Perception of Healthcare Facility Garden and Impressions of Interactive Elements

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Abstract

This research presents the effects of indoor healing gardens and interactive elements (technology) on people in medical facilities: patients, visitors, and staff. Previous studies showed that medical facilities generally received a negative perception by people who visited or worked there; yet the effect of indoor greenery seemed to improve the perceptions of those who were surveyed. In this study, the potential of added technology to a garden brought a new aspect to be explored. The participants were shown a video of four simulations of indoor gardens with added interactive elements (e.g., lights, sounds, music, images, interactive floor tiles); afterwards, the participants completed a short survey. The results of the research corroborated the literature regarding the benefits of indoor gardens on the study participants' enhanced mood when in a medical setting with the added appreciation for interactive elements. Of the interactive elements provided, the wall projections of flying birds had a positive feedback of 91.3 %. Interactive floor tiles had a high likability rate as well (85.1%). While many appreciated the garden-only option, participants favored the playful components as entertaining for the brief time they would be in the space awaiting for an appointment or on a staff break. Enhancing all medical spaces with natural and interactive elements should be a design goal for future new builds and renovation projects in healthcare or other commercial buildings.

Key-words:

indoor garden healthcare, interactive elements (lights, audio-visual images, of birds and animals, sound, color), healthcare facility.

الملخص

يعرض هذا البحث تأثيرات حدائق الاستشفاء الداخلية والعناصر التفاعلية (التكنولوجيا) على الأشخاص في المرافق الطبية كالمرضى والزوار والموظفون. حيث أظهرت الدراسات السابقة أن المرافق الطبية تلقت بشكل عام تصورًا سلبيًا من قبل الأشخاص الذين زاروا أو عملوا هناك؛ ومع ذلك، يبدو أن تأثير المساحات الخضراء الداخلية يحسن تصورات أولئك الذين شملهم الاستطلاع. في هذه الدراسة، وقد جلبت إمكانيات التكنولوجيا المضافة إلى الحديقة الداخلية جانبًا جديدًا يجب استكشافه. حيث عُرض على المشاركين في هذه الدراسة مقطع فيديو لأربع عمليات تصميم محاكاة للحدائق الداخلية مع العناصر التفاعلية المضافة (مثل الأضواء والأصوات والموسيقى والصور وبلاط الأرضيات التفاعلي)؛ بعد ذلك، أكمل المشاركون تعبئه استطلاعًا قصيرًا. حيث أكدت نتائج البحث الأدبيات المتعلقة بفوائد الحدائق الداخلية على الحالة المزاجية المعززة للمشاركين في الدراسة عندما يكونون في بيئة طبية مع التقدير الإضافي للعناصر التفاعلية. حيث أوضحت الدراسة انه من بين العناصر

والمكونات التفاعلية المقدمة، قد حصلت التوقعات عن تصميم محاكاه جدار الطيور الطائرة ردود فعل إيجابية بنسبة ٩١,٣ ٪. كما كان لتصميم الارضيات والبلاط التفاعلي بالصوت والألوان نسبة إعجاب عالية (٨٥,١٪). بينما أعرب الكثيرون عن تقديرهم لخيار الحديقة فقط بدون اضافه أي عناصر تكنولوجية، فضل المشاركون العناصر المرحة على أنها مسلية لفترة وجيزة في المكان لحين انتظار موعد أو في استراحة للموظفين. يجب أن يكون تعزيز جميع المساحات الطبية بالعناصر الطبيعية والتفاعلية هدفًا تصميميًا للمباني الجديدة المستقبلية ومشاريع التجديد في الرعاية الصحية أو المباني التجارية الأخرى.

الكلمات الرئيسية:
الرعاية الصحية، الحدائق الداخلية، العناصر التفاعلية (الأضواء، الصور السمعية والبصرية، للطيور والحيوانات، الصوت، اللون)، مرافق الرعاية الصحية.

Introduction

History and Background

The history of healing gardens goes back centuries. Marcus and Barnes (1999) discussed the early ages of gardens in hospitals in their book *Healing Gardens: Therapeutic Benefits and Design Recommendations*. The first healing gardens were found in the cloisters, which were courtyard gardens in medieval monasteries: "Hospitals and monasteries [in the middle Ages] ministering to the sick, the insane, and the infirmed often incorporated an arcaded courtyard where residents could find the degree of shelter, sun, or shade they desired in a human-scale, enclosed setting" (Marcus & Barnes, 1999, p. 10). Nature is a very important element for psychological stability; stress-free places are needed everywhere and most importantly in hospitals (Howell, 2011). The relationship between natural landscapes and their effects on health seems to positively impact patients' recovery. The innovation of medical facilities with modern installations include incorporating more natural views in the hospital landscape. "'Nature heals' is one of the oldest therapeutic dicta," wrote Theodore Roszak in 1996 (p. 22). In his book, Roszak was trying to accentuate the benefits to acknowledge how nature can be an important factor for the healing of psychological ills in western societies. A decade ago, Richard Louv (2008) was worried by how children interacted with the natural world. A decade before that, previous studies emphasized the importance of nature for the well-being of people, particularly children (Moore, 1997). There have been many studies about the benefits gardens provide to people. Roger S. Ulrich is an expert in environmental psychology whose work influenced the healthcare facilities, documented that a patient with a window view of nature in his hospital room recovered more rapidly than other patients with the same health issues who did not have a window view of nature (Ulrich, 1984). The trend in healthcare needs to focus on the power of nature to positively affect patients. Whether inside or outside, plants have the power to heal both body and soul. The effect of gardens in hospitals has been shown to be positive for staff and patients alike (Franklin, 2012). In a St. Louis, Missouri hospital that was renovated four years after a devastating tornado, the architectural design of the medical facility saw major changes. John Farnen, the Executive Director of Strategic Projects at Mercy in Joplin, Missouri, said, "Hospital visits can be stressful at times and we try to do everything we can to reduce that anxiety and stress" (Clark, 2015, web). For that reason, gardens were installed all around the hospital building. Each of the many entrances to that large facility has a healing or therapeutic garden space. The Fox channel in St. Louis collected comments from the medical

staff, who affirmed the effectiveness of the green areas on the patients. All provisions were provided to the patients for visiting a garden. For example, patients had wheelchairs and mobile IVs—and close supervision by hospital staff. "We really feel like we want to do what's right for our patients and really create an environment where they can relax and reduce their anxiety, if we can reduce stress levels it certainly helps the healing process," said Farnen (as cited in Clark, 2015, web).

Purpose of the Study

The purpose of the study was to determine the effects of indoor gardens and related interactive elements on people's perceptions in a healthcare facility**.** Technology is a big part of our lives, and people use portable devices everywhere they go. The goal of incorporating technology into the design setting was to add light, sounds and wall projections (e.g., birds tweeting and images of birds) to enhance the sensation of the natural landscape for people, especially patients, who needed to feel like they were outdoors. Also, there were additions to the video simulations of interactive tiles for children to dance or play on.

Research Questions

1. What combination of interactive elements in a healthcare facility's garden had a greater positive effect on the perceptions of the patients, visitors, and staff?
2. What elements were less preferred by the patients, visitors, and staff, and why?

Review of the Literature

This study aimed to further the work of Whitehouse et al. (2001) and Sherman et al. (2005) by observing the impact of additional elements (interactive elements) for indoor healing gardens in a medical environment and comparing reactions of patients, visitors, and staff in the United States. As mentioned in the introduction, the history of healing gardens goes far back in time. The history of therapeutic environments in China began in the year 717 A.D. with "BeiTian Yuan," the first public hospice in ancient China. This public "hospital" served patients by providing them treatments within green settings, essentially in the form of courtyards. Unfortunately, there was no additional information on the history and development of therapeutic landscapes/ gardens in China (Jiang, 2014). The primary goal of hospitals in the past was to make patients feel more comfortable (Stein, 1990). In the Middle Ages, garden cloisters were used as a place of healing (Warner, 1995).

Biophilia

In the article "Building Biophilia: Connecting People to Nature in Building Design" by Heerwagen and Orian (2001), the importance of the growing body of scientific research that connected the human brain and behavior to the natural world. E. O. Wilson (1984) invented the term biophilia to describe the deep bonds between people and nature. Even if humans now live in many environments, there is a long history of hunting, farming, and connection to nature that has left its mark on our psyche. After all, this is the environment in which the brain evolved. The researchers pointed out that most buildings were designed to leave the greenery and natural aspects outside the building. As a result, the benefits of biophilia were realized by people who

spent the least amount of time in the building. An actual and truly biophilic building would extend the benefits to all spaces and all occupants throughout the day, not only in the recessional areas of the building or outside the offices and hallways.

Heerwagen and Orian (2001) stated that there were numerous studies regarding the benefits of indoor gardens. S. Kaplan (1995) studied office workers who had window views of nature. They felt less frustrated and becoming more patient and reported more life satisfaction and better health than workers who did not have visual access to the outdoors or whose view consisted only of built elements. The same was the case for the Orians, G., & Heerwegen, H (1995) study of behavioral adaptations to windowless offices. They found that workers in spaces without windows put more natural décor on their walls, including nature posters and pictures of animals or vegetation.

The Effect of Greenery on Patients

The connection between greenery and medical care has gradually gained more importance, partly due to advances in healing approaches and medical science. In the last decade, researchers noted the positive effect of nature and being in nature; furthermore, plants have been added to places such as hospitals, and the concept of nature is helping the healing process (Cooper, & Barnes, 1999; Olds, 1989). In the last few years, research on the effects of gardens on children and adults has been conducted. "Single pieces of land gardened collectively" (American Community Garden Association, 2007, web) showed multifaceted public health benefits, (American Community Garden Association) including lowering body mass index and blood pressure in adults (Zick et al., 2013) and children (Davis et al., 2011) and treating chronic diseases (Weltin, 2013). There is a lot of documentation about the stress level associated with hospitals; it is also associated with negative child health outcomes such as physical pain and emotional distress (Varni & Katz, 1997; Varni et al., 1997; Kiecolt-Glaser et al., 1998). Whitehouse et al. (2001) evaluated a garden environment. The study was conducted in a children's hospital (Children's Hospital and Health Center, San Diego) to determine whether the garden contributed to reduced stress, restored hope and energy, and increased visitors' satisfaction. A post-occupancy evaluation (POE) was conducted to observe the way children, visitors, and staff used the garden. The surveys and interviews showed some benefits of the garden; it was viewed as a place of restoration and healing, and increased visitors' satisfaction. There was limited use of the garden in this study, and children, parents, and staff recommended changes such as adding more greenery and trees and including more interactive items. Whitehouse et al. (2001) used literature to support their research; among the findings they showed that adults had a strong tendency to prefer natural landscape scenes rather than urban views, especially when the view lacked vegetation (Ulrich, 1977; Balling & Falk, 1982; Orians & Heerwegen, 1995; Schroeder, 1995). Generally, adults showed that they tended to go to natural landscapes when they were depressed or stressed (Marcus, 1995). The main finding about the preferences of children was that youngsters were mostly interested in the functionality of the environment, such as if the trees were easy to climb or if they could throw objects in the natural landscape or water (Gibson, 1979). The children preferred to be active and use the space they were in (Van Andel, 1990).

Visual environment. Lighting that is adequate and offers appropriate exposure, along with access to natural lighting entering through windows, is an important feature for medical facilities and hospitals. Salonen et al. (2013, web np#) stated, "Lighting controlled by a dimmer switch around the perimeter of the room, a central procedural light, and small task and under-counter lights are elements of a beneficial interior design." In the daytime, patients need to be exposed to natural light and to adequate bright artificial lighting when there is no sun available. The visual setting of natural lighting in gardens are beneficial for both plants and humans. Lighting for interactive elements should highlight the garden or features without glare or visual discomfort for persons in the space. Lights should not flash, be confusing, or trigger negative reactions.

The Effect of Music

For many people, music is a way to feel calm, peaceful, and happy (Harvard Medical School, 2011). Harvard Medical School (2011) published an article exploring the effects of music on people and their different conditions. While brain-damage injuries can result in defects on patients' musicality, music itself helps the patients to relax and rest for best recovery. Also, according to the Harvard Medical School, some forms of music exercises warm up brain cells to permit efficient information processing. The article gave the example of the positive effects of Mozart's music on people's IQ. While there is more study to be done on music and the mind, it is known that playing a musical instrument may enhance the ability to learn a new language and improve memory and attention. Music has reduced stress during every era in human history in all societies; music has helped people express themselves and communicate their feelings (Harvard Medical School, 2011). The British dramatist William Congreve said in 1697, "Music has charms to soothe a savage breast" (as cited in Harvard Medical School, 2011, web. np. #), meaning that people express their emotions through music, which reduces their stress. Music can also help heart and blood circulation, which is one way of reducing stress. A study from Wisconsin assessed 45 patients who had had heart attacks within the previous 72 hours (Harvard Medical School, 2011). All the patients were in the intensive care unit and were clinically stable. The subjects were randomly assigned to listen for 20 minutes to classical music or simply continue with routine care: "Almost as soon as the music began, the patients who were listening showed a drop in their heart rates, breathing rates, and their hearts' oxygen demands. The cardiovascular improvements linked to the music lasted for at least an hour after the music stopped, and psychological testing also demonstrated lower levels of anxiety" (Harvard Medical School, 2011, web. np. #). This study clearly showed the benefits of music on cardiovascular patients.

Technology and Colors in Design and the Importance of Light.

Many locations have thought about installing more technology such as animated television screens and wall projections to attract people and visitors. Interactive space research has been limited, yet there was a research study that took place in randomly selected museums in two regions: Europe (200 museums) and the United States (250 museums). The directors and managers of museums were asked questions about their museums and interactive spaces with the visitors in order to gather information about the interaction and the contact of visitors with

museums. It was found that museums equipped with interactive exhibits were more likely to attract visitors, especially families and children. The interactive spaces were designed to satisfy the educational curiosity of adults as well as children. These spaces were also a great help for people with disabilities, such as wheelchair users and those who have difficulty moving, so they too could enjoy art (Gül & Akmehmet, 2015). Colors and lighting in hospitals have a positive effect on people (Birren, 1978). Birren's (1978) research has demonstrated that lighting and color have an effect on people's responses to the environment, which impacts their perceptions. The study aimed to establish current color application in the design of hospitals. This study noted previous studies that provided the evidence of the effect of color and lighting in hospital's interior design. Color and lighting also affect patient recovery rates and improved the overall experience of the patients, visitors, and staff (Mahnke & Mahnke, 1947). There was experimental evidence that some people prefer certain colors more so than others (Boyce, 1981); these particular perceptions were likely to benefit patient progress to improve and enhance staff performance. The colors blue and green seemed to be the most preferred by the participants. Mahnke (1996) reported an experiment conducted in 1994 in which 38 participants were tested for two minutes while exposed to colors on screens. He looked for psychological and physiological reactions to different colored lights. He found that most of the participants associated red light with stress and anxiety, blue and green with calming feelings of relief, orange and red with excitement and stimulation, and violet with spiritual feelings. Some studies have shown a close relationship between color perception and patients' mental and/or emotional attitudes (Kwon, 2010), even if there was not enough scientific evidence to suggest a clear correlation between a certain color and a certain emotion (Fehrman & Fehrman, 2004; Tofle et al., 2004). The color of the environment may also affect the perceptions of other environmental features, such as acoustic and thermal environments (Tofle et al., 2004).

The Study

The study took place at the Cosmetic and General Dentist and Medical Clinics building of the Wayne State University Physician Group (WSUPG), Detroit, MI where there was an indoor garden. The dimensions of the indoor garden were not measured. The researcher can guess the size was around 35x25 ft. The study was seeking to determine whether the existing gardens and the proposed interactive elements would influence participants' perceptions.

Methodology

The research study used a mixed method (quantitative–qualitative) approach, commonly used in post-occupancy evaluation of healing gardens, as exemplified by a study in a pediatric cancer center (Sherman, Varni, Ulrich, & Malcarne, 2005). The rationale behind selecting the quantitative part of the study was the nature of the research outcomes. The numerical significance was used to examine the relationship between two or more variables of numerical data, and statistics were used to understand attitudes, behaviors, and, specifically, perceptions of garden elements. The qualitative component was used to gain more information from the participants about the indoor gardens and the interactive elements, and to know more about what they liked or disliked in the space. It was used to explore how the participants felt psychologically, physically, and mentally, by allowing them to answer open-ended questions

using their own words. Simulation design, Simulation videos were prepared by a company of smart business services (sa-sbs.com/contact). Each simulation video contained different examples of interactive elements, and they were as follows:

• Design 1: The first simulation showed a person entering the healthcare facility indoor garden with no additional interactive elements. Green space with plantings would be the focus.

• Design 2: The second simulation showed an animation of a person entering a garden equipped with floor tiles that generate sound, light, and color. As a simulated person stepped on the tiles, changes would occur for the viewer to experience.

• Design 3: The third simulation showed a person entering a garden in the facility where there were wall projections of moving animals (e.g., rabbits, squirrels, monkeys).

• Design 4: The fourth simulation showed a combination of the three previous designs.

Hypotheses

• H1: Participants will prefer the garden-only design and no other additional element from the proposed technological designs

• H2: The combination of nature with interactive flooring will be the most preferred by patients, visitors but not by staff.

• H3: Interactive elements:

1- Lights: Lights will have a positive influence on the participants' affective perception.

- Sounds: Sounds will have a positive influence on the participants' affective perception.
- Colors: Colors will have a positive influence on the participants' affective perception.

• H4: The interactive tile flooring will have more effect on younger (19–30) participants' perception than on the older participants.

• H5: Visitor participants who have children with them will like or rate the wall projections more positively than the flooring projections.

• H6: Female participants will appreciate interactive elements more than male participants.

Data collection process

Participants entering the medical facility indoor garden were randomly selected by the researcher, who was in the garden on the days of data collection. The researcher talked with people to determine their interest in participating in the study. Key information about the topic of the study was explained, along with the steps of the study and the simulation videos the participant would watch after they signed a written consent or gave verbal consent. The simulation videos were posted to a website for the sample to view on either an iPad or an Amazon Fire Tablet, whichever device they were more familiar with. After viewing the simulations, the questionnaire was offered in both a paper format or as an online option, again using the researcher's iPad or Tablet. Most of the sample chose to complete the paper document, and the researcher posted their responses to the data collection website. The survey was processed using the Qualtrics online program." It is a survey tool for creating, distributing surveys and analyze responses. The survey included demographic questions and queried preferences for garden interactive elements. Still images of the interactive elements in the garden that had been viewed in the simulations were offered with the questions as reference. Likert scale "It is a method for measuring behaviors and preferences used in psychological tests

devised by psychologist Renes Likert. It is used in questionnaires, especially in the field of statistics. The scale depends on responses indicating the degree of approval or opposition to a formula".

The garden: The frequency of visitation. The data showed that of the participants who have visited the garden at this facility for this study, 8.8% had been there more than 10 times, 12.5% visited 7 to 9 times, 35.6% 4 to 6 times, and most of the participants (43.1%) visited the indoor garden only 1–3 times. It was important to know how often the participants spent time in this space to determine whether they liked it or in what ways they were affected by nature or would consider interactive elements if added.

Length of stay in the garden. To the question "How long do you generally stay in the garden?" most of the participants (48.1%) said they usually spent 11 to 15 minutes in the garden. The people who spent 15 to 30 minutes made up 31.3% of the sample. Twelve and a half percent of the participants spent less than 10 minutes in the garden, while 7.5% stayed in the garden half an hour to an hour. Only 0.1% declared staying more than an hour in the garden.

Descriptive Statistics of independent variables:

The data for demographic variables were analyzed for frequency and percentage of sample participants.

Data Analysis

The data for demographic variables were analyzed for frequency and percentage of sample participants.

Sampling and Demographics

Gender and age. Adult participants (n=160) were asked demographic questions to note their age and gender. The participants who visited the indoor garden during the three months of September, October, and November in 2018 were 73 males and 87 females. The participants age range was a low of 19 years and a high of 89 years old see table 1. The highest percentage group was 31–50 years old see table 2.

Table 1

Gender of the Adult Participants

	Frequency	Percentage
Female	87	54.4
Male	73	45.6
Total	160	100.0

Table 2

Age of the Adult Participants

		Frequency	Percent
	19-30	37	23.1
	31-50	75	46.9
	51-70	37	23.1
	70+	11	6.9
	Total	160	100.0

Type of visitors. The gardens' visitors were mostly patients (30.6%). The employees and staff were 27.5% and non-medical visitors made up 26.9% of the survey participants. Parents accompanied by children were 15% of the group. Both Qualtrics and SPSS statistical software were used for all analyses. The null versions of the above hypotheses were tested using chi-square. The chi-square test gives differences among groups in a categorical variable (Filed, 2018). It tested whether the groups had been drawn from the same population. If the groups were different, then they did not come from the same population. Hence, there were differences in the preferences. Chi-square tests were performed on patients, visitors, and staff separately, with interactive flooring to determine whether the two categorical variables were statistically different. The p-values for each of the chi-square statistics were higher than the significance level $\alpha = .05$. The Wald-Wolfowitz test was used to measure the difference between two groups: the visitors participants' perception and whether the children liked or rated the wall projections higher than the flooring projections. Finally, the Mann-Whitney test was used to test the difference between the male and the female participants on appreciating interactive elements that were measured on an ordinal level see table 3.

Table 3

Frequency and Percentage of Visitor Type

	Frequency	Percent
Parent/guardian with a child	24	15.0
Employee/Staff	44	27.5
Non-medical visitor to the building/garden	43	26.9
Outpatient a doctor appointment or dental, test, procedure, etc.	49	30.6
Total	160	100.0

Results

We sought to know the participants' impressions of the indoor gardens with interactive elements to determine the best interior design in healthcare facilities for patients, visitors, and staff. The significance of the study was determined at an alpha level of 5% while balancing type 1 and type 2 error, based on the power, effect size, and sample of this survey.

Interactive Elements. Table 4 highlights the results when participants were asked whether they thought projections on the floors and walls would affect adult perceptions of the garden as shown in one of the simulations. The survey's results showed that 19.4% strongly agreed, 53.8% agreed, and 16.3% slightly agreed. Seven and a half percent of the participants were neutral, 2.5% slightly disagreed, and 0.6% disagreed. Overall, floor and wall projections were favored see table 4.

Table 4

Projections on Floors and Walls Will Make Adults Happy (Design 2 & Design 3)

	Frequency	Percent
Strongly agree	31	19.4
Agree	86	53.8
Slightly agree	26	16.3
Neutral	12	7.5
Slightly disagree	4	2.5
Disagree	1	.6
Strongly disagree	0	0.0
Total	160	100.0

To the question "Will people find something fun to play with in this garden (e.g., stepping on the tiles and viewing wall projections)?" the majority (87.5%) responded positively. Eight percent of the answers were neutral, and 4.3% did not agree see table 5.

Table 5

People Will Find Something to Play with in this Garden

	Frequency	Percent
Strongly agree	43	26.9
Agree	76	47.5
Slightly agree	21	13.1
Neutral	13	8.1
Slightly disagree	4	2.5
Disagree	3	1.8
Strongly disagree	0	0.0
Total	160	100.0

To the statement "I feel comfortable when seeing plants and interactive elements in healthcare facilities," the findings showed that most of the respondents (88.8%) had positive impressions seeing both greenery and interactive elements in the healthcare facility. Nearly 7% of the responses were neutral, and 4.4% didn't agree to the proposed design setting see table 6.

Table 6

Respondents Who Feel Comfortable When Seeing Plants and Interactive Elements in Healthcare Facilities

	Frequency	Percent
Strongly agree	60	37.5
Agree	71	44.4
Slightly agree	11	6.9
Neutral	11	6.9
Slightly disagree	3	1.9
Disagree	4	2.5
Strongly disagree	0	0.0
Total	160	100.0

For the answers to the proposal of listening to music while stepping on floor tiles, the participants strongly agreed at 36.9%, agreed at 28.1%, and slightly agreed at17.5%. On the other hand, a total of 10.7% didn't agree, and 6.8% remained neutral, see table 7. Overall, floor tiles with color, light, and music seemed popular. Hypothesis testing will later note which groups supported this design component.

Table 7

Respondents Who Would Like to Hear Music in the Garden

	Frequency	Percent
Strongly agree	59	36.9
Agree	45	28.1
Slightly agree	28	17.5
Neutral	11	6.9
Slightly disagree	6	3.8
Disagree	4	2.5
Strongly disagree	7	4.4
Total	160	100.0

Wall projections. Respondents were asked to agree or disagree about statements connected to wall projections. These included simulations of birds flying and changes related to those images. Table 8 notes impressions for lighted images of flying birds. The answers indicated that 90% would like to see images of flying birds around the gardens. Furthermore, 5.6% of the answers were neutral, and 3.8% did not want to see images of flying birds in the garden.

Study participants were asked what areas had a calming effect on them. More than 36% said that the area with the garden, music, and interactive elements had the most calming effects. Furthermore, 50.2% said the interactive elements were relaxing to them, while 38.2% said only the garden and music were calming. Eleven and a half percent said garden only, see table 8.

Table 8

Respondents Who Liked to See Light Images of Birds Flying Around the Garden (Design #3)

	Frequency	Percent
Strongly agree	71	44.4
Agree	57	35.6
Slightly agree	16	10.0
Neutral	9	5.6
Slightly disagree	2	1.3
Disagree	4	2.5
Strongly disagree	1	.6
Total	160	100.0

The setting that was the most calming to the participant was the interactive elements with 117 responses. Figures 1 and 2 show the gender preference for areas that had gardens only, gardens with interactive elements, and gardens with music. Most female participants (54%) preferred gardens with interactive elements; 41% liked gardens with music, 5% chose gardens only. Forty-five percent of male participants liked the gardens with interactive elements, while 35% liked gardens and music, and 19% the gardens alone.

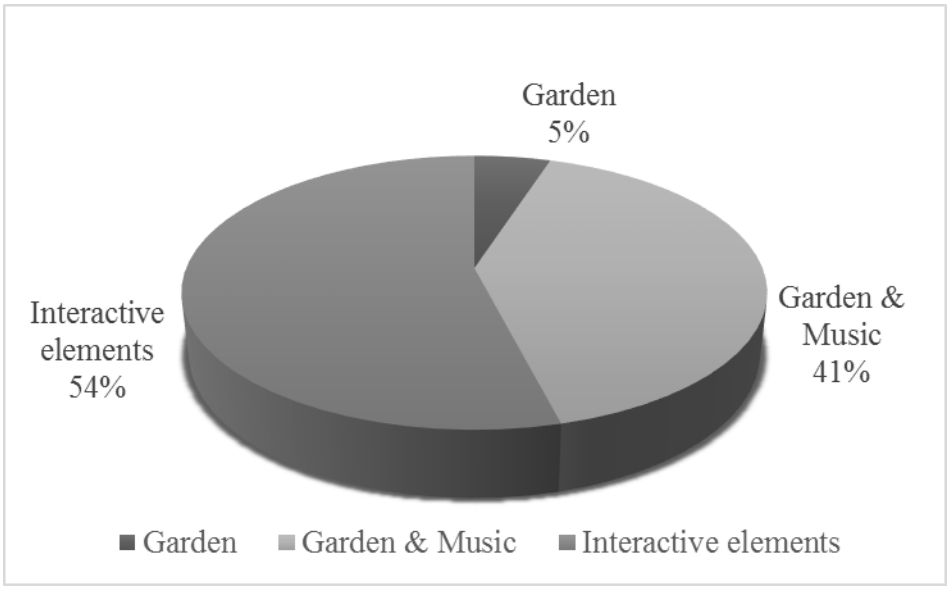

***Figure 1*. Elements that had a calming effect on females.**

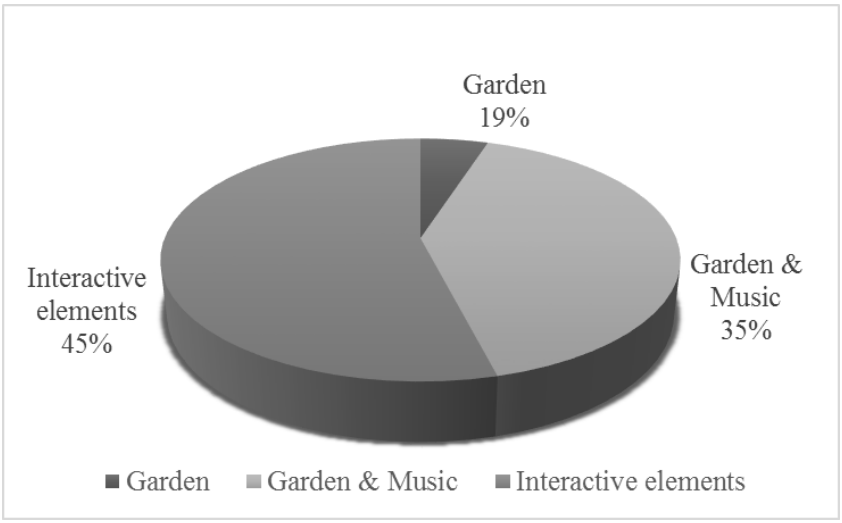

Figure 2. **Elements that had a calming effect on males.**

Figure 3, shows the calming effect of the designs on the staff/employees. Most employees (44%) found the gardens with music is the most calming, followed by the gardens with interactive elements at 38%, and finally the gardens alone at 18%.

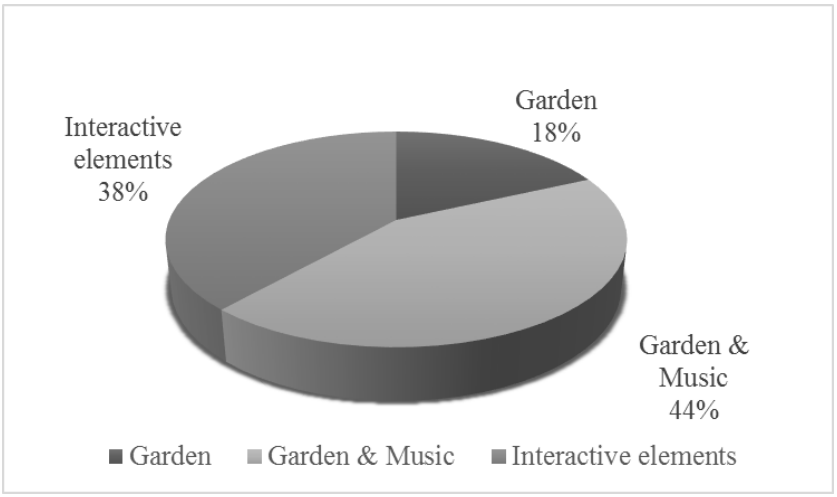

Figure 3. **Elements that had a calming effect on staff.**

Figure 4 shows the calming effect of the design elements on the outpatients. Outpatients liked the interactive elements (55%), the gardens and music (39%), and the garden only (6%).

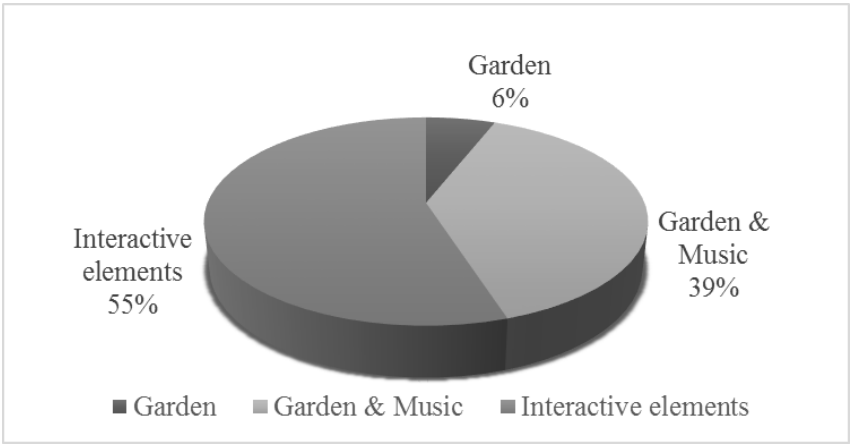

Figure 4. Elements that had a calming effect on outpatients.

Hypothesis Testing

Hypothesis 1.

H01: Participants will show no preferences among designs.

H1: Participants will prefer the garden-only design and no other additional element from the proposed technological designs.

The null hypothesis was tested using a chi-square test because the scale of measurement for item 12 was ordinal, see table 9.

Table 9

Preference for a Garden that Has No Additional Elements (Sound, Lights, Images)

	Value	df	Asymp. Sig. (2-sided)
Chi-Square	0.06	24	35.31
N of Valid Cases	160		

The p-values were higher than the significance level $\alpha = .06$. The null hypothesis was accepted. The participants would not prefer the garden-only design.

Hypothesis 2.

H2: The combination of nature with interactive flooring will be the most preferred by P and V but not by S.

H02: There will be no preference for interactive flooring among the patients, visitors, and staff (P, V, S).

For this hypothesis, chi-square tests were performed on P and V with interactive flooring, see table 10.

Table 10

Patient * Would you like to see lights in floor tiles in the garden?

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.801	6	.704
N of Valid Cases	160		

Table 10-1

Patient * Would you like to see color in floor tiles in the garden?

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.039	6	.504
N of Valid Cases	160		

Table 10-2

Patient * Would you like to hear music while stepping/playing on floor tiles in the garden?

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.440	6	.376
N of Valid Cases	160		

Table 10-3

Visitor to the building * Would you like to see lights in floor tiles in the garden?

	Value	df	Asymp. Sig. (2- sided)
Pearson Chi-Square	7.757	6	.256
N of Valid Cases	160		

Table 10-4

Visitor to the building * Would you like to see color in floor tiles in the garden?

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.094	6	.532
N of Valid Cases	160		

Table 10-5

Visitor to the building * Would you like to hear music while stepping/playing on floor tiles in the garden?

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.615	6	.268

Hypothesis 3.

H03: Interactive element such as

- Lights: Lights will have no effect on the participants' affective perception.
- Sounds: Sounds will have no effect on the participants' affective perception.
- Colors: Colors will have no effect on the participants' affective perception.

H3: Interactive elements such as

- Lights: Lights will have a positive influence on the participants' affective perception.
- Sounds: Sounds will have a positive influence on the participants' affective perception.
- Colors: Colors will have a positive influence on the participants' affective perception.

To test these hypotheses, the researcher used a Spearman's rank-order correlation. This test confirmed that lights would have a positive influence on the participants' affective perception.

However, sounds and colors were found not to have a statistically significant influence on the participants' affective perception at α = .05 see table 11.

Table 11

Interactive Elements (Light, Sounds, Color) Will Have a Positive Influence on the Participants' Affective Perception

			I think people who spend time in this garden will feel better.	Would you like to see lights in floor tiles in the garden?	Would you like to hear music while stepping or playing on floor tiles in the garden?	Would you like to see color in floor tiles in the garden?
Spearman's rho	I think people who spend time in this garden will feel better.	Correlation Coefficient	1.000	.193*	.108	.138
		Sig. (2-tailed)	.	.014	.173	.081
		N	160	160	160	160

Hypothesis 4.

H04: There is no relationship between the tile flooring effect and the younger participants' perception. To test these hypotheses, the researcher used a Pearson's correlation.

H4: The interactive tile flooring will have more influence on younger participants' perception. This test confirmed that there is no relationship between the tile flooring effect and the younger participants' perception at α = .05 see table 12.

Table 12

Interactive Tile Flooring Will Influence Younger Participants' Perception

		Younger Participants (19–30)	Would you like to see lights in floor tiles in the garden?	Would you like to see color in floor tiles in the garden?	Would you like to hear music while stepping or playing on floor tiles in the garden?
	Pearson Correlation	1	.127	.087	.061

Younger Participants (19–30)	Sig. (2-tailed)		.110	.271	.443
	N	160	160	160	160

Hypothesis 5.

H05: There will be no difference in (mean) rating between the flooring and wall projections. This hypothesis will be tested using the Wald-Wolfowitz runs test.

H5: Visitor participants' perception with kids will like or rate the wall projections higher than the flooring projections.

The test suggested that visitor participants' perception with kids would like or rate the wall projections higher than the flooring projections, see table 13.

Table 13

Visitors Who Think Kids Will Like Wall Projections more than Flooring Projections

		Number of Runs	Z	Asymp. Sig. (1-tailed)
I think some of the flooring and the wall projections will make the child happy or experience positive emotions.	Minimum Possible	5	-8.112	.000
	Maximum Possible	39	2.660	.996

Hypothesis 6.

H06: There will be no difference in (mean) rating between female and male participants' appreciation for interactive elements.

H6: Female participants will appreciate interactive elements more than male participants. The researcher tested the null hypothesis using a Mann-Whitney test.

The test indicated that female participants appreciated the interactive elements more than male participants, see table 14.

Table 14

Female Participants Will Appreciate Interactive Elements more than Male Participants

	I feel comfortable when seeing plants and interactive elements in healthcare facilities.
Mann-Whitney U	2370.500
Wilcoxon W	5071.500
Z	-2.975
Asymp. Sig. (2-tailed)	.003

Qualitative Responses

At the end of the survey, there were qualitative, open-ended questions regarding additional feedback about garden design. The questions were as follows:

1. Is there anything else you would like to tell us about the garden, the interactive elements, or how you feel when you are here?

Of the qualitative answers received, most expressed a feeling of happiness and relaxation thanks to the greenery, the projections, and the music. The parents with kids had the strong impression that their kids were not thinking about the doctor's appointment and therefore felt less worried. Regarding the interactive elements, the people who answered the open-ended questions said that the elements caught their attention and their children's; furthermore, some suggested putting the interactive components on each floor in the building to make the children more relaxed.

2. Is there something you would suggest adding to the garden that would make it appealing, calming, or fun? The answers varied from adding more natural aspects such as flowers and waterfall projections or real water fountains (10 responses). Some suggested adding occasional live piano music (2 responses) and skylights and more colors (2 responses). Some said they wanted to have comfortable chairs to sit on. It was also recommended that there be more educational kid areas with more toys and mental games (e.g., chess, Monopoly).

The participants were the visitors of the healthcare facility (Franklin Pointe Medical Center of Wayne State University Physician Group [WSUPG] in Southfield, Michigan) their ages were quite varied. The 31-to 50-year-olds participated the most. The female participants were dominant with 54.4%; the male participation was at 45.6%. The study observed that most of the participants were patients and staff, but some were other non-medical visitors to the building. The answers to questions about the garden showed that 38% supported the importance of greenery to people who visit healthcare facilities, they found it relaxing and calming. This finding confirmed the previous study of Whitehouse et al. (2001) for adults. The same relaxing effect was observed in children per the findings of Davis et al. (2011). The evaluated simulation environments in this study remained the same for both adults and children, with spaces perceived as helpful for people who are patients, visitors, or staff. Gardens reduced stress and occupied one's time. In the children's part of the survey, it was noticed that kids were more active in the gardens with the interactive elements, which aligns with the research of Van Andel (1990). The participants mentioned their mental wellbeing when they were in the garden, again confirming the work of Hartig et al. (1995), S. Kaplan (1995), and Launmann et al. (2001) on cognitive activity that highlights the importance of green space. The activities that were mentioned as happening in the garden (e.g., taking walks, interacting with others, or socializing), and the relaxation and feeling of calm in gardens aligns with the restorative conceptual framework and findings of Ulrich et al. (1983, 1991, & 1993). Parsons and Hartig (2000) noted that exposure to nature can increase positive feeling and reduce the feeling of pain, hence a healing component to nature/biophilia. This study's research questions were answered through different forms. The first research question explored the most enjoyable interactive elements, and the response was almost the same for each element. The participants liked the projections, the interactive floor tiles, and the sounds equally.

Research Questions

Question 1. What combination of interactive elements in a healthcare facility's garden had a greater effect on the perceptions of the patients, visitors, and staff?

The adult survey answers represented positive feedback (91.3%) that the participants liked the wall projections of flying birds and chirping sounds in the indoor garden, and the respondents, in answers to open-ended questions, suggested that they liked more of the interactive elements that were close to a natural aspect of the garden (e.g., birds flying and chirping). The results showed that the p-value of each category was higher than significance level $\alpha = .05$. The study remained inconclusive and we were unable to reject the null hypothesis because of the size of the sample that indicated which combination design was preferred in each participant type: Patient, Visitor, Staff.

Question 2. What elements will be the least preferred by the adult patients, visitors, and staff? Why?

The least preferred design was Simulation 4, with all the elements: the combination of floor tiles, wall projections, colors, and sounds. More than 50% of participants were favorable to the combination of all the interactive elements in the indoor garden. The explanation that was provided by the participants in the open-ended questions was that there were too many things to look at, and it was overwhelming. Furthermore, the researcher looked at respondents in demographic questions; the findings said that about 52% of females and 64% of males disliked the combination of all the elements. The research tested each element with patients, visitors, and staff separately. The results showed that the participants liked the lights in floor tiles and believed the birds' wall projections with a high percentage; the floor tiles had a high likability rate as well 85.1% of positive feedback. This confirmed that the lights had a greater effect on people's perceptions. However, sounds and colors were found not to have a statistically significant influence on the participants' affective perception at $\alpha = .05$.

Conclusion

This study examined a research question about the effects of indoor healing gardens and technological elements in healthcare facilities on patients, visitors, and staff. The main finding of the study was that people like to having interactive elements added to indoor gardens in healthcare facilities. Each design setting had different levels of acceptance by adult participants. The study resulted in positive feedback (at 91.3%) from participants who liked the wall projections of flying birds and chirping sounds in the indoor garden. The results also showed that floor tiles had a high likability rate as well (85.1%); however, the participants were favorable to the combination of all the interactive elements in the indoor garden at 50.6%.

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