



CHAPTER

7

SKIN AS VISUAL METAPHOR

The first step was acquire knowledge, to determine how to create an environment that positively stimulates patients, this was research in chapter 2, which started to identify specific design element which individually required further research which will follow in this chapter. Most importantly in this chapter theory will receive a means of being transformed to tangible design, through the introduction of skin as concept. Skin, made up of interdependent parts called cells that each play a fundamental role in the functioning of the skin and what it is able to do, draws a comparison to our buildings and their ability to perform and protect. Identifying that spaces are made out of interdependent elements and layers, which are referred to in this study as "enablers" as they enable a designer to create spatial literacy, fundamental to transforming information into visible design. These interdependent elements will be identified and research for each will be illustrated with a Infographic which is then followed by a detailed discussion.



SKIN
AS
METAPHOR

Inspirational
Pallette





7.1 LAYERS OF THE SKIN

A person's skin is their first defence against and contact with the outside world. It is a tough, breathable, protective, elastic organ that regulates body temperature and consistently regenerates itself. It is the largest organ in the human body. The touch sensors and pain receptors in skin mean that everything experienced externally is first sensed through skin (Kabir, 2011). Skin also supplies the unique identity prints of each human being. On a microscopic level, it is revealed that skin consists of interdependent cells. These form what we know as tangible skin and, more importantly, determine what skin is able to do. The interdependent cells of skin can be used as a visual metaphor for human environments. They too consist of interdependent elements that form the tangible environments and determine their ability to perform. This metaphor will specifically be applied to the healthcare environment. People transferred to this space are bruised physically and physiologically. They are in need of healing - body, mind and spirit. Therefore, this space needs to represent healing and the expression of wellness. In order to do so, various interdependent elements or layers of meaning need to be examined. Then they must be combined in detailed design that enables the elements or layers to work together (as the elements in skin do). In this way an optimal healing environment can be created, which can positively stimulate patients through a curing to healing continuum.

7.1.2 APPLICATION (PARALLEL PROCESS)

Spaces are composed of distinct design elements. Each element has its own function and meaning that are used to create spatial literacy. In order for a space to support healing, these elements must work together. They must be interactively designed to influence one another and create a whole. Just as skin is made up of interdependent elements that allow it to function, so must each design element or layer play a fundamental role in the environment's ability to support healing. The spaces within a healthcare environment are expected to meet certain requirements and maintain specific standards. Therefore, the design process is a parallel one: on the one hand, the design of different elements is addressed in layers and, on the other; focus is on the elements' ability to conform to regulations and standards. This design process can then result in an optimal healing environment that upholds healthcare standards.

7.2 INTERDEPENDENT DESIGN ELEMENTS

Elements of design that are most likely to optimise physical, mental, emotional and spiritual healing within healthcare environments have been identified through evidence-based theories and research on optimal healing environments. These elements are lighting, nature, orientation and sensory experience. Each of these is researched individually and design recommendations are made. Additionally, environmental complexity is addressed in order to control the intensity of design and implementation of these elements. A study of environmental complexity also enables control of the effects elements have on one another and of their function as interdependent elements.



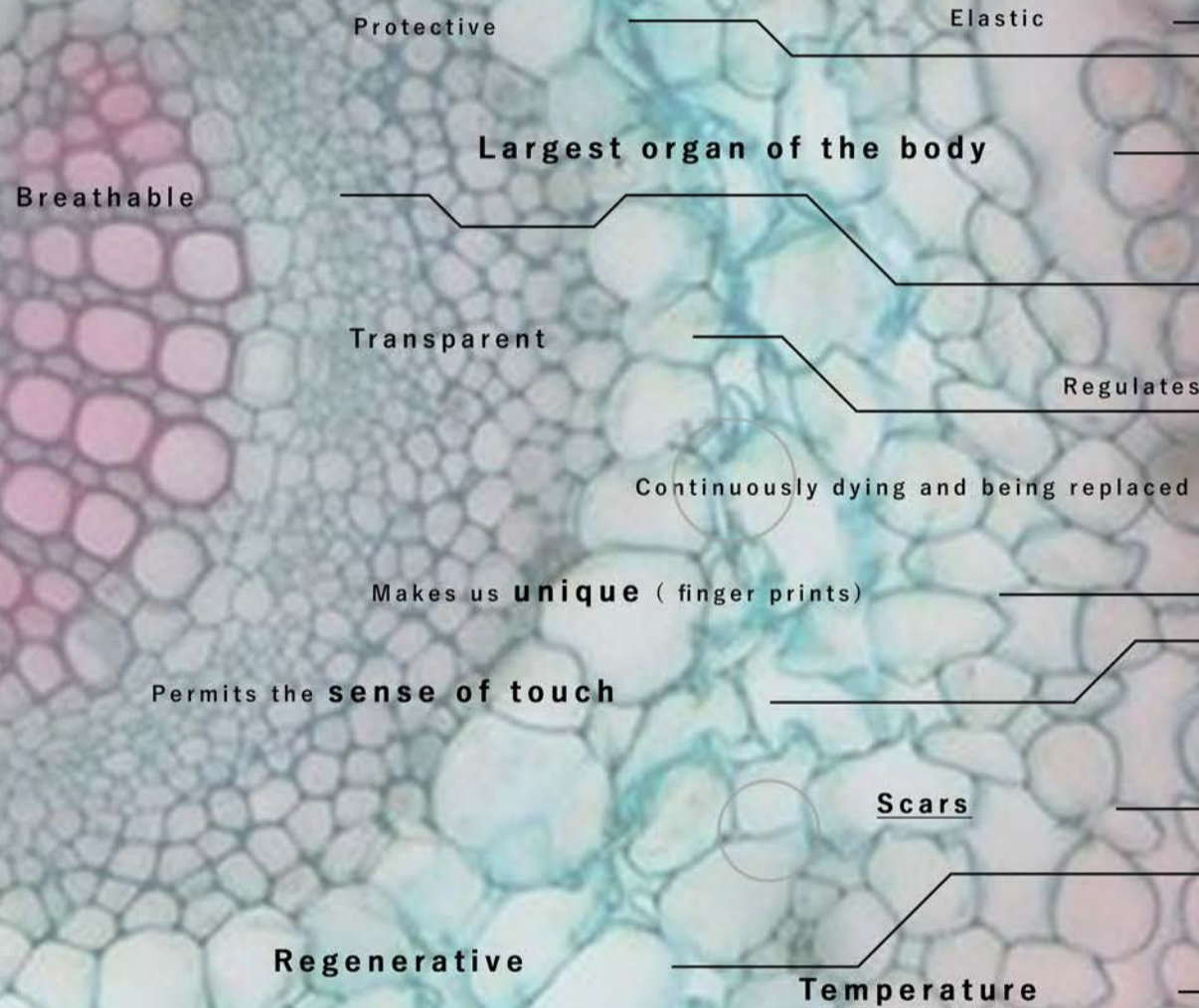
SKIN

interdependent cells play a fundamental role in the functioning of the skin & what it is able to do

SKIN CONSISTS OF INTERDEPENDENT CELLS

A person's skin is their first defence against and contact with the outside world. It is a tough, breathable, protective, elastic organ that regulates body temperature and consistently regenerates itself. It is the largest organ in the human body. The touch sensors and pain receptors in skin mean that everything experienced externally is first sensed through skin (Raisa, 2011). Skin also supplies the unique identity prints of each human being.

Interdependent cells of the skin



On a microscopic level, it is revealed that skin consists of interdependent cells. These form what we know as tangible skin and, more importantly, determine what skin is able to do.

The interdependent cells of skin can be used as a visual metaphor for human environments. They too consist of interdependent elements that form the tangible environments and determine their ability to perform.



COMPARISON

compared to interior spaces &
their ability to perform &
protect

SPACE

spaces consist of
interdependent elements
and layers

INTERDEPENDENT ELEMENTS OF DESIGN

referred to as enablers, since they
enable the creation of spatial literacy

LIGHTING

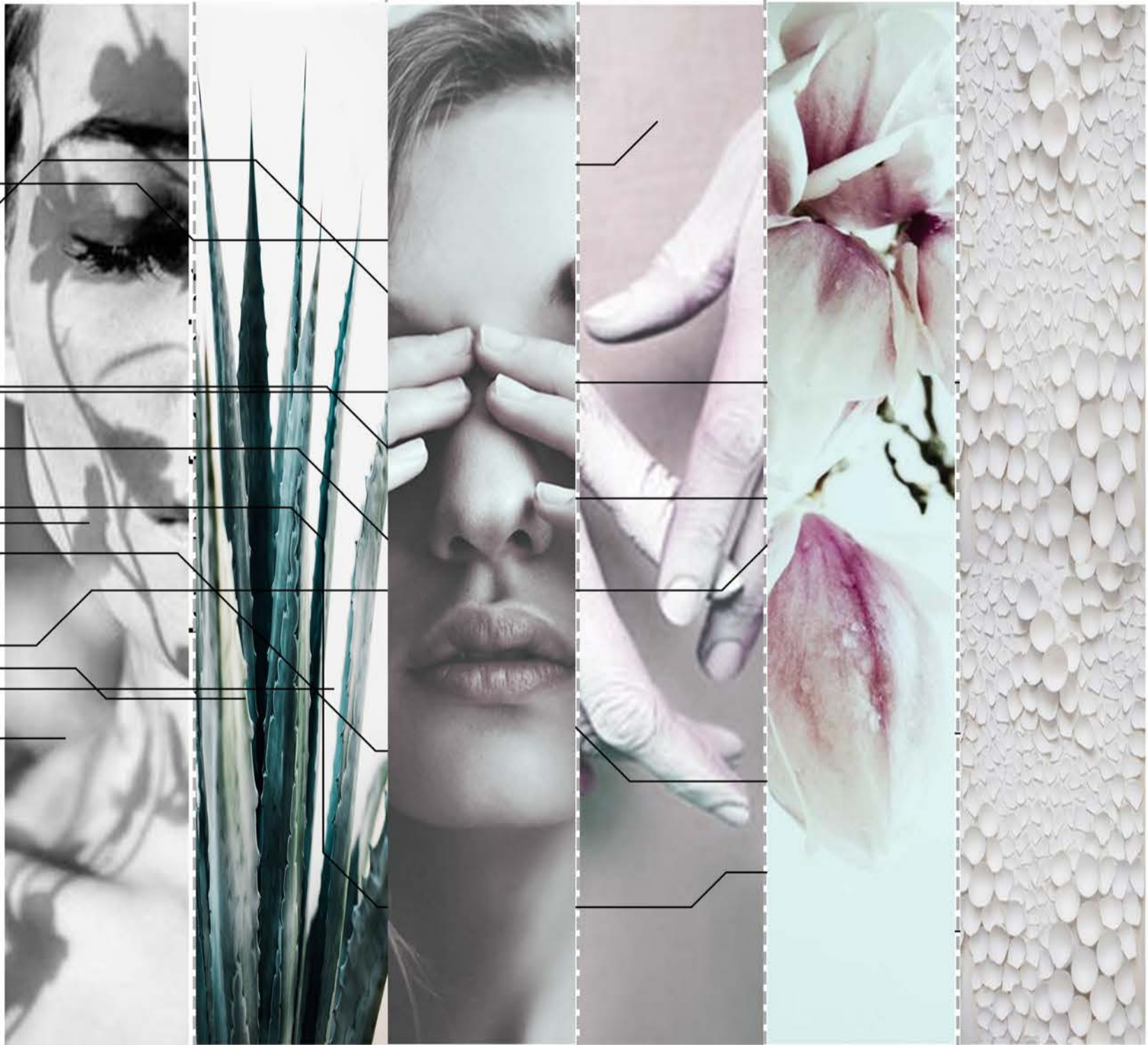
7.2.1

ORIENTATION

7.2.3

ENVIRONMENTAL
COMPLEXITY

7.2.5



NATURE

7.2.2

SENSORY

7.2.4

Fundamental in transforming
information into visible design

“It is the unqualified result of all my experience with the sick that, second only to their need of fresh air, is their need of light; that, after a closed room, what hurts them most is a dark room and that it is not only light but direct sunlight they want.”
— (Florence Nightingale, 1860 cited in Kreitzer et al., 2015)

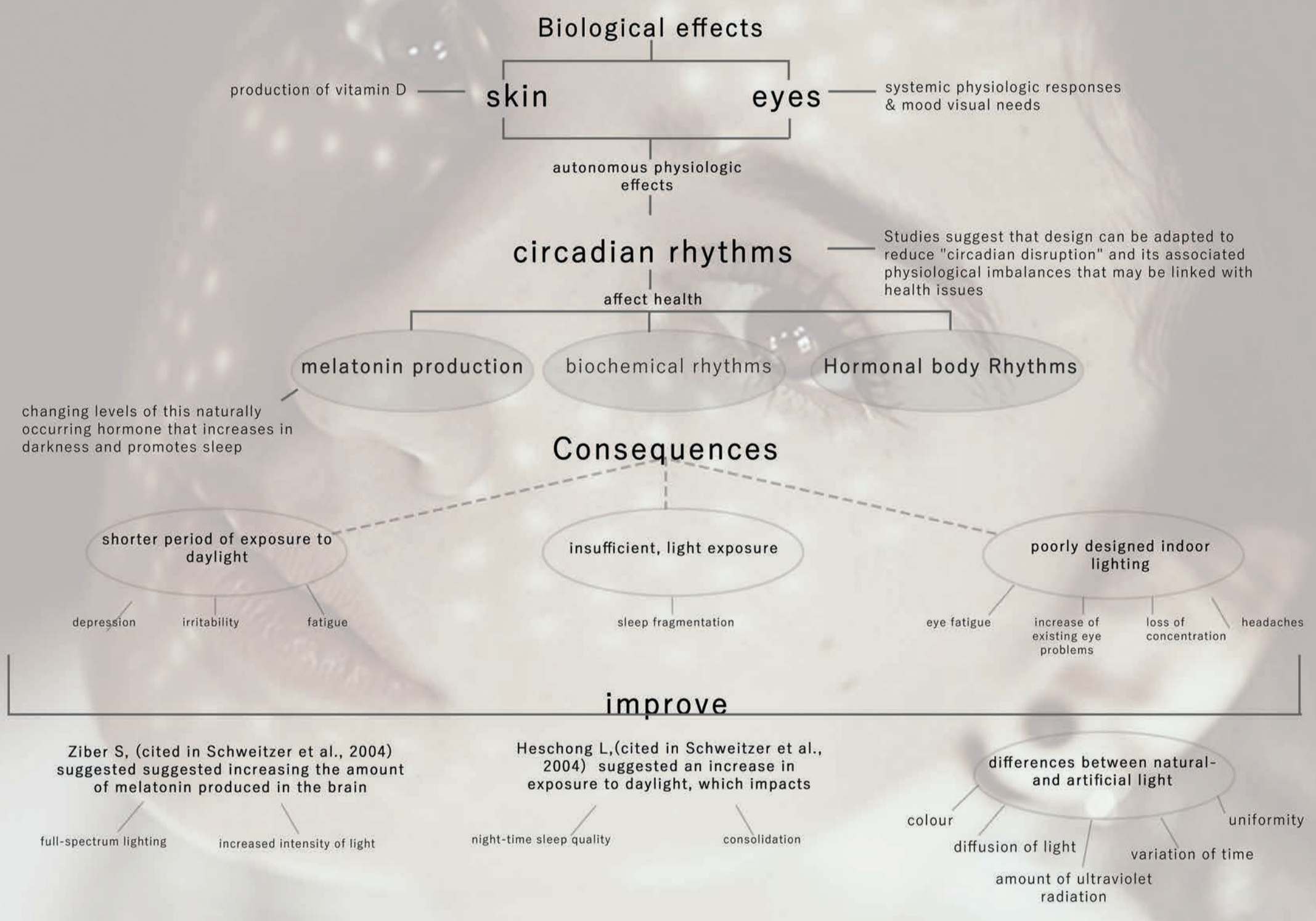


Figure 7.2 Perforated screen (Micro Design, 2015)



Figure 7.3 Detail window (UP Interiors, n.d.)



Figure 7.4 Texture through light (Cilento, 2009)



Figure 7.5 Infiltration of light (The Paper Mulberry, 2011)



Figure 7.6 Play with light (Archiproducts, 2016)



Figure 7.7 Shadows (Browistry, 2015)

Infographic 7.1 Lighting (Author, 2016)

7.2.1.1 CURRENT PROBLEM/ CHALLENGE IN HEALTHCARE

Hospitals are notorious for their absence of a visual passage of time, of either day or night, and the resulting disorientation is well documented (Devlin & Arneill, 2003, p.683).

7.2.1.2 EVIDENCE-BASED THEORY

Lighting has an effect on a person's health and healing. For over half a century, a growing body of knowledge, termed chronobiology (the study of biological rhythms), has described the influence of light exposure on the physical and mental health of humans. (Edelstein, 2005, p.1).

Light is registered through the skin and eyes and has a biological effect on the body. The exposure of skin to sunlight promotes the body's production of vitamin D. Light has a systemic physiologic effect on mood, as well as being a requirement for vision (Schweitzer et al., 2004, p.75).

Research on the autonomous physiological effect of light is focused on circadian rhythms. The natural circadian rhythm of light exposure influences one's health by regulating melatonin production, which influences biochemical and hormonal body rhythms. A 1993 survey revealed the existence of "over 3 000 references to research conducted on the effect of light on human chronobiology" (Schweitzer et al., 2004, p.75).

Shorter periods of exposure to daylight has been shown to trigger SAD (seasonal affective disorder) with effects of depression, irritability, and fatigue (Edelstein, 2005, p.2). To counteract this Zilber(cited in Schweitzer et al., 2004) suggested increasing the amount of melatonin produced in the brain through exposure to full-spectrum lighting or increased intensity of light.

Heschong (cited in Schweitzer et al., 2004) stated that insufficient light exposure causes sleep fragmentation. Studies on nursing home patients suggested that increased exposure to daytime light, measured by duration and intensity, has an impact on night time sleep quality and consolidation.

The differences between natural and artificial light are significant. These differences include levels of luminance, uniformity, diffusion of light, variation of time, colour and amount of ultraviolet radiation. The importance of natural sunlight as part of the healing process has been explored in a number of significant studies (Schweitzer et al., 2004, p.75). Walch et al. (2005) conducted research as part of a controlled clinical trial. It was clearly indicated that the healing process of patients was greater in brighter, well-lit rooms of 73 537lux as compared to those lit at 50 410lux. Data retrieved from medical records and self-reported measurement by postoperative patients also demonstrated that patients accommodated in brighter, well-lit rooms showed a remarkable reduction in analgesic medication use, pain medication cost, and severity of pain, stress, anxiety and depression.

Poorly designed indoor lighting results in source glare and flickering. These intensify existing vision problems, add to eye fatigue and headaches and contribute to loss of concentration (Schweitzer et al., 2004, p.75).

7.2.1.3 RECOMMENDED DESIGN IMPLEMENTATION

Lighting can play a critical role in the visual perception of a hospital and its environment. The overall effect is far "greater in both aesthetic and psychological value" when weighed against the cost of other types of architectural improvements (Devlin & Arneill, 2003, p.683).

Applications of lighting in healthcare settings offer specific challenges. By referencing current best evidence on the influence of electrical lighting, designers can select individual light sources that support normal circadian rhythms and improve healthcare experiences.

The design of lighting should be adapted to reduce "circadian disruption" and its associated physiological imbalances that may be linked with health issues:

- Lighting solutions involve site planning, building orientation, architectural openings, shading and screening systems, as well as electrical lighting systems (Edelstein, 2005, p.3).
- Easy access to daylight or electrical light of sufficient levels to stimulate the wake/ sleep system should be provided where and when possible (Edelstein, 2005, p.3).
- The programming of spaces for those who are required to work in darkness or in unnatural circadian patterns should prioritise easy access to daylight (Edelstein, 2005, p.3).
- Building orientation and openings should be designed to bring in controlled daylight where possible.
- Controlling illumination is paramount, regardless of whether the source is from the sun or from electrical lamps/ illumination. Furthermore, it not appropriate to assume that more light is better.
- Lighting must be controlled for glare, discomfort its effect on temperature.
- Safety and egress of light are essential.
- Visual acuity must meet the requirements for task performance. Individuals have differing needs regarding vision. Control of intensity, spectrum, and distance provide improved and appropriate lighting conditions (Edelstein, 2005, p.3).
- Individual and controllable lighting systems are better able to meet the needs of a broad range of users with various abilities for differing tasks (Edelstein, 2005, p.3)
- Windows are beneficial in patient rooms. However, during acute illness or periods of recovery darkened conditions that support rest or sleep are often required or preferred, even during the day.

- The provision of darkness for rest and sleep is rarely accommodated. Design should minimise the infiltration of light from sources in hallways, other patient rooms, nearby clinical stations or windows.
- Staff members may be subjected to divergent light cycles by virtue of their changing work patterns and responsibilities. Therefore, individually-controlled light sources are likely to be most suitable for supporting individual needs and performance.
- Circadian light solutions should be carefully controlled to minimise overexposure to light.
- Precautions must be taken to manage glare. Bright, indirect lighting is highly recommended (Devlin & Arneill, 2003, p.683).

7.2.1.4 DESIGN APPLICATION

- Site orientation of the building was identified and appropriate solar studies were conducted. This influenced the introduction of architectural openings and design inclusions in the form of shading and screening systems, as well as the use of appropriate electrical lighting systems.
- The design of a central atrium and vast, open, glazed façades allow for easy access to natural light. These are combined with electrical light of sufficiently variable levels to provide the ability to stimulate the wake/ sleep system
- The space programming considered the orientation of the building; prioritising and organising programs depending on individual requirements.
- More light is not necessarily better; controlling illumination is vital, regardless of whether the source is the sun or electrical. Mechanical louvers act as an extra skin on the building that allows for maximum control.
- Elements such as the screen behind the reception desk are designed to control and prevent glare, discomfort, and temperature effects. The skin layers of the building allow individual patients to control their environments.
- As safety and egress is essential, electrical lighting with light sensors is installed to compensate when necessary and maintain the constant lux required for certain spaces.
- The implementation of individual and controllable lighting systems should meet the needs of a broad range of users with various abilities for differing tasks.
- Windows provide necessary benefits in patient rooms. However, during acute illness or periods of recovery, darkened conditions that support rest or sleep are often required or preferred, even during the day. This is provided for by the implementation of individual mechanical louvers that are controlled under the supervision of the medical staff.
- Circadian light solutions are carefully controlled to minimise overexposure.
- Fibre optic cables can be used to transport natural light into spaces that are not exposed it. Such an implementation may also assist the electrical lighting systems.
- Specially designed walls are to use the infiltration of natural light to create lighting effects for sensory stimulation.

knowledge of the importance of natural environments to health is ancient
REAWAKENING
 to the significant role of natural environments in healthcare (Larson & Kreitzer, 2004, p.1)

DESIGN IMPLEMENTATION OF NATURE

VIEW nature

People prefer views of outdoor natural environments and scenes to urban views that lack natural elements (Ulrich, 1981; Schweitzer et al., 2004, p.75).



effects

- elicit positive feelings (Ulrich, 1981)
- reduce fear in stressed subjects (Ulrich, 1981)
- hold interest (Ulrich, 1981)
- block or reduce stressful thoughts (Ulrich, 1981)
- foster restoration from anxiety or stress (Ulrich, 1981)
- shorter hospital stays (Ulrich, 1981; Schweitzer et al., 2004, p.76)
- fewer moderate to strong analgesic doses (Ulrich, 1981; Schweitzer et al., 2004, p.76)
- took fewer moderate & strong analgesic doses (Ulrich, 1981; Schweitzer, et al., 2004:76)
- reduces anxiety and pain (Schweitzer et al., 2004, p.76)
- restorative effect on patients and staff (mood improvement, lower blood pressure, reduced heart rate) (Schweitzer et al., 2004, p.76)
- a sense of perceptual distance and expansiveness promotes "cognitive tranquillity", which aids mental functioning (Schweitzer et al., 2004, p.76)



effects

- (lack of views)
- connected to high rates of anxiety, depression & delirium. (Schweitzer et al., 2004, p.76)
- negative effects of sensory deprivation in an environment known to numb one's senses
- patients with no window views developed twice as many cases of post-operative delirium during a 72-hour period (Schweitzer et al., 2004, p.76)

EXPERIENCE nature

Where healthcare institutions maintain extensive gardens and landscapes, these are referred to as "healing gardens". This term is frequently applied to gardens designed to promote recovery from illness (Larson & Kreitzer, 2004).

"Patients and visitors should have opportunities to connect with nature through outside spaces, plants, indoor atriums, and views from windows".
 (The Joint Commission, 2016)

recommended application

INTERIOR skin of the building

recommended application

EXTERIOR landscaping

- Buildings with
 - _ Natural characteristics and visual features, including
 - _ Daylight
 - _ Nature views
- indoor plants, are highly preferred by occupants. (Schweitzer, et al., 2004:76)
- _ create connects with outdoor environments visually, and physically
- _ provide access to outdoor gardens

Indoor plants increase work efficiency and attentiveness as well as decreasing perceived stress, lowering blood pressure and reducing physical discomfort (Schweitzer et al., 2004, p.76).

Successful gardens follow these design principles:

1. Variety of Spaces
2. A Prevalence of Green Material
3. Encourage Exercise
4. Provide Positive Distractions
5. Minimize Intrusions
6. Minimize Ambiguity (Larson & Kreitzer, 2004:3)

McDowell's suggested 7 design elements to guide design of the space

- A special entrance (invites and embraces visitors)
- The element of water (psychological, spiritual and physical effects).
- The creative use of colour and lighting (elicit emotion and comfort)
- An emphasis on natural features (use of rocks, wood, natural fences, screens, trellises, wind, sound, etc.)
- The integration of art (enhance the overall mood and spirit of the garden)
- Garden features attract wildlife (provide habitat for wildlife) (Larson & Kreitzer, 2004, p.4).

blurring the threshold between interior and exterior environments

creation of tranquil gardens

Through the creation of tranquil gardens, exterior environments can be used to create healthier interior environments.

The significant relationship between health improvement and nature within healthcare environments has not been fully appreciated in recent years. As of late, there has been an increasing awareness and acknowledgement of nature's vital importance in the healing process of the body, mind and spirit (Schweitzer et al., 2004, p.72).

7.2.2.1 HISTORY OF NATURE AND HEALTHCARE

Knowledge of the importance of nature within healing environments can be traced back to ancient times, where gardens were used as a place of healing by early Asian, Greek and Roman cultures (Rodiek & Schwarz., 2005).

7.2.2.2 CURRENT HEALTHCARE AND ITS TRANSITION

Over the past 50 years, there has been rapid advancement in medical technology. This advancement, accompanied by economic pressure, has led to the role of nature being neglected and overlooked in healthcare environments. However, in the last 20 years there has been renewed interest in and appreciation of the role that designed natural environments play in improving health. Some modern healthcare institutions now maintain extensive gardens and landscapes as an integral part of the healing process. This may be due to the medical profession taking an integrated approach since the mid-1980s, which has assisted in reawakening the belief that gardens can play a significant role in the healing process (Larson & Kreitzer , 2004, p.1).

7.2.2.3 CHALLENGES

Spiritual needs

The healing process encompasses not only the body but also the mind and spirit. Apart from the occasional chapel, there are few facilities that fully address the spiritual needs of patients, their families and staff. Hospitals and institutions face a challenge as to the way in which to respond to the requirements of a diverse religious population. Nature as one of the most universal images of spirituality may be a solution to this challenge (Schweitzer et al., 2004, p.72).

Mediclinic

As identified in Chapter 3 (Site analysis), the existing softscape around Mediclinic Midstream is not being utilised. A strong disconnect also exists between interior spaces and exterior environments. There is a strong presence of plants in the interiors of Mediclinic Midstream. Brand advertising for these plants clearly highlights their contribution to cleaner air in the interior.

7.2.2.4 EVIDENCE-BASED THEORY

Despite the long history of natural environments used in healthcare, the effects of such use have only recently started to be systematically studied. Perhaps the best-documented study to date is Roger Ulrich's 1984 study of surgical patients and their access to views of the outside world.

The Joint Commission for the Accreditation of Hospital Organisation (JCAHO) is a healthcare institute that recognises the need for exposure to natural environments. It stated that,

"Patients and visitors should have opportunities to connect with nature through outside spaces, plants, indoor atriums, and views from windows"

(The Joint Commission, 2016). In a healthcare setting, nature can be depicted in two different ways. Firstly, it can be in the exterior gardens and landscaping of the premises –having a more physical presence. Secondly, it can lie in the views of nature from within – prioritising visual appeal.

In this study, nature will therefore be studied as two interdependent categories;

- Experiencing nature; and
- Viewing nature.

7.2.2.4.1 EXPERIENCING NATURE

Where healthcare institutions maintain extensive gardens and landscapes, these are referred to as "healing gardens". This term is frequently applied to gardens designed to promote recovery from illness (Larson & Kreitzer , 2004).

7.2.2.4.2 VIEWING NATURE

It has become evident that, with regard to aesthetics and affective responses, views of outdoor natural environments and scenes are preferred to urban views that lack natural elements (Ulrich, 1981; Schweitzer et al., 2004, p.75). This can be based on the fact that most natural views elicit positive feelings; reduce fear in stressed subjects; hold interest; may block or reduce stressful thoughts; and might also foster restoration from anxiety or stress.

It is clear that when comparing these two groups of patients, those with the window view over trees had shorter post-operative hospital stays; fewer negative evaluative comments from nurses; took fewer moderate and strong analgesic doses; and had slightly lower scores for minor post-surgical complications (Ulrich, 1984, p.6).

Further studies focused on intensive care units. They linked a lack of windows and views of nature to high rates of anxiety, depression and delirium. Where similar patients had views of nature, the results were shorter post-operative hospital stays; higher satisfaction with nursing care; and decreased use of medication (Schweitzer et al., 2004, p.76). Thus, patients and medical staff have greater preference for and improved performance in an environment that offers views of nature. To conclude, hospital designs and layouts that provide pleasant views of nature can positively influence a patient's emotional state and, accordingly, might improve their rate of recovery.

National Aeronautics and Space Administration studies state that a sense of perceptual distance and expansiveness - whether it be internal corridors with captivating focal points, the design of vertical surfaces, or views - promotes "cognitive tranquillity", which aids mental functioning (cited in Schweitzer et al., 2004, p.76).

Conclusion

These two interdependent categories - experiencing nature and viewing nature - are expressed in the proposed design through the implementation of exterior landscape gardens and the strategic design of the building's skin. Through such a design a connection with nature can be created and maximised. Ultimately, this enables use of the outer natural environment to create healthier stimuli for interior occupants.

7.2.2.5 RECOMMENDED APPLICATION (ON POSTER)

General

This design proposal aims to provide patients, their families and staff with access to nature by introducing indoor- and outdoor gardens, views of nature through windows, and artwork of natural scenes to relieve stress (Schweitzer et al., 2004, p.76).

Exterior - landscaping

_ Gardens: According to Therapeutic Benefits and Design Recommendations (Barnes and Cooper, 1999) these landscape gardens have a specific design. The intent is to focus on providing stress relief, alleviation of physical symptoms and to promote improvement of the overall sense of wellness of patients and healthcare staff. Successful gardens follow these design principles (Larson & Kreitzer, 2004, p.3):

1. Variety of Spaces: Spaces must be created for groups and for individuals. Patients are given a choice and thus an increased sense of control, which leads to decreased stress levels. These private spaces allow the patient to “get away” from the formal, sterile environment of the hospital. In addition, there should be specific areas where small groups (e.g., family members or support staff) can provide social support to the patient in relative privacy.
2. A Prevalence of Green Material: Plants and foliage should dominate the garden. Landscaping should cover only one-third of the area. The aim is to create an environment that softens the landscape so that patients may feel an improvement in their overall sense of wellness.
3. Encourage Exercise: Gardens that encourage walking as a form of exercise have been indicated to promote lower levels of depression.
4. Provide Positive Distractions: Natural distractions such as plants, flowers and water features lower stress levels. Other activities, such as working with plants and gardening, can also provide positive distractions within the garden setting.
5. Minimise Intrusions: Negative factors such as urban noise, smoke, and artificial lighting should be minimised within these gardens. Natural lighting and sounds are the stimuli for the positive effects that a well-designed landscape garden can have.
6. Minimise Ambiguity: Abstract environments (i.e., those with a high sense of mystery or complexity) can be interesting and challenging to the healthy, but may have a converse effect and outcome on the ill. Clearly identifiable features and garden elements should be incorporated into the design.

Seven suggested elements to guide the design and intention of the space (McDowell & McDowell, 1998):

- A special entrance that invites and embraces visitors.

- The element of water for its psychological, spiritual and physical effects.
- The creative use of colour and lighting (be they plant or human-designed light sources) to elicit emotion, comfort, and/ or awe.
- The emphasis of natural features as grounding points such as the use of rocks, wood, natural fences, screens, trellises, wind, sound, etc.
- The integration of art to enhance the overall mood/ spirit of the garden.
- Garden features that attract and provide a habitat to a diversity of wildlife (Larson & Kreitzer, 2004, p.4).

Interior - skin of the building

- Buildings with natural characteristics and visual features, including daylight and views of nature and indoor plants, are more preferred by occupants (Schweitzer et al., 2004, p.76).
- Indoor plants have been shown to increase work efficiency and attentiveness as well as decreasing perceived stress, lowering blood pressure and reducing physical discomfort (Schweitzer et al., 2004, p.76).

7.2.2.6 CURRENT DESIGN IMPLEMENTATION

- The implementation of a berm to block road noise.
- A specially designed garden with specific plants to create beautiful views from interior spaces.
- Paths with seating areas that allow patients to walk out and physically experience the garden.
- Plant choice as well as wetland and water features to encourage wildlife.
- Water features and wildlife will provide a calming natural ambient sound to the hospital environment.
- Plants will be incorporated on the balconies. The design intention is for the flowers on each balcony to bloom at different times of the year - allowing these environments to change continuously. Patients are thus encouraged to use and explore individual spaces at different times of the year. This will create an awareness of seasonal change.
- The north-western balconies are intended for plants that flower in the winter; encouraging enjoyment of the warm afternoon sun in winter.
- The south-eastern balconies are intended for plants that flower in the summer and will provide fresh bright mornings and cool shaded afternoons.
- The northern balconies will house plants that flower throughout the year.
- The interior visual axes are designed to frame deciduous trees in the garden. Seasonality is emphasised through the constantly changing garden views from the interior of the building.
- The garden, with its choice of brightly-coloured plants, balances the more muted interior spaces with a splash of colour here and there. The garden also provides a constant visual connection with nature through the permeable skin of the building.
- The above considerations are all intended to provide patients with positive and interesting distractions and views of nature as part of a sensory stimulation process. This process includes movement, smell, vision and hearing.

- The purpose and intention of these considerations are to improve patient well-being and the all-important healing process.



Stress is a common reaction to unfamiliar buildings such as hospitals. Long hallways with no landmarks present multiple-choice points - creating the same problem as when one approaches a maze
(Sternberg & Wilson, 2006:241)

DIALOGUE BETWEEN NEUROSCIENCE & ARCHITECTURE

By applying the principles of neuroscience and focusing on perception and spatial orientation, it is possible to develop an informed design of spaces. Informed design then enables identification of the environmental features that will minimise negative physiological, cognitive and emotional effects. (Sternberg & Wilson, 2006:239)

FACTORS THAT CREATE OUR ENVIRONMENT

the configuration of prominent stimuli or landmarks

paths that can be taken through different spaces

the individual characteristics of these factors influence the form and function of a space and create diverse spatial perceptions and memories
(Sternberg & Wilson, 2006, p.239).

HIPPOCAMPUS

- a ventricle in the brain -

the centre of

EMOTION

MEMORY

connection

SENSE OF PLACE

NEURONS IN THE SENSORY AREAS OF THE BRAIN

activated by any one type of stimulus, such as sound, smell or touch

AUTONOMIC NERVOUS SYSTEM

individual neurons respond when one moves to certain locations in an environment and different patterns of neural activity correspond to different locations

considering the factors that affect memory can help to improve the design of hospitals - occupied by individuals who need to self-navigate these complex environments

"PLACE" NEURONS

activated by a combination of features that serve to define our

INTERNAL SENSE OF PLACE

" HAPTIC SENSE"

(awareness of one's surroundings)

Place neurons are strongly dependent on a sense of orientation within the environment and different environments are associated with different patterns of neural activity.

AS SENSE OF "PLACE" IS DEFINED BY THE ACTIVITY OF NEURONS, ONE NEEDS TO DETERMINE WHICH FACTORS INFLUENCE THIS
(Sternberg & Wilson, 2006, p.240).

SPACE VERSUS PLACE

The internal representation of a place is heavily influenced by the way one moves within that place. Different places are connected based on the ability to move from one to the other.

For example, two rooms separated by a glass wall are physically next to each other, but the hippocampus will treat them as separate places as one cannot move directly from the one to the other. Other factors, such as consistent paths of movement, may also serve to separate places within the hippocampus.

ENHANCE A SENSE OF BEING

Environments should encourage free exploration and have design representations of "place" that are not strongly influenced by the paths used to navigate them. This may be applied in the design of spaces that are intended to enhance a sense of being within that environment rather than a feeling of "just passing through"
(Sternberg & Wilson, 2006, p.240).

LANDMARKS OF ORIENTATION

Landmarks and their contribution to ones sense of place, depends on

their contribution to determining an individual's location

orientation within an environment

"HEAD DIRECTION" NEURONS

neurons in the brain that keep track of the direction one is facing within an environment

The advantages of VISUAL LANDMARKS can keep people "oriented" as they move within and between environments

Windows that present distant, external landmarks support orientation and thus also the stability of spatial representations in the hippocampus. A strong sense of place is therefore reinforced.

Although individual landmarks enable orientation within an environment, a configuration of multiple cues also contribute to evaluation of location. These contributive cues, such as unique design features, can be either close to or far from the user.

Prominent stimuli in an environment create a strong sense of place (Sternberg & Wilson, 2006, p.241).

WHAT MAKES A PLACE MEMORABLE?

Memory of a place does not consist of a single location but of a sequence of connected locations (Lee & Wilson, 2002).

CAREFUL CONSIDERATION OF

path that will be taken through an space

design elements that allow these paths to be more easily navigated and remembered

PATIENT RESPONSES & BEHAVIOUR

The patient responds to the environment in one or perhaps some combination of three ways

PHYSIOLOGICALLY

Physiological responses refer not only to the body's reaction to heat, cold and other sensory effects but also to the mind's limitation on processing information.

Environments can be so rich in spatial literacy that patients are unable to process them.

EMOTIONALLY

The emotional response a healthcare organisation wants is primarily the type that promotes patient healing and satisfaction (Fottler et al., 2000, p.98).

COGNITIVELY

Includes expectations of the environment based on both prior experiences of the patient and non-verbal communication evoked by the physical cues in the environment. Humans tend to seek points of similarity between new situations and what they have done, seen or experienced before.

The more familiar an organisation can make the experience, the less confusion, frustration and unhappiness customers will experience (Fottler et al., 2000, p.98).

7.2.3 ORIENTATION

Stress is a common reaction to unfamiliar buildings such as hospitals. Long hallways with no landmarks present multiple-choice points - creating the same problem as when one approaches a maze (Sternberg & Wilson, 2006, p.241). A big problem in hospitals is not knowing where to go and getting lost in hallways that all seem identical. Orientation is thus a vital design element to be studied.

7.2.3.1 CHALLENGES

Mediclinic Midstream appears to be a textbook example of this problem. Based on both personal experience and enquiring from users, it is clear that the design, layout and signage are problematic and cause a maze-like confusion.

7.2.3.2 EVIDENCE-BASED THEORY

7.2.3.2.1 DIALOGUE BETWEEN NEUROSCIENCE AND ARCHITECTURE

Collaboration between neuroscience and architecture allows for better understanding of the way in which humans perceive their physical environment. By applying the principles of neuroscience and focusing on perception and spatial orientation, it is possible to develop an informed design of spaces. Informed design then enables identification of the environmental features that will minimise negative physiological, cognitive and emotional effects (Sternberg & Wilson, 2006, p.239).

Factors that influence and create our environment are: firstly, the configuration of prominent stimuli or landmarks and, secondly, the paths that can be taken through these different spaces. Consequently, the individual characteristics of these factors influence the form and function of a space and create diverse spatial perceptions (Sternberg & Wilson, 2006, p.239).

7.2.3.2.2 THE HIPPOCAMPUS

An important finding in neurobiology relates to spatial memory. This finding was the identification of the involvement of the hippocampus in both navigation and the formation and retrieval of memory of autobiographical events (Jeffery and Hayman, 2004 cited in Sternberg & Wilson, 2006, p.239).

A connection exists between memory and sense of place, as the hippocampus is critical to the functioning of both. Therefore, consideration of the different factors that affect our memories helps to influence and improve the design of hospitals. Improved design greatly assists users in their ability to self-navigate these complex environments.

7.2.3.2.3 SPACE VERSUS PLACE

Space versus Place (creating a strong sense of being)

The internal representation of a place is heavily influenced by the way one moves within that place. Different places are connected based on the ability to move from one to the other. For example, two rooms separated by a glass wall are physically next to each other, but the hippocampus will treat them as separate places as one cannot move directly from the one to the other. Other factors, such as consistent paths of movement, may also serve to separate places within the hippocampus.



Environments should encourage free exploration and have design representations of “place” that are not strongly influenced by the paths used to navigate them. This may be applied in the design of spaces that are intended to enhance a sense of being within that environment rather than a feeling of “just passing through” (Sternberg & Wilson, 2006, p.240). It also highlights the benefits of designs that address both the functionality and aesthetic elements of a space. The functionality of a space – its topological characteristics – can be seen in movement and usage patterns. Its aesthetic elements - topographic characteristics – are defined by physical layout and form. A strong sense of place may result from effective integration of these factors (Sternberg & Wilson, 2006, p.241).

7.2.3.2.4 LANDMARKS OF ORIENTATION

Orientation and Place (landmarks help with orientation)

Landmarks contribute to a person’s sense of place by determining an individual’s location and orientation within an environment. “Head direction” neurons keep track of the direction a person is facing within an environment. These are, therefore, responsible for the internal sense of direction. Visual landmarks can keep people oriented as they move within and between environments. Windows that present distant, external landmarks support orientation and thus also the stability of spatial representations in the hippocampus. A strong sense of place is therefore reinforced. Although individual landmarks enable orientation within an environment, a configuration of multiple cues also contribute to evaluation of location.

What makes a place memorable?

Memory of a place does not consist of a single location but of a sequence of connected locations (Lee & Wilson, 2002). Therefore, the paths that will be taken through a space and the design elements that form these paths need to be carefully considered. Such consideration will allow for easy navigation and recall of paths. Each location (with its cues) serves as a landmark for segments of a route and is used to direct the user through a given space.

These landmarks can take the form of pictures, objects, distinct wall colours, or floor texture. These do not necessarily contribute to a sense of orientation but to sense of place. Sense of place is achieved through prominent local cues that establish uniquely memorable routes. Prominent local cues combined with distant cues (that strengthen a sense of orientation) enhance the “memorability” of an environment (Sternberg & Wilson, 2006, p.241).

7.2.3.3 WAY FINDING

7.2.3.3.1 PATIENT RESPONSES AND BEHAVIOUR

Patients respond to the environment in one, or a combination, of three ways: physiologically, emotionally and cognitively.

- **Physiological responses**

Physiological responses refer not only to the body’s reaction to heat, cold and other sensory effects but also to the mind’s limitation on processing

information. Primarily, the latter is a result of environmental effects on a patient’s ability to process information. These limitations cause patients to become frustrated, confused, lost or overwhelmed where there is either too much information or too many options. Environments can be so rich in spatial literacy that patients are unable to process them. As patients are required to make decisions as to their current location, spaces should be kept relatively simple and familiar.

- **Cognitive responses**

Cognitive responses include expectations of the environment based on both prior experiences of the patient and non-verbal communication evoked by the physical cues in the environment. Humans tend to seek points of similarity between new situations and what they have done, seen or experienced before. If patients expect to see a clean, well-decorated waiting room with current magazines and coffee, then they will not pay special attention to the fact that there is no television. Therefore, the more familiar an organisation can make the experience, the less confusion, frustration and unhappiness customers will experience (Fottler et al., 2000, p.98). Physical cues tap into the previous knowledge that shapes the customer’s belief of what the experience should be like. As with all other aspects of the experience, physical cues must be carefully constructed and managed to be consistent with the expected experience (Fottler et al., 2000, p.98).

- **Emotional response**

The customer/ user may react emotionally to the environment. A positive emotional response to the healthcare organisation is primarily that response which promotes patient healing and satisfaction (Fottler et al., 2000, p.98).

7.2.3.4 PROPOSED IMPLEMENTATION:

- A vertical wall will serve as a prominent landmark of orientation. Its location allows it to be experienced from within the building and from the outside - moving past it, through it, under it and over it. It can thus be perceived differently on each occasion, yet it consistently assists in the process of orientation as the user navigates the building.
- On plan, the ground floor seems to progress outward from the central atrium in layers of static and kinetic spaces. These layers are distinguished from one another through differing floor finishes. These differentiations are associated with different patterns of neural activity. The spaces:
 - Kinetic: A design with strong paths;
 - Static: Spaces of being - environments that encourage free exploration.
- Adequate signage, in accordance with standard regulation will be implemented throughout the building to assist patients.
- Each passage is designed a visual axis towards the outdoor gardens. The views will depict deciduous trees that grow and change colour with the seasons. This allows each passage a distinct appearance. Therefore, each has its own pattern of neural activity, which prevents a maze effect.
- Identical positioning of reception on each floor assists with cognitive response to these different environments.



SENSORY EXPERIENCE

2.4

An environment that is numbing to the senses is one of the negative aspects associated with healthcare environments. Conversely, hospitals are also capable of causing a sensory overload (Baker, 1984). It has been suggested that some care units may be hazardous to health due to the feelings of anxiety they create. Baker (1984) identified four variables that could affect patients negatively:

- (a) Lighting that alters circadian rhythms;
- (b) Perception of crowding brought on by the presence of unfamiliar people;
- (c) Smells and tactile sensations that may be unwelcome; and
- (d) Noise from a number of sources.

Two extremes are identified above: a numbing of the senses and sensory overload. It is therefore important to carefully consider how the healthcare environment affects users' senses. Healthcare environments can then, through intelligent design, be enhanced to the benefit of the patient.

The following senses are addressed in this chapter:

- Noise
- Aroma
- Temperature & ventilation
- Colour

Healthcare environments can be associated with two extremes:
a numbing of the senses
and
sensory overload

It is therefore important to carefully consider how the healthcare environment affects users' senses. Healthcare environments can then, through intelligent design, be enhanced to the benefit of the patient.

NOISE

Designing comfortable acoustic environments in the healthcare context can play a critical role in supporting the safety, health, healing, and well-being of occupants (Devlin & Arneil, 2003, p.680). In addition, maintaining speech privacy in healthcare settings has proved to reduce medical errors through the support of open conversations among patients, families and staff, which directly affects patient satisfaction and well-being (Ceilings & Interior Systems Construction Association, 2010, p.5).

NEGATIVE IMPLICATIONS OF NOISE

PATIENT PRIVACY & COMFORT

impact both patients' and their families' perception of privacy, comfort and security

ACOUSTICS IMPACT BOTH THE PHYSIOLOGICAL AND PSYCHOLOGICAL WELL-BEING OF PATIENTS

Sudden noises cause "startle reflexes", which lead to higher blood pressure and respiratory rates in patients.

Prolonged exposure to excessive noises levels may lead to: memory problems, irritation, impaired pain tolerance and perceptions of isolation.

It leads to sleep disruption and deprivation.
(Ceilings & Interior Systems Construction Association, 2010, p.5)

SPEECH INTELLIGIBILITY _ SAFETY

Speech intelligibility is an important safety concern to staff in healthcare environments. Staff must be able to understand and respond to many types of auditory signals. If speech intelligibility is not fully addressed, it may negatively impact patient care and safety. .

A study on nurses in neurological intensive care units showed negative effects of irritation, fatigue, distraction and tension headaches due to poor acoustic environments.
(Ceilings & Interior Systems Construction Association, 2010, p.6)

THREE MAIN PROPERTIES TO BE ADDRESSED IN HEALTHCARE ENVIRONMENTS

SOUND PRESSURE LEVELS (SPLS)

BACKGROUND NOISE

REVERBERATION TIME (RT)



AROMA

Claims have been made that pleasing aromas can reduce blood pressure; slow respiration rates; and lower pain-perception levels. A study did indicate that fragrances perceived as moderately to extremely pleasant lowered patient-rated anxiety during magnetic resonance imaging (Schweitzer et al., 2004, p.74).

Most important is the elimination of odours ("negative smells") that have been observed to stimulate anxiety, fear, and stress. This can be achieved through proper space programming, ventilation and hygiene.

TEMPERATURE & VENTILATION

Numerous claims have been made regarding the health benefits of fresh air. The energy efficiency and sustainable design ("green architecture") of a building can improve natural ventilation. Thus the energy efficiency of a building is increased and indoor environmental conditions are improved.

The U.S. Environmental Protection Agency (EPA) estimates indoor air pollution to be one of the top five environmental risks to public health. The EPA further stated that indoor air pollutants can cause eye, nose and throat irritation; headaches; loss of co-ordination; nausea; cancer; and damage to the liver, kidneys and central nervous system (Schweitzer et al., 2004, p.74).

THIS DESIGN SHOULD THEREFORE CREATE A BALANCE BETWEEN ZONED NATURAL VENTILATION AND MECHANICAL

7.2.4.1 NOISE (ACOUSTICS)

7.2.4.1.1 DEFINING NOISE

Noise is the presence of unwanted sound. Baker (1984) described the physical properties of noise as “non-periodic waveforms, random in fluctuation, not harmoniously related, that interfere with desired signals.” Annoyance is the psychological reaction to noise (Devlin & Arneill, 2003, p.677).

7.2.4.1.2 WHY NOISE MATTERS

Designing comfortable acoustic environments in the healthcare context can play a critical role in supporting the safety, health, healing, and well-being of occupants (Devlin & Arneill, 2003, p.680). In addition, maintaining speech privacy in healthcare settings has proved to reduce medical errors. The environment thus supports open conversations among patients, families and staff, which directly affects patient satisfaction and well-being. Patients who experience a lack of privacy tend not to disclose complete and specific information regarding their medical condition. The potential consequence is that they unknowingly place their health at risk (Ceilings & Interior Systems Construction Association, 2010, p.5).

7.2.4.1.3 EVIDENCE-BASED THEORIES

The effect of noise on the subjective quality of sleep was examined using a test-only experimental design with volunteers in a sleep lab. Volunteers were assigned to listen to audiotapes of either an actual critical care unit (CCU) or of quietness. Participants in the noise condition took longer to fall asleep; spent less time sleeping; and were awakened more often (Devlin & Arneill, 2003, p.677).

A survey of 100 nurses measured levels of stress and sensitivity to noise (Topf, 1988). Telephones, alarms in equipment and the beeping of patient monitors were identified as annoyances. A certain measure of burnout correlated with the degree of noise-induced stress. The study also pointed out that sounds that disturb staff (e.g., beeping alarms) may differ from those reported to disturb patients (e.g., loud talking in the hallway). Another report relating to this research on nurses focused on measures that concern personal health (Topf, 1988). It revealed that noise-induced stress could account for 6% of the independent variance in headaches on the job. Individual differences, such as sensitivity to noise, were also contributors. The author specified the requirement that this self-reported research be confirmed by experimental studies. Were experimental studies to be supportive, it could indicate the need for “acoustic modifications in the structure of critical care units and patient bedside equipment” (Devlin & Arneill, 2003, p.677; Schweitzer, et al., 2004, p.74; Topf, 1988).

Research indicates that even low noise levels of 40–58dB can impair health outcomes. In 1974 the U.S. Environmental Protection Agency (EPA) recommended that hospital noise levels not exceed 45dB during the day and 35dB at night. For acute care areas, the International Noise Council has suggested a maximum average of 45dB during daytime, 40dB in

the evening, and 20dB (a soft whisper) at night.

However, recent studies have indicated noise levels ranging from 60–84dB over a 24-hour period within the intensive care unit and an average night-time noise level of 67dB in acute-care and general medical units. Patients sleep poorly in the intensive care unit and CCU and indications are that the main contributing factors are noise, pain and environmental temperature. Similar research showed that the number of night time disturbances is significantly greater in the hospital than at home. (Schweitzer et al., 2004, p.74).

7.2.4.1.4 NEGATIVE IMPLICATIONS OF NOISE

- Noise is not only an annoyance but also has the potential to affect the healing process (Devlin & Arneill 2003, p.677).
- According to Schweitzer et al. (2004, p.74), noise in hospitals is considered a negative environmental characteristic. Its presence appears to: increase patients’ perception of pain; increase the use of pain medications; and contribute to sleep deprivation. In certain cases, it may also cause patient confusion and disorientation. This study (Schweitzer et al., 2004, p.74) further indicated that noise disturbance also contributes to increased length of hospital stays; due to patients suffering from either poor sleeping patterns or deprivation of sleep.
- Shared rooms have been shown to be less than ideal. Noise from fellow patients, their visitors or attending staff can be particularly stressful. Patients have little or no control over these auditory intrusions; leaving them feeling like victims of circumstance (Schweitzer et al., 2004, p.74).
- Speech intelligibility is an important safety concern to staff in healthcare environments. Staff must be able to understand and respond to many types of auditory signals within their working environment. If speech intelligibility is not fully addressed, it may negatively impact patient care and safety (Ceilings & Interior Systems Construction Association, 2010, p.6). A study on nurses in neurological intensive care units showed negative effects of irritation, fatigue, distraction and tension headaches due to poor acoustic environments.
- Research suggests that high noise levels reduce patient satisfaction. Noisy environments cause people to become less interpersonally engaged, less caring and less reflective. A noisy environment also impedes cognition; leads to a loss of perseverance in addressing complex tasks; and creates a tendency for users to seek simple solutions (Schweitzer et al., 2004, p.74).

7.2.4.1.5 POSITIVE IMPLICATIONS OF NATURAL SOUNDS

Less extensive research has been conducted on the positive effects of sound. It can be assumed that natural sounds have a calming, relaxing effect that in turn improves sleep quality. Research has proved this to be the case when considering patients who are recovering from surgery (Schweitzer et al., 2004, p.74).

7.2.4.1.6 RECOMMENDED IMPROVEMENT THROUGH DESIGN

- Studies in a healthcare unit fitted with sound-absorbing ceiling tiles indicated that patients felt medical staff had better attitudes in comparison to medical staff in units with sound-reflecting ceiling tiles (Ceilings & Interior Systems Construction Association, 2010, p.7).

7.2.4.1.7 DESIGN SUGGESTIONS

Design details

- A number of smaller design details, which significantly affect acoustics, have been identified. These include: closing doors when possible; reducing the ringtone volume on telephones; and dimming lights (people have a natural tendency to lower their voices in dimly lit areas). (Devlin & Arneill, 2003, p.677).

Single rooms

- The ratio between number of patients and equipment per room suggests the design of single-rooms is preferable when aiming to reduce noise levels (Devlin & Arneill, 2003, p.677).

Adequate speech privacy

- Adequate speech privacy can be accomplished in both open- and enclosed spaces. It can be effected through: the provision of single-occupancy patient rooms; private discussion areas; effective space planning; appropriate partition placement; room finish specification; and sound-masking system selection (Ceilings & Interior Systems Construction Association, 2010, p.22).

7.2.4.1.8 CURRENT DESIGN APPLICATION

Floor specification to minimise the generation of noise:

- 3.4mm thick × 2.0m wide Sarlon Trafic 19dB acoustic heterogeneous vinyl sheeting with OVERCLEAN XL surface treatment.
- Floorworx manufactured in accordance with EN 651 and laid in Floorworx No.62 acrylic adhesive. Adhesive must be spread using a trowel fitted with an A2 notched blade at a rate of between 5.5m² and 6.5m² per litre on a previously prepared Class 1 sub-floor in accordance with SANS 10070. Floorworx Self Leveller can be used for preparation, when required, including all cutting and waste. The sheeting must be rolled in both directions with an articulated 68kg three-sectional roller immediately after it has been laid into the adhesive. Joins must be butted, grooved and heat welded using the manufacturer’s welding rod, ensuring that the welding rod bonds to more than 70% of the sheet thickness.

Suspended ceiling specification to maximise sound absorption within spaces:

- 600 × 1200 “ECOPHON HYGIENE CLINIC AC1” suspended ceiling tiles laid in a hygiene clinic system grid. Ceiling at 2 550mm UFFL installed in accordance with manufacture’s specifications.

Partitions in rooms to be constructed of materials that can deflect and/ or dampen noise.

•Wall surfaces in main circulation passage routes to be constructed of material that absorbs noise and prevents reverberation.

7.2.4.2 AROMA

Aromas in the healthcare environment will not be addressed in detail, but smell is recognised and acknowledged as one of our senses. Claims have been made that pleasing aromas can reduce blood pressure; slow respiration rates; and lower pain-perception levels. A study did indicate that fragrances perceived as moderately to extremely pleasant lowered patient-rated anxiety during magnetic resonance imaging (Schweitzer et al., 2004, p.74). Most important is the elimination of odours (“negative smells”) that have been observed to stimulate anxiety, fear, and stress. This can be achieved through proper space programming, ventilation and hygiene.

7.2.4.3 TEMPERATURE AND VENTILATION

Numerous claims have been made regarding the health benefits of fresh air. The energy efficiency and sustainable design (“green architecture”) of a building can improve natural ventilation. Thus the energy efficiency of a building is increased and indoor environmental conditions are improved. (Schweitzer et al., 2004, p.74).

This design should therefore create a balance between zoned natural ventilation and mechanical ventilation.

7.2.4.4 COLOUR

7.2.4.4.1 INTRODUCTION

In order to fully understand the different effects of colour, more research studies will have to be conducted. Colour is considered one of the most important tools designers can use to create ambience within a space. A designed and created space profoundly influences its inhabitants, therefore colour must be considered as fundamental in creating optimal healing environments (Jonas & Chez, 2004, p.1).

7.2.4.4.2 EVIDENCE-BASED THEORY

Studies on colour and colour psychology have concluded that colours have an effect on people. Colours evoke certain associations and direct connections have been made to different moods and temperaments (Babin, 2013, p.1).

Horsburgh (1995) stated that

“Appropriate facility design can positively influence wellness, the healing process, and management of patient care.”

Therefore, the use of colour and its known effects need to be considered both psychologically and therapeutically (Horsburgh, 1995).

Babin (2013) stated,

“...in healthcare environments, colour is of equal importance to other design elements, due to the fact that it has the ability to heal and to comfort.”

Babin’s primary objective was to determine how colour affects personal perception of a healthcare environment. A survey was conducted to determine colour preference and sensory reactions to healthcare environments in order to help determine a more precise model of the ideal healthcare setting.

“Colour in itself is a tool for the ambience we wish to choose,” and finding a way to use it is the key to separating a functional space from good design (Mahnke, 1996, p.130; Babin, 2013, p.26).

7.2.4.4.3 FURTHER STUDIES RECOMMENDED THE FOLLOWING:

- It is important to specify soothing and comforting colours and furniture in patient rooms (Steelcase Health, 2015, p.61).
- The infusion treatment room should, where possible, consist of colours, materials, lighting and furnishings that will create a welcoming, relaxing space instead of an overpoweringly clinical space (Steelcase Health, 2015, p.77).
- The physical and emotional comfort of individuals within transition spaces is crucial. Comfort can be achieved through environmental distractions and choice (the provision of an element of control has been shown to decrease stress and anxiety in patients). Colours, materials, textures, lighting and views that are calm and soothing make transition spaces less intimidating and help to put people at ease (Steelcase Health, 2015, p.91).
- Although there is a lack of evidence-based research, it is important to maintain a psychologically warm atmosphere, which requires the use of “warm” rather than “cool” colours. These colours should, however, be muted (as bright or dominant colours can create anxiety) (Block et al., 2004, p.7).
- Caution should be used when using different shades of grey as they could easily be associated with depression (Block et al., 2004, p.7).
- Avocado and yellow-greens tones are associated with nausea and therefore should be strongly avoided in spaces such as chemotherapy treatment rooms (Block et al., 2004, p.7).

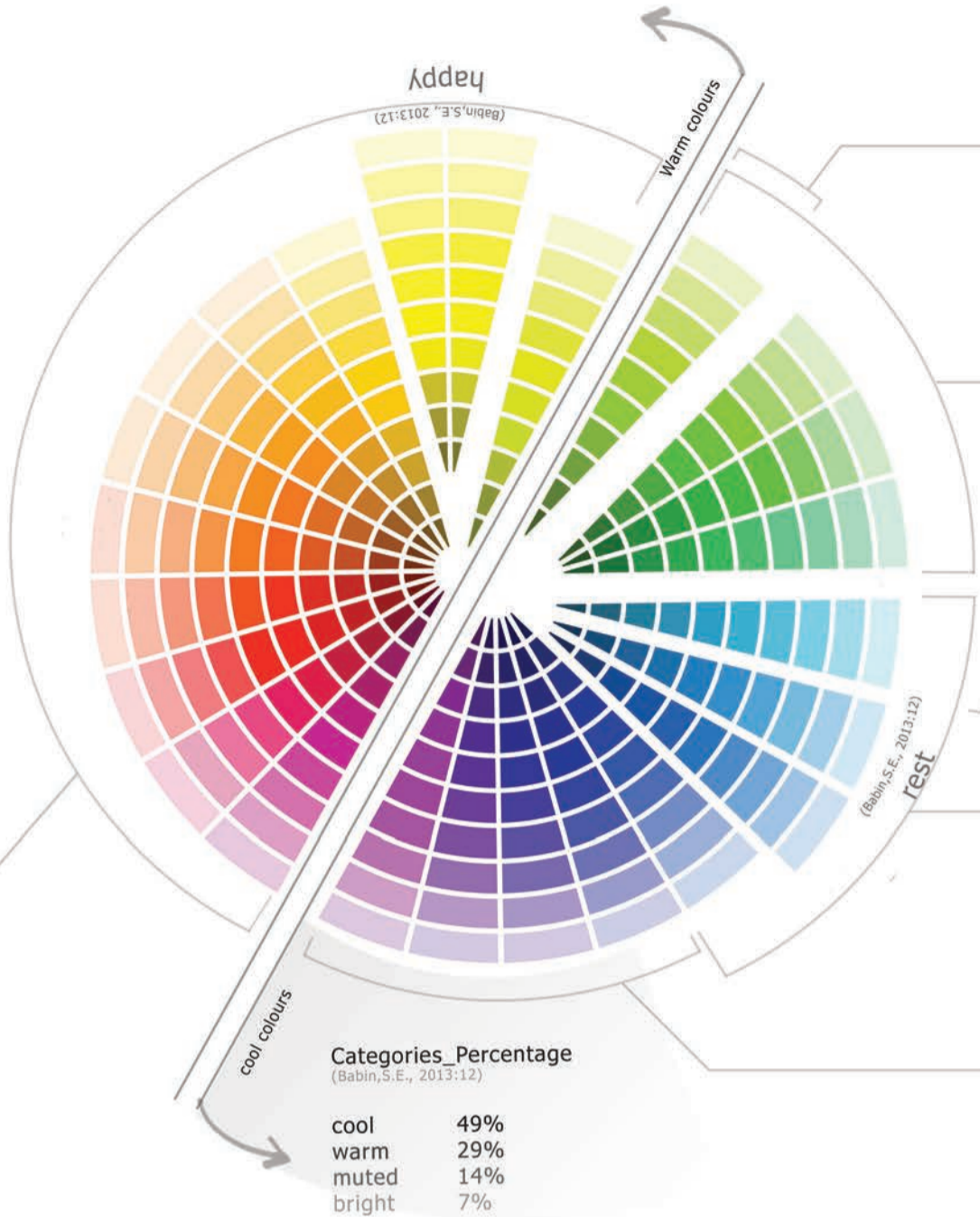
7.2.4.4.4 IMPLEMENTATION

In this study, colour was not used directly with any specific meaning connected to it. Colour was rather employed as a key component in creating a very specific ambience of tranquillity within the healing environment. Colours and different tones are used not only to distinguish environments from one another but also to create the complexity of a certain environment.



7.2.4.4 COLOUR

7.2.4.4



Categories_Percentage
(Babin, S.E., 2013:12)

cool	49%
warm	29%
muted	14%
bright	7%

It is important to maintain a psychologically warm atmosphere, which requires the use of more "warm" colours rather than "cool". However they should be muted therefore not bright or dominant, that will create anxiety. (Block, et al., 2004:7)

COOL COLOUR
MUTED (DULUX, 2015)

LIME

GREEN

TEALS

BLUE

VIOLET

THEORY

Avocado and yellow-greens tones are associated with nausea and therefore should be strongly avoided in space such as chemotherapy treatment rooms. (Block, et al., 2004:7)

MEDICLINIC
EXPERTISE YOU CAN TRUST.

Mediclinic's colours derived from photos and website graphics; Greens incorporated in plants within interiors

MEDICLINIC
EXPERTISE YOU CAN TRUST.

Mediclinic's colours derived from photos and website graphics; Blues found in signage

COOL NEUTRALS

WHITE

So to conclude light, cool colours are safe, when balanced with neutral and modern finishes, they create the best, most generic space for people of all ages and conditions. Still recognising the fact that we still need to develop studies that will help to full understand colour in order to continuously change our surroundings as time goes on. (Babin, S.E., 2013:26)

White associated with hygiene and "clean" (Babin, S.E., 2013:12)

Majority of Mediclinic Midstream's interiors as white with hints of grey in signage and detailing.

Caution should be taken when using different shades of grey as they could easily be associated with depression. (Block, et al., 2004:7)

Infographic 7.5 Colours (Author, 2016)

7.2.5 SPATIAL COMPLEXITY



The table below is based on Davidson, A W's research and Shannon's Theory. It contains both objective as well as subjective calculations that will assist in creating a variety of different interior space, that will provide different intensities of sensory stimulation on individual patients. This table is further elaborated on in the text to follow.

INTAGNABLE	TAGNABLE	CHARACTERISTICS OF ENABLERS				
		An estimate of the contribution to environmental complexity of the internal structure of enabler (objects) is further included. This was specified by describing several object attributes				
SPATIAL LITERACY (LITERIC LAYERING)	NUMBER OF SPATIAL ENABLERS (OBJECTS)	NUMBER OF POSSIBLE POSITIONS & ROTATIONS OF ENABLERS	SHAPE	TEXTURE	MOTION	PATTERN
<p>Shannon's theory: The amount of information increases & decreases the number of possible messages. The greater set of possible messages, the greater uncertainty the higher the information content in message however patterns in messages can be recognised.</p>	<p>The number of enablers (objects) of a similar type, multiplies the complexity of a space therefore a cluttered environments are complex</p>	<p>The information theory is formalized by counting the number of distinct possible environments. Therefore the number of possible positions (locations) and rotations are considered</p>	<p>can vary from a primitive shape (circle, triangle, square) to one with many curves and angles</p> <ol style="list-style-type: none"> 	<p>can range from flat and smooth to a rough and varied surface</p>	<p>may vary from stationary to dynamic - a rocking chair, plant, or television</p>	<p>can range from one solid colour to a multi-coloured weaving composed of many discernible small patterns</p>
SUBJECTIVE	OBJECTIVE		SUBJECTIVE			

SPATIAL COMPLEXITY CALCULATIONS

Number of spatial enablers X (log₂ Positions + log₂ Rotations + Shape + Texture + Motion + Pattern) = Complexity of Object Type.

SPATIAL COMPLEXITY RATING EXAMPLES

		log ₂ Positions + log ₂ Rotations				
1. Pebble-shaped seats convey message of lying & relaxation	-Pebble-shaped seats =4	log ₂ (7) + log ₂ (4) = 3 + 2 = 5	4	4	0	0
	-Structures = 2	log ₂ (5) + log ₂ (10) = 2 + 3 = 5	6	2	0	2
2. Structures in the background provide a surface for items, perhaps books for reading	-Lights =2	log ₂ (15) + log ₂ (0) = 4 + 0 = 4	1	0	0	0
	-Wall types = 1	log ₂ (0) + log ₂ (0) = 0 + 0 = 0	1	6	0	0
Total = 2	Space as a whole	-	-	-	-	-
		log ₂ Positions + log ₂ Rotations				
1. Seating configuration suggests waiting area	-Wooden circulation =2	log ₂ (1) + log ₂ (1) = 0 + 0 = 0	8	2	1	8
2. Desk represents a reception	-Seating = 9	log ₂ (2) + log ₂ (4) = 1 + 2 = 3	3	3	1	0
3. Wooden stairs and circulation send the message of a restricted busy environment	-Lighting (louvers) =2	log ₂ (1) + log ₂ (20) = 0 + 4 = 4	3	0	9	7
	-Wall image = 1	log ₂ (1) + log ₂ (0) = 0 + 0 = 0	1	1	0	0
	-Desk =1	log ₂ (3) + log ₂ (0) = 2 + 0 = 2	2	2	0	0
Total = 3	Space as a whole	-	-	-	-	-



7.2.5

NATURE	COLOUR	LIGHTING EFFECTS	SOUND	SMELL	TASTE	VARIETY OF SPATIAL COMPLEXITY	
						complexity of an	enabler type of enabler
						<i>mild</i>	
						0-235	
						<i>moderate</i>	
						235-255	
						<i>complex</i>	
						255-270	
						<i>super complex</i>	
						270-___	

estimated rating for each intensity

0	4	3	-	-	-	20	80
0	6	0	-	-	-	21	42
0	2	0	-	-	-	7	14
0	2	0	-	-	-	9	9
-	-	-	0	0	0	3	3
0	3	1	-	-	-	23	46
0	8	0	-	-	-	18	162
0	2	9	-	-	-	34	68
0	2	0	-	-	-	4	4
0	2	0	-	-	-	8	8
-	-	-	5	0	0	7	7



148



295

Infographic 7.6 Environmental Complexity (Author, 2016)



7.2.5 ENVIRONMENTAL COMPLEXITY

7.2.5 ENVIRONMENTAL COMPLEXITY

Hospitals are known to be numbing to the senses, but this study intends to counteract this through the implementation of interdependent elements as identified in Chapter 7. There is also, however, the possibility of sensory overload in hospitals. To control the intensity of an environment and (more importantly) create a variety of environmental intensities, it becomes critical to determine a means of measuring the environmental complexity of a space. There are many unscientific assertions of various spaces with different “environments complexities” that are nevertheless clearly beneficial to patients’ general mood and functioning (Schweitzer et al., 2004, p.74; Davidson & Bar-Yam, n.d., p.1).

7.2.5.1 THE IMPLEMENTATION OF THE STUDY - ENVIRONMENTAL COMPLEXITY: INFORMATION FOR HUMAN-ENVIRONMENT WELL-BEING BY ALICE WARE DAVIDSON

Davidson’s research gave evidence that an environment’s complexity influences cognitive function and well-being. It is, however, the methods used to determine this complexity that are of most value here - how environmental complexity can quantify the notion of sensory deprivation or stimulation (Davidson & Bar-Yam, n.d., p.1).

7.2.5.1.1 CALCULATING

There are various approaches to quantifying the complexity of physical systems. Davidson used the quantitative measure of complexity, which is based on Shannon’s theory of information (Shannon, 1948). The basic principle of this approach: as the amount of information increases so does the amount of possible messages; the greater set of possible messages leads to greater uncertainty on the part of the recipient. Algorithmic complexity allows for regularities/patterns in a message to be recognised, which consequently decreases the amount of information in a message – making it predictable and reducing uncertainty (Davidson & Bar-Yam, n.d., p.3).

In the Davidson study, environmental complexity is determined by estimating the number of distinct environments that can be created by the arrangement of objects in an environment (Davidson & Bar-Yam, n.d., p.3). Environmental complexity is thus dominated by the amount of objects in an environment - an empty environment is simple and a cluttered one complex.

7.2.5.1.2 MEASURES OF COMPLEXITY, IN DAVIDSON’S STUDY

- Qualitative Measure of Environmental Complexity.

Environments were assessed qualitatively. The degree of aesthetic appeal was determined by a panel of experts; an architect, an interior designer and an environmental researcher. They rated each environment: firstly, on complexity and secondly, on aesthetic appeal on a visual analogy line (VAL). 0 being not complex/ aesthetic at all and 100 being extremely complex/ aesthetic. From this a mean

was determined for both complexity and aesthetic. This measure is a semi-quantitative measure of complexity based on intuition (Davidson & Bar-Yam, n.d., p.4).

- Quantitative Measure of Environmental Complexity.

In the same environments, the number of possible positions and rotations for each object was determined. Each object also has internal structures that affect environmental complexity. The shape, texture, pattern and motion of objects were thus assigned an estimate of intensity, which was then multiplied by the number of objects (Davidson & Bar-Yam, n.d., p.4).

This calculation is demonstrated in Table 7.3 below:

Table 7.1 Complexity calculation table (Davidson & Bar-Yam, n.d.)

The calculation of the complexity for a particular object type corresponds to the expression: Number of objects x (\log_2 Positions + \log_2 Rotations + Shape + Texture + Motion + Pattern) = Complexity of Object Type.

Object Type	Number of Objects	Positions	$\log_2 P$	Rotations	$\log_2 R$	Shape	Texture	Motion	Pattern	Complexity of object	Complexity of object type
Clock	1	10	3.3	24	4.6	2	1	4	2	16.9	16.9
Window	1	4	2	8	3	10	2	9	20	46.0	46
Tables	3	20	4.3	2	1	2	2	0	2	11.3	34
TV	1	5	2.3	4	2	2	1	8	20	35.3	35
Pictures	3	20	4.3	10	2.3	2	1	0	10	20.6	62
Sm objs	31	20	4.3	15	3.9	8	2	0	10	28.2	875
Papers	5	20	4.3	6	2.6	2	1	0	20	29.9	150
Books	4	20	4.3	4	2	2	1	0	20	29.3	117
Total Complexity for Living Room of Participant 1										(Sum of complexities of all object types) = 1336	



7.2.5.2 SPATIAL COMPLEXITY FOR THIS STUDY

After studying the above information, a spatial complexity table was drawn up (Table 7) seen on the previous page. It is based on Davidson's qualitative measure of environmental complexity and is used to calculate the complexity of different spaces within this study. Additions were made to the table: firstly, the spatial literacy column that counts the number of possible messages the space could convey that impacts the complexity of the space (connecting to Shannon's Theory). Secondly, elements highlighted in Chapter 7 were also brought into consideration, such as lighting effects, presence of nature, sound, smell and taste, each with their own column and relevant impact on complexity. Sound, smell, colour and taste were not rated as objects, but rather on the space as a whole. The table contains both subjective and objective calculations. This is acceptable since the aim is to differentiate between different environments and not to calculate the absolute values of the numbers obtained. It is therefore important to be consistent with calculations. From the calculations, one environment's complexity can be compared to another's. This complexity could be greater or smaller, which allows the design to create a variety of spaces with different complexities.

The following must be taken into consideration: sensory variations in ambient conditions (such as light levels or temperature) between different spaces and over time is favoured by building occupants (Schweitzer et al., 2004, p.74). There is evidence that a variety of spaces (visually accessible versus visually enclosed) and "multiple sensory retreats" in a building are necessary for emotional and cognitive functioning and may affect immune-system function. Research done by Smith found that patients could *"rest better in a hospital environment with varied patterns of auditory input (music or stories) than with quiet ambience"*

(cited in Schweitzer et al., 2004, p.74).

This table (based on objective and subjective calculations) will thus assist in creating a variety of different interior spaces that can provide varying intensities of sensory stimulation for individual patients.



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