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Original Articles

Stress-Reducing Effects of Real and Artificial Nature in a Hospital Waiting Room

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Abstract

Objectives: This field study investigated the potential stress-reducing effects of exposure to real or artificial nature on patients in a hospital waiting room. Additionally, it was investigated whether perceived attractiveness of the room could explain these effects.
Design: In this between-patients experimental design, patients were exposed to one of the following: real plants, posters of plants, or no nature (control). These conditions were alternately applied to two waiting rooms.
Location: The location of this study was two waiting rooms at the Radiology Department of a Dutch hospital.
Subjects: The subjects comprised 457 patients (60% female and 40% male) who were mostly scheduled for echocardiogram, dual-energy x-ray absorptiometry, magnetic resonance imaging, computed tomography scans, or nuclear research.
Results: Patients exposed to real plants, as well as patients exposed to posters of plants, report lower levels of experienced stress compared to the control condition. Further analyses show that these small but significant effects of exposure to nature are partially mediated by the perceived attractiveness of the waiting room.
Conclusions: Natural elements in hospital environments have the potential to reduce patients' feelings of stress. By increasing the attractiveness of the waiting room by adding either real plants or posters of plants, hospitals can create a pleasant atmosphere that positively influences patients' well-being.

Introduction

For most patients, a hospital visit is a stress-provoking experience. Hospital encounters are generally characterized by fear, anxiety, stress, and uncertainty.[1,2] Notably, these negative psychologic feelings can have a deleterious effect on health and recovery.[3] When looking at most hospitals in which these encounters take place, one might rightfully ask how well these health care environments satisfy the psychologic needs of patients. In an attempt to reduce stress and anxiety and to promote health and well-being, design for health care environments currently includes aesthetic enhancements.[4] Recent research into the so-called "healing environment"[4–6] focuses on how such aesthetic enhancements in the hospital environment may reduce negative psychologic feelings.

Waiting areas in particular may play an important role in distressing ambulant patients.[7] The time period spent waiting provides the patient with time to think about what is going to happen and to ruminate on worst-case outcomes.[8] Several studies emphasize the importance of the aesthetic qualities of waiting rooms. Ingham and Spencer[9] showed that both decorations and more comfortable furniture in the waiting room led to patients feeling more comfortable, secure, and relaxed. Environmental stimuli such as scents appear to have beneficial effects on, for example, feelings of anxiety.[10] Research has also demonstrated the beneficial effects of scents on anxiety and mood in waiting dental patients.[11] Aesthetic enhancements can thus provide unobtrusive and inexpensive stress and anxiety management methods.

One interesting area of investigation pertains to the effects of natural elements in health care environments. It appears that exposure to nature can have beneficial effects on the health and well-being of people.[12] Adding indoor plants to the health care environment may consequently serve as a noninvasive and effective complementary therapy for patients. It has, for instance, been shown that individuals recover sooner from stress when exposed to a natural environment compared to an urban environment.[13] Lohr and Pearson-Mims[14] showed that a significantly larger

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proportion of respondents in a room containing indoor plants were able to keep their hand in ice water for 5 minutes, as compared to control conditions, which suggests increased pain tolerance by exposure to indoor plants. Park and Mattson[15] demonstrated that surgical patients exposed to indoor plants in their hospital room showed more positive physiologic responses, reported significantly lower levels of anxiety and fatigue, and higher satisfaction about their room, compared to a control condition. Recently, Lechtzin and colleagues[16] showed that patients undergoing bone marrow aspiration and biopsy experienced reduced pain when watching a nature scene (but only after controlling for different operators). Despite these positive findings, a recent literature review concluded that the effects of exposure to indoor plants on psychologic benefits are at best mixed.[17] The researchers argue that more evidence is needed and that future research should also explicitly aim to unravel the mediating process(es) that may explain why exposure to plants is beneficial.

One factor that appears to play a role is the perceived attractiveness of the environment. Natural environments are consistently rated as more attractive than built environments (see, for example, Ulrich et al.[13] and Lohr and Pearson-Mims[14]). In turn, research showed that the perceived attractiveness of environments is related to psychologic well-being. For instance, Van den Berg et al.[18] showed a positive relationship between beauty ratings of natural and urban environments watched in a video, and affective restoration after a stress manipulation. These authors argued that people prefer natural environments because of their potential to provide restoration from stress.

Based on this, it is argued that the stress-reducing effects of natural environments may be partially explained by the environments' perceived attractiveness. A recent laboratory study provided preliminary evidence for this idea. After reading a scenario describing hospitalization, participants were exposed to a photo of a hospital room that either did or did not contain plants. Results showed a stress-reducing effect of exposure to indoor plants, and that this effect was mediated by rated attractiveness of the room.[19]

The present study investigated the stress-reducing effects of indoor plants in a field experiment in a hospital waiting room, and tested the mediating effect of attractiveness of the environment. Additionally, it was investigated whether exposure to images of plants can be equally effective in reducing stress as exposure to real indoor plants. It was hypothesized that the presence of indoor plants and images of plants in a hospital waiting room would lead to reduced levels of stress among patients, compared to a control condition. In addition, and in agreement with Dijkstra et al.,[19] it was expected in the current study that the relation between plants and stress would be mediated by the perceived attractiveness of the waiting room. In order to investigate these hypotheses, a field experiment was conducted in two waiting rooms of a Dutch hospital.

Materials and Methods

Subjects

The participants were patients with an appointment for treatment at the Radiology Department of a Dutch hospital. The treatments varied from echocardiogram/dual-energy x-ray absorptiometry scan (28%), magnetic resonance imaging/computed tomography scan (42%), nuclear research (13%), several treatments, or unknown (16%). They were seated in one of the two waiting rooms used in this study. Of the 748 questionnaires that were distributed, 457 questionnaires were completed by the patients (response rate of 61.1%). The sample consisted of 276 females (60.4%) and 181 males (39.6%), with ages ranging from 14 to 88 years (mean = 53.2, standard deviation [SD] = 15.6).

Procedure

On arrival at the Radiology Department, all patients reported at the reception desk. A hospital employee subsequently directed the patients, depending on the type of treatment the patient was going to receive, to one of five waiting rooms. Patients who were directed to the two waiting rooms part of this study were requested to fill out a paper-and-pencil questionnaire. It was presented as an inquiry into how visitors experience their hospital visit to improve service quality. In one waiting room, patients were awaiting nuclear research (room A, 11 seats), and in the other waiting room (room B, 28 seats) the patients were awaiting x-ray research. While waiting for their treatment, the patients had time to fill out the questionnaire. Patients were requested to deposit the questionnaire in a mailbox in the waiting room, either when they had completed it or when they were called for treatment and could therefore not complete the questionnaire. Only completed questionnaires were used for the analyses.

Stimuli and experimental manipulation

In the two waiting rooms, real plants, posters of plants, or no plants were placed. In the real plant condition, five foliage plants were placed across the larger waiting room B and four in waiting room A. Two types of plants (Zamioculcas, Spathacea) were used. In the poster condition, four posters of plants were hung on opposite walls in the waiting rooms. The four posters (each 90-cm long × 60-cm wide) showed close-up color photos of the foliage plants used in the real plant condition. The real plants or posters were clearly visible regardless of seating position in the room. In the control condition, no plants or posters were present in the waiting rooms, while all other aspects of the room were exactly the same. To enable randomization, the different conditions were alternately applied to the two waiting rooms. In the first week of the study, the real plant condition was applied to room A, and the control condition to room B; in the second week the poster condition was applied to room A and the real plant condition to room B; in the third week the control condition was applied to room A and the poster of plants condition to room B.

Measures

After measuring some demographic variables and a check of the room in which the patient was seated, the questionnaire continued with the following measures in successive order.

Perceived attractiveness of the waiting room. Patients rated the attractiveness of the waiting room on a 10-item bipolar adjective scale.[19] This scale consisted of 5-point scales

such as "pleasant–unpleasant," "lively–boring," and "friendly–unfriendly" (Cronbach $\alpha = 0.90$).

Experienced stress. The experienced level of stress was measured with two existing scales. Patients rated their current feelings on five items of the Profile of Mood States (shortened version, tension dimension; e.g., "I am restless" and "I am nervous")[20] and six items from the Dutch and abridged State Trait Anxiety Inventory (STAI-6, e.g., "I feel calm" and "I am worried").[21] All items were measured on 5-point scales (1 = absolutely not, 5 = very strong). These 11 items loaded on one main factor (eigenvalue 4.84, 44% explained variance) and were combined in one index measuring experienced stress (Cronbach $\alpha = 0.92$).

At the end of the questionnaire, several patient characteristics and control variables were measured. Patients were asked about the number of previous hospital visits of the patient in the same hospital; how much trust they had in the hospital (1 = very little to 5 = very much); to choose which category of treatment they were awaiting (x-ray research, nuclear research, combined treatments, other); the number of times the patient had undergone the current treatment before; whether the patient had the company of friends or family in the waiting room (yes or no); and the patient's current health status (1 = excellent to 5 = very bad).

Results

Patient characteristics

It was first tested whether there were any differences in patient characteristics among the three "exposure to nature" conditions. Table 1 reports the patient characteristics for participants in, respectively, the no plants, real plants, and posters of plants conditions. It is important to note that gender ($\chi^2 < 1$, not significant [NS]) and age ($F < 1$) were equally distributed across conditions. Second, no differences were observed in the number of previous hospital visits ($F < 1.04$, NS), trust in the hospital ($F < 1$), number of previous treatments ($F < 1$), current health status ($F < 1$), and whether they had the company of family or friends (χ^2 [6] = 3.20, NS). The same holds for the type of treatment patients were awaiting (χ^2 [6] = 8.18, NS). This suggests that there were no systematic differences between exposure to nature conditions on these variables.

Experienced stress

To test the main hypothesis about the stress-reducing effects of exposure to nature, the authors conducted a 3 (Exposure to nature: real plants, posters of plants, no plants) × 2 (waiting room) univariate analysis of variance on experienced stress. This revealed a marginal main effect of exposure to nature, F (2, 451) = 2.33, $p = 0.099$, $\eta_p^2 = 0.01$. Results of a Tukey *post hoc* test, listed in Table 1, confirmed this study's predictions; both patients in the real plants and posters of plants conditions reported significantly lower levels of experienced stress compared to the no-plants control condition (both ps = 0.04). The real plants and the posters of plants condition showed no difference ($p = 1.0$), suggesting that real plants and images of plants have equal stress-reducing effects. Although experienced stress was overall higher in room A (mean = 2.49, SD = 0.87) compared to room B (mean = 2.33, SD = 0.84), this main effect of waiting room was nonsignificant, F (1, 451) = 2.15, $p = 0.14$, $\eta_p^2 = 0.005$. More importantly, no interaction was observed (F (2, 451) = 0.92, $p = 0.40$, $\eta_p^2 = 0.004$), which shows that the effect of exposure to nature conditions is equal in the two waiting rooms.

Perceived attractiveness of the waiting room

A main effect of exposure to nature showed that the waiting rooms were rated as more attractive when elements of nature were present, F (2, 451) = 4.70, $p = 0.01$, $\eta_p^2 = 0.02$. As

Table 1. Means (and Standard Deviations) for the Patient Characteristics and the Dependent Variables in the No Plants Control Condition, Real Plants Condition, and the Posters of Plants Condition

	Exposure to nature		
Variable	*No plants (N = 160)*	*Real plants (N = 150)*	*Posters of plants (N = 147)*
Patient characteristics			
Gender (% female)	60.6%	58.7%	61.9%
Age	54.0 (15.9)	53.7 (15.7)	51.7 (15.2)
Previous hospital visits	3.10 (1.21)	2.99 (1.37)	3.20 (1.18)
Trust in the hospital	3.84 (0.75)	3.77 (0.86)	3.86 (0.83)
Number of previous treatments	1.18 (1.47)	1.10 (1.37)	1.16 (1.33)
Current health status	2.54 (0.73)	2.50 (0.75)	2.61 (0.93)
Company of family or friends (% answered "no")	50%	59%	51%
Type of treatment (% within conditions)			
ECHO/DEXA	24%	29%	33%
MRI/CT scan	46%	44%	38%
Nuclear research	16%	13%	10%
Several treatments or unknown	14%	13%	20%
Dependent variables			
Experienced stress	2.51 (0.87)[a]	2.27 (0.79)[b]	2.27 (0.86)[b]
Perceived attractiveness of the waiting room	2.72 (0.63)[a]	2.97 (0.63)[b]	3.01 (0.65)[b]

Mean values with different superscripts (a, b) differ significantly according to a Tukey *post hoc* test.
ECHO/DEXA, echocardiogram, dual-energy x-ray absorptiometry; MRI/CT, magnetic resonance imaging, computed tomography scans.

shown in Table 1, the waiting rooms were rated as significantly more attractive in the real plants and the posters of plants conditions, compared to the control condition ($p = 0.003$ and $p = .000$, respectively). The real plants and the posters of plants condition showed no difference ($p = 0.84$). Neither a main effect of waiting room nor an interaction effect was observed (Fs < 1). The rated attractiveness of the room also showed a significant correlation with the stress measure, r (457) = −0.11, $p = 0.02$, showing that with higher attractiveness of the room, lower stress levels were reported.

To test whether perceived attractiveness of the waiting room mediated the observed stress-reducing effects of exposure to plants, Preacher and Hayes's[22] method was used for testing indirect causal effects. This method employs a resampling procedure from the data at hand to repeatedly estimate the indirect effect (see also Hayes[23]). Five thousand (5000) bootstrapped samples were used to estimate 95% confidence intervals (CIs) around the hypothesized indirect effect of attractiveness of the waiting room. The indirect effect was tested for twice using two dummy variables as independent variable; one for the real plant condition, and one for the posters of plants condition with the control condition as the reference category. Following Preacher and Hayes's,[22] these two analyses used one dummy variable as the independent and the other as covariate, with experienced stress as dependent variable, and attractiveness of the room as mediator.

These tests showed that both the direct effect (i.e., c path) of real plants (B = −0.24, $p = 0.01$) and posters of plants (B = −0.24, $p = 0.01$) on experienced stress decrease when the mediator is added to the equation (i.e., indirect, c' path), although both effects remain significant (B = −0.21, $p = 0.03$; B = −0.21, $p = 0.03$, respectively). The indirect effects of attractiveness of the room for real plants (indirect effect = −0.027, standard error [SE] = 0.017, 95% CI = [−0.072] – [−0.002]), and posters of plants (indirect effect = −0.032, SE = 0.02, 95% CI = [−0.080] – [−0.0001]) on experienced stress were found to be significant as the 95% CIs do not contain zero.[22] These results suggests a partial mediation by the perceived attractiveness of the room, meaning that a significant part of the stress-reducing effect of real plants and posters of plants is explained by the intervening variable attractiveness of the waiting room.

Discussion

The current field study investigated the effects of a specific aesthetic enhancement (i.e., exposure to either indoor plants or posters of indoor plants, in the waiting room of a Radiology Department). The results highlight the effects that hospital environments can have on the feelings of patients. Adding elements of nature to the hospital interior turns out to be an effective means to reduce negative psychologic feelings of patients.

Interestingly, both real indoor plants and posters of plants were equally effective in reducing stress in patients. Much research on indoor plants in hospitals has focused on health risks rather than on health benefits.[24] It has been suggested that indoor plants may cause hospital-acquired infections because they are a potential source of bacteria through their soil and water, yet this has not been confirmed by research.[25,26] Undoubtedly, however, the introduction of real indoor plants in various parts of hospitals requires care and close monitoring regarding infection risks. In this light, it is interesting that posters of plants lead to beneficial effects similar to those of real indoor plants. Introducing artificial nature is a safe, but still effective, option in those areas of health care facilities where infections are most likely to occur.

The current study also aimed to provide additional evidence to explain why exposure to natural elements is beneficial. Results of mediation analyses showed that the observed effects were partially explained by the perceived attractiveness of the waiting environment. Adding real plants and posters of plants both resulted in a higher perceived attractiveness of the room, which in turn is related to reduced negative psychologic feelings.

These findings were obtained in a field experiment using real patients in a real health care environment, which greatly enhances external validity. At the same time, a field study allows less potential to thoroughly investigate subtle explanatory mechanisms. Based on this study's finding that the beneficial effects of plants are explained by the attractiveness of the room, one could possibly argue that any improvement in the attractiveness of the room will have stress-reducing effects. In other words, natural elements may not necessarily be needed for these effects. The setup of this study did not allow this to be tested. However, future research could employ cognitive measures to specifically study the cognitive and affective consequences of exposure to nature. This may shed additional light on the specific effects of exposure to nature, and whether it has distinctive stress-reducing effects over other aesthetic enhancements. Based on earlier work, however, one may argue that using elements of nature could be a more generally effective means to enhance the attractiveness of health care environments. People in general have a preference for nature, and a predisposition to respond positively to it.[27–29] For other aesthetic enhancements (e.g., art work, furniture) there may be larger individual differences that may render weaker effects. Future research may also shed light on the question of whether other types of natural elements, such as water features, natural stone, or the presence of wood, will be equally effective. There is already some evidence suggesting that exposure to water elements could even be more beneficial than exposure to green elements.[30]

Conclusions

The current findings on the stress-reducing effects of plants extend previous research by replicating the effects of laboratory studies[13,19] on real patients visiting a real hospital. Given that evidence about effects of specific interior design features on patients' well-being is still very limited,[6] this field experiment provided important information. Moreover, the results of these mediation analyses provided an explanation about the psychologic process through which these effects occur. Although the effects observed in this study were relatively small (a reduction of 10% in reported stress in the nature conditions compared to control), the effects may accumulate for recurring patients. Adding real or artificial natural elements to health care environments provides an unobtrusive and inexpensive stress and anxiety management method. Hospitals can relatively easily create a pleasant atmosphere to significantly benefit their patients' well-being.

Disclosure Statement

No competing financial interests exist.

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