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Do elements of nature have a healing effect? The impact of wooden materials and landscape pictures in patient rooms

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Abstract

A quasi experiment was conducted at St. Olavs Hospital in Trondheim to investigate well-being in patient rooms and whether the use of natural materials, landscapes and artworks in patient rooms has beneficial psychological effects. Patients were randomly distributed among three different patient room types: Wood Rooms, which included considerable amounts of visible natural materials; Landscape Rooms, with a large landscape picture; and Artwork Rooms, which were standard patient rooms decorated with a work of art. All patient rooms in the de-partment were single occupancy rooms.

Outcomes comprised data from questionnaires and information from patient journals. Patients in the Department of Orthopaedic Surgery (N=271) completed questionnaires measuring emotions (prior to and after hospitalisation), VAS scales measuring pain and stress during the stay and preferences for the room. Surgical procedure, haemoglobin level, pulse, blood pressure and use of painkillers were also recorded for each patient. Most of the patients had undergone surgery for knee or hip replacement.

Likert scale items for emotions were visualised using diverging stacked bar charts. The analysis revealed that the healing process of hospital patients can be influenced by room design and material choice. The results indicate a correlation between architecture and health, and that more humanistic and patient-oriented healthcare institutions can be important for the patients' recovery process. The results are in line with previous research findings by studies of the impact on interior wood use on stress (c.f. Fell 2010) and duration of hospital stay (cf. Ulrich 1984).

Key words:

Environmental psychology, wood, construction materials, beneficial psychological effect, recovery

1. Introduction

Over the past decades, several empirical studies have documented that both passive and active experience of nature may be beneficial for human health and well-being. (e.g. Ulrich 1984; Kaplan and Kaplan 1989; Ulrich et al. 1991; Hartig et al. 2003; Ulrich 1999). Psychological benefits have been reported on the basis of surveys and experimental data with regard to different nature experiences and in environments of varying scales, from wilderness to gardens and window views (e.g. Kaplan and Kaplan 1989). The relationship between built environments and health is a complex issue that involves a large number of different factors, some of which are physical and others psychological.

It is likely that nature elements are of importance for the residents' and users' wellbeing. Studies have concluded that window views to nature can affect the well-being and recovery process of hospitalised patients (Ulrich 1984). Several studies have reported a decrease

in stress responses when indoor plants were present as opposed to when they were not (Bringslimark et al. 2009). Positive relationships between aesthetics and occupant wellbeing have been investigated (cf. Cold 2001).

Elements of nature and natural building materials are frequently considered to be aesthetically pleasing (cf. Kellert 2005) and should thus have a positive influence on wellbeing. New design strategies are emerging that focus on implementing the psychologically beneficial effects of nature to the built environment. Biophilic design emphasizes the necessity of transferring the beneficial experience of nature to the built environment (Kellert 2005; Kellert 2008). According to Kellert (2008), both direct experience of natural features in the built context (e.g. natural materials and window views to nature), indirect experiences (e.g. potted plants and water fountains) and symbolic representations of nature through images and pictures can all appeal to this innate affinity and evoke positive experiences in built environments.

With increasing urbanization, people have less access to nature in their daily life. In Western societies, people spend most of their time in indoor settings. Integrating features of nature into the built environment can therefore give people the opportunity to experience and interact with nature to a larger degree than is usual today. The use of natural building materials, such as wood, in the indoor environment allows the easy implementation of natural elements in buildings through design strategies. This is relevant for all types of buildings, but is particularly favourable in hospitals or institutions where there are limitations on the use of indoor plants. And compared to a window view, it will also be available at night.

In general, people have positive attitudes towards wood and the use of wood in the interior of buildings. Nyrud and Bringslimark (2010) reviewed the literature on psychological responses to wood, and provided an introduction to theories of why the use of wood may have a psychologically beneficial effect on people in indoor and outdoor settings. Wood in indoor settings included flooring, panelled ceilings and walls, and also furniture made of sawn wood, engineered wood products and wood-based panels. Results from preference studies and other relevant research provide evidence that architects and interior designers can use natural materials, such as wood, to promote health and wellbeing the built environment.

A recent review of literature on wood as a restorative material was conducted by Augustin and Fell (2015). The review covered articles on wood in healthcare settings, psychophysiological responses to wood, selfreported studies and unpublished research in English. The results from the limited number of articles reviewed are similar to results from studies on plants and other natural elements. The authors conclude that "we are healthier, happier and more productive when connected with nature" (Augustin and Fell, 2015, p. 21). Lower levels of stress, lower heart rate and skin conductivity, and higher heart rate variability were found to be linked to exposure to wood.

Burnard and Kutnar (2015), building on the review by Nyrud and Bringslimark (2010), examined the research studying wood use and human stress. Both previous studies of psychophysiological responses to wood and methods for assessing stress in experimental settings were reviewed. Though few studies directly examining the psychophysiological effects of wood on human health were found, all but one of the studies concluded that wood generally has a positive effect on occupants. Many of the studies covered in the review were found to have limited sample sizes, but the results could provide useful indications for further research in the field. Burnard and Kutnar (2015) also pointed out that wood can address each of the six tenets of biophilic design (cf. Kellert, 2008): As a recognisable natural element, wood provides a direct link to nature. Patterns in the wood grain have natural shapes and forms. Grain patterns, knots and the colour spectrum evoke natural patterns and process. Wood has colour diversity and the ability to be deployed in products without losing its familiarity as a natural product. Using locally sourced wood can evoke a connection to nature through historical and regional building methods. Wood has for millennia been used as a source of shelter, for tools, in transportation and as art.

Most empirical studies addressing the psychological effects of wood use have been conducted in laboratory settings. The setting of the current study is, however, in a real-life hospital environment. An empirical study was conducted in a hospital ward to investigate wellbeing in patient rooms and whether the use of natural materials, landscapes and artworks in patient rooms has any measurable effects. The study is to some extent comparable to Ulrich's (1984) study of the healing effects of window views in hospital settings. A description of the study is available in Aslaksen, Bringslimark and Nyrud (2012).

The current study expands the research in some very important respects. First, conducting a study in real-life settings will improve the knowledge about beneficial psychological effects from using wood in buildings. The relationship between built environments and health is complex, and the psychological effects can be obscured by activities taking place in the actual environment. It is therefore important to improve the understanding of which effects can contribute to improving the environment the magnitude of these effects. Second, the study demonstrates a simple test scheme for gauging psychological effects that relate to interior construction material. The methodology used in the study is theoretically founded, non-invasive and can easily be applied in most settings. Third, since the body of previous research on wood as a restorative material is based on controlled laboratory experiments, the study is important because it enables evaluation of the validity of findings from previous research carried out in experimental settings.

2. Methods

In order to investigate possible beneficial psychological effects of wood use, a quasi-experiment was designed to measure the effect of exposure to different wood interiors on the healing process. Patients staying in the rooms took part in a survey of the aesthetical performance of the rooms and changes in emotions. The survey period lasted from August 2009 to March 2011, as part of the research project *Psychological effects of wood in indoor use*. But the data was not analysed appropriately because of lack of funding. There is no reason to believe that Norwegian patient's perception of architecture or preferences for interior buildings materials have changed since the study was conducted

The study was carried out in cooperation with the owner of St. Olavs Hospital in Trondheim, Helsebygg Midt-Norge. The hospital is designed with a focus on providing a healing environment for patients and the architects have applied results from evidence-based design. For example, the design of the hospital is patient centred, all the architects in the building project had "Nature" as their main theme when designing the different departments of the hospital, and there is also an elaborated use of art in the hospital. One specific design feature was that all patients should be able to view a natural element through the window in their room. In this respect, the window view can be considered fairly similar in this respect, although the window views are not similar for all rooms between rooms. In addition, factors such as patient privacy and safety are also major concerns. The hospital ward where the quasi-experiment took place is newly constructed and was opened for patients in 2009.

The impact of wooden elements on patient wellbeing in a hospital setting is evaluated through comparing parameters measuring wellbeing for wood and non-wood rooms. The patients were randomly distributed among three different patient room types: Wood Rooms, which included considerable amounts of visible natural materials; Landscape Rooms, with a large landscape picture; and Artwork Rooms, which were standard patient rooms decorated with a work of art. The patients were assigned rooms randomly. All patient rooms in the department were single occupancy rooms.

Eight hospital rooms were used in the study, including three different room designs: 1) Four regular hospital rooms without a wooden panel, 2) two hospital rooms with a large oak panel mounted in front of the bed in the room facing the bed and 3) two hospital rooms with a large birch panel on the wall facing the bed. Four different interiors were used in the study (Figure 1). The "Control" room is a standard room at the hospital. A piece of artwork depicting natural scenery was added to the "Picture" rooms. The rooms with wood interior had either a birch wall or a wall panel of oak installed.



Figure 1. The different interiors used in the hospital rooms. From top left to bottom right: Control group (standard hospital room); Picture (artwork depicting nature); Birch panel; Oak panel.

Panels of both birch (*Betula pubescens*) measuring 2600 mm×3000 mm and oak (*Quercus robur*) measuring 4200 mm×1800 mm were used. The oak panel was designed by the hospital architect for the purpose of the study. Due to hospital sanitary regulations the front sides of the panels were surface treated with a transparent varnish to facilitate cleaning. The back sides of the panels were untreated. Birch panels, prefabricated as modules, were glued to the wall, whereas the oak panels were fastened with screws.

All respondents were asked to complete questionnaires measuring emotions (prior to and after hospitalisation), pain and stress (measured twice daily during the stay by means of Visual Analog Scales (VAS)), and preferences for the room (measured upon departure). Three questionnaires were filled out by the patients during their stay. On the day of admission and release they were asked to answer a questionnaire measuring their emotional state. Two times a day, each morning and afternoon, they were asked to state their level of pain and stress. On the day they were released, the patients were asked to evaluate the room they had stayed in. Data from patient journals was also accessible, such as length of hospitalisation, surgical procedure, haemoglobin level, pulse, blood pressure and use of painkillers, but these data are not recorded consistently with the questionnaires and are therefore not included in the present study.

3. Results

Outcome comprised data from questionnaires and information from patient journals for patients in the Department of Orthopaedic Surgery (N=271). The majority of the patients had undergone surgery for knee or hip replacement. The average patient age was 60.6 years and 178 women and 93 men participated in the study over the 15-month survey period. The results from the questionnaires are apparently not exhibiting any time trend or other indications that the respondents' perceptions changed over this period.

Likert scale items for emotions were visualised using diverging stacked bar charts. The analysis revealed no visible differences between the different patient rooms and the control group. Results for patients' emotions at admission to the hospital and at release are shown in Figure 2. There was little or no difference in responses for the items measuring patient emotions, both among rooms and at the time of admission and release.

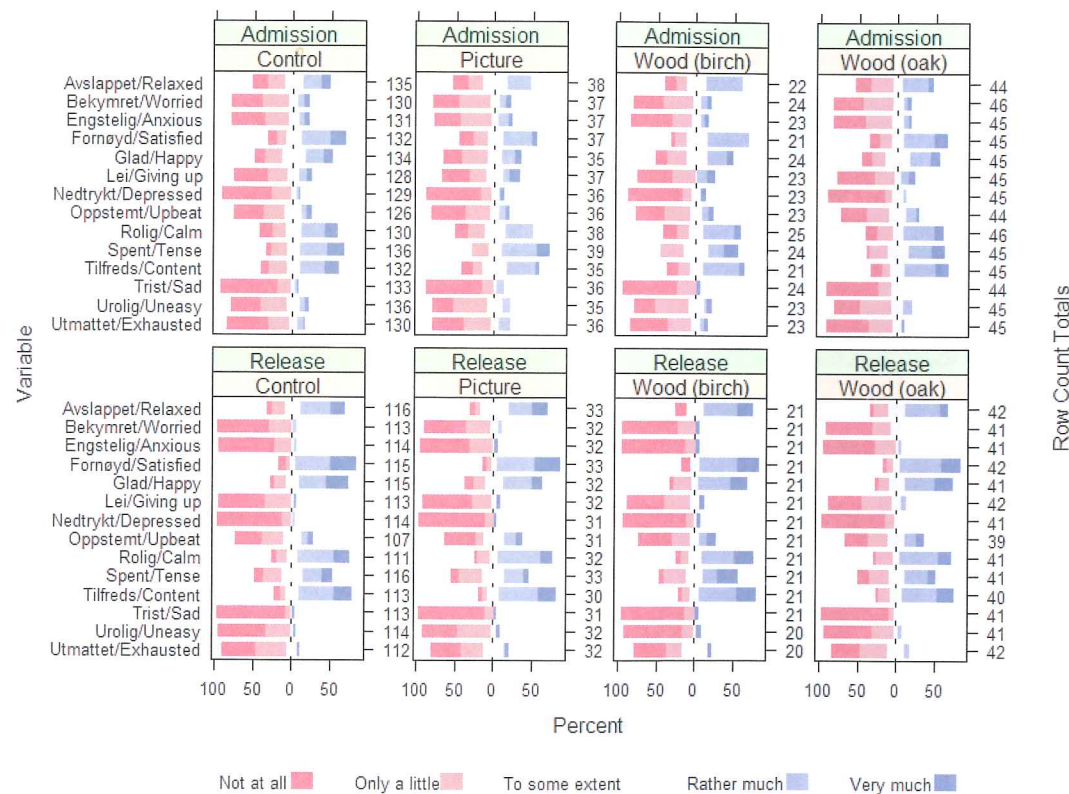


Figure 2. Patients' emotions at admission and release from the hospital. The number of patients for each item can be found in the row count totals for each room.

The patients were asked to evaluate the rooms they stayed in at their release from the hospital. The patients were generally very content with the rooms they stayed in. On a scale from "Completely disagree" to "Completely agree" the rooms received a positive evaluation for most of the items, except for a few items such as "Masculine" and "Ordinary" where a majority answered "Neither disagree nor agree". The results for the items used in the evaluation are shown in Figure 3.

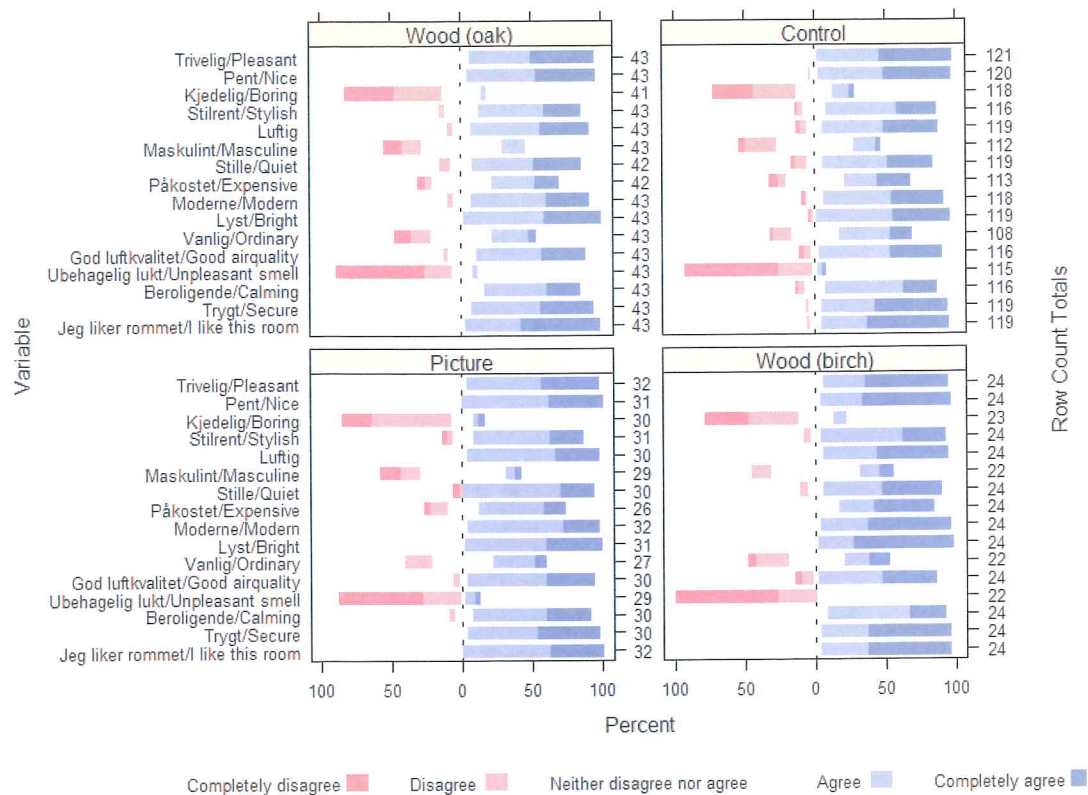


Figure 3. Room evaluation at time of release from the hospital. The number of patients for each item can be found in the row count totals for each room.

Patients' report of pain and stress levels during the stay at the hospital is shown in Figure 4. Mean values and standard deviation were reported twice a day for both stress and pain. The grey dots show individual responses. The patients were asked to indicate their pain and stress levels on a scale from 0-100, with 0 indicating no pain or stress and 100 a very high level of stress. Boxplots were used to visualise measures of pain and stress, showing a moderately steeper downward slope for the smoothed conditional mean scores for pain in wood rooms compared to the control and picture rooms.

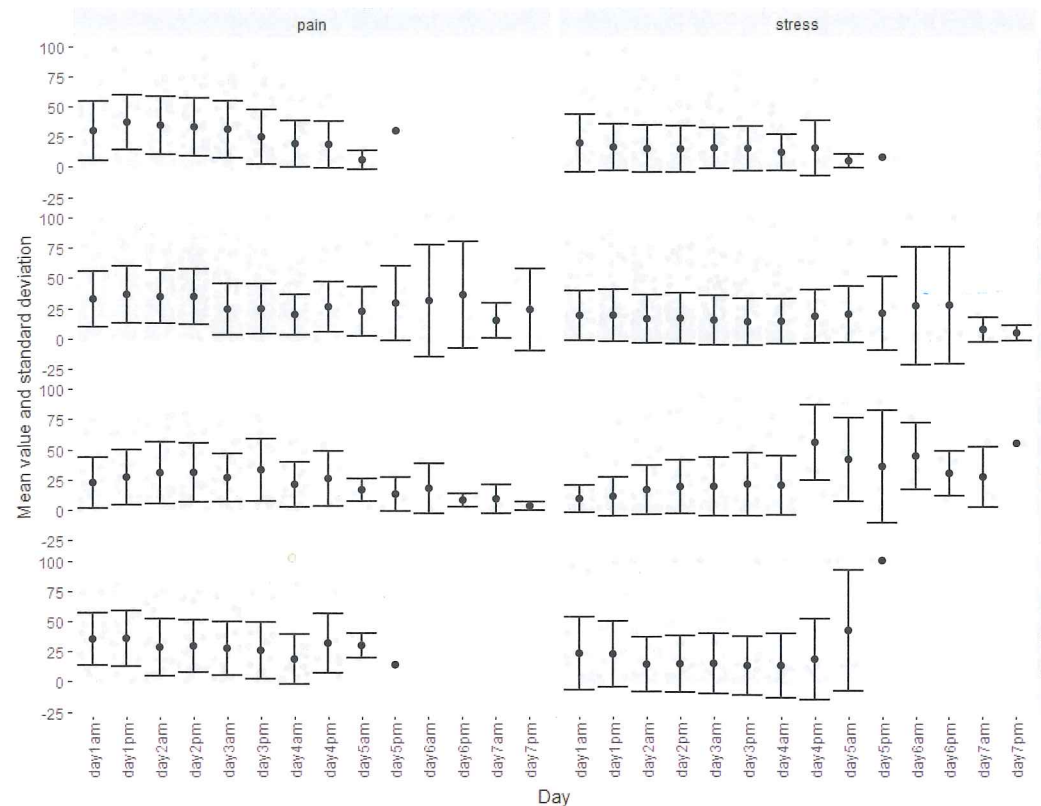


Figure 4. Pain and stress levels reported by patients, mean values and standard deviation.

Across all rooms there is an increase in the level of pain during the first two days of the stay. After the initial increase in pain, there is a slow decline in mean levels of pain until day four of the stay. After day four there is again an increase in the mean levels of pain. Table 1 provides an overview of the relative share of patients completing the questionnaire. Not all patients completed the questionnaire the first day. The second day all patients completed the questionnaire. The remaining days (i.e. day 3 through 7) the relative amount of patients completing the questionnaire decreases. This implies that patients leave the hospital during this period. For the Wood Rooms, there are no patients staying for more than five days. For the Control and Picture Rooms, there are patients staying up to seven days.

Table 1. Pain and stress levels reported by patients. Patients who completed the questionnaire, measured as a percentage of the highest number of patients that responded to the questionnaire for the different rooms.

Day	1		2		3		4		5		6		7	
Time	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm
<i>Pain</i>														
Wood (oak)	68	78	100	98	98	93	70	25	8	3	0	0	0	0
Control	56	67	100	98	96	84	68	22	11	5	3	3	3	2
Picture	69	79	100	90	90	69	66	21	17	10	10	10	10	7
Wood (birch)	82	86	100	95	86	73	68	32	14	5	0	0	0	0
<i>Stress</i>														
Wood (oak)	68	78	100	98	95	93	63	25	5	3	0	0	0	0
Control	55	65	100	100	96	84	66	22	12	5	4	4	3	2
Picture	62	79	100	93	83	69	59	24	14	10	10	10	10	3
Wood (birch)	81	86	100	100	86	76	62	38	14	5	0	0	0	0

4. Discussion

There are several results from the research that indicate a correlation between architecture and health, and that more humanistic and patient-oriented healthcare institutions have a positive impact on the patients' recovery process (a relevant literature review is provided in Augustin and Fell 2015). The overall results indicate that patients are very satisfied with the hospital rooms. The questionnaires indicate that the patient's emotions improve during the stay, the patient rooms are considered pleasant and the practically all respondents stated that they liked the rooms. This result does also probably reflect that the patient experience was good, and that they stayed in a brand new and well-designed hospital ward (the ward was built in 2009). The positive influence of new buildings (aesthetically pleasing) and perception for such environments is well documented (cf Nasar 1992 and Nasar 2017).

The healing process of the patients is investigated through the evaluation of experience of pain and stress. In general, the results indicate that the pain decreases over time. For all room types, there is an inverse ratio between experienced pain and time since the surgery took place. The level of stress does not decrease for all room types. It is likely to expect that stress might increase as the patient is closer to being released from the hospital. The results do, however, indicate that the patients in Wood Rooms with oak are less susceptible to stress, both with respect to variation and also the decreasing trend of the results. The oak wood may provide an opportunity to positive distraction. This is in line with previous research findings in laboratory experiments (c.f. Fell 2010) and Ulrich's study of patients with a window view (Ulrich 1984). Furthermore, the results indicate that patients in the Wood Rooms were released earlier than patients in the Control Rooms and Picture rooms. These results do also coincide with the results from Ulrich (1984).

The study implies that survey methodology, with application of questionnaires, can be applied in a hospital setting, and most likely also in other restorative settings. The respon-

dents successfully evaluated their emotions, the rooms as well as experience of stress and pain. The results should therefore also be comparable with other studies that have evaluated emotions and restorative effects of wood use. As have been pointed out in previous review studies (Nyrud and Bringslimark 2010, Augustin and Fell 2015, Burnard and Kutnar 2016) there are evidence that wood use is psychological beneficial.

As stated above, the relationship between built environments and health is a complex issue that involves a large number of different factors, some of which are physical and others of which are psychological. This study is based on the assumption that wood provides natural elements in building, and that the mere presence of wood exhibits favourable psychological and restorative effects. Window may affect the well-being of patients (cf. Ulrich 1984), but keeping in mind the effort made in order to provide similar views from all hospital rooms and the fact that the preference data are similar for all rooms, there are not strong evidence room view has affected the results substantially. The assumed positive effect of the ward being brand new may imply that patients' satisfaction with the rooms may decrease over time, but this effect is not evident over the 15 month period the survey was conducted. Furthermore, it is not considered likely that that this effect will influence the measures of pain and stress. There is somewhat difficult to generalize the results from the oak rooms and birch rooms. The visual characteristics, in particular colour, differ greatly between oak and birch. In addition, the oak panels were designed for the purpose and mounted directly opposite the bed, whereas the birch panels for practical reasons were assembled around the sink and mirror. The apparent stress reducing effect of the oak panels, may therefore possibly be ascribed to the dark colour and purposeful design.

Future research should take this experience into consideration. Instead of just introducing wood surfaces in the interior, emphasise should be put on evaluating which inherent properties of wood that that can improve the indoor environment and thus provide positive psychological effects. This includes both physical properties of wood as well as properties that are expressed as important by users.

5. Conclusions

The results from this study indicate that the physical surroundings, architecture and design in healthcare institutions do indeed have an effect on health and that these aspects ought to be considered when planning and designing new healthcare facilities. In particular, the potential stress reducing effect and reduced duration of hospital stay in the oak rooms are promising. These results also coincide with previous research findings (cf. Ulrich 1984 and Fell 2010). It is nonetheless difficult to draw unequivocal conclusions on what constitutes the most optimal architecture and design. The reason for this is that how the physical surroundings in healthcare facilities affect patients is a very complex process that implies a series of different vari-ables such as the condition of the patient's health, as well as individual and organisational factors. Further analysis of the data should employ methodologies that enable more direct comparison of patients.

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Business models in industrialized building of wooden houses in Norway

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