers should consider suitable materials to create pathways. One of the first things to do when designing a garden is to think about the different types of users that may be visiting to ensure that

Table 2. Design aspects and recommendations.

Design aspect	Design recommendation	Priority	Available evidence
Accessibility	Pathways created with suitable surfaces considering users such as wheelchair or pushchairs.	Essential	Strong
	Provide comfortable seating around the garden located near sensory planting.	Essential	Moderate
Wayfinding	Signage to direct users around the garden aiding orientation and encourage interaction.	Desirable	Moderate
	Pathways laid out to encourage exploration of the whole garden.	Desirable	Moderate
Fostering Serenity	Serene spaces created with use of sound (running water, fountains, windchimes/long grasses).	Essential	Strong
	Encouraging wildlife such as birds to foster a feeling of serenity.	Essential	Strong
Variety of Planting	Multi-sensory planting including mixtures of colours (reds/oranges for stimulation or whites/lilacs for calming), textures, scents, and where possible edible plants (e.g. herbs).	Essential	Strong
	Pollinator friendly planting to encourage wildlife.	Essential	Strong
	Consideration of seasonal changes providing year-round interest.	Desirable	Moderate
Spatial Organization	Creation of rooms with natural materials (climbers, trees, shrubs, log stacks)	Essential	Strong
	Spaces for privacy/seclusion (enclosed space with views looking out).	Essential	Strong
	Spaces for social gatherings.	Essential	Strong
	Include options for sunny and shady spaces.	Desirable	Moderate
Cultural Artefacts	Use fountains/playful elements (mosaic art or chimes that users can interact with).	Optional	Weak
	Borrowing views, optimizing cultural artefacts (seating overlooking views of nearby cultural buildings).	Optional	Weak

Priority level based on Available Evidence of the quality ([Appendix 4](#)) and quantity of citations reviewed (Strong = >50%, Moderate = >25%, Weak = <25%).

they can easily move across the pathways and explore the garden, making it more compatible for desired activities (Marcus and Barnes 1999; Kaplan and Kaplan 1989). Ulrich (1977, 1983) recommends that there should be even ground surface texture to support feelings of safety and reduce threat. This is also reflected in the perceived sensory dimensions of nature framework, which suggests that people prefer pathways made of hard surfaces (Stoltz and Grahm 2021). Research evidence may provide further support for this, with one study reporting ease of movement as a positive predictor of perceived restoration in natural environments (Herzog et al. 2003). In terms of design considerations, this could include having suitable surfaces that people of different abilities can easily move over such as smooth paving slabs as opposed to gravel stones that may be difficult for wheelchair users. Whilst there is no clear evidence as to what specific ground surfaces people prefer, Shackell and Walter (2012) recommend that the path design should

generally follow accessibility standards (Church and Marston 2003) to ensure usability for people with disabilities. Design guidelines also recommended that light or white surfaces should be discouraged due to reflection and glare from sunlight that can cause eye discomfort (Marcus and Barnes 1999).

Also included in the accessibility theme is the use of appropriate seating. Gibson's theory of affordances (Gibson 1977) suggests that humans perceive the environment based on the functional properties it can provide. Gibson suggests that people actively engage with the environment and modify it to meet their needs, which is important for personal comfort. Eckerling (1996) considers seating to be a foundation of healing gardens and suggests use of adaptable seating in sunny and shaded areas. As such, design considerations should include seating that people can freely move around so that it can be functional and suitable for different activities and users, making the environment compatible for the individual user (Kaplan and Kaplan 1989). Naderi and Shin (2008, 117) suggest 'seating should be in a diversity of places that are comfortable, oriented to witnessing nature, and situated in response to microclimates'. It is important that the seating is comfortable and supportive, so people enjoy spending time sitting in different areas of the garden. Again, both the systematic review of hospital healing gardens (Shukor, Stigsdotter, and Nilsson 2012) and the therapeutic design recommendations (Marcus and Sachs 2013) discuss the importance of including a variety of seating so that there are suitable spaces for different users and so that people have control and freedom over how and where they would like to spend time in the garden. If the garden is accessible to all and has appropriate seating, then more people are likely to spend time in the garden and ultimately achieve benefits there.

Wayfinding

The theme of wayfinding was identified in 10 of the studies and suggests that the garden should be easy for people to navigate around and encourage exploration. The term wayfinding was developed by Kevin Lynch who said 'disorientation, and the sense of anxiety and even terror that accompanies it reveals to us how closely it is linked to our sense of balance and well-being' (Lynch 1964, 4). Wayfinding is the necessity to know where to go and how to get there (Montello and Sas 2006). This is also fitting with both Kaplan's preference model (1992) and Ulrich's Affective Aesthetic theory (1983). These theories are based on an evolutionary perspective of environmental aesthetics where it was a necessity for early humans to be able to understand and explore the environment, which has evolved into aesthetic landscape preferences over time. In the environmental preference model,

Kaplan termed this as coherence, which means the layout should aid understanding of the environment (Kaplan and Kaplan 1989). Similarly, Ulrich argues that the visual aesthetics of the environment may signal danger or safety, providing information for when it is safe to rest. These evolutionary-based theories emphasize the importance of wayfinding to help garden users feel safe and able to explore.

Important design considerations for wayfinding include use of signage and creating interesting pathways to explore. Three of the studies discussed using signage to help visitors find their way around, encourage exploration and even using signage on sensory plants to encourage interaction with them. Worden and Moore (2004, 137) suggest 'planting should provide different spaces and pathways that give a sense of direction, with signage used to encourage interaction'. The pathways should encourage exploration and entice people to walk further into the garden. This can be created with curves in the path and linking it to different areas. It is important that the paths do not just come to a dead end and instead link to all areas of the garden so people can explore the entirety of it. This use of pathways was also found to be important in the systematic review by Shukor, Stigsdotter, and Nilsson (2012) and in the therapeutic design recommendations by Marcus and Sachs (2013) who both mention the importance of pathways that are easy to navigate. According to Hussein (2010, 122) 'pathways may be the most important aspect with different sizes and shapes of pathways that encourages people to walk around the whole garden. Pathways need to be clear and accessible and link to all areas of the garden for people to engage'. This helps provide a sense of direction and encourages exploration of the garden.

Fostering serenity

The third important quality for restorative garden design was fostering serenity. Twelve of the studies reviewed discussed this quality and suggested that the garden should provide a peaceful and quiet space to relax in and to aid restoration. Stigsdotter and Grahn (2003) suggest creating a serene space which is peaceful, silent, and caring. This aspect of garden design is also relevant to current theory. Specifically, ART suggests that a restorative environment should provide a sense of being away, i.e., it should be free from daily hassles and demands that tax directed attention (Kaplan and Kaplan 1989). This is reflected in qualitative research which suggests that people see the garden as a space to escape from daily hassles and relax (Gross and Lane 2007). One way a serene space can be created is with use of sounds. For example, SRT suggests that water is an important environmental feature for promoting stress recovery (Ulrich 1999). Indeed, there is a large amount of literature exploring the restorative benefits of soundscapes. For example, systematic and literature reviews have reported that positive soundscapes such

as birdsong and gentle running water are associated with improved stress recovery and better self-reported health (Aletta, Oberman, and Kang 2018; Ratcliffe 2021).

In terms of design considerations, 11 of the reviewed studies discussed creating a serene space with use of sound. For example, Worden and Moore (2004, 137) suggested 'include features that provide sounds like grasses, chimes and water features'. Also, Eckerling (1996, 23): 'create sound that includes water, birds, plants that rustle in the breeze, wind chimes'. Therefore, a serene space in the garden can be fostered with sounds including running water features, wind chimes, long grasses and encouraging pleasant wildlife into the garden such as birds with use of feeders. It is also important to consider the users of the garden and design any use of water features appropriately, e.g., regarding safety issues such as depth and cleanliness of the water (Shukor, Stigsdotter, and Nilsson 2012).

Variety of planting

The fourth identified garden design aspect was planting, mentioned in 13 of the studies. This includes multisensory planting involving different colours, scents, textures, and where possible edible plants to evoke different senses. Use of multisensory planting is also discussed in the systematic review by Shukor, Stigsdotter, and Nilsson (2012) and in the therapeutic design recommendations by Marcus and Sachs (2013). The specific sensory aspects of interacting with plants has been neglected in current environmental psychology theories. There is some evidence for how colours, shapes and scents can affect our emotions, but this has not yet been looked at in the garden context. For example, blues and greens, such as those found in nature, are associated with low arousal and low anxiety (Valdez and Mehrabian 1994). When it comes to shape, radially symmetrical flowers have been shown to be preferred, and popular flower colours are blue, pink, and purple (Hůla and Flegr 2016). Higher plant biodiversity within the garden has shown positive effects on perceived restoration (Young et al. 2020). The scent of different flowers can also impact on mood. For example, the olfactory system is closely linked with the limbic system, which regulates emotions and has strong links to memories, which for some can be positive memories of experiences in gardens (Franco, Shanahan, and Fuller 2017; Uzzell, Gatersleben, and White 2010). Studies in aromatherapy have shown that specific fragrances can decrease depression, anxiety, stress, and blood pressure (Haze, Sakai, and Gozu 2002). Whilst there is emerging evidence to support the use of different shapes, colours and scents in planting schemes, there is significant lack of understanding of how different plant textures and tastes can affect us (Franco, Shanahan, and Fuller 2017). For example, we do not know how

touching plants, tasting different herbs, or brushing through long grass impacts our emotions and senses. Such specific questions could be the focus of future research interested in gardens and wellbeing.

In terms of design considerations, Vapaa (2002) suggests that the garden should evoke the senses with multisensory planting using colour, smell, taste, and textures. Brighter colours can have an arousing effect on the senses and cooler colours can promote relaxation. For example, Worden and Moore (2004, 136) suggest ‘in sensory gardens warm colours such as red, orange and yellow stimulate the senses; cool colours such as blue, purple, white have calming and soothing effect’. Different scented plants can be included such as lavender or rosemary, and plants that encourage touching (e.g., lambs’ ears, *stachys byzantine*) can also evoke different senses and emotions. It is important that there are no toxic or allergenic plants if people are going to be encouraged to interact with the planting. Instead, the planting should be quite hardy so they can withstand frequent touching. This connects with the concept of signage from the abovementioned wayfinding aspect, as people are more likely to interact with the sensory planting if they know what the plants are and that they are allowed to engage with them. For example, signs could encourage people to touch or smell specific plants. Also, within the planting theme, it was suggested that using wild and local flora can provide a sense of place and encourage local biodiversity into the garden (Douglas, Lennon, and Scott 2017; Shackell and Walter 2012). This will also encourage birds and other wildlife into the garden, which will help create the feeling of serenity mentioned above. This can also provide a sense of fascination, allowing directed attention to replenish as described in ART (Kaplan and Kaplan 1989). Evidence suggests that watching wildlife can promote feelings of wellbeing (Curtin 2009). Finally, the changing seasons should also be considered in the planting scheme. This is so that the garden is attractive and can still evoke the senses and encourage garden users at all times of the year (Vapaa 2002; Shackell and Walter 2012).

Spatial organization

The fifth quality of restorative garden design was spatial organization. Sixteen of the studies discussed this quality and the importance of creating different ‘rooms’ in the garden with use of natural materials such as trees, climbers, and tall grasses. Only one study suggested using fencing and walls to create rooms. Sidenius et al. (2017) suggested ‘a prerequisite for an effective therapy garden is that it constitutes an overall protective and safe environment that hosts a variety of distinctive spaces that can facilitate different operations and natural experiences of varying character’. The compatibility of the environment and affordances it provides needs to be flexible to

accommodate changes in mood state (Kaplan and Kaplan 1989; Herzog et al. 2003). As mentioned, Gibson's affordance theory (Gibson 1977) suggests that humans perceive the environment based on the functional properties it can provide. The environment should be able to meet people's different needs, which is important for personal comfort. Privacy regulation theory explains that people's need for privacy and social interaction continuously changes and emphasizes the importance of being able to control the level of privacy needed for wellbeing (Altman 1977). Also, supportive environments theory highlights that an individual's perception of the environment and the need for different spaces within it will be different depending on the individuals current physical and mental state (Grahm and Stigsdotter 2010). SRT discussed the importance of the environment making individuals feel safe for it to aid stress reduction (Ulrich 1999). This feeling of safety is also linked to prospect-refuge theory, whereby we prefer to see out into the environment (prospect) but from a protective vantage point (refuge) (Appleton 1984). However, if there is too much of either element, the environment may be experienced negatively (Dosen and Ostwald 2016). All these theories emphasize the importance of acknowledging different needs for social interaction and privacy when creating the right type of spaces in wellbeing gardens.

In terms of design considerations, there should be a variety of different rooms, some large with open views and allowing room for social gatherings and activities. There should also be enclosed rooms creating a feeling of safety and seclusion. This should be a comfortable space for individuals to contemplate or meet in privacy with friends. Stigsdotter (2015) recommends creating garden rooms that makes users feel safe with use of natural materials, such as trees, climbers, and grasses. Also, when creating different spaces within the garden, it is important to include a mixture of sunny and shady spots that people can chose to spend time in. As such, a wellbeing garden should provide different spaces that people can use depending on the activities they wish to carry out, such as sitting alone in privacy or meeting up with a group of friends.

Cultural artefacts

The final important quality of restorative garden design identified in this review was cultural artefacts. This theme was discussed in seven of the studies reviewed. Specifically, the studies discussed the importance of the garden having cultural and historical significance that can facilitate fascination over time. A cultural artefact is described as objects created by humans which provides information about the people and culture of a society. Shahrads (2013) explains that the history and geographical context of the garden can affect the user's experience. The theme of culture also bears some relevance to ART. For example, the papers reviewed express that a garden with cultural

and historical significance can help inspire fascination which Kaplan and Kaplan (1989) describe as aspects of the environment that capture effortless attention and therefore allow directed attention to restore. Cultural elements may help people form attachments to places, as one survey based in Japan found that experiencing a sense of attachment to a natural place accounted for 30% of the effects of nature on wellbeing (Basu, Hashimoto, and Dasgupta 2020). A systematic review found that cultural elements within urban environments had restorative effects and were viewed as pleasant and relaxing (Weber and Trojan 2018). It could be that fostering a sense of culture in the garden can help users feel more connected to the garden space.

In terms of design considerations, it may not be possible to ensure every newly-designed wellbeing garden is historically or culturally significant. However, it can still provide the fascination and structure described in the theories and literature. This can be supported with use of features such as water fountains (Lau, Gou, and Liu 2014), perhaps pleasant views of cultural artefacts that are close by such as a church (Naderi and Shin 2008), and even some more playful elements such as natural art or sculptures (Shukor, Stigsdotter, and Nilsson 2012). However, it is important to be considerate of what artefacts are placed in the garden as abstract art and sculptures can be interpreted negatively by highly stressed individuals (Marcus and Sachs 2013).

Further considerations

Whilst these six garden design aspects appear to be important for designing gardens that can promote wellbeing (Table 2), other practical aspects are worth considering. The first thing to consider is the actual location and climate of the garden (Marcus and Barnes 1999). This is important to know so that the appropriate plants can be placed there. This leads to the second consideration, which is maintenance (Marcus and Barnes 1999). It is no good having a garden filled with beautiful plants that require lots of attention unless the budgeting allows for a full-time gardener to maintain it. Finally, it is very important before even designing the garden to consider the type of users (Marcus and Barnes 1999). For example, is the garden going to be located near a school that parents and children will predominantly use, or is it going to be used mostly by the elderly in a care home or by students on a college campus? This is where the EBHDL tool should be applied and can help guide the designer in identifying the needs of the users, which is important for compatibility as discussed above (Stigsdotter and Sidenius 2020).

Conclusion

The objective of this review was to understand the defining characteristics of a garden that promotes wellbeing. This included accessibility, wayfinding,

fostering serenity, variety of planting, spatial organization, and cultural artefacts were discussed. This review has achieved its objectives, but it is also important to note the limitations of the review process. First, the review process is broad and so it can be difficult to establish clearly defined boundaries and methodologies. This means there can be variability in terminology and definitions as well as interpretations of results. Measures were taken to reduce this with three of the authors independently reviewing over half of the papers and agreeing on the terms and definitions used. This review has followed systematic frameworks (Page, Moher, and McKenzie 2022; Peters et al. 2015) and has successfully summarized literature to date on garden design recommendations that promote wellbeing.

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Notes on contributors

Bethany Harries is a postgraduate researcher in Health Psychology. Her current research focuses on the pathways between nature, health, and wellbeing.

Lauriane Suyin Chalmin-Pui is a postdoctoral research fellow at the Royal Horticultural Society and at the University of Sheffield.

Birgitta Gatersleben is Professor of Environmental Psychology at the University of Surrey. Her research focuses on sustainability, nature engagement and wellbeing.

Alistair Griffiths is the Director of Science and Collections at the Royal Horticultural Society. His research focuses on sustainability and human health through gardening.

Eleanor Ratcliffe is a Lecturer in Environmental Psychology at University of Surrey. Her research focuses on restorative environments, including diverse sensory experiences, and place attachment.

ORCID

Bethany Harries  <http://orcid.org/0000-0001-7571-5439>

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