Light and Media Projections in Patient Rooms

A Preliminary Case Study

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Abstract

New media and lighting technology and new ways to connect and control it have the potential to improve the environment in hospitals with the goal of increasing patient satisfaction. How should such system be designed to do so and how can it be tested? In this paper it is investigated how a specific case, an interactive lighting and media system installed in a patient room, can be improved to support a greater experience of patient satisfaction. Through questionnaires given to 14 mothers who have just given birth and their husbands staying in an interactive patient room, the experience of staying in the room and the patient satisfaction have been assessed. The results from the questionnaires are hereto combined to data log on how the media system has been used, which additionally leads to a design evaluation for the interactive media system. The results imply several areas which can be improved to meet the specific needs of the patients and thereby provide higher patient satisfaction. Hereto, the main findings suggest that the control of the lighting needs to be less complicated, the different lighting settings needs to be better tailored to the actual needs, noise from the projector and light coming from the iPad needs to be reduced, and for critical situations, the medical equipment needs to be an exact copy of what the caregivers are used to.

Keywords: media projection, lighting design, interactive lighting, patient satisfaction

When adding an interactive media system to a space to enhance the atmosphere through projections, light and sound, one should always carefully consider the side effects that might be introduced as well. This includes, but is not limited to, noisy equipment, light pollution equipment, technical errors and insufficient support.

Introduction

Any environment impacts the people within it. The size, the colors, the perceived safety, the quality of the lighting and architectonical elements, etc., all alters the overall feeling of a person's well-being in that specific space (Böhme, 2013; Cold, 2001). The term Healing Architecture covers how spaces can be designed to impact the people within it in a positive way by providing a higher sense of well-being and safety. In a hospital setting, when done right, the environment can even make patients feel a higher degree of personal identity and less pain (Nielsen & Mullins, 2017; Ulrich et al., 2008).

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Healing architecture can be achieved through designing a space with room for relatives, possibilities for privacy and physical comfort and where attention has been paid to the overall mood of the room through lighting, art, furniture, etc. Furthermore, the current research done within the field of Healing Architecture shows how architectural elements such as sound, light and color have the potential to support patient healing and well-being (Frandsen et al., 2011; Nielsen et al., 2017; Timmermann & Birkelund, 2013; Ulrich & Gilpin, 2003).

Additionally, other studies show that it might not even be necessary to physically be in a healing environment to experience its healing effects. Tricking the brain into thinking it is, is enough. Studies that used the technology of VR to *emerge* test subjects into an artificial environment, showed positive impacts on the sensation of pain as well. In a study dealing with burn victims, when entering a snowy environment, the self-reported pain score decreased from an average of 6.3 to 2.8 on a 10-point scale. In addition, the amount of time the patients spent thinking about pain fell from 76% to 22% (Hoffman, n.d.).

The crowing knowledge of effects within the field of Healing Architecture are in these years inspiring hospitals around the world to consider the physical environment as a supporting tool for healing, thus applying a more holistic and sensorial approach to patients and their recovery process. In Denmark, this tendency is especially applied within birth environments, where physical environments are designed to support the release of the oxytocin hormone, which supports relaxation and contractions and thus a more soothing sensation to the process and experience of giving birth. Even within the last five years, five birth units in Denmark have incorporated two types of design concepts to their birth environments, by the integration of media screens and different elements of light, color and sound (cf. figure 1 and 2).

Figure 1. Sensory Delivery Room at Northzealands Hospital - Wavecare

Figure 2. Interactive Delivery Room at Herning Hospital - MODOS

While research has been carried out on the effects of sound, light and color for healing and well-being, a holistic evaluation of patient's experience of the space when applying media screens in hospitals settings is scarce.

Aim

The aim of this paper is to investigate how new media and lighting technology and new ways to connect and control it have the potential to improve hospital environments with the ultimate goal of increasing patient satisfaction. This is addressed by evaluating the use and experience of The Interactive Patient Room - a specific case of an interactive lighting and media system installed in a patient room - and how this system can be designed and improved to support a greater experience of overall patient satisfaction during hospitalization.

Case

As a further development of the integration of media screens in the birth environment, The Interactive Patient Room was installed in the beginning of 2017 at the Gynecological-Obstetric Ward at the Regional Hospital in Herning, Denmark, co-designed by MODOS and staff members of the birth unit. The Interactive Patient Room is an experimental room, where an interactive media system serves as the main source for mood giving digital art, entertainment and

information. The mood giving elements consist of sound and video projections of nature scenery which are supported by the electrical lighting in the room. The patients are via an iPad able to pick and choose at any time between relaxing moods (cf. figure 3), information and entertainment. Besides the media system, the interior space has been designed using homey furniture and hospital equipment is hidden in neutral cabinets. The aim has been to support a homey and comfortable atmosphere in the room and at the same time increase the feeling of safety.

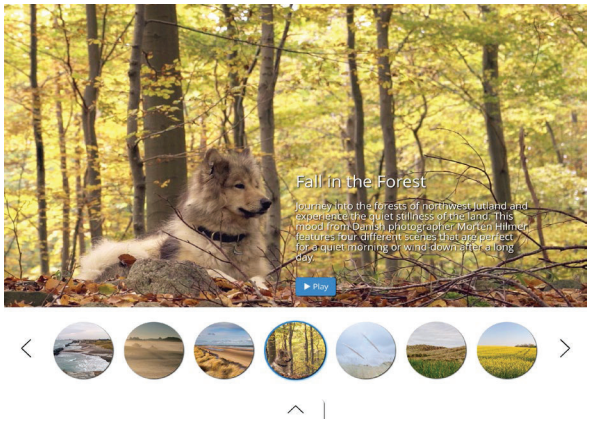

Figure 3. iPad screenshot showing the user interface for selection the predefined moods and projections.

The interactive lighting and media system consist of a projector, lights and speakers, all wirelessly connected and controlled from an iPad positioned on the left side of the bed. Through an app on the iPad, the projector can be controlled to show information about the patient's hospitalization, general information for new parents, stream television, and show different sceneries to create certain moods in the space (cf. figure 4). The five available moods are named: Fall Forest, North Sea Serenity, Spring Morning, Winter Silence and Evening Atmosphere in Copenhagen. All moods are designed by MODOS (Modos, n.d.), (cf. figure 7 and 8) and are based on knowledge about the positive effects that nature has on the human body and mind (Ulrich, 1984; Wilson, 1984).

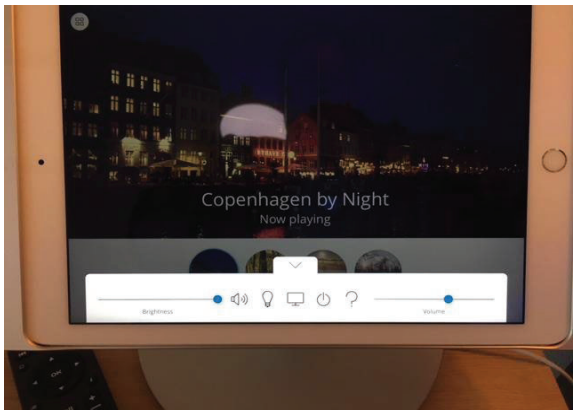

Figure 4. iPad positioned left to the bed showing the user interface for controlling i.e. brightness of the lighting and volume of the sound.

All five moods are based on one or more pieces of seamlessly blending and looping footage with accompanying sound through speakers integrated in the ceiling. The design intent is to create an experience of calmness and serenity. There are no or little camera movements in the footage. Just a view into different nature sceneries (cf. figure 7 and 8). The lighting in the room adjusts automatically to fit the colors and brightness of the lighting in the footage to enhance the spatial experience of being present in the specific scene and not only isolate the scenery to a screen picture. After selecting a certain mood, it is

possible for the patients to customize the lighting and sound/music according to individual needs.

Methods

A preliminary case study was carried out at the Gynecological-Obstetric Ward at the Regional Hospital in Herning, Denmark in the period of March-July 2017. The test subjects were new parents, mothers and fathers, who had just given birth. The patients were staying at the hospital to recover from the birth in a timespan of 7 to 240 hours depending on their individual condition.

Originally, the case study was designed as a comparative study, thus consisting of both The Interactive Patient Room and a control room. In relation to this, two adjoining rooms with the same dimensions and orientation were used for the study. One of the rooms (The Interactive Patient Room) was equipped with the interactive lighting and media system along with a modern interior layout (cf. figure 5), while the other (the control room) was a standard patient room with standard interior and no interactive system (cf. figure 6).

The entrance to both rooms is a hallway half the width of the room itself. To the right, there is a door to the bathroom. To the right in the interactive patient room there is a homey looking double bed with a white neutral cabinet above it. At both sides of the bed small lamps are mounted in the wall. The standard patient room contains an institutional looking single bed with exposed medical equipment above it. Next to the bed in the standard room is another single mattress on wooden legs. The height of it is different from the other bed. To the left in the interactive patient room, opposite the bed, the projection from the media system is present. It is approx. 2.5 meters wide and 1.5 meters high. The similar wall in the standard patient room features a small flat screen TV. A large window is placed at the end wall in both rooms. In the standard patient room, the incoming daylight can be blocked with white diffuse curtains while the interactive patient room is equipped with venetian blinds. In front of the windows, there is a seating area in both rooms. In the standard patient room there is a desk and two upright chairs in the left corner and an armchair in the right. In the interactive patient room, the seating area is centered and consists of a two-person couch with large pillows, an armchair and a small coffee table. The area is furthermore decorated with art, a bookcase with flowers, a mobile and a pendant hanging from the ceiling. In the standard patient room there is nothing.

The patients were assigned to one of the two rooms randomly in the hours after giving birth.

To assess the interactive lighting and media system and its effect on the patient satisfaction, data was collected through a questionnaire, completed by the patients towards the end of their stay. The questionnaire for the interactive patient room consisted of 36 questions revolving around their experience of the room and their use of the interactive media system, rated on a 6-point Likert scale (Gut & Fuglsang, 2015). Indirectly they were asked about their perceived experience of competence, autonomy and relatedness, which is defined by Ryan and Deci (2002) as three innate psychological needs, that when satisfied leads to enhanced self-motivation, mental health and a greater sense of perceived security and safety, and thus, a greater overall satisfaction. The questionnaire was answered on an additional iPad handed to the patients by the caregivers.

The questionnaire for the control room didn’t contain the questions directly related to the interactive system but was otherwise similar to the questionnaire given to the patients in the interactive patient room. 14 answers from the interactive patient room and 3 from the control room was collected. Due to the low and a skewed amount of test subjects between the two rooms (14 against 3), the results were mainly analyzed as a preliminary design evaluation for the

interactive media system, only considering the answers from the interactive patient room.

Figure 5. Interactive Patient Room

Figure 6. Standard Patient Room

Figure 7. Spring Morning

Figure 8. Evening Atmosphere in Copenhagen

Results

The 14 answers from the patients staying at the interactive patient room revealed a row of insights to how the interactive system is used and how it can be improved.

The moods were used between 2-40% (0.5-30 hours) of the total length of the stays. Furthermore, patients mainly used it in the beginning of the stay and in the afternoon/evening for relaxation.

Although supporting a relaxing and homey atmosphere, data showed how the interactive lighting and media system can be greatly improved before investigating its impact on patient satisfaction further.

First of all, the control of the projections and especially the lighting could be less complicated to use. Although the system is rated intuitive to use by most of the patients, more than half of them state that they needed an introduction to the system. A couple who couldn't get an introduction to the system, failed to use it at all. Also, three of the patients stated that it was overcomplicated to switch the lighting on/off compared to using a traditional switch. One of them says: *"There are many things to deal with when having a new baby. It is easier to turn on the lights using a switch than on an iPad".* That the lighting can only be controlled from one side of the bed, is also mentioned as a problem.

Secondly, the lighting schemes can be improved. Especially the night setting is mentioned as being too harsh. Here it is also mentioned that the lighting coming

from the iPad screen was a problem during the dark hours. Furthermore, a need for the possibility to be able to turn on a single functional light for i.e. changing diapers during night time was pointed out.

Thirdly, it was mentioned that the projector was noisy and couldn't be turned off through the iPad. Only by manually using a broom to turn it off, the patients could get a silent room to sleep in.

Lastly, a couple experienced connection errors and the caregivers didn't have time to troubleshoot the system. One states that *"it is a nice room and you feel comfortable here, but the technical challenges with the projector and the lighting made it a less great experience".*

Besides the less critical technical problems, one patient experienced that the interactive patient room made her feel less safe. She says: *"When I got ill due to heavy bleeding, the facilities above the bed seemed clearly foreign or inadequate for the staff. They had to hold things manually, which wasn't comforting."* She further stated that she would have liked to be in a normal patient room as the furniture are more practical. A couple of other test subjects stated that the non-adjustable height of the bed in the interactive room was a problem as it was difficult to enter for lower women.

In relation to the overall patient satisfaction between the interactive patient room and the control room, the answers about the experienced competence, autonomy and relatedness showed no difference. Patients from both rooms gave high ratings.

Discussion

Generally, the results of the preliminary case study showed that the different use cases of the patient room need to be investigated further to give relevant input to how a holistic lighting and media interface design meets the needs of the patients to a greater extend.

Whether using questions about the perceived competence, autonomy and relatedness as a valid measure for overall patient satisfaction, is not clear from this preliminary study. The number of test subjects were expected to be higher. But due to the complexity of collecting data in a real-life environment dependent on staff, patients and the implementation of the technical systems, the numbers of test persons are low and heavily skewed between the interactive room and control room (14 against 3). Furthermore, it would be beneficial to support the data from the questionnaire with actual quantifiable data, i.e. tracking the use of the moods and adjustments and i.e. compare it to the cortisol level of the patients, to provide more valid results. Additionally, a higher level of qualitative research methodologies could be of value in order to further investigate the potential of light and media-projections in patient rooms, e.g. in relation to when, which and why patients apply the moods of the interactive system during hospitalization. Also, to test the effect of the lighting and media system alone, the two rooms should have similar interior designs.

This preliminary study also suffered from an inconsistent collection of data. For further studies, all parties involved in the project must be instructed in the importance of a consistent flow of data and agree that specific resources have been assigned to make sure that all relevant data is collected.

Finally, the results of the preliminary case study should be viewed in consideration to The Interactive Patient Room being installed just one month prior to the starting time of data collection. Thus, startup issues with the interactive lighting and media system affected the data.

Conclusion

This preliminary case study gave answers to how The Interactive Patient Room - a specific case of an interactive lighting and media system in a patient room - can be improved before further investigating its impact on overall patient satisfaction. The results showed more attention needs to be given to the fact that the patients of the study are in a state where they are focused on and overwhelmed by their new-born baby. Thus, the lighting needs to be easier to adjust and turn on/off. Also, a general introduction to the system should be prioritized. Furthermore, results showed how technology-related sound and light pollution should be addressed and optimized.

When adding an interactive media system to a space to enhance the atmosphere through projections, light and sound, one should always carefully consider the side effects that might be introduced as well. This includes, but is not limited to, noisy equipment, light pollution equipment, technical errors and insufficient support. To take these negative effects into consideration seems especially important for spaces where people tend to stay for an excessive period of time, and where people are in a stressful situation, like in a patient room. The positive effects a person potentially will experience from the media system can be diminished or even abrogated by these negative phenomena. The design must take the very sensitive situation into consideration and see the media design as a holistic design meeting people in a stressful situation, where patients have cultural expectations to a room in a hospital. In some cases, the overall experience of a space might even be more stressful with the system than with no system at all.

While emerging technologies open up for many useful interactive features for low cost, they also open up for more complex user interfaces. It can be argued that for the best possible experience, turning a light source on and off through an application interface, shouldn’t be more complex than turning a regular switch on and off. That is a one-click procedure. Again, this is especially important for spaces where people are staying for a longer period of time. For more sophisticated changes like adjusting the color temperature or intensity of the lighting, switching the projected footage, etc., in other words, things you can’t do with a regular lighting setup, a longer procedure can most likely be accepted, although it should be kept to an absolute minimum.

On this note, this preliminary study is stressing the importance of understanding and qualifying the design of light and media projections as architectural elements in our build (health care) environment. The effects of the projections should be considered as an impactful media to create illustrations, such as natural phenomena. At the same time light and media projections can be very impactful for the atmosphere of a space. Thus, it should be considered that light and media projections are new elements in our build environment and that user's interaction and perception of these media and its effects must be taken into further consideration and investigation. This is why this kind of case studies in real-life environments are both challenging and yet highly important.

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