

## ECO-DESIGN SALUTOGENIC OUTCOME

*Creating healthy environments*

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# The Beneficial Health Outcomes of Salutogenic Design

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“We shape our  
buildings;  
thereafter,  
they shape us.”

(Sir Winston Churchill)

**T**here is an urgent and ever-growing awareness world wide of the need to invest in healthy and sustainable infrastructure. By applying salutogenic design principles that seek to promote greater health, this landmark shift can begin to occur. The resulting and striking healthful outcomes of such existing structures bring these concepts to the forefront of global building opportunities. This approach now comprises the leading edge of change in our society. By embracing these precepts to shape our built environments and infrastructure, we engage in shifting the quality of such environments. Salutogenic architecture is taking its rightful place in the vanguard of preventative care strategies that have the potential to change our lifestyle for the better.

Health has become a commodity that is not equally distributed within society. Certain groups of individuals are more successful than others in having access to proper health-related knowledge and information. This data gathering is very often supported by a healthier lifestyle, in combination with lower exposure to risk factors within the built environment.

The author discusses the principles and ideas for a salutogenic design approach in planning future built environments with one simple goal: to create a healthier society. For design professionals (architects, planners, designers et al), the focus upon and concern for designing a sustainable healthy future society is the most compelling task to be addressed and implemented in all societal sectors where human beings live work and play.

## Introduction

In 1997, the World Health Organization identified that the health “arena” should include these frequently used priority spaces: the workplace, schools, hospitals, correctional institutions, commercial offices, public spaces within our towns and cities, and indeed

our own homes as the apex of health promotional activities in the 21st century.

During the 66th General Assembly Meeting of the United Nations in September 2011, the socio-economic challenge of non-communicable diseases was discussed for the first time. The author argues that built environments have a significant impact upon human health and states his commitment to bringing this understanding to the design and health professions to help reduce the prevalence of lifestyle diseases that are becoming the major health problem in our planet. Embracing a salutogenic approach when shaping our built environments creates a preventative care strategy that changes the current focus from risk factors and treatment of disease to a more holistic understanding and evolution towards a healthier society.

For this shift to occur, there must be an ever-increasing emphasis on promotion of a healthful society that is supported by investment in healthy and sustainable public, social, institutional and domestic infrastructure. Research on the salutogenic direction highlights the impact that design factors can have, inspiring both designer and planner to create a healthy society.

For the designer, the compelling question is: “How do we design for a sustainable healthy future?” First of all, we need to envision how such architecture might look if it is to be sustainable and salutogenic. This query necessitates an expanded understanding by addressing the health consequences of architectural design’s functions and processes. This shift includes finding new models for design, seeking new construction and production systems, materials and processes, along with the action we must take to realize this new vision with comprehensive salutogenic strategies.

On a global level, businesses and industries face similar concerns – seeking to understand the environmental consequences of their workplace, with

new business models, new production systems, materials and processes for better health performance.

The salutogenic design approach becomes an opportunity for the architectural profession to not only help the world with its problems, but also to stop creating new issues. Salutogenic design must become the core essence of all architecture, changing the way we design. But how should we shape our future environment so it responds to the pressing demands of our society?

We are living in a post-industrial age amidst the knowledge (Google) society; in this milieu, architecture should provide positive stimuli that promote creativity. Therefore a new way of looking at the role of the built environment is required within the context of health and well-being: this new perspective is Salutogenic design.

Salutogenic design highlights the impact of design factors that inspire both the designer and planner to create a healthy society: (1) by developing healthy urban design that stimulates healthy behavior and thereby (2) supporting the prevention of diseases and the promotion of health. Increased consideration of a salutogenic design approach leads to social innovation. Salutogenic design requires an interdisciplinary application of psychosocial factors with architecture that actually promote a healthy lifestyle. In order to reduce the global burden of disease in an efficient way, major investments need to be made in the promotion of healthy lifestyles and development of healthy spaces.

### **Theoretical Framework of Design and Health**

Promoting healthy lifestyle and spaces depends upon ecological designs with infrastructure that creates clean air, clean water, clean food and clean land – through water management and retention, natural heating and cooling, and renewable energy – which in turn are necessary for human health. These

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life-giving principles are intertwined with those of salutogenic design, which supports human health in daily behavior (Ken Yeang, Design and Health, WCDH2012). Improving population health as the foundation for social and economic development will only be achieved through salutogenic and ecological design principles. Salutogenic design can provide social organization, structure and function in society while ecological design works to continually restore the natural environment.

Ken Yeang, the father of eco architecture, linked the relationship between an ideal building and its environment to a human being with a prosthetic device. He considers that only if the device is in complete harmony with the body will it function optimally. In the same way, nature can be considered as the “host organism” to manmade infrastructure, with the same level of biointegration required if the whole system is to succeed.

The world requires a new paradigm, and the creation of a healthy global society is a vision we should all embrace. Ecological design deals with infrastructure that creates clean air, clean water, clean food and clean land – and these ideals are focused on achieving an ideal interaction between the built and the natural environment.

Research has shown that well-designed and people-friendly spaces stimulate walking, cycling and the use of public transportation. High levels of greenery also encourage physical activity, which lowers blood pressure, decreases the risk of heart disease, stroke and diabetes, and prevents falls in the elderly. Evidence also shows that attractive and open public spaces reduce mental fatigue and stress.

All these elements contribute to a reduction in the burden of disease, which may eventually reduce the costs of healthcare. “Global health means making major investments in the promotion of healthy lifestyles throughout the world and the development of healthy spaces to reduce the burden of disease.” Julio Frenk, Dean of Public Health at Harvard University told Alan Dilani in an interview for World Health Design, October 2010.

Largely informed by global recognition of the urgent need to reshape our built environment and tackle the 21st century challenges of chronic- and non-communicable diseases, The International Academy for Design and Health has undertaken nearly two decades of dialogue and interdisciplinary, research-based design. While significant progress has been achieved to understand the value of salutogenic and eco design, there are still inadequacies when it comes to implementation.

One of the most pressing subjects is the rehabilitation of our existing cities and built environments into eco-cities that can actually create healthy societies. We need the new generation of designers, architects and engineers to learn how to apply ecological and salutogenic design principles in their work. In the meantime, we also need the support of governments around the world to understand the value of manifesting a healthy and sustainable society.

Science, research and innovation in eco design, as well as development of the built environment, includes hospitals, schools, workplaces, public places and urban spaces and must drive the policies and building practices of national governments. The author continues the search for a common strategy that is based on eco design, alongside salutogenic principles, to effectively create a healthy global society.

### The Principles of Salutogenic Design

Despite improvements in the health status and life expectancy of people from developed countries living in the 20<sup>th</sup> century, global healthcare systems face new challenges. These are characterized by increasing healthcare costs, an aging population and a rise in the level of lifestyle diseases, most notably diabetes and obesity.

We are living in a post-industrial age, known as the ‘knowledge’ or ‘Google’ society, where health policy should be focusing upon providing “wellness” as well as treating illness. We need to design healthcare infrastructure and city master plans that help prevent disease by creating an active life in which people walk and have exposure to positive stimuli from the beauty of urban design. This formula requires a new way to look at the impact of architecture and design so it truly promotes and supports human health and well-being.

We call this ‘health-promoting’ or the salutogenic design approach to architecture and urban planning; it is completely compatible with eco design and sustainability. Greater consideration of the possibilities of salutogenic architecture lead to social innovation and economic growth through an interdisciplinary application of sciences, such as architecture, medicine, public health, psychology, design and engineering in connection with culture, art and music.

Colleagues from government municipal and health departments, universities, health providers, and industries are the main figures who are responsible to connect with designers and architects, planners and engineers to discuss the following: how can science, research and innovation in the field of eco design and salutogenic

principles drive the development of healthy built environments and city infrastructures in our society?

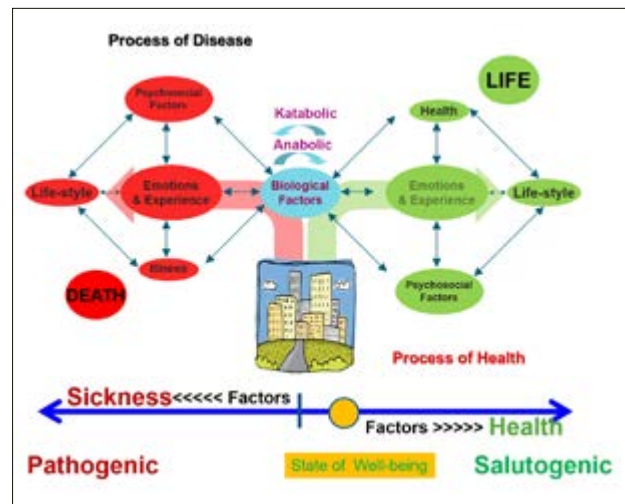
Let us explore here the principles of salutogenic design that lend clarity to the following topics:

- How do we embed health, science and innovation in the creation of healthy built environments?
- How do we plan our city, workplace, healthcare facilities, schools and public institutions so they successfully support human health and well being?
- How do we implement research-based design to promote health and wellness?

### Definitions of Health and Salutogenesis

According to Ewles and Simmet (1994), health is difficult to define since it is a subjective experience. It is affected by norms and expectations – and it is also formed by previous experiences (ibid.). The following are different definitions of health:

- Lawrence has defined health as “a condition where resources are developed in the relationship between humans and their biological, chemical, physical and social environment”, (Lawrence, R.J. 2002).
- According to WHO, “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”
- “The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being, without distinction of race, religion, political belief, economic or social condition.” Preamble of World Health Organization Constitution, 1948.



The processes of health and disease

According to Dilani (2001), the model (see figure on page 14) describes how the physical environment is the foundation upon which the social organization, structure and function is built in our society – and in the long run, it promotes either health or disease. The model is used within the field of architecture to integrate design elements with health and well being.

Health is considered a process composed of psychosocial factors, lifestyle, emotions and experiences that lead to either disease or health. But there are also the biological and measurable factors between them that determine the status of health or disease. The state of health for each of us is matter of the balance between the two processes. The ‘salutogenic’ approach strengthens health processes, whereas the pathogenic approach highlights the process of diseases. For the latter, medical scientists have found 8,000 diagnoses or symptom of diseases; but medical science has ignored the search for the *causes* of health. They could also identify 8,000 causes of health or wellness factor that could lead to a healthier society.

Emotions and experiences are central parts of the health process and can be strengthened by exposure to positive stimuli from surrounding environments where we live, work and play.

Health can be divided into two different perspectives: the biomedical and the holistic. From a biomedical viewpoint, health is considered to be a condition without diseases (Andersen, Göransson & Petersson, 2004). In the western world, the biomedical perspective has been the leading perspective, and has therefore informed the medical and healthcare field (Nordenfelt, 1991).

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The holistic viewpoint emphasizes multiple dimensions of health, including the physical, psychological, emotional, spiritual and social (ibid.). From a research perspective, health can be divided into a pathogenic and salutogenic starting point. Pathogenic research focuses on explaining why certain etiological factors cause disease and how they are developed in the physiological organism (Anton-

ovsky, 1979). The primary aim of pathogenic research is often to find medical treatments (ibid.).

Salutogenic research is based on identifying wellness factors that maintain and promote health, rather than investigating factors that cause disease (Antonovsky, 1991). Together, the salutogenic and the pathogenic approach offer a deeper knowledge and understanding of health and disease (ibid.). To be able to answer the salutogenic question, we must ask, “What is causing and maintaining healthy people?”

Antonovsky (1991) developed the concept of a sense of coherence (SOC). It maintains that a person with a high sense of coherence chooses the most appropriate coping strategy in a stressful situation. For example, the person may decide to fight, flee or be quiet, depending on what kind of stressor the individual is exposed to (ibid.). Research has shown that it is possible to measure a person’s sense of coherence and thereby predict an individual’s health (Suominen, Helenius, Blomberg, Uutela & Koskenvuo, 2001).

A strong sense of coherence predicts good health and a low sense of coherence predicts poor health (ibid.). In his study, Heiman (2004) showed that students with a high sense of coherence did not experience high levels of stress. The research also showed that coping strategies were significantly correlated with the individual’s sense of coherence (ibid.). The concept of sense of coherence has three vital components: (1) comprehensibility, (2) manageability and (3) meaningfulness (Antonovsky, 1991). A person with a strong sense of coherence scores high on all three components.

According to Antonovsky (1991), the term comprehensibility implies that the individual perceives the surrounding environment and that which is happening in the world as coherent. If something unexpected is happening, such as an accident or personal failure, the person who understands why these things are happening has a higher sense of coherence than one who cannot. A person with a low sense of coherence perceives himself as unlucky.

Manageability means that the individual experiences that she has all the required resources necessary to cope with a given challenge or demand. This means that the individual feels that she is influencing that which is happening around her and does not perceive herself as a victim of circumstance. Antonovsky (1991), believes that a person’s sense of meaningfulness is connected to his or her perception that there are important and meaningful phenomena in life. Meaningfulness is the component that motivates a person’s sense of coherence (ibid.).

According to the salutogenic theory, a sense of coherence is fostered by people’s ability to compre-

hend the built environment (comprehensibility), to be effective in his behavior (manageability) and to find meaning from the stimuli and exposure from their built environment (meaningfulness).

Ken Yeang (2015) describes the key salutogenic components as the following:

(1) 'environmental comprehensibility' that requires environmental orderliness, predictability and legibility. This includes, for instance, the importance of creating visual order in the built environment with legible, intuitive way-finding, the elimination of visual chaos, etc. (2) 'Environmental manageability' requires effective family and social support, and (3) 'Environmental meaningfulness' requires the provision of visual and aesthetic meaning, interest, satisfaction and attendant spaces for contemplation in the urban environment.

## Impact of Built Environment on Health and Well Being

There is an interaction between the health of human beings and their built environment. According to Dilani (2006), the physical environment is not only vital for good health, but can also be a critical stressor for the individual. Physical elements in an organization can contribute to stress, and therefore are essential design factors that are increasing comfort (Dilani, 2001).

Despite this reality, the majority of humans in the western world spend most of their time in indoor environments. There is a lack of knowledge about how these environments affect a person's health and wellbeing. There is a general belief that humans are always adapting to the environment (ibid.). Often called the theory of adaptation, this belief indicates that people become less conscious of the environment the longer they reside or work in that given environment (Carnvale, 1992). A general belief is that if one lets oneself be affected by the physical surroundings, it is a sign of weakness.

In order to create supportive physical environments, it is crucial to understand an individual's fundamental needs (Heerwagen et al., 1995). It is also necessary for different professional disciplines to willingly cooperate in creating the best conditions for humans (Heerwagen et al. 1995; Lawrence, 2002). Before a zoo is built, it is common practice for architects, designers, biologists, landscape architects, animal psychologists and building specialists to collaborate in creating an environment that optimizes living conditions for the animals (Heerwagen et al., 1995). Factors such as materials, vegetation and lighting are

taken into consideration; animals need enough space to eat, sleep and decide when to be social or seek solitude, and even their need for control and choice have been noticed. The aim is to create an environment that will completely support the animal's physical, psychological and social wellbeing. Ironically, humans do not seem to make the same demands when a workplace for people is going to be designed.

Heerwagen et al. (1995), created a framework and guidelines for a salutogenic design which highlighted the following factors: (1) Social cohesion, both formal and informal meeting points; (2) Personal control for regulating lighting, daylight, sound, temperature, and access to private rooms; (3) Restoration and relaxation with quiet rooms, soft lighting, access to nature and a good view.

Stokols (1992) also contributed with design suggestions for health-promoting environments that stem from three different dimensions of health: physical, mental and social. Physical health can be promoted by an ergonomic design with non-toxic environments. Mental health can be promoted by personal control and predictability as well as aesthetic, symbolic and spiritual elements. Social health can be promoted by access to a social support network, and participation in the design process.

However, within health research, it is not a new idea to view the physical environment as a health-promoting factor. During the nineteenth century, Florence Nightingale developed a theory of health care which emphasizes that physical elements are vital for an individual's health (SHSTF, 1989). For example, noise, lighting and daylight were considered vital factors in affecting a person's mood (ibid.).

During the 20th century, different researchers developed stress models that illustrate how the physical environment may affect human health and wellbeing (Levi, 1972; Kagan & Levi, 1975; Dilani, 2001; Dilani 2006b). Levi (1972) founded the stress theory, which was later developed by Kagan and Levi (1975). The model describes how the physical environment is the foundation upon which societal organization, structure and function is built and in the long run, is critical to the promotion of health or disease (Dilani, 2001). The model is based on a system that points to a deeper understanding between the physical environment and different human components (Kalimo, 2005). The model describes that the physical environment is the basis for creating social organization, structure and function in society.

According to Kalimo (2005) the theory has developed a deeper understanding for the physical environment's effect on humans. Emdad (2005) has developed a model called *Instability of Pyramids of*

*Stress*, where architecture and art are measurable variables. Emdad presents a new framework, which in relation to health in the workplace, has taken neuro-ergonomics into consideration. For example, there is a risk that the employee will develop stress related symptoms and disease if he or she experiences high demands from the surrounding environment, but does not receive any reward. Furthermore, the employee will experience stress if the reward is too low or inadequate. The employee will also experience stress if they do not have any suitable effort strategies in relation to psychosocial factors, home and family factors or neuro-ergonomics. The model integrates all these factors and focuses on health, burnout, cardiovascular disease and short-term memory (ibid.).

## Salutogenic Design Principles Create Healthy Built Environments

Salutogenic design principles serve to create healthily built environments that support users and the local community through the application of a holistic, knowledge-based approach in the delivery of healthy built environment. This approach is a systematic application of research-based knowledge with a focus on the wellness design factor including exposure of positive stimuli experienced by users as enjoyable when activity promotes health, wellbeing and quality of life.

Salutogenic design environments stimulate and engage people, both mentally and socially, and support an individual's sense of coherence. The basic function of salutogenic design is to start a mental process by attracting human attention, which may reduce anxiety and promote positive psychological emotions. The principles of Salutogenic design describes the following:

### Space for Social Support

Social support is an important factor when the aim is to promote an individual's health and wellbeing (Costa, Clarke, Dobkin, Senecal, Fortin, Danoff and Esdaile, 1999; Saito, Sagawa, Kanagawa, 2005; Jacoby and Kozie-Peak, 1997; Oginska-Bulik, 2005). The knowledge and consciousness of social support and its relation to health increased in the 1950's (Fleming, Baum and Singer, 1985).

At the same time, researchers established that the ways the physical environment influences people's emotions, behaviors and motivation are important to take into consideration when the aim is to promote health and wellbeing (ibid.). It is therefore essential



Space for Social Support

to identify design factors in the built environment and through a salutogenic approach, create meeting points that can promote spontaneous social interaction and social support (Fleming et al. 1985, Connors, 1983). Crowding is closely linked to social support and is often defined as the number of persons in a certain area or how much space every individual has received in a certain area (Geas, 1994). Altman (1975) describes crowding as a condition where a person's private sphere is trespassed; for example, when a person or group is exposed to more social interaction than desirable. If there is too much undesirable contact, an individual may experience a sense of crowding. On the other hand, if an individual experiences too little contact, there is a risk that he or she may feel lonely and isolated (ibid.). This balance between social interaction and desired loneliness can be regulated and achieved if one can control his or her own levels of social interaction (Maxwell, 2006).

### Crowding Space

Crowding can be reduced by creating buildings and space, where the individual can control and decide if they would like to be in privacy or participate in social

interactions (Altman, 1975). For example, research has shown that a certain length and layout of student dormitories can increase the number of social activities and promote social interaction, creating a higher sense of control and reducing a sense of crowding (Baum & Davis, 1980). Even a high ceiling can contribute to a reduced sense of crowding. Even though the area of the room is the same, people perceive a room with a high ceiling as lighter and more spacious.

Therefore, if architecture and design can create space that minimizes crowding, it can reduce the experience of stress and promote social interaction (Baum & Valins, 1977). Crowding can also constrain social interaction and social support (Geas, 1994), which are closely linked to health and wellbeing (Costa, Clarke, Dobkin, Senecal, Fortin, Danoff & Esdaile, 1999; Saito, Sagawa & Kanagawa, 2005; Jacoby & Kozie-Peak, 1997; Oginska-Bulik, 2005). This illustrates the importance of identifying factors in the physical environment that promote spontaneous social interaction and social support (Fleming et al., 1985).



Place for Restoration, walking and cycling

### Nature and Its Meaning for Health

Most people have some kind of relationship to nature and there are many people who greatly value diverse natural environments. There are also many people who want to get away from everyday life, during weekends and holidays, and regain their strength in relaxing amidst natural recreational areas. What is

it that makes people feel at ease in nature? Does the natural environment affect people in different ways? Is it possible to draw any general conclusions about nature's influence on human beings?

### Direct and Indirect Attention

Kaplan and Kaplan (1989) have developed the *Attentional Restorative Theory* (ART), which identifies two attention systems and how they are related. The researchers have chosen to call them direct and indirect attention. Indirect attention does not demand any energy or effort from the person and it is activated when something exciting suddenly happens or when one does not have to focus on anything in particular.

Direct attention is activated as soon as a person needs to concentrate and focus on a task and simultaneously block other disturbing stimuli. After an intense period of direct attention, a person is in need of restoration; otherwise they will easily become mentally exhausted. People who have been using their direct attention without resting often become impatient and irritated; and it has been shown that a mentally exhausted person often commits so called 'human errors' (ibid). A person who does not have the capacity to concentrate often becomes careless, less cooperative and less competent (Kaplan & Kaplan 1989; Kaplan 1995; Herzog, Maguire, & Nebel, 2003). Therefore, in order to work efficiently, it is vital to have a well-functioning attention system and find time for restoration.

### The Restorative Environment

In their studies, Kaplan and Kaplan (1989; 1995) have been able to distinguish the following four needs when individuals are in need of restoration and recreation.

- The need for being away from everyday life and its surrounding routines, sounds and crowding, etc.
- The need for fascinating stimuli which effortlessly stimulate the individual and diminish the risk of boredom.
- The need for extent (breathing space) which at the same time can create a feeling of being in a completely different world.
- The need for compatibility while performing one's tasks (ibid.).

The restorative environment should be inviting and well balanced with an aesthetic beauty that allows people to reflect (Herzog, et al. 2003). Nature offers various colors, forms and scents, which can encourage humans to forget about their everyday life (Kaplan & Kaplan, 1989; Kaplan 1995; Herzog et al. 2003).



Natural environments often offer an atmosphere in which the individual's needs for harmony and compatibility are met. It is therefore very important that natural environments are accessible at the workplace (ibid.). The ART has been tested and confirmed by different researchers (Herzog et al., 2003; Tennessen and Cimprich, 1995). One of the studies (Herzog et al., 2003) showed that three of the four components: being away, extent, and compatibility, are seen as measurable indicators of how to create a restorative environment.

## **Natural environments often offer an atmosphere in which the individual's needs for harmony and compatibility are met.**

Several studies have also confirmed that human beings perceive natural environments as more restorative than urban environments (Van den Berg, Hartig and Staats, 2007). Therefore, when human beings are tired and mentally exhausted, nature is the appropriate place for restoration. Other studies have shown that viewing nature through a window has positive health outcomes (Moore, 1981-1982; Ulrich, 1984; Leather, Beale and Lawrence, 1998; Frumkin, 2001).

### **Daylight, Sunlight, Windows and Lighting's Effect on Health**

There is a great deal of research on daylight's positive effects on a human being's psychological wellbeing (Evans, 2003). A lack of daylight can lead to both physiological and psychological difficulties (Janssen & Laike, 2006). Another researcher studied a correctional institution in Michigan and the results proved that inmates who had their windows facing the prison yard were visiting the health care facility more often than inmates who had windows facing the forest and farming fields (Moore, 1981-1982). Ulrich & Lundén (1984) showed that hospital patients who were staying in rooms with windows viewing nature were rehabilitated faster than patients who viewed a brick wall. Research has also shown that daylight in a classroom is necessary for the pupils to maintain a balanced hormone level (Küller & Lindsten, 1992).

Windows can also have positive health outcomes on patients (Verderber, 1986; Lawson, 2001). For example, the window can contribute to improved

health by allowing fresh air and daylight to enter, or by providing a view and a link to the outer world, thus satisfying a patient's or prisoner's need for viewing the seasonal variations (Verderber, 1986; Lawson, 2001). Another study showed that exposure to direct sunlight via windows in a workplace increased the workers' well being and had a positive impact on their attitudes and job satisfaction (Leather et al., 1998).

Rooms without a window can affect human health and well being negatively (Janssen & Laike, 2006; Küller & Lindsten, 1992; Verderber, 1986). One of the studies showed that blue collar workers who worked in rooms without windows experienced more tension and were more negative towards their physical working conditions than workers who had offices with windows (Heerwagen & Orians, 1986). Patients who are staying in rooms without windows can develop sensory deprivation and depressive reactions and exacerbate perception, cognition and attention (Verderber, 1986).

Since daylight positively influences human physiology, it should be prioritized more than artificial daylight, which claims to have the same affect. According to some research, artificial daylight can positively affect a pupil's cortisol levels and perhaps contribute to fewer sick days (Küller and Lindsten, 1992). Lack and Wright (1993) showed that exposure to lighting at certain times during a 24-hour period can prolong sleep and improve the quality of sleep.

Energy consumption and costs can decrease if the individual has the ability to control the lighting levels (ibid.), which also has positive effects on environmental resources (Moore, Carter and Slater, 2004). Furthermore, an individual's general satisfaction was higher when they had the ability to control the lighting levels themselves (ibid.). Küller's (2002) conclusion suggests that lighting will become more important in the future, especially since it is becoming more common to have buildings without windows that have no access to daylight.

### **The Impact of Color on Health**

Colors can possibly affect the brain's activity and create a sense of well-being and originality within architecture (Janssen, 2001). Colors can also have symbolic value and, in that way, contribute to the building's identity and/or cultural meaning. Colors should be of high interest to city planners, mainly because of the aesthetic values, but also because of their symbolic values, which can reflect the organization's philosophy (ibid.). The so-called warm colors (red, yellow and orange) are considered to have an activating effect, while the so-called cold colors

(blue, purple and green) are considered to have a calming effect (Küller, 1995).

Küller (1995) refers to a well-known color study from 1958 in which researchers conducted different physiological tests to investigate the brain's activity during exposure to different colors. When the participants were exposed to the color red, their brain activity increased more than when they were exposed to the color blue. The results showed differences in blood pressure, breathing, and blinking frequencies (ibid.). Another study showed that restoration was more complete when the participants were exposed to blue light, which confirms that colors do affect brain activity (Ali, 1972).

Goldstein (1942) calls attention to an important viewpoint which asserts that an individual's former experiences can affect their emotions, actions and behavior, depending on what color they are exposed to. There are geographical, cultural and historical factors that may affect a person's color choice and some colors have a religious meaning (ibid). Berlyne (1971) and Janssen (2001) highlight that colors should suit the contextual environment and it is important that color activation should be well balanced to match the environment.



Landmark within the building, designed by Farrow

### The Impact of Design as Landmark on Health and Well Being

Space is both what separates people from one another and bonds them together (Lawson, 2001). It is the architecture, with its buildings, rooms, surfaces, dormitories and facilities, that create the prerequisites for individuals to cooperate, work in privacy, create relationships and fulfill their general social, psychological and physiological needs (ibid.).

According to Vischer (2005), the organization's image and identity are viewed and expressed through the architectural facilities. Vischer (2005) also maintains that the employee's working identity and role are associated with the working environment and therefore, the architectural design partly forms the employee's identity. Furthermore, the physical work environment's design has a pronounced effect on worker performance, and in the long run affect the organization's productivity. Physical, psychological and functional comfort can have positive outcomes on employee performance and morale (ibid.).

Other design factors for well-being are landmarks in buildings (Dilani, 2004; 2006b). Landmarks are closely related to the perception of space and building related to the level of stress (Dilani, 2004), serving as reference points in the buildings for easy orientation and helping to create cognitive maps of the environment (Dilani, 2006b). These landmarks could be objects such as sculptures, paintings, aquariums or different colors in different area of the built environment that work as a GPS to navigate us and make way-finding much easier.

### The Impact of Noise Level on Health and Well Being

Noise is one of the most evident problems within public institutions. High noise levels can disturb sleep, increase stress and complicate communication (Janssen & Laike, 2006). Studies have shown that noise can contribute to irritation, which can lead to stress and cause stress-related diseases (Dijk, Souman, De Vires, 1987). Research has also shown that noise can lead to increased levels of cortisol (Brandenberger, Follenius, Wittersheim & Salame, 1980; Evans, Bullinger & Hygge, 1998). Other researchers proved that noise can increase an individual's blood pressure (Lang, Fouriaud & Jacquinet-Salord, 1992; and Evans et al., 1998). Noise can also negatively influence the healing process (Fife & Rappaport, 1976) and contribute to mental exhaustion, which in turn may affect the amount of medication that a patient takes (Persinger, Tiller & Koren, 1999; Yoshida, Osada, Kawaguchi, Hosuhyama, Yoshida & Yamamoto, 1997).

Investigations have also established the connections between noise, irritation and lack of concentration (Dijk et al., 1987). Finally, other studies indicate that the perception of life quality decreases in a noisy environment (Evans et al., 1998) and high noise levels can also inhibit social interaction (Mathewes & Canon, 1975).

Leather, Beale and Sullivan (2003) have shown that noise can have a significant relationship to working demands, where the workers' perception of work stress decreases with lower noise levels. The researchers explain that workers in a less noisy environment need fewer coping strategies for adapting to the physical environment and can therefore focus their energy and coping strategies on other stressful events. In that way, the physical auditory environment can be a vital factor in helping individuals cope with other stressors (ibid.). It is also important to realize that the experience of sound is highly individual (Staples, 1996). Kryter (1994) describes three variables that affect an individual's sound experience: volume, predictability, and possibilities for control.

### The Impact of Music on Health

There are sounds that can promote health and Lai, Chen, Chang, Hseih, Huang, Chang and Peng (2006) maintain that music is one of these factors, since it may contribute to a decreased activation in the sympathetic nervous system. Music has psychological affects and can unite people, open their senses and help them cope with difficulties and trauma. Music may also lead to lower heart and breathing frequencies



Music, Health and restoration

and increased body temperature (ibid.). Lee, Chung, Chan and Chan (2005) conclude that music can be an effective method for decreasing negative physiological effects, when people are suffering from anxiety and stress.

Music, either by itself or in combination with therapeutic treatment, can improve a patient's healing process (Nilsson, 2003). For example, McCaffrey and Good (2000) showed that patients who listened to music after surgery experienced less pain, anxiety and fear than those who did not. The patients claimed that, instead of being frustrated over pain and fear, music helped them to focus on healing (ibid.). In her research, Spychiger (2000) showed that more music lessons in school had positive emotional, social and cognitive affects and that the pupils with more music education cooperated better and had greater motivation for learning than pupils who had fewer lessons.

Paul Robertson (2001) suggests that music is human richest language that expresses complex, emotional insight and for long time, it has been linked to human well-being. Robertson also suggests how different music therapy programs are used instead of medicine at the different treatments, where the music rhythm and melody distract a patient's perceptions of pain and also reduces a patient's stress hormones. The challenge of salutogenic design is to integrate space for music experiences in the built environment.

### The Impact of Culture on Health

Participation in cultural activities has positive effects on human health (Koonlaan, 2001). His study showed that individuals who did not participate in cultural activities had a 57 percent higher mortality risk compared to those who participated in cultural activities. The research showed that those who had not been participating in cultural activities, but who changed their behavior to become active cultural consumers, had almost as good health at the end of the study as those who had been participating in cultural activities from the beginning.

In his study, Koonlan (2001) proved the close connection between being an active cultural consumer and being able to increase one's health status rating. Koonlan also found sup-

port for his hypothesis that if a person is changing her behavior to participate in cultural activities, her health perception becomes more positive.

Another study showed that people who participate in cultural activities have the potential to live a longer life (Bygren, Benson & Johannson, 1996). Theorell (2000) concludes that cultural consumption is very important from a public health perspective.

Music can be a health-promoting activity in a built environment. Silber (2005) studied a choir project for women, where the results indicated that participation in a choir had positive effects on health. For example, the choir became a new social platform where the participants created social bonds with one other. The participants learned to listen to each other, receive criticism and express themselves in a different way. Silber's (2005) research emphasizes the value of choirs and explains that the choir can help people to improve their perceptions and relationships to others, including authoritative persons (ibid.).

In a choir, the members have to follow and trust the conductor, which can be a good training for the person who has difficulty with authoritative figures. In an institution, conflicts can arise regarding power and control between director and employees. With the conductor, the participant has to cooperate and together strive for a common goal, which does not imply power or control (ibid.). Furthermore, the choir generates a dynamic interrelation between its members. Every member has to

control his or her own voice and at the same time listen and cooperate.

To achieve this, the members train their self-control, patience, intuition and trust, which can strengthen the participants' self-esteem and give them a more positive self-image. Pratt (1990) considers that music can create a new reality, which can make it possible for participants to find herself/himself in another context. Music can create a sense of freedom, which can give the participants new inspiration and strength to change their behavior. It can help the individual to survive, grow and create both a personal and collective identity. Pratt also explains that the space created by music reminds people about their fundamental and psychological need for freedom. Music can make the person forget about worrisome thoughts and emotions, allowing them to temporarily live in the present moment (ibid.). The research on the choir's positive, social and therapeutic affects in institutional and workplace environments is limited (Silber, 2005).

However, there are several reasons why it is worth investigating how a choir can be a good method for helping people to change their behavior, such as increasing the people's self-esteem, empathy, self-control, and decreasing aggression and the need for immediate acknowledgment (ibid.).

**Music can create a sense of freedom, which can give the participants new inspiration and strength to change their behavior. It can help the individual to survive, grow and create both a personal and collective identity.**

#### **Art, Healing Process and Well Being**

According to art historians, humans today live in a more aesthetic world, where art, fashion and design offer countless aesthetic experiences (Leder, Belke, Oeberst and Augustin, 20004). When a person observes and appreciates different visual scenes, such as a piece of art, complex cognitive and emotional processes arise (Keith, 2001). In order to understand the meaning of a painting it is important to understand its different parts before it is possible to understand the whole. During the observation of a painting and in the process of understanding it, a person can for example experience joy, participation, discomfort or inter-



Art and Culture Royal Children's hospital, designed by BLP, Bates Smart and HKS

est. These emotional and cognitive responses are called *aesthetic experiences* (ibid.) and often lead to positive stimuli, satisfying and rewarding experiences for the viewer (Leder et al., 2004).

According to Kreitler and Kreitler (1972), art psychology is an empirical, scientific discipline that focuses on a person's internal and external behavior and how they are related to art. There are several psychological theories that try to explain and describe an individual's experience of art. In summary, Kreitler and Kreitler believe that psychological models regarding art perception should be based on the homeostatic behavior model, which suggests that there is an optimal physical condition in which humans strive to reach the balance between tension and relaxation. This condition of homeostasis can explain some parts of the individual's relationship to art, and that the art experience can help an individual restore the homeostatic balance (ibid.).

Art therapy (music, dance, painting and drama therapy) has a unique potential to reach patients with psychosomatic diseases, who are otherwise difficult to reach with traditional therapeutic methods (Theorell & Konarski, 1998). For example, Argyle (2003) showed how a group of people, identified as being in the risk zone for mental disease, participated in different art projects and improved their social and mental wellbeing. The participants testified that the project had strengthened their self-esteem and given them a sense of belonging to a social group. This health promoting art project is considered to be cost effective (ibid.). Gardner (1994) also maintains that participation in different art processes can give the individual the tools to express feelings and experiences in a way that is nonverbal.

### Salutogenic Design and Productivity

When an organization's management wants to increase productivity, they often focus on employee competence and personal motivation rather than the physical environment and design (Heerwagen et al., 1995). In his study, Herzberg (1966) observed employee motivation and the relationship between worker behavior and the physical environment.

When the physical environment is perceived as disturbing it can negatively affect employee motivation and thereby decrease productivity. Herzberg emphasized that it is necessary to have access to a physically supportive environment, which can contribute to employee motivation (ibid.). Maslow's (1987) theory of motivation is one of the most well-

known theories related to human need and motivation. Maslow's theory was developed to analyze and explain the social environment, but it can also be applicable to the physical environment (Heerwagen et al. 1995). For instance, the need for safety can be achieved through designed environments that allow people to have a good visual overview (ibid.). If humans are not stimulated by their surroundings, they can easily lose interest and this can result in reduced performance (Lawson, 2001). On the other hand, too much stimulation can lead to stress, since a person may not have the capability to deal with the stimulation (ibid.).

Increased knowledge and consciousness about the relationship between improved health and increased profitability would affect how designers, architects and managers design, build and maintain buildings (Fisk, 2000). For instance, improved indoor climate can improve employee health, decrease the amount of sick days, reduce healthcare needs and increase productivity, which in turn strengthens the human capital and leads to higher company profitability. Ergonomic improvement for employees has also been proven to increase a company's profitability (ibid.). For example, IBM invested \$186,000 in ergonomic education and implemented extended ergonomic changes, whereby they changed the design of the workplace and various working tools (Helander & Burris, 1995).

The improvements contributed to better working positions, improved lighting, lower noise levels and better support with heavy work routines. The project decreased sick days by 19 percent, which generated



Healthy workplace designed by BVN

an annual profit of \$68,000. In addition, the changes contributed to higher productivity and improved quality, which led to an annual profit of \$7,400,000. In other words, investments and changes within the physical environment led to profits through an increase in health conditions and productivity (ibid.).

### Discussion and Conclusion

As a consequence of our knowledge and idea-driven society, fueled by the internet, it can be argued that diseases are becoming more psychosocial and psychosomatic in nature. Credible research is also finding that people who frequently experience positive emotions are also more likely to be healthier – they have fewer heart attacks, for example, and fewer colds.

With the link between a positive outlook and good physical health moving from hypothesis to fact, it is time to recognize that the way we live, where we work, the way we interact with the built environment all have a tremendous impact on our emotions and experiences. These emotions and experiences are central parts of the health process that could be strengthened and supported by the stimuli from salutogenic design and psychosocial design factors, among them nature with most positive stimuli within the built environment.

The growing prevalence of non-communicable diseases (NCDs), or “lifestyle” diseases, is highly related to the quality of eco design and built infrastructure and the design of the built environment.

Suggestions about how we can reduce NCDs such as obesity are one of the primary challenges facing the designer and planner. Ageing populations and urban growth are a further two huge challenges to which salutogenic design could be applied to increase life quality and exposure for positive stimuli and active lifestyle behavior for the elderly. We must focus on the innovative design and planning of ecological, sustainable and salutogenic healthy urban planning around the world. It is the task of the designer and planner to reconsider the value of eco design and health promoting with a knowledge-driven approach to salutogenic design. The aesthetic value of our surroundings communicates the value of our society; beautiful places are not only stimulating, but they have also been proven to be sources of enjoyment that make us feel less anxious and less stressed.

A well-designed built environment can positively shape the social, psychological and behavioral patterns of our society: if we were to bring nature to the built environment through eco design and fill our workplaces with art and culture, then we could optimize brain performance and restore our energies.



Singapore Gardens by the Bay – space for healthy lifestyle, designed by CPG

The approach of eco design and salutogenic architecture promotes a healthy lifestyle by creating a built environment that focuses on wellness factors that promote health, thereby contributing to the realization of a healthy society.

An increase in the consideration of the principals of eco design and salutogenic architecture leads to social innovation and economic growth, not least of which is through its interdisciplinary approach, integrating sciences such as architecture, medicine, public health, psychology and engineering with culture, art and music.

Our challenge is to commit to the innovation and innovative ideas that will inspire architects and planners to tackle a demanding economic outlook. The “Eco and salutogenic design” perspective should be considered as a tool for designers to be more competitive: by designing highly salutogenic environments, we can reduce the rising burden of healthcare costs, and save and improve lives in our planet. As more scientific research comes to light on the link between eco and salutogenic design and our health and well-being, it becomes even more apparent that we need to develop and apply more research.

**The aesthetic value of our surroundings communicates the value of our society; beautiful places are not only stimulating, but they have also been proven to be sources of enjoyment that make us feel less anxious and less stressed.**

**There is still much more theoretical work, technical research and invention, environmental study and design interpretation that needs to be done and tested before we can have a built environment with an entirely salutogenic design.**

The aim of this study was to illustrate how salutogenic design principals are compatible in creating built environments for a healthy global society. The research has shown that the salutogenic perspective forms a theoretical framework for designing our built environment that could stimulate, engage and improve an individual's sense of coherence and thereby strengthen their coping strategies and promote health.

To implement above mentioned design principals, it is necessary that the whole organization, government and/or policy makers understand the meaning of eco design with a salutogenic perspective. Knowledge of which environment factors contribute to health and well-being can thereafter be guidelines in making political decisions. In the process of making decisions it is important to have an interdisciplinary perspective where different individuals with different backgrounds and knowledge work together in this field – people such as psychologists, architects, landscape architects, doctors, behavioral scientists, engineers and health promoters.

Fortunately, it is becoming more common to use an interdisciplinary perspective as a central strategy (Barry, 2007). For example, the Internet technology sector recruits sociologists, anthropologists and psychologists who can study and explain how a product will be used in different cultural contexts. The application of an interdisciplinary approach to work may challenge existing ways of thinking may make research and innovation more democratic and receptive to public input (ibid.).

Decision makers should consider the following factors during the process of building: good lighting; positive interior distractions; and access to daylight and/or nature, art, symbolic and spiritual objects. Other important factors to take into consideration are the individual's need for control over lighting, noise, indoor temperature and the possibility of choosing when to seek social interaction or solitude. It is also important to create attractive and inviting spaces that promote social interaction and social support as well as creating spaces

for restoration and private conversations. In order to motivate people to change their lifestyle, it is necessary to offer them activities that strengthen their self-esteem and self-efficacy. This can partly be achieved by participating in different cultural activities.

In summary, this study has shed light on salutogenic design principles that can create our cities and our built environment with infrastructure that could promote health, well-being and increase productivity and profitability. Secondly, we have shown that there is a need for more empirical studies that verify, investigate and identify more benefits of eco design and salutogenic built environment. Thirdly, we encourage decision makers to implement eco and salutogenic design that in turn promotes health and well-being.

Finally stated, salutogenic design is still very much in its infancy. The totally Salutogenic city does not yet exist – and neither has the complete application of salutogenic design principal been implemented. We can find some of those principles in the built environment, but not complete application in any kind of design that authors experienced yet. There is still much more theoretical work, technical research and invention, environmental study and design interpretation that needs to be done and tested before we can have a built environment with an entirely salutogenic design.

We all need to continue this great search of our time. It is the most important scientific question of modern civilization, of the “Google society”. How do we maintain our health and quality of life far into old age? How do we reduce the burden of lifestyle diseases through shaping our city and built environment and infrastructure that actively promote health in our global society? This study is the basic ideas and question to be explored further as a future research agenda that highlights the most important interdisciplinary research program to be developed and serve humanity in its future. The search for the application of Salutogenic Design to create sustainable global Healthy Society will continue!

“Be the change  
you want to see  
in the world.”

(Mahatma Gandhi)



St Olavs Hospital Norway, commissioned and managed by Helsebygg Midt-Norge, designed by Nordic Office of Architecture / Ratio Arkitekter / Studio4 Arkitekter / KHR / Pre Knudsen Arkitekter / Asplan Viak / Niels Torp Arkitekter / Pol G Kavli

## A clear example of salutogenic design

### St Olavs Hospital, Trondheim, Norway

The hospital Considered by the judges of International Academy Awards to be at the leading edge of innovation in terms of both its adoption of digital technology, its approach to health promotion and the way the hospital design had been integrated with the city, St Olavs was judged to be the overall winner of three categories, including International Health Project (over 40,000 sqm); International Salutogenic Design; and Product Design for Healthcare Application for an interactive digital installation that assist patients and families to educate themselves about their health.

The hospital has also received awards for the category Use of Art in the Patient Environment; whilst its specialist Knowledge Centre building received a

special award for Sustainable Design; Interior Design and International Health Project (under 40,000 sqm).

In 2014 World Congress on Design and Health held in Toronto, Canada the hospital has been awarded for an outstanding acute or non-acute healthcare building where patient-centered considerations are as evident as clinical and managerial priorities. The project has demonstrated an understanding of the therapeutic effect of a supportive environment for healing process, and shows how innovative design permits ongoing flexibility of use, addresses issues of sustainability, which recognizes the broader civic context.

With seven Academy Awards winner the hospital should be considered the most advanced in the world and for the first time in the history of International Academy for Design and Health receiving 7 Academy Awards creating a benchmark and new standard for healthcare design in Europe and rest of the world. □

From left: Alan Dilani, Founder of International Academy for Design & Health; Ragnhild Aslaksen, Helsebygg Midt-Norge; Per Anders Borgen, Ratio Arkitekter; Liv Haugen, Helsebygg Midt-Norge; Alf Haukeland, Asplan Viak; Kjell Olav Lyngsmo, Helsebygg Midt-Norge; John Arne Bjerknes, Nordic Office of Architecture; Trond Heggem, Asplan Viak.

Foto: Siri M Bakken







Professor **Alan Dilani**, Ph.D. is a founder of the International Academy for Design and Health (IADH) and the journal, *WORLD HEALTH DESIGN*. Dr Dilani has been engaged worldwide in several universities in the field of Design and Health developing a “Salutogenic Design”, in both medical and design institutions. He holds a Masters of Architecture in Environmental Design from the Polytechnic of Turin, Italy and a Ph.D. in Health Facility Design from the Royal Institute of Technology, Stockholm.

His research at the Karolinska Institute, Medical University, which developed a multi-disciplinary research approach, led to a new definition called “Salutogenic Design”. He has designed all types of healthcare facilities and has been consulted as an advisor for several Ministries of Health around the world.

He lectures worldwide and author of numerous articles and books in the field of Design and Health. Dr. Dilani was awarded in 2010 from the American Institute of Architect, Academy of Architecture for Health for his promotion of high quality design research.

## References

- Ali, M.R. (1972). *Patterns of EEG recovery under photic stimulations by light of different colours*. *Electroencephalography and Clinical Neurophysiology*, 33, 332–335.
- Altman, I. (1975). *The environment and social behaviour: privacy, personal space, territory, crowding*. Monterey, California: Brooks/Cole Publishing Company.
- Andersen, P., Göransson, A., Petersson, C. (2004). *Hälsa och hälsofrämjande arbete – en studie av vårdpersonalen och landstingspolitikernas uppfattningar*. [Health and health promoting work – a study of healthcare employees and political decision makers’ opinions]. FoU-rapport 2 004:2. Landstinget Kronoberg.
- Antonovsky, A. (1991). *Hälsans mysterium* [The Mystery of Health]. Stockholm: Natur och Kultur.
- Antonovsky, A. (1979). *Health, stress and coping*. San Francisco: Jossey-Bass.
- Barry, A. (2007). *The meeting of disciplines – why interdisciplinary is a central strategy*. *Britain today*, 72.
- Baum, A., & Davis, G.E. (1980). *Reducing the stress of high-density living: An architectural intervention*. *Journal of Personality and Social Psychology*, 38 (3) 471–481.
- Berlyne, D.E. (1971). *Aesthetics and psychobiology*. New York: Appleton-Century-Crofts.
- Brandenberger G, Follenius M, Wittersheim G, Salame P. (1980). *Plasma catecholamines and pituitary adrenal hormones related to mental task demand under quiet and noise conditions*. *Biological Psychology*, 10, 239–252.
- Bygren, L. O., Benson, B. & S. E. Johansson (1996). *Attendance at cultural events, reading books or periodicals and making music or singing in a choir as determinants for survival*. *British Medical Journal* 313, 1577–1580.
- Carnevale, D.G. (1992). *Physical settings of work: A theory of the effects of environmental form*. *Public Productivity & Management Review*, 15(4), 423–436.
- Connors, D.A. (1983). *The school environment: a link to understanding stress*. *Theory into Practice*, 22, (1), 5–20.
- Costa, D.D., Clarke, A.E., Dobkin, P.L., Senecal, J-L., Fortin, P.R., Danoff, D.S., & Esdaile, J.M. (1999). *The relationship between health status, social support and satisfaction with medical care among patients with systemic lupus erythematosus*. *International Journal of Quality in Health Care*, 2 (3) 201–207.
- Dijk, F.J.H Van, Souman, A.M., & De Vries, F.F. (1987). *Non-auditory effects of noise in industry. VI. A final field study in industry*. *International Archives of Occupational and Environmental Health*, 59, 133–145.
- Dilani, A. (2006). *A new paradigm of design and health in hospital planning*. *World Hospitals and Health Services*, 41 (4) 17–21.
- Dilani, A. (2006b). *A new paradigm of design and health in hospital planning*. *World Hospitals and Health Services*, 41(4), 17–21.
- Dilani, A. (2001). *Psychosocially supportive design – Scandinavian healthcare design*. In: Dilani, A (Ed). *Design and health – The Therapeutic Benefits of Design* (pp. 31–38). Stockholm: AB Svensk Byggtjänst.
- Dilani, A. (Editor) 2004. ( pp. 300) *Design and Health III– Health Promotion through Environmental Design*, Proceeding Book of the 3rd International Conference on Design and Health, in Montreal, Canada (English).
- Emdad, R. (2005). *Comparison of the “Instability of Pyramids of Stress (IPS)”*, *Occupational Health and Work Envi-*

- ronment Stressors in Dentists and Cleaners. CEJOEM, 1 (1) 33–71.
- Evans, G. W. (2003). *The build environment and mental health*. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 80 (4) 536–555.
- Evans, G.W., Bullinger, M., & Hygge, S. (1998). *Chronic noise exposure and physiological response: A prospective study of children living under environmental stress*. *Psychological Science*, 9 (1) 75–77.
- Ewles, L & Simnett, I. (1994). Hälsoarbete [Health work]. Lund: Studentlitteratur.
- Fife, D. & Rappaport, E. (1976). *Noise and hospital stay*. *American Journal of Public Health*, 66 (7) 680–681.
- Fisk, W.J. (2000). *Health and productivity gains from better indoor environments and their implications for the U.S. Department of Energy*. Annual Review of Energy and the Environment, 25, 537–566.
- Fleming, R., Baum, A., & Singer, J.E. (1985). *Social support and the physical environment*. In: Cohen, S. & Syme, S.L. (Ed.). *Social Support and Health* (s. 327–345). Orlando, Florida: Academic Press.
- Frumkin, H. (2001). *Beyond toxicity. Human health and the natural environment*. *American Journal of Preventive Medicine*, 21 (3) 234–240.
- Geas, G.G. (1994). *Prison Crowding Research Re-examined*. Federal Bureau of Prisons.
- Goldstein, K. (1942). *Some experimental observations concerning the influence of colors on the function of the organism*. *Occupational Therapy and Rehabilitation*, 21, 147–151.
- Gardner, H. (1994) *The Arts and Human Development* (2nd Edition) New York: Basic Books.
- Heerwagen, J.H., Haubach, J.G., Montgomery, J., & Weimer, W.C. (1995). *Environmental design, work, and well being: managing occupational stress through changes in workplace environment*. *Official Journal of the American Association of Occupational Health Nurses*, 43 (9) 458–468.
- Heiman, T. (2004). *Examination of the salutogenic model, support resources, coping style, and stressors among Israeli University students*. *The Journal of Psychology*, 138 (6) 505–520.
- Helander, M., & Burri, G. (1995). *Cost effectiveness of ergonomics and quality improvements in electronics manufacturing*. *International Journal of Industrial Ergonomics*, 15, 137–151.
- Herzberg, F. (1966). *Work and the Nature of Man*. New York: Crowell.
- Herzog, T. R., Maguire, C. P., and Nebel, M. B (2003). *Assessing the Restorative Components of Environments*. *Journal of Environmental Psychology*, 23, 159–170.
- Jacoby, J.E., & Kozie-Peak, B. (1997). *The benefits of social support for mentally ill offenders: prison-to-community transitions*. *Behavioral Sciences and the Law*, 15 (4) 483–501.
- Janssens, J. (2001). *Facade colors, not just a matter of personal taste: A psychological account preferences for exterior building colors*. *Nordic Journal of Architectural Research*, 14, 17–21.
- Janssen, J., & Laike, T. (2006) *Rum för återanpassningen fysiska miljöns betydelse för ungdomsvården – en miljöpsykologisk översikt* [Rooms for readapting – a physical environment's meaning for youth care – an environmental psychological review]. Statens institutionsstyrelse (SIS). Rapport 2/06, Edita Stockholm 2006.
- Kagan, A. R., & Levi, L. (1975). *Health and environment – psychosocial stimuli: a review*. In: Levi, L. (Ed.). *Society, stress and disease: childhood and adolescence*; Ed. 2 (pp. 241–268). London, New York & Toronto: Oxford University Press.
- Kalimo, R. (2005). *Reversed causality: a need to revisit systems modeling of work-stress-health relationships*. *Scandinavian Journal of Work, Environment & Health*, 31 (1)1–2.
- Kaplan, R., & Kaplan, S. (1989). *The Experience of Nature: A psychological perspective*. New York: Cambridge University Press.
- Kaplan, S. (1995). *The Restorative Benefits of Nature: Toward an Integrative Framework*. *Journal of Environmental Psychology*, 15, 169–182.
- Keith, M. (2001). *Making Meaning Brings Pleasure: The Influence of Titles on Aesthetic Experiences*. *Emotion* 1(3) 320–329.
- Konlaan, B. B. (2001). *Cultural experience and health: The coherence of health and leisure time activities*. (Doktorsavhandling) Umeå universitet.
- Kreitler, H., & Kreitler, S. (1972). *Psychology of the Arts*. Durham: Duke University Press.
- Kryter, K.D. (1994). *The handbook of learning and effects of noise*. San Diego: Academic Press.
- Küller, R. (1995). *Färgens inverkan på människan* [The color's affect on humans]. In: Hård, A., Küller, R., Sivik, L., Svedmyr, Å (E.d.). *Upplevelse av färg och färgsatt miljö* [Experience of colour and painted environments] (pp. 13–30) Stockholm: Byggnadsforskning.
- Küller, R. (2002). *The influence of light on circa rhythms in humans*. *Journal of Physiological Anthropology*, 21(2) 87–91.
- Küller, R., & Lindsten, C. (1992). *Health and Behaviour of Children in Classrooms with and without Windows*. *Journal of Environmental Psychology*, 12, 305–317.
- Lack, L., & Wright, H. (1993). *The effect of evening bright light in delaying the circadian rhythms and lengthening the sleep of early morning awakening insomniacs*. *Sleep*, 16, 436–443.
- Lai, H-L., Chen, C-J., Peng, T.C., Chang, F-M., Hsieh, Huang, M-L., & Cang, S-C. (2006). *Randomized controlled trial of music during kangaroo care on maternal state anxiety and preterm infants' response*. *International Journal of Nursing Studies*, 43, 139–146.
- Lang, T., Fouriaud, C., & Jacquinet-Salord, M-C. (1992).

*Length of occupational noise exposure and blood pressure.* International Archives of Occupational and Environmental Health, 63, 369–372.

Lawrence, R.J. (2002). *Healthy Residential Environments.* In: T. Bechtel, R.B., & Churchman, A. (Ed.). Handbook of Environmental Psychology (pp. 394–412). New York: Wiley & Sons.

Lawson, B. (2001). *The language of space.* Oxford: Architectural Press.

Leather, P. Beale, D., & Sullivan, L. (2003). *Noise, psychosocial stress and their interaction in the workplace.* Journal of Environmental Psychology, 23, 213–222.

Leder, H., Belke, B., Oeberst, A., & Augustin, D. (2004). *A model of aesthetic appreciation and aesthetic judgements.* British Journal of Psychology, 95, 489–508.

Lee, O.K.A., Chung, Y.F.L., Chan, M.F., & Chan, W.M. (2005). *Music and its effect on the physiological responses and anxiety levels of patients receiving mechanical ventilation: a pilot study.* Journal of Clinical Nursing, 14, 609–620.

Levi, L. (1972). *Stress and Distress in Response to Psychosocial Stimuli* (Avhandling för doktorsexamen). Karolinska institutet.

McCaffrey, R. G., Good, M. (2000). *The Lived Experience of Listening to Music while Recovering from Surgery.* Journal of Holistic Nursing, 18, 378–390.

Maslow, A.H. (1987). *Motivation and personality* (3th Ed). Longman.

Mathewes, K.E. & Canon, L.K. (1975). *Environmental noise level as determinant of helping behavior.* Journal of Personality and Social Psychology, 32, 571–577.

Maxwell, L.E. (2006). *Crowding, class size and school size.* In: Frumkin, H., Geller, R. J., Rubin, I: L (Ed). *Safe and healthy school environments* (pp.13–19). Oxford: University Press.

Moore, T., Carter, D.J., & Slater, A. (2004). *A study of opinion in offices with and without user controlled lightning.* Lighting Research and Technology, 36 (2)131-146.

Moore, E.O. (1981-82). *A prison environment's effect on health care service demands.* Journal of Environmental Systems, 11, 17–34.

Nilsson, U. (2003). *The effect of music and music in combination with therapeutic suggestions on postoperative recovery* (Avhandling för doktorsexamen) Linköpings universitet.

Nordenfelt, L. (1991). *Hälsa och värde* [Health and Value]. Stockholm: Thales.

Ogi ska-Bulik N. (2005). *The role of personal and social resources in preventing adverse health outcomes in employees of uniformed professions.* International Journal of Occupational Medicine and Environmental Health, 18 (3) 233-240.

Persinger, M.A., Tiller, S.G., & Koren, S.A. (1999). *Background sound pressure fluctuations (5dB) from overhead ventilation systems increase subjective fatigue on university*

*students during three-hour lectures.* Perceptual and Motor Skills, 88, 541–456.

Pratt, R. (1990). *Rhythm and Resistance: The Political Uses of Popular Music.* Washington DC: Smithsonian Institution Press.

Saito, E., Sagawa, Y., & Kanagawa, K. (2005). *Social support as a predictor of health status among older adults living alone in Japan.* Nursing and Health Science, 7 (1) 29–36.

Silber, L. (2005). *Bars behind Bars: The impact of a women's prison choir on social harmony.* Music Education Research, 7, 251-271.

SHSTF. (1989). *Florence Nightingales anteckningar om sjukvård – ur vårt tidsperspektiv.* (Svensk översättning av Florence Nightingales Notes on Nursing – what it is and it is not). FoU rapport 31. Skellefteå: Artemis Bokförlag.

Psychiger, M.B. (2000). *Music Education is Important – Why?* In: Matell, G., & Theorell, T. (Red.). *Musikens roll i barns utveckling* [The role of music in children's development] (pp.110-122). Institutet för psykosocial medicin. Karolinska Institutet.

Staples, S. L. (1996). *Human response to environmental noise.* American Psychologist, 51 (2) 143-150.

Stokols, D. (1992). *Establishing and Maintaining Healthy Environments.* American Psychologist, 47 (1) 6–22.

Suominen, A., Helenius, H., Blomberg, H., Uutela, A., & Koskenvuo, M. (2001). *Sense of coherence as a predictor of subjective state of health results of 4 years of follow-up of adults.* Journal of Psychosomatic Research, 50, 77–86.

Tennessen, C.M., & Cimprich, B (1995). *Views to nature: effects on attention.* Journal of Environmental Psychology, 15, 77–85.

Theorell, T. & Konarski, K. (1998). I: Theorell, T. (Red.). *När orden inte räcker* (s.13–22). Stockholm: Natur och Kultur.

Ulrich, R.S. (1984). *View through a window may influence recovery from surgery.* Science, 224, 420–421.

Van den Berg, A. E., Hartig, T., & Staats, H. (2007). *Preference for Nature in Urbanized Societies: Stress, Restoration, and the Pursuit of Sustainability.* Journal of Social Issues, 63 (1) 79–96.

Verderber, S. (1986). *Dimensions of person-window transactions in the hospital environment.* Environment and Behaviour, 18, 450–466.

Vischer, J.C. (2005). *Space Meets Status – designing workplace performance.* New York: Routledge.

Yeang K. 2009, *Eco Masterplanning*, John Wiley & Sons (UK)

Yeang K. 2009, *Eco Skyscrapers*, Images Publishing Group (Australia).

Yeang K. 2006, *EcoDesign: A Manual for Ecological Design*, John Wiley & Sons (UK)

Yoshida, T., Osada, Y., Kawaguchi T., Hosuhyama, Y., Yoshida, K., & Yamamoto, K. (1997). *Effects of road traffic noise on inhabitants of Tokyo.* Journal of Sound and Vibration, 205, 517–522.