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Effects of Biophilic Nature Imagery on Indexes of Satisfaction in Medically Complex Physical Rehabilitation Patients: An Exploratory Study

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Abstract

Objective: Exposure to nature has been shown to influence various dimensions of human experience in the healthcare environment. This mixed method study explores the effects of the presence of biophilic, nature-based imagery on patient perceptions of their hospital room and aspects of their experience in rehabilitation. **Background:** In settings where patients have high degrees of medical acuity and infection control is a major concern, exposure to the benefits of real nature may be precluded. This is also true in many older healthcare facilities which were not designed with salutatory nature exposure in mind. In these settings, the presence of nature imagery may provide benefits which positively impact patient experience. **Method:** Seventy-six physical rehabilitation patients on a medically complex/cardiopulmonary rehabilitation unit filled out questionnaires assessing their perceptions of their room and various indexes of patient satisfaction. Data were collected from 47 patients in enhanced room containing nature imagery and 29 patients in standard rooms which served as controls. **Results:** Scores on the Environmental Assessment Scale (EAS) indicated a significant difference between experimental and control group in the rating of their rooms ($p = .0071$). Ratings of quality of room, quality of stay, quality of sleep, and overall care trended in the direction of the hypothesis but were not significant. Data from qualitative questionnaires supported the results of the EAS. **Conclusion:** We conclude that the presence of biophilic nature imagery in the hospital rooms had a significant effect on patients' room ratings and positively influenced indexes of patient satisfaction.

Keywords

biophilia, nature-based therapy, horticultural therapy, healthcare design, mixed methods research, environmental psychology, physical rehabilitation

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Patient Experience and Patient Satisfaction

Completing a course of inpatient physical rehabilitation can be a daunting experience. Patients often cope with pain, difficulty sleeping, stress related to their medical conditions, changes in independence, and resuming life roles after discharge (Carpenter, 1994; Luker et al., 2015). As medical acuity increases, it becomes more challenging to meet varied patients' needs. Providing an optimal healing environment and high-level patient-centered experience to meet the specific needs of patients is an important goal in the current healthcare environment.

Patient experience and patient satisfaction have become increasingly important in the current healthcare environment, and perceptions of care have become an important addition to the healthcare outcomes of the patient (Bosch & Lorusso, 2019; MacAllister et al., 2016). Not only is patient experience important to focus on from a humanistic perspective, but it is also important from a value point of view. Value is defined as quality over cost (Porter et al., 2013). Quality is related to outcomes such as function, infection rates, readmission rate, discharge to home, and the patient and family rating of their care—patient satisfaction or patient experience (Berwick et al., 2008). Thus, considering this formula anything that improves quality/outcomes in addition to the patients' healthcare outcomes, while keeping costs constant (or decreasing them) improves value. Improved patient experience is an important outcome that improves the value of healthcare delivery.

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Evidence Linking Nature and Health

One way to address these issues is through enhancement of the patient environment with exposure to nature. Emerging evidence has shown a wide array of health benefits associated with exposure to nature (Frumpkin, 2001), many of which are relevant to medical settings. Stress reduction as a result of exposure to nature is a prominent finding and has been reported by a number of researchers (Brown et al., 2013; Hartig et al., 2003; Ulrich, 1986; Ulrich et al., 1991; Wichrowski et al., 2005). Exposure to nature has been shown to create positive shifts in mood and affect (White et al., 2013; Barton & Pretty, 2010; Berman et al., 2012; Hartig et al., 2014). Parsons and Hartig (2000) posit that a positive shift in mood and reduction in stress indicators occurs in minutes after exposure. Bratman et al. (2015) found decreased rumination and decreased activity in the subgenual prefrontal cortex, an area of the brain associated with depression, in subjects who participated in a 90-min nature walk, compared to a group who walked 90 min in an urban setting.

In addition to positive shifts in mood and stress reduction, beneficial cognitive effects have been reported as a result of nature exposure. According to attention restoration theory (Kaplan & Kaplan, 1989), scenes that contain the elements of being away (promotes a shift in mental focus), compatibility (with one's current needs and intentions), fascination (contains elements that capture attention), and extent (scope of experience) have the potential to restore fatigued capacity for attention, a clearing of the mind's clutter, which ultimately aids in survival.

Later studies concur. Berman et al. (2008), Tenneson and Cimprich (1995), and Cimprich (1993) have all reported increased attentional capacity as a result of nature exposure. In a cumulative review of reviews, van den Bosch and Sang (2017) confer that increased exposure to nature improved affective state and reduced cardiovascular disease mortality, as well as all-cause mortality. Hartig et al. (2014) sum it up by stating that there is an array of benefits which affect human health, some of which are strong, but that substantial gaps in knowledge still remain. Thus, the potential exists to apply nature in a variety of settings to impact health and well-being.

Applications of Nature in Healthcare

Nature exposure has been utilized in many healthcare settings for a range of benefits. A classic study by Ulrich (1984) reported postsurgical patients who had a view of a copse of trees from their hospital windows needed less pain medication, had less complaints in the nursing logs, and got discharged slightly sooner than matched patients who had a view of a brick wall. For patients waiting to undergo dental surgery, anxiety was lower on days that an aquarium was present in the waiting room and clinician ratings for patient compliance were higher (Katcher et al., 1984). Park and Mattson (2009) reported less anxiety, pain, lower blood pressure, and increased satisfaction with hospital stay for patients recovering from hemorrhoid surgery when plants were added to the room. Rehabilitation patients reported increased satisfaction when plants were added to common spaces (Raanaas et al., 2010), and a study by Ozdemir (2010) concluded that views of nature increased patient satisfaction.

Applications of Nature Imagery in Healthcare

While exposure to real nature conveys a range of health benefits, a number of medical settings preclude the inclusion of real nature. It is recommended that patients having organ transplants or who are otherwise immunocompromised do not have contact with soil and plants due to infection concerns. Surgical and procedure rooms need to be sterile and are often filled with necessary equipment precluding use of real nature. In these settings, the images of nature may possibly convey similar benefits.

Positive outcomes have also been reported utilizing nature imagery in the design of spaces in various medical settings. Images of nature have been determined to facilitate stress reduction (Kjellgren & Buhrkall, 2010). Parsons et al. (1998) reported photos of vegetation reduced blood pressure and improved mood and feelings of restorativeness. Ulrich et al. (1993) reported patients recovering from cardiac surgery with a nature scene in their room, needed fewer doses of strong pain medication than those with an abstract picture or no picture. Lee et al., (2004) reported visual distraction from nature imagery reduced pain for patients undergoing colonoscopy. Diette et al., (2003) found patients experienced less pain during a flexible bronchoscopy procedure when nature imagery and sounds complemented standard analgesia. Pati et al. (2016) found less anxiety and stress and increased satisfaction with the environment when inpatients had views of ceiling murals with nature scenery in an inpatient rehabilitation facility. Kim et al. (2010) report improved mood. Malenbaum et al. (2008) state that viewing nature may decrease pain by eliciting positive emotions, reducing stress, and distracting patients from focusing on their pain. In a systematic review of the impact of viewing nature on health, stress reduction, improved attentional capacity, faster recovery from illness, increased physical well-being for elderly people, and behavior changes leading to improved mood and overall well-being were found (Velarde et al., 2007).

Biophilia and Nature Imagery

The choice of nature imagery in this study was informed by the biophilia hypothesis (Kellert, 2008; Kellert & Wilson, 1994) defined as the affiliation humans have for the natural world resulting from the span of evolutionary time spent as hunters and gatherers. This hypothesis posits that humans are genetically programmed to respond positively and are attracted to stimuli in our environment, which support survival. It is suggested that humans have an intuitive preference for environments that hold high potential for yielding drinking water, food, safety, and security (Thake et al., 2017). Evidence from studies of gardens in healthcare environments suggests adults respond favorably to verdant foliage, flowers, water, grassy spaces with trees or large shrubs, and a degree of spatial openness (Marcus & Barnes, 1999). There appears to be substantial potential to utilize this response to biophilic stimuli to positively impact the patient experience within the healthcare environment. The nature imagery chosen (see figures) were bright, contained diverse plant life including flowers, water features, open vistas, and a place to observe from,

which offers prospect and refuge (Appelton, 1975; Kellert, 2008).

Purpose of Study

While there is mounting evidence supporting the role of the environment in creating positive outcomes in healthcare settings (Frampton, 2012; Lorenz & Dreher, 2011; Maben et al., 2016), there has been minimal inquiry into the effects of nature imagery in the design and decor of hospital rooms. With increased implementation of patient-centered care philosophies and the importance of patient satisfaction ratings regarding reimbursement and willingness to recommend, exploring this topic has implications in many areas of healthcare. This is especially pertinent where exposure to real nature may be contraindicated, that is, with immunocompromised patients, within procedure rooms, or in areas of increased medical acuity where plants and soil are prohibited.

The purpose of this study is to explore the effects of biophilic imagery in hospital rooms on patient perceptions of their room, indexes of satisfaction, and perception of care, using a mixed methods design. There is a current lack of evidence in research evaluating healthcare settings and fewer evaluations of specialized and sensitive healthcare settings (Sadek & Willis, 2020). Due to the lack of highly tested methodologies and scales and a lack of a "good fit" in choosing a scale with the potential of assessing the goals of this project, qualitative information was also collected. Additional open-ended inquiry was aimed at examining convergent validity with questionnaire results and providing specific and useful information on room design and patient preferences. The hypothesis being that patients with biophilic imagery in their rooms would rate the space higher and show improved perceptions of their rooms and other aspects of care, compared to standard room ratings.

Method

Setting

This rehabilitation unit is located on one floor (ninth floor) within a large urban medical center. There are 13 patient rooms, 11 of which have two beds and two are single bed rooms. There is a long hallway with a therapy gym and staff offices on the one end and patient rooms on both sides of the hallway at the other end. A nursing station sits midway down the hall. The rooms have large windows which look out on a city scape with no views of nature. The patients are engaged in at least 3 hr of therapy divided up between physical therapy, occupational therapy, and speech therapy, with additional medical and psychological services available as needed. This takes place in the therapy gym on the unit, in the hallway, and in their rooms depending on scheduled activity and functional capacity of the patient. When not in therapy, many patients rest in bed with even less contact with the outside.

Subjects

Data were collected on 76 randomly selected patients in a medically complex/cardiac rehabilitation unit. Patients typically present with cardiopulmonary issues (bypass surgeries, heart failure, valve surgery and replacement, pulmonary fibrosis, and COPD), neurological conditions, limb loss, and for postorgan transplant rehabilitation. All patients on the floor are also typically diagnosed with one or more comorbid conditions such as diabetes, debility, and/or infections. Forty-seven (16 males, 31 females) patients were in experimental condition (enhanced room), and 29 (eight males, 21 females) patients were in control rooms (standard decor). Ages ranged from 24 to 93 years with a mean of 69.7 years. Mean length of stay was 11.9 days for enhanced room group and 11.6 days for standard decor rooms.

Inclusion criteria: Patient needed to be English speaking and oriented to person, place, and situation. Secondly, patient needs to have remained in the same room and bed for duration of their stay.

This study was approved by the Rusk Rehabilitation Performance and Quality Improvement Committee.

Research Design

A mixed methods between groups design was utilized. The assessment tool consisted of five

parts and was developed by the research team. Part 1 consisted of an Environmental Assessment Scale (EAS), a 13-item adjective pair, Semantic Differential Scale, scored between 1 and 9 on each pair, with greater scores indicating higher levels of satisfaction with the particular item. The EAS has been used in previous studies to evaluate the affective characteristics of the environment and the various features it contains. (Park & Mattson, 2009; Rohles & Milliken, 1981), but no reliability data were found. Results of the total sum of all of the items on initial EAS score were compared with the discharge EAS score within each condition with a *t* test to determine whether there were any changes in room perception over the course of their stay. This checked for possible differences in scores due to healing and progress in the patients' rehabilitation goals during their stay. The total sum of EAS discharge scores between conditions (enhanced rooms vs. standard rooms) was then compared with a *t* test to assess differences in room ratings due to the presence of the nature imagery. Additional parts of the questionnaire were added by the researcher to assess for convergence with EAS and to gather additional information regarding patients' preferences. Responses on individual EAS items were also represented as percentages to compare specific items between conditions. Part 2 was open-ended and asked participants to list three positive and three negative parts of their room. Part 3 assessed pain control, quality of sleep, overall care, and quality of room during their stay, on a scale of very poor, poor, fair, good, and very good, scored 1, 2, 3, 4, or 5, respectively, and compared with a *t* test across the two conditions. Part 4 asked open-ended feedback on ways to improve the room. Part 5 asked for any additional comments. $p = .05$ was chosen as a level of significance due to the exploratory nature of the study (see Figure 1 for assessment tool).

Procedure

The environmental intervention consisted of hospital room enhancement with nature stimuli comprised of one nature-themed bed curtain (see Figure 2) with biophilic elements and two-nature-based wall posters with biophilic elements. Two patient rooms (four beds) comprised the treatment group (see Figure 3) and were compared with two standard decor patient rooms (four beds) comprising the control group (see Figure 4). Patients were randomly assigned to rooms as they were discharged from acute care and beds became available on the rehabilitation floor. Patients were initially assessed, and a history and physical note completed by their physician. Patients in the designated rooms who were oriented to person, place, and situation were approached to participate in the study. Once consented, patients were given Part 1 of the questionnaire (EAS) within 2–3 days of their stay. Toward the end of their stay, 1 or 2 days before discharge, they were given the EAS again, with the additional four sections (Parts 2–5), and any questions regarding the study were answered. This was a single blind study with subjects independently filling out scales. On three occasions, the researcher helped patient fill out questionnaire due to misplaced reading glasses.

Results

One hundred twenty-one patients were approached to participate. Complete data were collected on 76 patients (47 in treatment group and 27 in control group). The data collection phase was slated for 1 year to capture four complete seasons. Toward the end of the year, there was a greater influx of transplant patients and room switches due to patient placement protocols for organ transplants and in order to keep same gender rooms. This contributed to the inequality in participant numbers for the two conditions. In addition to the completed questionnaires, 45 patients (21 in treatment condition and 24 in control group) didn't participate or finish discharge questionnaire for the following reasons, room switches to maintain same gender rooms (24; 14 in treatment group and 10 in control group), declined participation (5; three in treatment group and two from control group), medical emergency/transfer to acute care three, and early discharge with no final data collected (13; six in treatment group and seven from control group). No data from incomplete questionnaires were included in analysis.

Your opinion is important to us!

#_____

Please help evaluate your hospital room by answering the following questions. Read each carefully.

1. Several opinions regarding your room are listed below. Please circle the number that corresponds with your opinion.

annoying -	1	2	3	4	5	6	7	8	9	-satisfying
dirty:-	1	2	3	4	5	6	7	8	9	-clean
stressing-	1	2	3	4	5	6	7	8	9	-relaxing
uncomfortable-	1	2	3	4	5	6	7	8	9	-comfortable
drab-	1	2	3	4	5	6	7	8	9	-colorful
sad-	1	2	3	4	5	6	7	8	9	-happy
smells bad-	1	2	3	4	5	6	7	8	9	-smells good
dull -	1	2	3	4	5	6	7	8	9	-bright
crowded-	1	2	3	4	5	6	7	8	9	-spacious
irritating -	1	2	3	4	5	6	7	8	9	-calming
cool-	1	2	3	4	5	6	7	8	9	-warm
unattractive -	1	2	3	4	5	6	7	8	9	-attractive
noisy-	1	2	3	4	5	6	7	8	9	-quiet

#_____

Please help evaluate your hospital room by answering the following questions.
Read each carefully.

2. Please list 3 positive and 3 negative parts of your room.

Positive	Negative
1._____	1._____
2._____	2._____
3._____	3._____

3. Several components of your rehabilitation experience are listed below.

Please indicate your opinion.

	very poor	poor	fair	good	very good
Pain controlled	0	0	0	0	0
Quality of sleep	0	0	0	0	0
Overall care	0	0	0	0	0
Quality of room	0	0	0	0	0

4. Please list two ways to improve your room.

_____
_____
_____

5. Additional comments welcome. Use back of sheet if necessary.

_____
_____
_____

Figure 1. Hospital Room Evaluation Scale.

Figure 2. Nature-themed bed curtain in enhanced room.

Quantitative Results

On the EAS, the discharge scores of the 13 items summed in total and were compared using a *t* test. There was a significant difference at the .05 level ($p < .0071$) in responses between groups comparing enhanced ($n = 47$) versus standard rooms ($n = 29$) at discharge (see Table 1). There were no significant differences comparing initial EAS responses to discharge responses within the enhanced group ($p > .25$), or the control group ($p > .40$), thus the shift in perception occurred early on and was maintained throughout the stay.

Individual items of the EAS discharge scores were calculated as an overall percentage (sum of scores for item divided by sum of maximum possible score). This allowed for analysis and comparison of specific items between conditions (see Figure 5).

Part 3 of the questionnaire assessed general pain control, quality of sleep, quality of care, and quality of room on a scale of *very poor* = 1, *poor* = 2, *fair* = 3, *good* = 4, and *very good* = 5. A *t* test was used to compare enhanced and control conditions at discharge. These results, although statistically not significant, did trend in the direction of the hypothesis. Data summary is shown in Table 2.

Qualitative Results

Qualitative results were analyzed with the method of qualitative description in this case designating themes and frequency of comments within themes (Braun & Clark, 2006). Part 2 of the questionnaire asked respondents to list open-ended, three positive and three negative features of their room. Results are listed in Figures 6 and 7, with frequencies listed on the vertical axis. Table 3 gives a breakdown of comment compared to no comment between the groups further categorized into positive and negative comments. In these open-ended comments compared to the control group, the experimental group responded

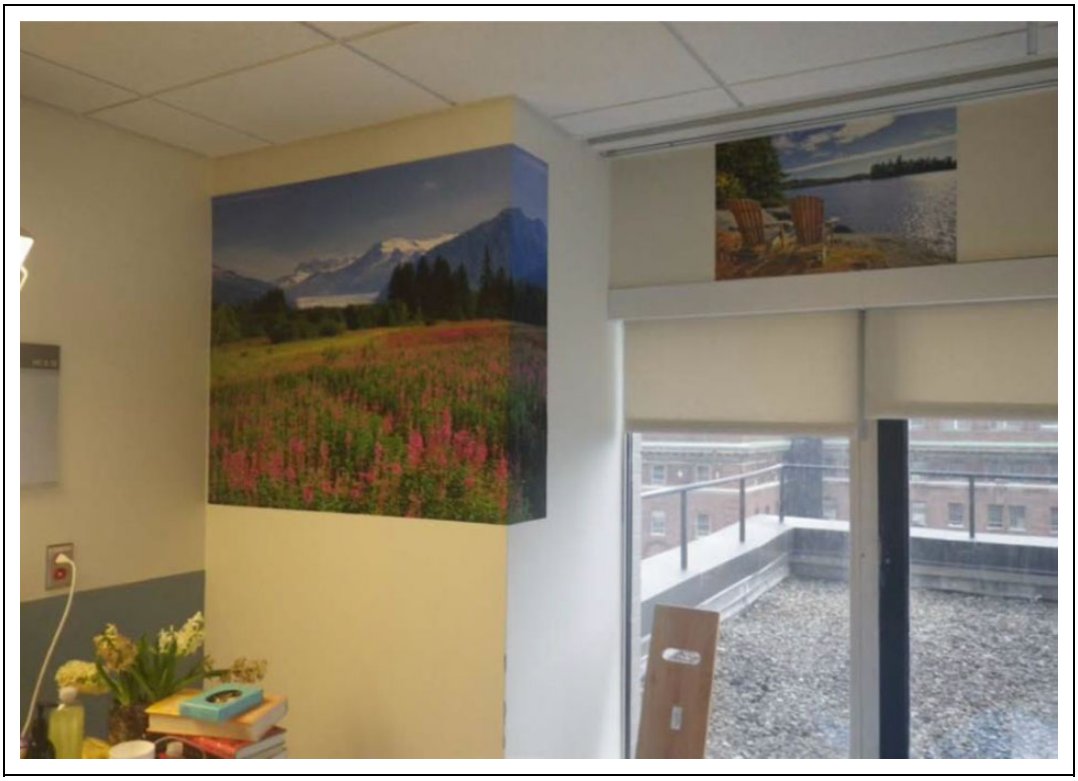

Figure 3. Biophilic-themed poster in enhanced room.

Figure 4. Standard room.

Table 1. *T*-Test Analysis of EAS.

Condition	2–3 Days Post Admission	1–2 Days Prior to Discharge	Significance
Control room ($n = 29$)	85.79 ($\pm$3.78)	86.76 ($\pm$3.64)	$p > .40$ NS
Enhanced room ($n = 47$)	98.35 ($\pm$2.64)	99.43 ($\pm$2.64)	$p > .25$ NS
EAS difference	12.56 higher in enhanced	12.67	($p = .0071$)*

Note. EAS = Environmental Assessment Scale; NS = nonsignificant at .05 level.
*$p < .05$ significant.

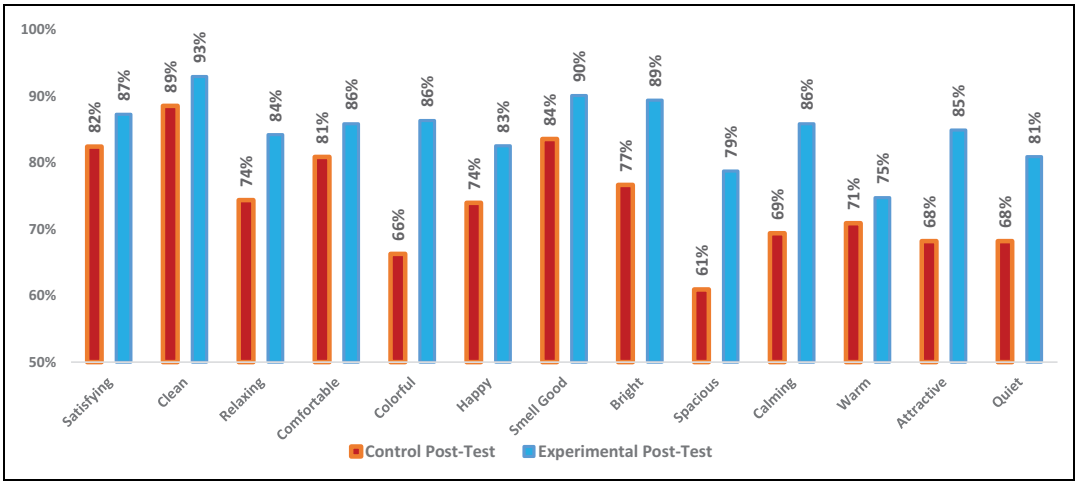

Figure 5. Environmental Assessment Scale ratings for specific items.

Table 2. *T*-Test Analysis of Part 3 of Assessment.

$N = 76$ $E = 47$ $C = 29$	Pain Controlled		Quality of Sleep		Quality of Care		Quality of Room	
	Enhanced	Control	Enhanced	Control	Enhanced	Control	Enhanced	Control
Mean	4.51	4.26	3.53	3.48	4.63	4.48	4.37	4.07
Standard Deviation	.66	.93	.87	.96	.57	.50	.78	.81
p Value	.23 NS		.82 NS		.27 NS		.14 NS	

Note. NS = nonsignificant at .05 level.

with higher frequencies that the room was bright (14 vs. 5), had pleasing colors (6 vs. 0), was sunny and pleasant (5 vs. 1), and was clean (9 vs. 2). Regarding negative comments, the control group mentioned the room being crowded (11 in control vs. 7 in experimental rooms), noisy (6 control vs. 4 in experimental rooms), and temperature (5 negative comments in control group vs. 2 in experimental rooms). Overall, patients in enhanced rooms chose to comment more frequently and had a higher percentage of positive comments compared to negative comments than those in standard rooms. Qualitative results regarding room features supported results from EAS.

A few negative comments regarding room features were mentioned only once and not included in Figure 7. These were: food could be better, roommate difficulties, and TV sound quality poor.

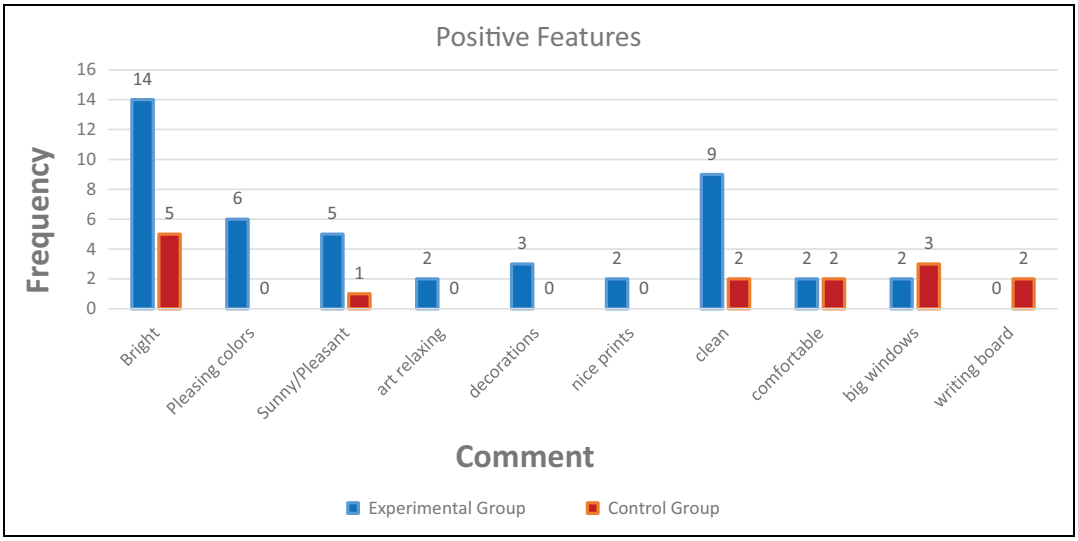

Figure 6. Positive features of room and frequency mentioned.

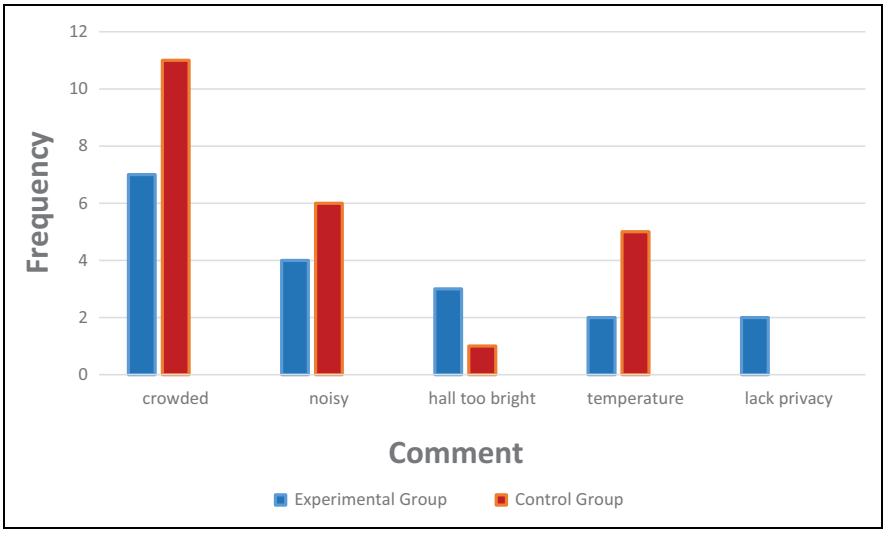

Figure 7. Negative features of room and frequency mentioned.

Part 4 of the questionnaire asked respondents to list two ways to improve the room (see Table 4).

Part 5 of the questionnaire asked for additional comments. Responses included: hard to open "certain lunch packages," "provide eye masks for nighttime," "staff noise at night makes it hard to sleep," and "best experience in any hospital."

Discussion

Comparing the total sums of all items on the discharge scores on the EAS, there was a significant difference at the .05 level ($p < .0071$) between ratings of enhanced rooms compared to standard rooms, but no significant difference within both conditions (enhanced $p > .25$, standard $p > .40$) from initial questionnaire to discharge questionnaire.

Table 3. Percentages of Patients in Each Condition Who Provided Comments and Breakdown of Positive and Negative Comments.

	Experimental Group (%)	Control Group (%)
No comment	15	21
Comment	85	79
Positive comment	59	51
Negative comment	41	49

Table 4. Comments Regarding Room Improvement and Frequency by Experimental Condition.

	# Responses Per Group	
Comments	Treatment	Control
Need more color	—	3
Paint walls soothing colors	—	2
Easier control for lighting	1	1
Bigger room	1	1
Consistent temp	2	—
Manage equipment better	2	—
Single room	1	—
More space (room for stuff)	1	—
Better light near window	—	1

Thus, the subjects in enhanced rooms rated the space significantly better than those in standard rooms on the discharge questionnaires, and ratings in both conditions were stable over their course of their stay. This result is in alignment with past studies which indicate responses to one's environment occur soon after immersion (Ulrich, 2008; see Table 1).

There was a 20% increase in the ratings of "colorful" and a 17% increase in the ratings of "attractive" between the groups. Patients expressed a clear difference in these room features. Perceived attractiveness has been found to influence stress reduction, patient satisfaction, and perceived quality of care (Dijkstra et al., 2008). In terms of affect-oriented responses on the EAS, there was an increase of 15% on ratings of "calming," a 10% increase on ratings of "relaxing," a 9% increase on ratings of "happy," and 5% increase on ratings of "comfortable." This finding is consistent with McMahan and Estes's (2015) report that exposure to natural environments reduced negative emotions and showed strong and consistent effects on positive emotions. These increases in ratings reflect clear differences in patient perceptions of the general decor of their rooms. The differences in responses regarding affect-oriented items also supported a positive affective shift in room perception for the enhanced room group, which has been shown to factor in patient satisfaction ratings (Dijkstra et al., 2006; Swan et al., 2003). Andrade et al.'s (2012) review concurs that the physical environment generates satisfaction with the service, as well as with the staff, which are predictors of intention to recommend and use the hospital again.

Part 3 examined the effects of nature imagery on pain, quality of sleep, quality of care, and quality of room. Although the results of this section trended in the direction of the hypothesis, they were not statistically significant. Previous studies have found connections between various types of nature stimulation and distraction from pain (Park & Mattson, 2009; Verra et al., 2012), improved sleep (Astell-Burt et al., 2014; Grigsby-Toussaint et al., 2015), and quality of care (Dijkstra et al., 2008). Responses to the "quality of room question" had a larger difference between conditions compared to the other questions in this section. Due to the relatively low degree of control of confounding variables in this in vivo study, interpretation of these items needs further evaluation. A higher number of subjects and controlling for possible confounds would provide a better foundation for interpretation of these trends.

Open-ended qualitative responses (Table 3) converged with responses from the EAS questionnaire (Table 1). Positive comments focused on the room being bright, sunny and pleasant, having pleasing colors, and there were a few positive comments regarding the art on the walls in enhanced rooms. A higher percentage of positive comments were provided by the enhanced room group compared to standard room group.

Responses regarding negative parts of the room centered on the room being crowded, cluttered with equipment, noisy, temperature uncomfortable, and lack of privacy. One control respondent, an architect, commented that "there

was no thought in decoration." As with the positive comments section, there was a difference in frequency of negative comments between enhanced condition and standard room condition, with a higher percentage of negative comments among the standard room group.

An interesting finding occurred when analyzing the responses. There was a positive shift in ratings of the nature enhanced rooms compared to standard rooms on environmental factors which were the same in both conditions. For example, the "smells good" item on the EAS was rated at 90% for enhanced rooms, but only 84% for usual decor rooms. Rooms in both conditions were cleaned and sanitized on the same frequency and were considered equivalent in this regard. Other similar examples in this study were: spaciousness, 79% versus 61%; cleanliness of room, 93% versus 89%; and brightness, 89% versus 77%. This was also apparent in the differences in frequencies of open-ended comments regarding positive room features (bright, sunny/pleasant, and cleanliness) and negative room features, with the standard rooms reporting more negative comments on temperature, noise, and crowdedness of rooms compared to nature enhanced rooms (Figures 5 and 6). This is also reflected in the differences in percentages of positive and negative comments between the groups (Table 3). There seemed to be a shift in overall perception toward higher ratings for rooms with nature. Similar findings were reported by Swann et al., (2003) and Gotlieb (2002). This "green effect" shows some promise, certainly in the arena of patient satisfaction, and is worthy of further exploration.

Although it is unknown how patients with different diagnoses might respond using the EAS Questionnaire or how they might have rated their rooms using a different questionnaire, the findings of this study have potential to generalize to different patients and settings aside from those in physical rehabilitation, including waiting rooms, treatment rooms, surgical suites, rehabilitation gyms, and intensive care units, where positive distraction and stress reduction would be clinically relevant. Devlin et al. (2016) in their study of patient's perspectives of their rooms conclude that positive distractions emerged as a major focus for patients. In situations where patients spend much of their time in the same room, especially in acute medical situations where patients may not be able to see out of the window, nature imagery can be placed on the ceiling or in the field of vision (Diette et al., 2003). Recent work using a virtual nature inspired audio–visual presentation with cancer patients has shown increased distraction and relaxation (Scates et al., 2020), showing promise in this area. In addition, an increased sense of control can be afforded the patient when they can choose their room decor. While biophilic nature scenery has been shown to positively affect humans in general, ultimately, a person's experience of nature is subjective and develops over time as a function of their experiences with nature and learning (Biederman & Vessel, 2006). Wyles et al. (2019) found differences in gender and age regarding the restorative potential of nature. Thus, providing patients a choice of biophilic images for room decor may increase the meaningfulness of the environmental impact, as well as provide a sense of perceived control, which has been identified as a factor in patient satisfaction (Karnik et al., 2014; Devlin et al., 2016; Hesselink et al., 2020). Providing these options can serve to heighten the level of patient-centered care.

In taking the presentation of nature stimuli a step further, there is evidence from a variety of medical settings that multisensorial approaches to nature contact, integrating sound and scent as well as imagery, can increase the therapeutic effect. Laursen et al. (2014) found lowered anxiety and pain levels associated with the use of nature sounds and music in a number of healthcare applications. Dijkstra et al. (2008) conclude that increasing the perceived attractiveness of the healthcare environment is associated with lower stress levels and improved healing. Edris's (2007) review reports on an array of benefits associated with the use of aromatherapy on health. McSweeney et al. (2015) in a comprehensive review of indoor nature exposure (INE) conclude that presenting indoor nature stimuli that integrate visual, auditory, and olfactory sensory experiences will better replicate the experience of being outdoors and, thus, enhance the therapeutic benefits of INE. It makes sense that with a more immersive

sensory experience, there is more potential for positive distraction and a shift in focus from one's discomforts with their medical situation.

While more recently constructed healthcare settings may be designed to provide views and access to nature, there are many older settings which may not be specifically designed to be supportive of patient experience and healing. Older buildings often go through periodic renovation. In these instances, the cost effective addition of nature stimuli can add to the patient centeredness of the environment, potentially improving outcomes and patient satisfaction.

. . . the cost effective addition of nature stimuli can add to the patient centeredness of the environment, potentially improving outcomes and patient satisfaction.

This quality improvement project illustrates that nature imagery is associated with improved patient experience. Improved patient experience equates to greater value for the individual patient and also on a more macroscopic scale. Value is often the deciding factor in a healthcare system for helping to decide which programs to maintain or expand and which to discontinue. The value model is being espoused by many hospitals and healthcare systems as a model to help individual patients, large groups of patients, and indeed even the entire healthcare delivery system in the United States (Berwick, 2008; Porter, 2013).

Limitations

Due to the exploratory nature and naturalistic setting of this study, a number of limitations exist. Study rooms were chosen for similarities in layout and potential for sight lines to stimuli. Placement of the nature scenes was optimized but not ideal. There were a number of patients that filled initial assessment but were switched to a different room to maintain same gender rooms when new patients were admitted. This had the effect of reducing the potential number of subjects, possibly influencing statistical results. The lack of well-validated scales to specifically evaluate hospital rooms was also a factor. Regarding to Part 3 of the questionnaire, there are many determinants of a patients perceptions of pain, sleep quality, overall care, and quality of room. It is difficult to link the results specifically to the presence of nature imagery in their rooms.

Conclusions

The presence of biophilic nature scenes in inpatient physical rehabilitation patient rooms positively affected patients' ratings of the space. This presents a relatively low-cost opportunity to improve patient satisfaction through inclusion of biophilic nature scenes as part of usual room decor. Results regarding patient comments provide information on specific areas to address for potential improvement projects. These findings are applicable in many areas within the healthcare system. The positive effects of nature on health and the "green effect" warrant further study, especially in medical environments. The findings indicate a more focused and controlled look at the effects of nature on patient satisfaction could be promising in many ways.

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The findings indicate a more focused and controlled look at the effects of nature on patient satisfaction could be promising in many ways.

Implications for Practice

- Patient-rated room evaluations were significantly higher in rooms with nature imagery.
- Patient preferences in regard to decor can inform design process.
- Nature imagery can be utilized in healthcare settings where real nature is precluded.
- Nature imagery in patient rooms can positively impact satisfaction.

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