



DIGICOM 2021

SHORT PAPERS

**PROCEEDINGS OF THE SHORT PAPERS
OF THE 5TH INTERNATIONAL CONFERENCE ON DESIGN
AND DIGITAL COMMUNICATION, DIGICOM 2021
4-6 NOVEMBER 2021 // BARCELOS, PORTUGAL**



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Synaesthetic Design towards a more sensuous, sustainable, and humane hospital

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Abstract. This study is part of an ongoing design research regarding the design of sensory stimuli (e.g., colour, sound, and temperature) in healthcare facilities. Healthcare environments are perceived by many of their users, including patients, physicians, and healthcare workers, as unpleasant, stressful, chaotic places. Many designers have already focused their attention on the psychological needs of patients, proposing solutions to cope with the stress, ensure calm and promote social interaction in healthcare settings. However, the important topic of sensory stimuli in healthcare settings is still not sufficiently explored. In our research we are adopting a Synaesthetic Design approach, which takes into consideration the multiple and concomitant stimuli physically present in the environment, to study how the different sensory stimuli could be designed together to provide an environment more suited to the needs of users in their various circumstances. In addition to the contributions to the health and well-being of users, we think this approach may also have advantages from the point of view of the health sector overall sustainability since it is estimated that hospitals are responsible for over the 20% of the public sector energy consumption. In this paper, we present a sensory harmonization strategy for healthcare facilities and discuss its potential not only in promoting health and well-being but also in energetic efficiency. The use of technology-based solutions with sensors, AI, IoT, which could be used to achieve benefits at both levels, is discussed.

Keywords: Synaesthetic Design, Design for Health, Sensory Design, Healthcare Sustainability

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1 Introduction

Healthcare facilities are often considered as uncomfortable spaces by their users, contributing to increased dissatisfaction about the experience offered, with a direct impact on patient recovery (Ulrich, 2000). In parallel, it is also known that, in most cases, these facilities perform very poorly in terms of energetic sustainability (HPOE, 2014). Hospitals are among the public facilities with the highest level of carbon footprints.

From a design point of view, these two perspectives (sensory and sustainable) have been usually considered separately, but we believe that adopting a synaesthetic design strategy that integrates them can result in great benefits at both levels.

Indeed, a great part of today's energy consumption (e.g., constant lighting levels) is not necessary and is responsible for the generation of sensory stimuli (e.g., fluorescent lights) that are often poorly designed. These stimuli might have a negative impact on people's well-being. For example, constant exposure to fluorescent lighting is responsible for alterations in the circadian cycle (Barbalace et al., 2021).

1.1. Sensory aspects in healthcare design

From a patient perspective, healthcare environments, particularly hospitals, are often oversaturated with the presence of unpleasant sensory stimuli (e.g., blinding fluorescent lights, loud environmental noises, auditory warnings, mismatched temperatures, harsh textures).

The intensity and negative perception of these stimuli tend to increase when people are ill or suffering. For example, our sensibility to temperature increases in case of fever, our sensibility to light and sound increases in case of migraines, our sensibility to smell and tastes increases in case of nausea (Upali, 2017). This condition is commonly defined as "sensory satiation". To reduce these sensory stressors, some environments have been deprived of sensory stimuli, generating empty sterile places (sensory deprivation). Healthcare environments should have an adequate proportion of pleasant stimuli, as suggested by Gordon and Rapoport, (1979).

1.2. The Impact of Healthcare Facilities on Energetic Sustainability

Energy consumption in healthcare is a sensitive issue for environmental sustainability. It has been estimated to account for almost the 20% of all public sector energy consumption in the State of Victoria, Australia and similar figures are expected for most developed countries (The Victorian Auditor General's Office, 2012). This study also suggests that half of the hospital's direct energy consumption is due to heating, ventilation, and air conditioning (ventilation and temperature control are used to reduce the risk of infections). Lighting and medical equipment account for the other half (Burger, 2012).

As in many other sectors, healthcare committees are under the pressure from different stakeholders to reduce their carbon footprint and adopt sustainable solutions (Health Research and Educational Trust, 2014). However, currently, most resources are invested in innovation related to patient safety, without allocating sufficient resources to design sustainable solutions. In this regard, the World Health Organization has suggested that sustainable initiatives in healthcare facilities could reduce energy expenditure and free up resources that could be used to improve patient care, as well as the quality of the spaces (WHO, 2017).

In the following chapter, we will present a common strategy for sensory harmonization and the energetic improvement of healthcare settings.

2 A Synaesthetic Approach

2.1. Towards a more humane hospital

Usually, at the level of healthcare facilities design, the designers' work is especially focused on maximising efficiency, safety, and hygiene, which are the most important aspects for performing medical acts and controlling the risk of infections. Thus, designs are almost always executed within the framework of reductionist, pathogenesis approaches. The term pathogenesis defines a reductionist approach to health and illness, with specific attention to the causes that generate disease. These approaches in the context of design for health have been useful in understanding complex health phenomena, breaking them down in their most basic parts, helping to create solutions that are efficient but, at the same time, almost always considered stressful, institutional, cold, and unpleasant (Ulrich, 2000).

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

WHO (1948). Constitution of the World Health Organization, p.1

According to WHO Constitution, social and psychological aspects are as important as pathogenic ones. During the last decades, the most important achievement in healthcare design has been the shift from a pathogenic approach to a broader perspective focused on the psychological and social needs of patients, i.e., *salutogenesis*.

2.2. From a Pathogenic-Reductionist to a Salutogenic-Holistic approach

The term *Salutogenesis*, proposed by Antonovsky (1979), describes a theoretical model that seeks to understand the whole complexity of wellbeing and illness regardless of the specificity and the detail of the disease itself. It is a holistic approach, focusing on the factors that underpin health and well-being, which has been used to reduce the stress in the healthcare environment and meet the psycho-physical needs of patients by offering, as much as possible, a pleasant, calm, and reassuring experience.

In recent years, there has been a great deal of international agreement, at the level of healthcare committees, on the idea that a human-centred design can enable patient recovery and reduce the length of stays, as well as diminishing patient hospital avoidance. This resulted in the growth of the salutogenesis approach in the design of spaces so that they promote social interactions and ensure people's intimacy, privacy, and dignity, i.e., more humane spaces.

In this context, the term "humanization" defines a strategy for "*making more human and compatible with human dignity, the experience of people in hospital*" (Vannetti & Monsù Scolaro, 2015). Thus, from an environmental perspective, a hospital can be considered humane when is intimate, has a familiar appearance and is gracefully finished. From a social perspective, the hospital is considered humane when patients are treated as individuals and communication between patients and the staff is very friendly and open, fostering social relations.

2.3. Synaesthetic Design: a strategy to humanize hospitals using the senses

Sensory stimulation in healthcare settings is a complex and multifactorial problem. Most of the healthcare facilities are considered unpleasant, stressful, and chaotic places by a large part of the population because they are oversaturated by the presence of unpleasant sensory stimuli. Most often, these problems are tackled by working on specific sensory modalities, such as the application of phono-absorbing coating for noise. This means that stimuli are analysed in a mono-medial way.

However, the field of Synaesthetic Design defends the idea that is impossible to isolate a stimulus and that all stimuli should be designed together because, even in cases where we are dealing with a mono-medial stimulation, such as sound, this stimulation is object of the interpretation of all other sensory modalities (Anceschi & Riccò, 2000). Our central nervous system does not process each stimulus individually but involves several modalities at the same time.

Synaesthetic Design is a field of design research, first defined in 2000 at Politecnico di Milano, Italy (Anceschi & Riccò, 2000), with the aim of assessing the systematic connections between sensory modalities during the design process. Unlike the term "*anesthesia*" (from the Greek "an": without "aisthēsis": sensation), which defines the action of subtracting stimuli and that is quite popular in the health field, the term

“*synesthesia*” (from the Greek “syn”: together “aisthēsis”: sensation) means perceiving together, subtending the idea of having multiple stimulations present at the same time.

It is the aim of synaesthetic design to coordinate all the sensations stimulated by an object (or environment) in a way that results in a pleasant, harmonious overall appearance while coinciding with the particular function desired. Synaesthetic design has the goal of achieving the optimal configuration of objects (or environments) based upon the systematic connection between the modalities

Haverkamp, M. (2013). *Synaesthetic design: handbook for a multisensory approach* (W. de Gruyter [ed.]). Birkhäuser. p.14

In the current research, we are adopting a Synaesthetic design approach to seek to improve the comfort of healthcare environments and, at the same time, obtain a positive effect on people’s health. (Duarte et al., 2019; Gambera et al., 2018b; 2018a; 2019a; 2019b; 2019c; 2019d; 2020) such as evidence-based healthcare design, salutogenic architecture and environmental psychology, agree with the importance of the built environment (e.g., space, equipment and environmental variables

What distinguishes our approach from others is that, rather than seeking to improve healthcare facilities by controlling or reducing the sensory stimuli present in the environment, we set out to design the interaction between concomitant stimuli. To do so, we are working, specifically, on cross-sensory interaction between modalities that can interfere with the perception of pain and produce an analgesic effect without further pharmacological interventions.

Since the publication of the “Gate Control Theory” (Melzack & Wall, 1965) and especially after the subsequent “Neuromatrix Theory” (Melzack, 1999), models that explain that the sensation of pain has a major component at the level of the central nervous system, several studies have proposed techniques based on distraction, counterirritation or motivation, proposing analgesic effects without the use of any pharmacological treatment. Most of these studies proposed interventions involving sensory stimulation in different modalities, such as tactile, visual, and acoustic (Gardner & Licklider, 1959), proposing interventions to distract, motivate or create counterirritation that could reduce pain. For instance, pain perception could be weakened (or increased) by the simultaneous presence of stimuli from other sensory registers.

3 The Sensuous Project

The Sensuous Project, which is part of a doctoral research in design at IADE – Universidade Europeia, aims to explore how sensory stimuli variations in the

environment (variations of light, sound, temperature), designed in a synaesthetic way, can impact people's health and well-being. Our aim is to identify different sensory setups that show high potential to improve the perceptions of admitted patients and are, at that same time, likely to be implemented in healthcare settings (e.g., hospitals), with benefits for energetic sustainability.

Before proceeding with tests in the field, we are conducting a laboratory experiment, in a controlled environment, to test combinations in a systematic way, with high internal validity. Thus, an experimental setup was created in the Neuro-Psychophysiology Laboratory of the Universidade Europeia (see figures 1 and 2), consisting of a room with good control of external environmental variables, equipped with an armchair, LED lights offering chromatic and intensity variations, a sound system with headphones with environmental noise neutralisation and a cold-pressor test system to assess participants' pain resistance (psychophysiological measurements).

The cold pressor test is an ethically approved test involving induced pain caused by the immersion of the non-dominant forearm in cold water (5°). People's resistance to pain caused by the cold water is assessed, measured in seconds. The objective is to assess whether exposure to different sensory combinations of this synaesthetic environment, with changes in light, sound and temperature, can generate an analgesic reaction. Behavioural (reactions) and perceptual (responses) data are collected.



Fig.1 Laboratory Experiment in which the participant is immersed in a Synaesthetic Environment. The evaluation of the environment is done collecting psychophysical data as well as qualitative subjective data.



Fig.2 We are evaluating different Synaesthetic scenarios including variations of sound, light, and temperature. The test phase is currently taking place in the Neuro-Psycho-Physiology Laboratory of Universidade Europeia.

4 Final considerations

Among the various advantages of adopting sustainable technology in healthcare facilities, we highlight the impact that these solutions can have on the well-being and health of patients, as well as the greater energy efficiency. In this respect and based on the analysis already made for the Sensuous Project, we present some considerations.

Important outcomes in terms of sensory harmonization and energy consumption can be achieved by adopting smart LED lighting. This type of lighting is energy efficient and, if used with smart hubs, allows customisation and individual control. Patients will thus be able to adjust preferred intensity and colour temperature. If they are unable to do so, there will be the possibility of the adjustment being made by an AI (Artificial Intelligence) unit, fed with data regarding the patients' own health status. The possibility of using chromatic lighting in combination with sound, through dedicated applets, will allow multiple solutions in terms of sensorial characterisation of the environment.

In order to maintain optimal control over the variables, all the environments should be acoustically and thermally insulated. Both thermal and acoustic insulation can be achieved with the use of natural materials (e.g., cork and wood fibre), which are hygienic, naturally perfumed and offer a warm sensation to the users. Natural and non-natural insulating materials offer important outcomes in terms of sensory harmonization and in terms of energy consumption by reducing heat

dissipation (less energy needs to be used to warm up/cool down the temperature in the environment).

Moreover, the presence of natural element in the environment is found to have important outcomes in terms of patients' recovery. The Ulrich's Nature Views (Ulrich, 1984, 2000) demonstrated that the presence of a window with a view of natural settings, was an important factory in terms of recovery time after a surgery.

Generally, the energy efficiency of buildings is seen only as a goal for environmental sustainability or, in second analysis, to break down the energy costs. However, the reduction of energy-related costs might free up economical resources that could be reinvested in innovation and improvement of the quality of the spaces, with an impact on other expenses related to medical care, including stays and medication costs.

The adoption of a holistic synaesthetic approach is aligned with one of the greatest trends in technology. According to a recent report (Sony Ericsson, 2020), the biggest trend for 2030 will be the shift from IoT (Internet of things) to IoS (Internet of Senses). This revolution will drive designers to create more immersive environments. Future experiences will be enriched with digital flavours/aromas, more sophisticated haptic stimulations, and immersive interfaces. It is estimated that the introduction of IoS services will make society more environmentally sustainable, with higher consumption of digital experiences rather than physical products.

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