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The Psychological Impact of Architectural Design

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Professor Craig Bowman

by
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Abstract

The interplay between architectural design and human psychology is significant, yet it remains largely unnoticed or even ignored both in and outside the design industry. Moreover, the relationship between design and psychology is not only consequential, it is bidirectional. On the one hand, successful design has been shown to have clear psychological and physiological impacts; on the other, psychology, human experience, and the function of our neurological systems all play a significant role in what we perceive to be successful design. This thesis endeavors to create an understanding of how that complex relationship evolved and how it works in today's world. It does so by first exploring how the human brain and nervous system is structured and functions, how that structure and function benefited our human ancestors, and how modern society impacts that function. With that knowledge as a background, the interrelationship – both positive and negative – between design, psychology and our nervous system is explored. Successful design patterns are reviewed, including those that evoke the same sense of security sought by our human ancestors, as well as those whose specific patterns have a meaningful psychological basis. Similarly, reasons why some design forms and themes have not been successful are explored, as is the modern-day challenge of human stress that results from those poorly designed buildings and spaces. Finally, the importance of incorporating nature into the human built environment to take advantage of its positive psychological impact and restorative properties is explored.

Keywords: Architecture, Design, Psychology
Architectural and interior design have been societally classified as aesthetic bonuses to the “built environment” i.e., that environment comprised of man-made structures and settings within which human activities take place. This has not only damaged the legitimacy of the field but has also prevented it from receiving the necessary funding and attention of the general public that it deserves. Architecture started out as a means of protection, a shelter from our surrounding environment. It gradually evolved into an art form into which subjectivity, creativity, and beauty were introduced. Today, we are seeing architecture evolve yet again, this time from an art form to a subject of psychological study and purposeful implementation focused on psychological well-being. As this thesis demonstrates, studying the psychological effects of architectural and interior design is important due to their immense influence on the emotional and psychological well-being of humans.
The Evolution of the Mammalian Brain

To understand how architectural and interior design impact humans psychologically, it is important one first understands, at least at a basic level, the psychological effects of certain stimuli on the human brain.

During the course of evolution, human brains have evolved in a more sophisticated manner compared to other mammals. The human forebrain for example, which is the center of executive thinking, planning and emotion is disproportionately larger than that of other mammals. However, the more primitive portions of the brain and brainstem still function in a very similar manner to that of other mammals; specifically, those areas are still designed and function in a way that help us survive and pursue pleasure. In its most simplistic form, survival is predicated on the pursuit of shelter, food, and mating. In the modern world, because we have no natural predators, survival has taken on a different, less objective meaning which now varies across demographics, social class, and geographical location. Pleasure on the other hand has, for the most part, held the same meaning for the past 200,000 years or so. Pleasure is a feeling of happiness, satisfaction, and enjoyment. The ways in which this feeling can be achieved however, are subjective and have changed as our interests as humans have evolved and our available resources have changed.

The human central nervous system is divided into a highly complex brain and spinal cord. The brain itself is further divided into a number of different processing systems and working parts that focus on different tasks. The human brain has evolved to include a large forebrain or cerebrum, a smaller hindbrain or cerebellum, and a central brainstem consisting of the midbrain, pons and medulla. The brainstem, which serves as
the connection between the brain and spinal cord, is responsible for such involuntary functions as breathing, swallowing, heart rate, reflexes, etc. The brainstem is also of particular relevance as it serves as the relay station for information to and from the brain. It takes in sensory system information from the peripheral nervous system and distributes it to the corresponding parts of the brain where it is later classified as pleasing or displeasing.\(^1\) Evolutionarily, human brains have been encoded to associate a sense of pleasure with objects and places that increased our chances for survival.\(^2\) For the earliest of humans that consisted of food, water, shelter, and more specifically, the layout of the savanna. The appeal of the savanna was its advantageously spaced trees, the lush countryside, and the water and food it provided.\(^3\) Although most humans no longer live in such rural environments, the characteristics of the savanna are encoded in our brains and dictate our preferences within today’s built environment. As a result, modern humans still associate shelter with pleasure, but in a more subjective manner. This will be addressed in more depth in Chapter 2.

The cerebellum, or hindbrain, receives information from the peripheral nervous system via the spinal cord and various other parts of the brain. It controls posture, balance, and coordination.\(^4\) The cerebrum or forebrain, which is divided into frontal, temporal, parietal and occipital lobes also receives information from the peripheral nervous system. The forebrain takes that information, processes it and then triggers the

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proper reactions. The forebrain controls our crucial cognitive skills like memory, language, judgement, problem solving, sexual behavior, and emotions; in other words, it is responsible for both our rational and emotional thought. While the various functions of the cerebellum and cerebrum are all necessary for one’s survival, it’s the forebrain’s role in cognition and experiencing emotion that is the most important as it pertains to the psychology of design.

The entire nervous system (peripheral and central) works together in various functional units. Two that are of critical importance are the limbic nervous system and the autonomic nervous system. The former is responsible for emotion, learning, memory, and motivation, while the latter is important for controlling many basic bodily functions like breathing and response to stress. The autonomic nervous system is further divided into two parts: the sympathetic and parasympathetic nervous systems. Those two systems, and how they respond to stress were crucial to our ancestor’s survival. When mammals experience danger the sympathetic division of the autonomic nervous system jumps into action raising heart rate and blood pressure, and opening lung airways to improve breathing. These changes result from the release of adrenaline and norepinephrine, followed by cortisol to slow the bodily functions that are not necessary for survival. This is the fight or flight response that evolved in mammals to increase the

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8 How does the nervous system work? (2016).
chances of survival in response to threats. Once the threat has been neutralized either through fight or flight, the parasympathetic nervous system kicks into action. The parasympathetic system works to return the body to its resting state, returning digestion to its normal levels, and reactivating various routine metabolic processes.\(^{10}\)

While the connection between these working systems and the psychological effects of architectural and interior design on the human brain might not be immediately apparent, the two play a very important role when it comes to stress regulation in the modern human. Modern day humans experience stress very differently than did our ancestors and other mammals. Stress for our ancestors came primarily from threatening factors that were out of their control including predators and inclement weather. The combination of modern humans no longer having natural predators and the ready availability of shelter that protects us from the natural environment has not only allowed us to advance intellectually, it has also radically changed our stressors. Stress can come from virtually anything and differs greatly from person to person. It is often due to factors in everyday life ranging from traffic, to a job, to relationships; stress can also come from seemingly trivial things. Regardless of the source, our bodies today react to stress in the same manner as when it was a matter of life and death for our ancestors: the sympathetic nervous system kicks in and all functions that are irrelevant to immediate survival are slowed. Unlike the episodic stresses our ancestors faced, our stress is problematic because many stressors never go away, and our bodies spend too much time in survival mode at times when our survival is not even remotely at stake. Constant or chronic stress can lead to extremely detrimental, and even permanent, mental and physical health

\(^{10}\) How does the nervous system work? (2016).
issues. It is associated with the development of anxiety, insomnia, depression, a weakened immune system and muscle pain. It can also lead to the development of serious health issues such as heart disease, and high blood pressure.\textsuperscript{11} Perhaps most significantly, chronic stress has actually been clinically proven to directly shorten life spans. Studies have shown that chronic stress physically shortens the parts of chromosomes known as telomeres, a protective casing on the ends of our DNA. When cells divide, they lose some of their telomeres. Normally this is not a problem as an enzyme known as telomerase restores them. However, when a person is experiencing chronic stress and their sympathetic nervous system constantly produces cortisol, it leads to a decrease in production of telomerase, thus preventing your body from replenishing the damaged telomeres. Without the telomeres, the cell will die, thus accelerating the aging process.\textsuperscript{12}

Because stress has become such a prominent factor in modern life, and the health consequences of stress are now well known, strategies such as psychological therapy, meditation, drugs and more are all being employed to combat it. While there are many conflicting opinions about which of the above methods is most effective, it is universally agreed that reducing stress to at least some degree is possible. This is where architectural and interior design and their positive psychological effects have become extremely relevant.

The Positive Psychological Effects of Thoughtful Architectural Design

Architectural style has evolved over time as the preferences of the general public have changed, and as new materials and building processes have been discovered. Some styles have been fads that have quickly come and gone, while others have stood the test of time and been around for centuries, even influencing some modern architecture today. What separates the architectural styles that last from those that do not? Don Ruggles (2017), a prominent architect in Denver, Colorado believes there are three components that make for a “beautiful” building: form, use, and beauty.  

Although the word “beautiful” is fundamentally subjective, the feeling associated with it is universal. Seeing something we define as beautiful causes us to feel pleasure. The feeling of pleasure is a result of oxytocin, endorphins and DHEA being released inside our brain. If the sole purpose of buildings is form, or a place where humans can simply gather for some specific purpose, why then would they have the ability to positively impact us physiologically? Again, the answer has its basis in evolution. Buildings that provide us with a sense of pleasure are those that incorporate the architectural elements that our brain recognizes as having similar characteristics to those locations that helped our human ancestors to survive. Thus, it is important to identify which specific characteristics or patterns our brain associates with those survival attributes and why.

Patterns, have long been a subject of human curiosity, and we have successfully adapted them for use in our ability to plan ahead. There are several different ways in

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which our brain recognizes patterns. The first, known as feature matching, is when incoming pattern information is broken down by the brain into parts which are then compared and contrasted one by one with parts of a previously stored pattern. Prototype matching is similar to feature matching except rather than our brain matching an incoming pattern to a stored pattern, it attempts to link the incoming information with certain characteristics of a known prototype. This would be equivalent to identifying an apple as a fruit, rather than an apple as an apple (the latter being an example of feature matching). The last method of matching is template matching, in which only certain aspects of the incoming pattern are matched to a template or prototype, rather than the entire incoming pattern.

Patterns represent consistency and organization; a lack of chaos. When our ancestors were able to identify a pattern and predict what came next, their chances of survival were improved. Today, patterns in our built environment that the brain recognizes from nature as having been advantageous to our ancestors evoke the same physiological reaction. It makes intuitive sense that chaos or unpredictability, the opposite of pattern, can negatively impact us physiologically. The human brain has used pattern recognition as a form of survival for so long, it has become something we do subconsciously daily. Although your conscious mind might not realize the feelings it is experiencing are due to a pattern, or lack thereof, our physiological system does resulting in the same sympathetic or parasympathetic response our ancestors experienced.

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The importance of pattern goes beyond the ability to recognize something literal like shelter or a house. It is also important due to its aesthetic impact on beautiful architecture. Pattern in architecture is often referred to as rhythm; it is what causes the eye to flow from one focal point to the next (for example from one part of a room, or house, to the next). Not only does it work to grab one’s attention, but it also contributes to the beauty of the object (house or room). There are four categories of rhythm in the architectural world: Alternation, the repetition of a contrasting pair; Progression, either increasing or decreasing the size of the element in the pattern; Repetition, continuously repeating a single element; and Transition, the use of a line that the eye is able to continuously follow from one point to the next.\(^\text{17}\) We find buildings that incorporate certain aesthetically pleasing patterns or rhythm to be more beautiful because our brains are conditioned by evolution to associate those patterns with safety, security, well-being and survival. As noted previously, that perception results in the release of oxytocin, endorphins and DHEA, and throttles back the fight or flight sympathetic nervous system, all resulting in a sense a pleasure. This in turn works to restore our body, immune system, telomeres, etc., which is beneficial for both our mental and physical health.

With this information as background, we can now understand the architectural success of some historical buildings. Many of the most critically acclaimed buildings throughout time have been those that have been built with patterns that mimic the natural environment from which we came. La Sagrada Familia, designed by Antoni Gaudi, is an extravagant cathedral located in Barcelona, Spain. The construction first began in 1882,

but because the details of the building are so exquisite, it is projected the building will not be fully completed until 2026. Gaudi’s inspiration for the cathedral came from the forest, and the many trees that it consists of. Upon walking into the cathedral, one is greeted by hundreds of 78-foot-tall pillars that branch off at the tops and converge into the ceiling and one another, like the intertwining branches of tree canopies. (see figure 1).

![Figure 1. A photo of the tree-like pillars that fill La Sagrada Familia. From Inside Sagrada Familia, by Trey Ratcliff, 2017, https://www.flickr.com/photos/stuckincustoms/34317112306/in/photostream/. Copyright 2017 by Trey Ratcliff.](image)

The National Taichung Theater located in Taiwan, designed by Toyo Ito, resembles the natural formation of rocks (see figure 2).
The contemporary style of the building, its soft rounded curves, and its use of neutral earth-like tones are intended to exemplify rocks in their natural setting. The Eden Project in Cornwall, England, consists of several transparent domes that house a wide variety of plants. The architect Nicholas Grimshaw found his inspiration from bubbles, making it easy for the translucent domes to effortlessly coexist with the surrounding nature\(^\text{18}\) (see figures 3 and 4).

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Figure 3. An inner view of the vegetation enclosed within The Eden Project. From The Eden Project, by Herry Lawford, 2009, https://www.flickr.com/photos/herry/3294823869/in/photolist-629Qm6-cvye5y-dfnzYY-dfnyca-629Swn-dfnDzW-a5Bx27-cyvcgL-62egCb-YgtxSP-CbzPLA-629RLk-YgtAaz-629R7D-62e3gy-62a4Cr-62e2RS-629Lcv-62e9t1-bkjoK-dfnvmP-2YBx3q-629Md6-ZeSVow-2WZM2n-dfnzWg-6PpSdx-ca4NF1-2WZJ9a-2YBuvQ-2YwZF629Lwa-a5Bt2j-CbzTmG-8AVE1u-a5yxLa-a5yBj8-2YwXVp-a5yGga-2Yx2N6-YgtxGi-a5yM4p-4EmYUE-a5yWip-CbMnj-2WZMvpcbzw7-2YBd87-YgtxqB-deg4fc. Copyright 2009 by Herry Lawford.

Figure 4. The bubble-like domes of The Eden Project, shown here as part of an artistic installation, was inspired by the form of bubbles. From Field of Light, by Bruce Munro, 2017, http://www.brucemunro.co.uk/exhibitions/eden-project-st-austell-cornwall-uk/. Copyright 2017 by Bruce Munro.
All three of these buildings are well-known for their beauty. One principle reason why we perceive these buildings as beautiful is that our brains process the sensory information it is receives from them and correlates it with patterns that had previously proven to be evolutionarily beneficial in nature. Yet, because this pattern recognition happens at a subconscious level, most viewers are unaware of the neuropsychological and physiological basis behind their perception of this sense of beauty. This same physiological reaction can happen even when the resemblance of the building to the natural environment is not as obvious as the examples above.

The ability of architecture and design to impact our emotions is more complicated than architecture simply simulating nature. The kinds of patterns used in design also play a significant role in our perception. “As architects and artists, we are in the profession of making patterns.” – Don Ruggles (2017).19 Don had the good fortune to spend much of his young life traveling the world and observing everything from museums, to sculptures, to everyday homes. It was during these travels that he started to discover his preference for some buildings over others. Eventually he realized that the buildings he considered beautiful, all exhibited variations of a certain kind of pattern known as the Nine Square. The Nine Square is not a recently discovered architectural phenomenon. Ancient Asian cultures used it as they believed it to have cosmological significance; in the Middle East, it is believed to represent primordial and perfect form; and it was used extensively during the Renaissance and neoclassical eras.20 The root pattern of the Nine square consists of a 3 x 3 grid, with a centralized space (the middle square) surrounded by an exterior zone

(the outer 8 squares) (see Figure 5a). However, because humans inherently see patterns in most things, there are many variations of the Nine Square that produce the same effect. This is because the Nine Square is less about the squares themselves and more about the division of space that creates the squares. The four lines that define the Nine Square can either be pushed closer together (see Figure 5b), pulled farther apart (see Figure 5c), broken apart so they are not continuous, or even removed fully. You can also create the Nine Square within a square of a larger Nine Square.

![Figure 5a](image1.png) ![Figure 5b](image2.png) ![Figure 5c](image3.png)

*Figure 5. Various versions of the Nine Square Pattern.*

The pattern can be applied to everything from city plans, to exteriors of buildings, and to floor plans. The center of the Nine Square has been utilized in Barcelona’s block plan as well as the Basilica of St. Peter in Rome which uses the center of the Nine Square as well as the corner four squares. The Greek Parthenon, Roman Pantheon, and the Taj Mahal in India are also examples of the Nine Square. These buildings are important references due both to their universally recognized beauty and to their standing the test of time, both physically and metaphorically. Believed to have been built between 447 and 432 B.C., the Parthenon resides in Athens, Greece, and was constructed to be viewed from the outside only with viewers only being able to catch a glimpse of the inside.

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through the outer pillars.\textsuperscript{22} The Pantheon in Rome, Italy is believed to have been built around 120 A.D., and consists of both a height and diameter of 142 feet. It utilizes the Nine Square at the entrance of the building, as well as in the main plan of the building which is viewable from an aerial perspective. Today, it remains one of the largest unsupported domes in the world.\textsuperscript{23} Lastly, the Taj Mahal, considered by some to be one of the world’s 7 wonders, was built between 1628 and 1658.\textsuperscript{24} It also incorporates two Nine Square patterns: one in the 9 arches in the front of the building and another inside the center front arch. These examples illustrate the importance of the Nine Square pattern as an important historical architectural concept. These buildings also show how structurally sound the pattern is, as they have lasted for centuries. Their universally accepted beauty shows how psychologically impactful the Nine Square pattern is to the human brain. More recently, the Nine Square has been used in buildings such as the Apple Store in New York City, the US Capitol Building, Frank Lloyd Wright’s Falling Water house, Richard Meier’s 1965 Frederick J. Smith’s Residence, and many more.\textsuperscript{25} Due to the vast dispersion across time and location of these buildings, it is unlikely that the continuous use of the Nine Square in the built environment is simply the product of cultural integration. More likely, the frequency of its use is a result of the beneficial psychological impact of the pattern being encoded in the human brain, and therefore, in the minds of the architects who conceived these buildings.

Another important factor contributing to the popularity of the Nine Square pattern in architecture can be found in its similarity to the structure of the human face. Facial recognition is one of the paramount survival adaptations of the human race. In fact, this is so critical that 65% of the brain’s neuronal structure in a newborn child is devoted to facial recognition mechanisms.\textsuperscript{26} Facial recognition is what allowed us to distinguish between humans, animals and inanimate objects; it also helped us to do such wide-ranging things as recognize and avoid predators and to recognize our parents from a very young age. In addition, facial recognition helped identify important social cues that were once necessary for survival, including things like identity, age, gender, and emotion.\textsuperscript{27} To recognize faces, humans employ several different strategies that process the following information: \textit{featural information} which helps us to analyze the shape of individual facial features; \textit{second-order configural information} which is used to evaluate the space between each facial feature\textsuperscript{28}; and lastly, \textit{holistic information} which allows us to consider the overall facial structure.\textsuperscript{29} In addition to those processing strategies, clinical studies of facial recognition have found that the brain recognizes certain patterns or features that make faces more easily distinguishable. Two of these are worth noting. The first, face inversion effect, is the idea that humans are less accurate recognizing faces when the

\textsuperscript{26} Ruggles, D. (2017).
\textsuperscript{28} Maurer D., Le Grand R., Mondloch C. J. (2002). The many faces of configural processing. Trends Cogn. Sci. 6, 255–260. 10.1016/S1364-6613(02)01903-
pattern is inverted as opposed to upright\textsuperscript{30}; the second is known as the part-whole effect, which is simply that humans more accurately recognize the identity of a feature when it is presented on its respective face rather than alone.\textsuperscript{31} Research conducted on infant preference has shown that they prefer certain facial hinting patterns to others. In one study, infants were presented with patterns, made up of various squares that vaguely resembled facial structures (the shape of a “T” for example) (see Figure 6a).

\begin{figure}[h]
\centering
\includegraphics[width=0.8\textwidth]{figure6.png}
\caption{The shape of a T made up of various square to vaguely resemble facial structure. Inverting the T lessens its resemblance to facial structure.}
\end{figure}

The infants were shown these shapes in their upright form, as well as upside down, which obscured their resemblance to normal facial structure (see Figure 6b). It was found that the infants were partial to the shapes when they were right side up and most resembled faces.\textsuperscript{32}

It’s also essential to note here that the upright “T” pattern of the human face, among the others shown to the infants, very closely resembles the Nine Square (see Figure 7). The human face consists of two symmetrical eyes, a centered nose, and a centered mouth. When laying the Nine Square over the face, the left eye lies in the top

\begin{figure}[h]
\centering
\includegraphics[width=0.8\textwidth]{figure7.png}
\caption{The Nine Square pattern.}
\end{figure}

\textsuperscript{31} Maurer, Le Grand, Mondloch. (2012).
left square, the right eye in the top right square, the nose in the most center square, and the mouth in the center square on the bottom row (see Figure 8).

*Figure 7 (left).* The similarities between the basic facial structure and the Nine Square. *Figure 8 (right).* Example of the human facial structure and the Nine Square. Background Image from 2643525, by Tiluria, 2015, https://pixabay.com/en/portrait-child-face-boy-human-2643525/. Copyright 2015 by Tiluria. Note: Reference lines for the Nine Square in Figure 8 are not part of the original photograph. They were added to emphasize the similarity of the human face and the Nine Square pattern.

The close resemblance of the Nine Square to the human face raises the distinct possibility that humans subconsciously see faces when observing certain forms of architecture and in the patterns of that architecture, providing another explanation for the physiological reactions and feeling pleasure that certain architecture can evoke.

So far, we have focused on the positive effects of architecture. It is as important to observe the negative influence that poorly designed or constructed buildings and spaces have on human psychology and physiology.
The Negative Psychological Effects of Poorly Designed Architecture

While the psychological benefits of beautiful architecture are more commonly recognized today, there was a time when the traditionally taught elements of architecture (form, use, and beauty), were discarded in exchange for form, utility and craft. Post World War II, there was an increase in demand for housing and institutions due to an increasing population from the baby boom. Thus, the need for faster, more efficient building was born. Due to the limited technology at the time, this meant less detailed, smaller houses that focused on the aforementioned form, utility and craft. This led to the proliferation of small, ugly (in the way that they lacked the characteristics that activate our pleasure response) one floor ‘box’ houses in the 1950’s that were not well thought out in terms of floor plan, use of space, or aesthetics (see Figure 9).33


In was in this way that suburbia, consisting of neighborhoods with endless rows of mostly indistinguishable houses situated as close together as possible so as to make room for more houses, was born (see Figure 10).

*Figure 10.* The stressful, overcrowded, and repetitive neighborhoods that characterized the age of suburbia. From Image Levittown, Long Island, NY by unknown, 1948, [https://www.flickr.com/photos/markgregory/8087087647](https://www.flickr.com/photos/markgregory/8087087647). Copyright 2011 by Mark Mathosian.

This trend of simple, architecturally unoriginal buildings was not unique to houses; it also greatly influenced the industrial side of the built environment at the time. Due to an increase in material production capability from the war, there was access to new building products which were easy produced in the factories that previously had been dedicated to the war. These materials set in motion the Modernism aesthetic that characterized many of the industrial buildings in the 1950s-1990s (see Figure 11). Glass, concrete, aluminum, synthetics and steel were the primary materials utilized to create a boxy, futuristic, space-
like style.\textsuperscript{34} Monochromatic colors, poorly placed windows, an absence of architectural detail, and repetitive styles produced a unique form of sensory deprivation. Not only did this trend result in a lack of intellectual stimulation, it effectively removed every aspect of human touch, creating a cold, unwelcoming environment that lacked the ability to produce a positive physiological response or a sense of well-being.

\textit{Figure 11.} The overuse of cement in this building is representative of the color devoid, overly simplistic, boxy architecture that was frequently used in city landscapes during the post-war modern period. From Image George Square Theater, by Andy A., 2011, \url{https://www.flickr.com/photos/kaputniq/6113408115}. Copyright 2011 by Andy A.

It comes as no surprise then that the style of this period was soon replaced, and a new desire for individualistic and creative architectural freedom emerged as the high demand for houses began to die down. Once again, the ancient principles of beauty that

\textsuperscript{34} World War II/Post-War Building Styles. (2016, December 07). Retrieved October 02, 2017, from \url{https://heritage.utah.gov/history/world-war-ii/post-war-building-styles}
characterized Classical period began to re-emerge. There was a newfound emphasis on structure, geometry (the use of patterns such as the Nine Square), and the uniform grid. There was also a return of buildings raised on platforms, classically styled columns, entablature (see Figures 12 and 13), and colonnade (see Figure 13). This further emphasizes the previous point that buildings that employ beauty and patterns stand the test of time amid changing styles and societal preferences. In addition to reincorporating many of the structural elements of the Classical period, this movement brought back the materials used during that period including travertine, marble, and granite, and also introduced to the field of architecture the use of man-made products that mimicked the aforementioned materials. As a result of the above, the houses produced during this time were much larger in size and much more expensive.

*Figure 12. An example of segment of entablature, a continuous horizontal lintel that is supported by columns; applied in the Parthenon and Pantheon as previously discussed. From Image Ionic capitals and entablature, Free Trade Hall, Manchester, by Orangeaurochs, 2011, [https://www.flickr.com/photos/orangeaurochs/5763101886](https://www.flickr.com/photos/orangeaurochs/5763101886). Copyright 2011 by Orangeaurochs.*

Figure 13. An example of colonnade, a row of columns that support a roof; as demonstrated in this picture of the Parthenon. Their purpose is both structural and aesthetic. From Image Parthenon-Restoration-Nov-2005-a, by Barcex, 2005 https://commons.wikimedia.org/wiki/File%3AParthenon-Restoration-Nov-2005-a.jpg. Copyright 2005 by Barcex.

Just as successful architecture has a positive psychological impact on humans, poorly constructed buildings and settings have a significant negative impact. Public health has been at the forefront of governmental concern as far back as 1926, when the Supreme Court declared public health protection (defined initially as physical health) to be a fundamental responsibility of local governments. That declaration provided governments with legal authority to regulate land use. As time progressed, the World Health Organization expanded the concept of public health to encompass mental and social well-being rather than just physical health and the absence of disease. Furthermore, the WHO insisted that rather than just control disease (both mental and physical), we should act to prevent it.37 While city planning is essential to the protection of public

health, so is the architecture of individual buildings that comprise the built environment in the city. Studies have shown that battered houses and neighborhoods, and abandoned and dilapidated buildings make us feel unsafe, thus evoking fear and anxiety.\(^\text{38}\) We already know that these feelings activate our survival mechanisms and kick our sympathetic nervous system into action. In their book *Cognitive Architecture: Designing for How We Respond to the Built Environment*, Sussman and Hollander (2015) explore the negative psychological impact urban cities have on humans. They argue that humans are generally healthier when their built environment contains a variety of independent shops, unique spaces and buildings rather than generic, cement buildings and repetitive chain stores.\(^\text{39}\) Sussman and Hollander were not the only individuals interested in this phenomenon. Neuroscientist Colin Ellard took it a step further. By monitoring skin conductance and electrodermal responses to emotional excitement, he led a group of participants down two city streets. The first included a large, generic Whole Foods building; the other included a plethora of unique and lively restaurants whose buildings were made up of open doors and windows. He found that the former environment resulted in the lowest arousal level of the study, while the latter produced a high level of excitement. These results led Eller to conclude: “The holy grail in urban design is to produce some kind of novelty or change every few seconds, otherwise, we become


cognitively disengaged.”[^40] Such disengagement is undesirable from a psychological perspective; studies conducted by Merrifield and Danckert suggest that even small amounts of boredom can actually induce stress.[^41]

In summary, architecture and design can have a substantial impact on human psychology and emotions. Well-designed buildings that use successful patterns like the Nine Square, or that evoke the sense of security our ancestors felt on the savanna have a positive psychological impact, and cause the release of neurochemicals that make us feel a sense of pleasure. Poorly maintained buildings make us nervous and fearful by activating our sympathetic nervous system which is detrimental to our health. A wide variety of unique buildings and shops stimulate our mind, while dull repetitive buildings bore us which has been clinically proven to induce stress. Furthermore, constant exposure to such negative building characteristics can be detrimental to health since they can be a source of chronic stress. Fortunately, this is both avoidable and correctable considering all of the cognitive research and building technology at our disposal. Ideally, the construction of new buildings and urban areas should not simply avoid these negative attributes, but work to counteract them by incorporating the aforementioned methods of beautiful design.

The Importance of Human Interaction with the Environment

Thus far, we have discussed some of the many characteristics of architecture that effect our mental, emotion, and psychological well-being and why. There is another crucial element that, when absent, has the ability to completely derail the effectiveness of even good architectural design: nature and the environment.

The field of environmental psychology studies the environment’s impact on human behavior as well as the consequences of our behavior on that environment. Human behavior, to a significant extent, is determined by the environment in which it takes place and the resources that exist within that environment. Furthermore, a human’s response to environmental stimuli has been shown to be dependent upon several factors including: a) the landscape and its complexity, novelty, and patterning; and b) the individual and their past environmental experiences, the amount of time they have spent in an environment, their ability to appoint structure on the environmental landscape, their personality traits, and their sensory associations with the environment. In 1986, Edward O. Wilson published the book *Biophilia* (1986), in which he coined the term Biophilia to describe what he believed to be the necessity for modern humans to be in contact with nature. Wilson proposed that this necessity was a vestige of the attraction for all living things experienced by our human ancestors; he also felt that we possessed a genetic predisposition to that attraction. Wilson further believed this attraction remained intact during our evolution from our ancestors because it was beneficial to us in the process of reproduction. Eventually, as we became sufficiently cognitively aware to discern a

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difference between humans and other species, a more specific attraction to our own human species replaced the more generic attraction to all living organisms. None-the-less, remnants of that former attraction to all living organisms remains a preference for humans due the positive psychological responses that came from being around them evolutionarily. This ingrained affinity for the natural environment and the living things that reside there helps to explain, at least in part, our preference for architecture and designs like La Sagrada Familia and the Eden Project that incorporate elements of nature to various degrees.

Despite our human affinity for natural environments, there can too much nature incorporated into architecture and design; when that occurs, it tends to evoke a similar stress-type response to that seen when there is too much uniformity in a built environment like we’ve already seen in Colin Ellard’s research. Russell and Lanius (1984) developed a model to identify the preferred balance of built and natural environments, using positive physiological responses to identify that preference. Their model breaks the possible emotional reactions to environments into four categories; arousing and not arousing, and pleasant and unpleasant. Those emotional categories were used to classify the various words study subjects used to describe their emotions.\footnote{Russell, J. A., & Lanius, U. F. (1984). Adaptation level and the affective appraisal of environments. \textit{Journal of Environmental Psychology}, \textbf{4}(2), 119-135. doi:10.1016/s0272-4944(84)80029-8} For example, active is an emotional descriptor associated with arousal on the pleasant side of the spectrum; while hectic, another descriptor for arousal, would be categorized as unpleasant. When an environment is arousing but unpleasant, we feel panicked and tense,
and our sympathetic nervous system is activated. Likewise, when the environment is unpleasant but not arousing, we feel unstimulated and bored; boredom, as we have already seen, also leads to stress. When environments are pleasant, they can either be arousing (making us feel excited and stimulated, causing chemicals like oxytocin to be released), or they can be not arousing (making us feel pleasantly relaxed and at peace, helping our autonomic nervous system to run smoothly). Regardless of which side of the spectrum an environment falls on (arousing or not arousing), being extreme on either side causes us to feel uncomfortable which in turn generates a physiological response that causes us to seek either arousal reduction or sensory enhancement. Humans will for this reason seek out built environments that they find to be most pleasant and least stressful.

It is important to note that because each human being is unique, each person has different preferences and different reactions to environmental stimuli resulting from complexity, partiality and past experiences. Regardless of individual variations, human beings generally favor environments that are pleasant (whether arousing or unrousing) over environments that are unpleasant. One benefit of arousing and pleasant environments is the mental stimulation they provide. This turns out to be an important architectural and psychological consideration in our built environment. In fact, information processing is a separate environmental preference theory which suggests that because humans are natural born information processors, we prefer environments that provide us with ample amounts of information to process.45 Applying that knowledge to the world of architecture, it's easy to understand why the simplistic and unimaginative

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designs of the immediate post-WWII era haven't lasted, while more ornate architecture using more classical columns, colonnades and entablature has lasted across centuries.

But just as too much nature can be overwhelming, so too can too much information which tends to push the arousing environment away from the pleasant and closer to the unpleasant category. Kaplan and Kaplan (1987) took this environmental preference theory one step further in their preference model. The Kaplan model was created as a combination of native (Biophilia) and constructivist elements. Constructivism works in opposition to Biophilia and other native approaches in that it proposes that the process of perception is an active one in which we analyze incoming information and compare it to stored experiences.\textsuperscript{46} The categories defined in the model (coherence, legibility, complexity and mystery), are believed by Kaplan to increase an individual’s preference for a specific environment. To define Kaplan’s, coherence is the degree to which the environment is organized as a whole; legibility is the degree of distinctiveness through which the viewer is able to categorize the contents of the scene; complexity is the variety and number of elements to a scene; and lastly, mystery is the amount of hidden information a scene contains.\textsuperscript{47} In Kaplan’s view, the more of each of those components a certain environment has, the higher the individual’s preference for it is. In other words, individuals are partial to environments that possess the attributes that they find most useful to their specific survival needs as defined by their stored experiences.

As noted in Chapter 2, good architectural design finds much of its influence in the patterns of nature. The stress reducing capabilities of those designs are a direct result of

\textsuperscript{46} Bell. (2011).
our brain recognizing visual similarities to nature. The beneficial impact of natural design elements goes deeper than an improved sense of psychological well-being though. Restorative environments are, as the name implies, those environments that foster restorative processes. Merely being in contact with nature and these environments is enough to set this process in motion. Such restorative effects were clinically proven in a number of studies conducted by Roger Ulrich. In one study, Ulrich (1979) demonstrated that simply viewing pictures of nature had the ability to lessen the effects of exam induced stress. In another, Ulrich (1984) demonstrated shortened post-surgical recovery times for patients in hospital rooms with a window overlooking a small stand of trees compared to patients recovering in a room with a brick wall in place of the window. In a third study, Ulrich (1991) analyzed the physiological effects of a stress inducing 10-minute black and white video displaying industrial accidents on two groups of subjects. Following the initial video, one subject group viewed a 10-minute color video displaying everyday nature, while the second watched a 10-minute color video of urban areas. The participants exposed to the nature video experienced an increase in positive feelings and were found to have lower blood pressure, muscle tension, and skin conductance levels; the urban scenes failed to produce any of these positive physiologic effects.

Knowing the important restorative effects that come from human interaction with nature, it follows that architecture that incorporates nature and the environment into it can facilitate the same restorative effects. Turning our personal shelter into a natural environmental provides us with refuge (a safe sheltered place) and prospect (an unobstructed view of the surrounding environment).\(^{52}\) Incorporating Ulrich’s findings into the building process today is very simple. Of course, the degree to which this incorporation is possible will depend on available space and available resources. In the most basic form, having windows with a view of nature is easily done. When this can’t be done, as in a city for example, simply adding pictures of nature to one’s house can produce similar effects. When resources are bountiful, houses that have large windows or glass walls permitting an unobstructed view of nature (the closer the nature the better), or that have the space to place plants inside, will be the most beneficial at producing the aforementioned psychological benefits. Adaption of such natural landscapes into our built environment is also an essential part of developing an attachment to that space. Place attachment is defined as a sense of “rootedness” felt toward a certain location.\(^{53}\) Attaching sentimental value, a sense of safety, or a feeling of psychological well-being to a place provides us with an incentive or need to return.

Ulrich’s findings are also applicable to the urban landscape. Unfortunately, most urban environments utterly fail from an architecture and design perspective if the goal is to produce a low stress, psychologically healthy environment. Urban architecture is often bland and featureless which we now know creates low level stress and results in


\(^{53}\) Bell. (2011).
insufficient mental stimulation. Urban areas are also frequently devoid of the natural environment which not only creates further stress but also eliminates the potential important restorative benefits nature can provide.
Conclusion

There is now extensive research demonstrating that good architectural design has clear psychological and physiological benefits that transcend the mere sense of an aesthetically pleasing appearance. We also now understand there is a direct link between poor architectural design and execution and negative health and psychological issues. Finally, today we have a better understanding of the human evolutionary basis for many of those psychological and physiological responses to design. Utilizing that knowledge and the technological tools we now have available, we have an opportunity to create architecture that is not only aesthetically beautiful, but more importantly, psychologically beneficial. With health problems such as stress induced heart attacks and obesity, high blood pressure, depression, anxiety, etc., increasingly plaguing the modern world, employing architectural design that doesn't take advantage of elements known to produce psychological and restorative benefits is no longer an option.

It is also important that we reconsider the societally ingrained constructs that have wrongly labeled the field of architectural design as simply an art form, thereby stripping it of the meaningful legitimacy it deserves as a field that has the potential for real societal benefit. If the positive psychological and restorative impact of architecture is seen only by psychologists and architects, and not the general public, then the psychological impacts of thoughtless architectural design will never be addressed and the field will continue to lack the resources necessary to improve the world we live in. In short, this needs to be recognized as a societal issue that is pressing and important to society itself.
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