ISSN: 0974-5823 Vol. 7 No. 1 January, 2022

International Journal of Mechanical Engineering

Presenting the Pseudoscientific Neuroaesthetic Model as an Analytical Framework of City Centers' Streetscape Architecture

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ABSTRACT

Every day, the architecture and built environment we inhabit envelopes our minds and bodies and influences how we feel and mentally behave. (Ku¨ leer & Lindsten, 1992; Baker & Standeven, 1995; Brager, Paliaga, & De Dear, 2004; Mehta & Zhu, 2009; Fich et al., 2014; Ellard, 2015). When people interact with a given environment, they perceive and respond to qualities of the whole system created by the organization of many interdependent parts (Adams, 2014; R. Kaplan & Kaplan, 1989). Following a developed neuroaesthetic model as a foundational framework that was inspired by the aesthetic triad of (Chatterjee and Vartanian, 2014; Coburn, 2020). The framework is set to explore the mental responses of street users to the aesthetics of the visual exterior stimuli in streetscapes in the context of city centers. This area has never been strongly investigated, presenting an identified gap in the relevant literature, and is going to be explored through a multi-dimensional literature survey. This research believes that the streetscape design in city centers has a significant neuro aesthetical effect. The research presents an author observational survey framework to inductively arrive at data consisting of five phases. Image survey: is the author's observation and analysis of (photos, drawings, etc.) as research materials while referring to theories to arrive at the data. In the framework, each pre-analysis survey observation is going to be connected to the most relevant of the three mental reactions: the sense of belonging, visual comfort, and fascination, in order to arrive at data outcomes. The final step is to classify these data outcomes into the three aesthetic qualities: formal, sensory, and symbolic.

Key Words: City-center, Streetscape, Aesthetic, Street User, Neuroaesthetic.

INTRODUCTION

Commercial, cultural, economic, political, and climatic aspects are usually significant in shaping city center streetscapes. The aesthetical reaction of street users can easily be neglected in architectural designs. In such cases, the streetscapes in city centers are formed to favor commercial, cultural, economic, and climatic benefits in the first degree. The psychological and aesthetic responses to the built environment are derived from the cognition of aesthetic properties in urban configurations and are examined based on the different design features of the environment. (Nasar, 1994; Heft and Nasar, 2000; Olascoaga, 2003). Evidence suggests that the aesthetic qualities of the built environment may predict wellbeing better than any single design variable measured in isolation (Adams, 2014; S. C. Brown, 2014; Ellaway, 2014; Kyttä et al., 2011). The façades, however, are the first and most impactful element on street users in the urbanized built environment. In addition to that, the facade is not only a reflection of the architectural character of a region; it is also a representation of local, cultural, social, climatic, political, and economic circumstances (Askari & Dola, 2009). Building façades are an integrated system between the rationality of function and the surrealism of beauty, capturing people's imagination and triggering emotive reactions (Bechtel and Churchman, 2003).

Many studies suggest that contemporary urbanization is associated with higher levels of anxiety, depression, and other mental disorders (Lederbogen et al. 2011; Peen et al., 2010). Every day, the architecture we inhabit envelopes our minds and bodies and influences how we feel and behave (Ellard, 2015). The design of our built environment can modulate how comfortable (Baker & Standeven, 1995; Brager, Paliaga, & De Dear, 2004) or focused (Mehta & Zhu, 2009) we feel in a given moment, can influence hormonal patterns (Fich et al., 2014; Ku¨leer & Lindsten, 1992), speed up recovery from surgery (Ulrich, 1984), and long-term cardiac health (Kardan, Gozdyra, et al., 2015).

Studies indicate that the aesthetic qualities of architecture have an impact on our mood, cognitive functioning, behavior, and mental health (Adams, 2014; Hartig, 2008; Huppert & Cooper, 2014; Joye, 2007b). In their study, Dornbusch and Gelb (1977) consider that the aesthetics of buildings are the most important criterion in evaluating environmental quality and users' productivity. The aesthetics of the buildings were also linked to visual recognition (a significant cognitive phenomenon of visual reasoning) in the theories of design emergence that can be reflected in architecture (Oxman, 2002).

The research is going to develop a neuroaesthetic model as an analytical framework that architects and urban designers can follow to pseudoscientifically explore the street users' neuroaesthetic reactions to streetscapes. The outcomes are not necessary to be accurate as this is not fully scientific research. The citations that this research relies on are mainly referred to experiments on a particular group of participants under particular circumstances. Most of the experiments that are referred to are mostly based on participants' own preferences and do not use neurological techniques such as galvanic skin response (GSR) tests, blood cortisol tests, and neuroimaging to understand the aesthetic mental effects on them. Hence, this makes the research more pseudoscientific.

Most neuroaesthetic research involves two-dimensional images. This makes sense when the stimuli viewed are flat paintings, although issues of scale and visual texture remain relevant in so far as experiments are typically conducted on a computer screen in a laboratory. Even architecture-specific investigations have relied on flat visual stimuli to represent three-dimensional architectural space, and thus might be treated more like artwork than buildings in these experiments. Real buildings induce more immersive and multisensory experiences than images of architecture or visual art. The specific experience of being in such a space might be more difficult to capture experimentally. A similar issue arises with installation art, which has not been investigated in any systematic way in neuroaesthetics. Perhaps in the near future, virtual reality techniques will permit a reasonable approximation of the experience of immersion in an architectural space.

Relatively little empirical work has been conducted on the neuroscience of architecture. Future research must go beyond inferences from neuroscientific knowledge applied to architecture to direct experimental work in which architectural experience itself is the target of neuroscientific research. (Coburn, 2018). This research explores the mental responses of street users to the aesthetics of the visual exterior stimuli (architectural outdoor streetscapes) in the context of city centers' streets, following a developed neuroaesthetic model as a foundational framework, which was inspired by the aesthetic triad of (Chatterjee and Vartanian, 2014; Coburn, 2020).

There has been limited research to date on the neuroscience and psychology of aesthetics in architecture, and the disparate neuropsychological response measures that have been tested remain disconnected from any cohesive psychological or neuroscientific framework (Chatterjee & Vartanian, 2014; Graham et al., 2015; Eberhard, 2008). Hence, the research will present a pseudo-scientific framework that can present a first step towards future neuroscientific research. It can also help us neuroaesthetically explore streetscapes using multi-dimensional case and literature survey methods. As far as we reviewed, no such framework has ever been used in exterior built-environment streetscape research. By investigating and providing empirical evidence, this research tries to support this gap by providing enough base for future neuroaesthetic explorations. This paper believes that the visual design of the streetscapes in city centers is significant in street users' neuroaesthetical mental reactions. The framework that the paper aims to use starts with an observational survey and then considers relative theories to analyze them to deliver the data as outcomes. It is a pseudoscientific explorative framework study on people's mental reactions to streetscape aesthetics.

The framework uses mixed quantitative and qualitative data analysis methods to be conducted. This increases the validity and reliability of the indicator's measurement of aesthetic value and allows us to objectively explore the dependent variable's aesthetic, including the highlighted area and buildings of attention. As a result, the framework will assist researchers in exploring the city center streetscapes' neuroaesthetic qualities.

The framework is based on streetscape aesthetic guidelines and design principles to be analyzed while referring to a list of psychological dimensions that evoke specific neural signatures in the form of a developed neuroaesthetic model as a foundational framework, which was inspired by the aesthetic triad of (Chatterjee and Vartanian, 2014; Coburn, 2020). The outcome data is going to be classified into the three main aesthetic qualities: formal, sensory, and symbolic.

The research significantly contributes to several areas, including neuroscience, architectural design aesthetics, design psychology, urban environmental behavior research, and methodological design implications based on empirical evidence. The research does not just draw its conclusion on the statistical evidence; rather, the findings are discussed before being translated into aesthetic architectural design recommendations. This study's findings can provide architects and urban designers with practical insights into healthy aesthetical architectural external appearance for more comfortable vision and mental well-being. This paper aims to produce a neuroaesthetic model as an aesthetical analysis framework that architects and urban designers can follow to pseudoscientifically explore streetscapes. The exploration data of the selected streetscapes can also present guidelines that have a high potential to neuroaesthetically improve the existing outcomes or elevate the quality of architects' and urban designers' future outcomes to make them more aesthetically united and positioned toward one clear positive mental effect. It will not only alert architects and urban designers to pay attention to the three main mental reactions, but also the qualities of aesthetics: symbolic qualities, formal qualities, and sensory qualities, and deal with them properly.

NEUROAESTHETICS

This chapter provides a first step towards a deep understanding of research with such topics as aesthetics, design theories, neuro-architecture, and architectural perception. The visual design significance of the environment on the people who use it presents a challenge to the architecture and planning realm. This challenge is rooted in the general yet important objective of providing the users of the built environment with comfortably perceivable designs.

This chapter begins by reviewing the broad concept of design theories, including environmental and architectural design psychology and perception, while expounding the neurophysiological and neurochemical approaches and interpretations. The findings of these reviews aim to help accentuate and justify this research topic by identifying the gap, providing valuable methodological insights, and significantly pointing to the research problem area.

The field of neuroarchitecture studies the effects of the built environment on its inhabitants by using neuroscientific tools (Edelstein, 2008; Nanda et al., 2013). This paper by Coburn et al. (2017) focuses on the burgeoning interest in the intersection of neuroscience and architecture and promises to offer biologically inspired insights into the design of spaces. The goal of such interdisciplinary approaches to architecture is to motivate the construction of environments that would contribute to people's flourishing in behavior, health, and well-being. Studies suggest that this nascent field of neuroarchitecture is at a pivotal point at which neuroscience and architecture are poised to extend to a neuroscience of architecture. In such a research program, architectural experiences themselves are the target of neuroscientific inquiry. Coburn (2020) draws lessons from recent developments in neuroaesthetics to suggest how neuroarchitecture might mature into an experimental science. The review includes the extant literature and offers an initial framework from which to contextualize such research.

Referring to the aesthetic triad by Coburn et al. (2017) and another research by Ellard (2015), both pointed out that the aesthetical experience of buildings and spaces has an important role in shaping people's behavior, health, and wellbeing. Noted that,

if people feel visually uncomfortable in outdoor spaces, the consequences may be dysfunctional and destructive patterns of behavior, passive-aggressive denial, or distorted self-perception. In its turn, this can lead to restlessness, or discomfort, hypersensitivity, lethargy, or anxiety. Moreover, our reactions to design are largely unconscious (Best, 2012). This indicates that each design element can have an unconscious effect on the viewers and their temporary mental behavior. In neurology, mental change occurs when a specific neurological message, including visual messages coming from the eye (visual cortex), can have a role in resulting in a normal brain neurophysiological reaction, therefore, mental behavior such as mood changes and anxiety (Sewilam, 2013).

Sewilam explained in (2013) that upon observing a visual message, a neurochemical reaction must occur in our brain by releasing neurotransmitters such as norepinephrine, serotonin, dopamine, GABA (Gamma Amino Butyric Acid) and some hormones such as oxytocin (pleasure hormone), cortisol (stress hormone) and melatonin (sleepiness hormone), which all eventually lead to anxiety as a normal and natural temporary mental reaction. Hence, there can be strong chemical-physiological evidence and interpretation of the path of visual messages in our brains that stimulates us to behave in a specific way mentally. That comes from the message that is sent from our eyes to the visual cortex and then to the limbic system, the emotional responsible part of our brains. Therefore, a sudden change in visual message has a strong potential to result in a tangible mental reaction. The streetscape's aesthetic influence on urban outdoor users' mental behavior is, however, going to be furtherly explored by filling the gaps in relevant literature. Despite individual differences, consistent patterns of neural activity are emerging from this line of research that, in the future, could help architects design brain-informed buildings.

In conjunction with increased precision in defining design concepts (Stamps, 1999), the neuroscience of architecture is well positioned to study the biology of architectural beauty. Much work remains to be done. The hope is to improve human experience and well-being by optimizing the built structures that surround us for much of our lives.

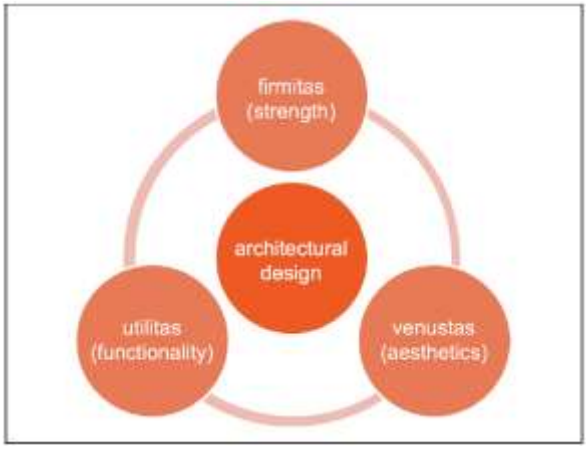

Figure 1. The Vitruvian triad.

Two thousand years ago, the Roman architect Vitruvius highlighted beauty as one of three core dimensions of architectural design. His formative Vitruvian triad (see **Figure 1**) illustrated that a building must be strong and structurally stable (firmitas), meet the functional needs of its occupants (utilitas), and appeal to their aesthetic sensibilities (venustas; Vitruvius Pollio, Morgan, & Warren, 1914). the Vitruvian (aesthetic) triad suggests that sensory and emotional response patterns shaped by bio evolutionary forces may form the foundation of architectural experience, but also that this experience is substantially modified by a person's education, cultural upbringing, and personal experience. Viewing architectural spaces elicits a broad range of aesthetic experiences, from feelings of comfort and excitement to judgments about a building's age and style. (Coburn, 2018)

The authors (Coburn et al., 2017) all confirm that philosophers since ancient Roman times have emphasized the experiential importance of architectural aesthetics. However, only in the past decade or so have scientists started to investigate this topic with rigor. Here, it is described how an existing model—the aesthetic triad—can serve as a useful initial framework for researching venustas, the relatively hidden dimensions of the Vitruvian triad. Although a few theoretical models have been developed to frame empirical research on the aesthetics of architecture, a neuroscientific model of architectural experience has been outlined to serve as a foundational framework. **Figure 2** presents the neuroscientific model of aesthetic experiences in the built environment in general, which is mediated by three large-scale neural systems: knowledge-meaning, emotion-valuation, and sensorimotor systems (c; Coburn et al., 2017).

A burgeoning interest in the intersection of neuroscience and architecture promises to offer biologically inspired insights into the design of spaces. The goal of such interdisciplinary approaches to architecture is to motivate the construction of environments that would contribute to people's flourishing in behavior, health, and well-being. (A. Coburn, O. Vartanian, and A. Chatterjee, 2017)

The design of places and spaces that provide a context for human experiences—architecture—has a long and often distinguished history. The conscious, frontal lobe processes of shaping this context are only partially understood by architects and have yet to surface in the roiling waters of neuroscience studies. Even less well understood is the role of architecture in shaping human experiences. Social and behavioral scientists have explored this terrain over the past 50 years, but the results of their work are shallow knowledge.

Coburn et al. (2020) hypothesize that interactions with architectural scenes can be explained by a limited number of underlying psychological constructs. This hypothesis is motivated by past studies that have identified latent psychological dimensions underlying aesthetic responses to visual stimuli in other contexts.

Coburn's PCA (principal components analysis) results in (2018) indicates that the most salient aesthetical responses to architectural scenes are likely generated by the integration of cognitive, emotional, and sensory information. *Cognitive judgments* associated with knowledge-meaning systems, *emotional responses* derived from emotion-valuation systems, and *behavioral-motivational responses* linked to sensorimotor activation. Within this psychological framework, Coburn et al., (2020) applied sixteen

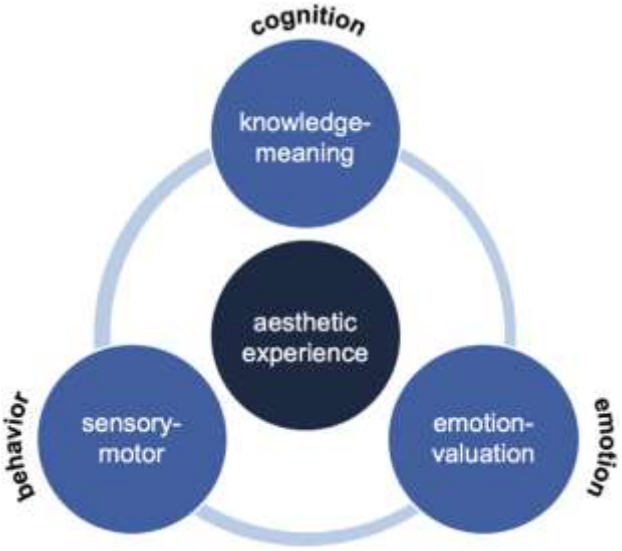

Figure 2. The aesthetic triad. Adopted from Chatterjee and Vartanian (2014).

aesthetic rating scales (measures) that capture the three mentioned important aspects of the aesthetical experience (see **Table1**).

The sixteen measures are divided into three parts by five key measures of cognitive judgement in the built environment: ***complexity, organization, modernity, naturalness, and beauty***. Eight measures of emotional experience in the built environment are outlined below: ***personalness, hominess, relaxation, comfort, stimulation, uplift, vitality, and valence.*** Lastly, three behavioral measures **are**

Table 1. Prompts and end anchors of 7-point rating scales for the aesthetic rating scales. (Coburn et al., 2020).

Aesthetic Rating Scale	Rating Prompt	Low Anchor	High Anchor
Complexity	This room looks...	Simple	Complex
Organization	This room looks...	Disordered	Organized
Naturalness	This room looks...	Artificial	Natural
Beauty	This room looks...	Ugly	Beautiful
Personalness	This room looks...	Impersonal	Personal
Interest	This room looks...	Boring	Interesting
Modernity	This room looks...	Aged	Modern
Valence	This room makes me feel...	Bad	Good
Stimulation	This room makes me feel...	Bored	Excited
Vitality	This room makes me feel...	Lifeless	Alive
Comfort	This room makes me feel...	Uncomfortable	Comfortable
Relaxation	This room makes me feel...	Stressed	Relaxed
Hominess	This room makes me feel...	Alienated	At home
Uplift	This room makes me feel...	Diminished	Uplifted
Approachability	If I saw this room, I'd...	Leave	Enter
Explorability	If I saw this room, I'd...	Ignore it	Explore it

interest, approachability, and explorability. All the 16 response measures have featured prominently in previous environmental psychology and empirical aesthetics research. **The following subsections clarify that the measures are highly correlated with the visual scene aesthetic preference.**

1. Knowledge - Meaning Systems

Education, memories, and the context in which a person encounters an aesthetic object or a built environment can have an impact on the person's experience. Expertise, for instance, is known to influence aesthetic experiences. In one fMRI study, architecture students recruited different cortical areas when viewing buildings than students from other disciplines (Wiesmann & Ishai, 2011). Another experiment showed that architects, compared to nonarchitects, had increased activation of reward circuitry, including the bilateral medial orbitofrontal cortex and the subcallosal cingulate gyrus, when making aesthetic judgments about buildings (Kirk, Skov, Christensen, & Nygaard, 2009). Architects also exhibited greater activation of the hippocampus and precuneus compared to control participants when viewing buildings but not faces, suggesting that memories are rendered.

A person's past experiences in a built environment can modulate their present interactions with that space. Exposure to an environment generates a cognitive map using place and grid cells of the hippocampus (McNaughton, Battaglia, Jensen, Moser, & Moser, 2006; O'Keefe & Nadel, 1978), which in turn facilitates more efficient navigation in future encounters (Astur, Taylor, Mamelak, Philpott, & Sutherland, 2002; Maguire et al., 2000). Grid cells encode memories of both events and the places in which they occur (Edelstein et al., 2008). Since familiarity influences liking (Montoya, Horton, Vevea, Citkowicz, & Lauber, 2017), it is likely that familiarity and ease of navigation will influence the aesthetic experience of spaces.

Cuborn (2020) discussed five key measures of cognitive judgement in the built environment: ***complexity, organization, modernity, naturalness, and beauty***. Visual *complexity* has drawn attention from many architectural theorists (Alexander, 2002a; Kroll, 1987; Salingaros, 2007; Venturi, Scully, & Drexler, 1977), environmental psychologists (R. Kaplan & Kaplan, 1989; S. Kaplan, Kaplan, & Wendt, 1972; Ulrich, 1983), and aesthetics researchers (Daniel E. Berlyne, 1971; Frith & Nias, 1974). Visual complexity refers to "the volume of information present in a space" (Dosen & Ostwald, 2016, p. 3) and the informational "richness" of a scene (R. Kaplan & Kaplan, 1989, p. 53). Positive, linear correlations between complexity and preference have been found in various contexts, including the evaluation of artwork (Day, 1967; Leder et al., 2004; Taylor, Micolich, & Jonas, 1999), natural landscapes (S. Kaplan, 1987; Ulrich, 1977, 1983), and built environments (Ç. Imamoglu, 2000; S. Kaplan et al., 1972). In some cases, preference ratings have been found to follow an inverted U-shaped curve when plotted as a function of stimulus complexity (Daniel E. Berlyne, 1970, 1971; Güçlütürk, Jacobs, & van Lier, 2016; Taylor et al., 1999). This relationship often depends on how complexity is operationalized (Nadal, Munar, Marty, & Cela-Conde, 2010a), which may explain the variability in findings.

personalness is also critical to the psychology of architecture. Visual order implies both an absence of randomness (Tullett, Kay, & Inzlicht, 2015) and the presence of predictable patterns like symmetry (Alexander, 2002a; Reber, Schwarz, & Winkielman, 2004; Salingaros, 2007) and structural redundancy in scenes (Kinchla, 1977; Kotabe, Kardan, & Berman, 2016b). The psychological effects of visual organization have been discussed extensively in architectural theory (Alexander, 2002a; Salingaros, 2007; Vitruvius Pollio, Morgan, & Warren, 1914) and art aesthetics literature (Birkhoff, 1933; Eysenck, 1957; Reber et al., 2004). Perception of order can also be modulated by a building's age, condition, and architectural style. These variables have been captured in past studies by measuring participants' perceptions of *modernity* in the built environment (Acking & Kuller, 1973; Ç. Imamoglu, 2000; V. Imamoglu, 1979).

Interacting with natural environments enhances many aspects of psychological functioning (Berman et al., 2012; Berto, 2005; Bratman, Daily, Levy, & Gross, 2015; S. Kaplan, 1995; Ryan, Weinstein, Bernstein, & Brown, 2010). *Naturalness* appears to be a salient measure of environmental judgement (Berman et al., 2014; Kotabe, 2016) that correlates highly with scene preference ratings (Kardan, Demiralp, et al., 2015). Recent studies also show that the perception of naturalness is not merely determined by natural content (e.g., recognition of trees and vegetation) but is also predicted by specific low-level visual patterns that can occur in both natural and man-made objects and environments (Berman et al., 2014; Coburn et al., 2019; Kardan, Demiralp, et al., 2015; Kotabe, 2016). For instance, Graham and Field (2007) found certain man-made paintings have similar low-level visual properties to natural scenes. Indeed, several scholars propose that nature-like aesthetic qualities are present, to varying degrees, in the built environment, and that naturalistic architectural spaces may confer some of the same psychological benefits as natural landscapes (Alexander, 2002a; Joye, 2007; Kellert, 2003; Salingaros, 1998).

Beauty, which is perhaps the most global measure of aesthetic judgment, is among the most frequently measured qualities in empirical aesthetics (Chatterjee, 2013; Ishizu & Zeki, 2011; Leder & Nadal, 2014; Nadal et al., 2010). Beauty has long been regarded as an important quality of architectural design in cultures around the world (Mak & Thomas Ng, 2005; Patra, 2009; Vitruvius Pollio et al., 1914). Efforts to understand environmental beauty have gained traction in both environmental psychology (Cooper, Burton, & Cooper, 2014; S. Kaplan, 1987; Zhang, Piff, Iyer, Koleva, & Keltner, 2014) and architectural research (Kirk, Skov, Christensen, & Nygaard, 2009; Vartanian et al., 2013, 2015), perhaps because of the growing view that "attractiveness is a key element in how the built environment affects our wellbeing" (Cooper & Burton, 2014), as well as the primary role that beauty plays in our desire to live in a place (Ritterfeld & Cupchik, 1996).

Although this research authors provisionally categorized these five response measures as cognitive judgments, they likely depend on input from all three nodes of the aesthetic triad, rather than from cognitive processing alone. For instance, low-level spatial and color features of environmental scenes significantly predict subjective ratings of complexity, order, and naturalness (Berman et al., 2014; Kardan, Demiralp, et al., 2015; Kotabe et al., 2016b; Kotabe, Kardan, & Berman, 2017), even when the semantic content of scenes is removed (Kotabe, Kardan, & Berman, 2016a; Kotabe et al., 2016b), suggesting that these measures can be shaped by low-level sensory input. Furthermore, the experience of beauty likely involves complex interactions among sensory, emotional, and cognitive inputs (Chatterjee & Vartanian, 2014; Leder & Nadal, 2014; Leder et al., 2004).

2. Emotion-Valuation Systems

The emotions people feel in the presence of beautiful architecture are likely mediated by the brain's reward circuitry. In a meta-analysis of neuroimaging studies investigating positivevalence aesthetic appraisal, Brown and colleagues proposed that the processing of aesthetic emotions occurs through a core neural circuit involving the orbitofrontal cortex (OFC), the basal ganglia, the anterior cingulate cortex (ACC), and the anterior insula (S. Brown, Gao, Tisdelle, Eickhoff, & Liotti, 2011). One study revealed that curvilinear building interiors are judged as more beautiful and pleasing than rectilinear spaces, and that ratings of the beauty of curved rooms are correlated with increased activation of the anterior cingulate cortex (ACC), which is a region of the brain associated with emotional salience monitoring (Vartanian et al., 2013). The ACC is connected with both the orbitofrontal cortex (OFC), which processes emotion and reward in decision-making, and the anterior insula, which is also involved in emotional processing. The ACC is often co-activated with these regions in neuroimaging studies of rewards (S. Brown et al., 2011).

Cuborn (2020) indicated eight measures of emotional experience in the built environment, and they are outlined below***: personalness, hominess, relaxation, comfort, stimulation, uplift, vitality, and valence.*** The degree of personal feeling that a building generates is an important consideration in architectural design (Alexander, 2002a; L. T. Graham et al., 2015; Sommer,

1969; Wiking, 2017). *Personal* spaces feel warm and intimate (L. T. Graham et al., 2015; Sommer, 1969) and generate feelings of "depth, tenderness, and longing" (Alexander, 2002a, p. 302), whereas impersonal spaces often feel cold and standardized (Linnet, 2012). A related measure, the degree to which an architectural space makes a person feel cozy or "at home" (Daniels, 2015; L. T. Graham et al., 2015; Ritterfeld & Cupchik, 1996), is captured by the Canadian concept of *hominess* (Linnet, 2012; Wiking, 2017). Considerable emphasis has been placed on the degree of stress or, conversely, *relaxation* that people experience in response to environmental design (Baum & Davis, 1980; Fich et al., 2014; L. T. Graham et al., 2015; Tullett et al., 2015; Tyrväinen et al., 2014; Ulrich et al., 1991). *Comfort* is also a salient measure of occupant experience that abounds in architectural research (Baker & Standeven, 1995; Brager et al., 2004; Fanger, 1973; Nicol & Humphreys, 2002; Thorsson, Honjo, Lindberg, Eliasson, & Lim, 2007).

Researchers have taken an interest in understanding how design parameters modulate the degree of physiological *stimulation* that occupants experience (Acking & Kuller, 1973; L. T. Graham et al., 2015; Ritterfeld & Cupchik, 1996). A related measure is the extent to which a place feels *uplifting*, on the one extreme, and depressing, on the other (Evans, 2003). This scale may be particularly relevant to wellbeing, as the frequency of daily uplifts a person experiences predicts long-term health measures like stress and depression (Kanner, Coyne, Schaefer, & Lazarus, 1981; Vitaliano, Scanlan, Ochs, & Syrjala, 1998). Scholars have also measured the impact of environmental design on *vitality* (Ryan et al., 2010; Tyrväinen et al., 2014), which covaries with important physiological and psychological health measures (Ryan & Deci, 2008; Ryan & Frederick, 1997). Vitality has been defined as "a positive sense of aliveness and energy" (Nix, Ryan, Manly, & Deci, 1999, p. 530) and is closely related to the Chinese concept of *chi*, which Nix and colleagues defined as a source of calm energy that "can be more or less accessed by individuals depending on their lifestyles and personal practices" (Nix et al., 1999, p. 268). A related but broader measure, *valence*, describes the degree to which an architectural space makes an occupant feel good or bad. Valence is among the most frequently studied affective measures in empirical aesthetics and is closely related to other common measures such as preference, liking, and pleasantness (Acking & Kuller, 1973; Daniel E. Berlyne, 1970; Di Dio et al., 2007; Leder et al., 2004).

Although these affective response scales are associated with neural networks regulating pleasure and emotion, it is likely that cognitive and sensory processes also influence emotional responses to architecture. For instance, *hominess* ratings are likely modulated by cognitive evaluations based on an individual's culture, upbringing, and memories of home. Pleasure responses to architectural scenes have also been shown to depend on education and expertise (Kirk et al., 2009), suggesting that *valence* may be influenced by top-down cognitive processing.

3. Sensory-Motor Systems

The final class of aesthetic response scales encompasses the psychological measures of behavior, movement, and motivation, which may be, to a first approximation, linked to sensorimotor processing in the brain. Aesthetic parameters such as olfaction (odour), somatosensory sensations, and acoustics, including reverberation time, have also impacted on how we observe our built environment. For instance, they influence an occupant's comfort, emotional state, and perception of beauty. Aesthetic parameters also have an impact on decisions to approach or avoid a space (Vartanian et al., 2015), which may be governed by reward and emotion processing areas like the nucleus accumbens, the anterior insula, and the basolateral amygdala (Vartanian et al., 2013).

Aesthetic parameters like enclosure have an impact on decisions to approach or avoid a space (Vartanian et al., 2015), which may be governed by reward and emotion processing areas like the nucleus accumbens, the anterior insula, and the basolateral amygdala (Vartanian et al., 2013). Intriguingly, Joye and Dewitte found that exposure to images of tall buildings, which were associated with heightened feelings of awe, caused participants to experience greater immobility and respond more slowly to a manual clicking task than exposure to images of low buildings (Joye & Dewitte, 2016). These findings suggest that our aesthetic evaluations of architecture can propel or inhibit motor activity and influence the specific qualities of the viewers' experiences.

Coburn, (2020) focused on three behavioral measures**: interest, approachability, and explorability.** *Interest*, an important response measure in empirical aesthetics (Daniel E. Berlyne, 1971; Day, 1967; Silvia, 2005, 2012) and environmental psychology (R. Kaplan & Kaplan, 1989; Ulrich, 1983), is closely linked to sensory perception (Day, 1967) and motivation (Silvia, 2008). James (1892) described interest as an automatic psychological process that enables us to identify and attend to sensory stimuli that are important for our welfare. Environmental psychologists later applied this idea to landscape perception by proposing that sensory features of the environment are more likely to capture human interest if they prove beneficial or detrimental to our species' survival over the course of evolutionary history (Appleton, 1975; S. Kaplan, 1987; Wilson & Kellert, 1995).

Interest can also motivate motor responses to physical surroundings (Joye & Dewitte, 2016; R. Kaplan & Kaplan, 1989; Ulrich, 1983), including fundamental decisions to *approach* or avoid architectural spaces (Ritterfeld & Cupchik, 1996; Vartanian et al., 2015, 2013). Another important behavioral response to architecture is "the need to *explore*, to find out more about what is going on in one's surroundings" (R. Kaplan & Kaplan, 1989, p. 51). Although these response measures are associated with sensorimotor processing, they likely involve input from the cognitive and affective domains discussed previously. Despite being strongly influenced by sensory content, *interest* has often been described as a measure of emotion (Silvia, 2005, 2008, 2012), and could be categorized as an effective response measure. Like valence and beauty, *approachability* describes a global psychological response that is likely modulated by cognitive and emotional processes.

THE FRAMEWORK: THE NEUROAESTHETIC MODEL

The most significant pre-analysis survey observations of each streetscape are connected with the most relevant mental reactions in order to arrive at data outcomes. The mental reactions are the sense of belonging, visual comfort, and fascination. The final step

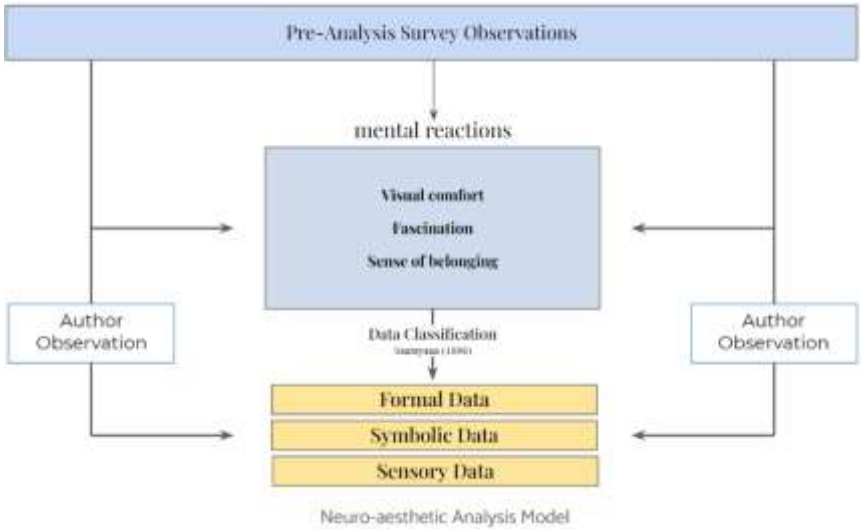

Figure 3. Neuroaesthetic Analysis Model

is to classify these data outcomes into the three aesthetic qualities: formal, sensory, and symbolic.

3.1 Pre-Analysis Observations Collection

Pre-analysis guidelines were mainly derived from (Santayana, 1896; Lang, 1988; Berleant, 2004; Coburn, 2020; Spanjar, 2020; GAM,2021). In this research, there are seventeen observation guidelines, each of which is concerned directly with streetscape aesthetics. Every guideline helps us to objectively analyze streetscape architecture in the form of mages (pictures, drawings, plans...). See pre-analysis survey observation guidelines measured in **Figure 4**.

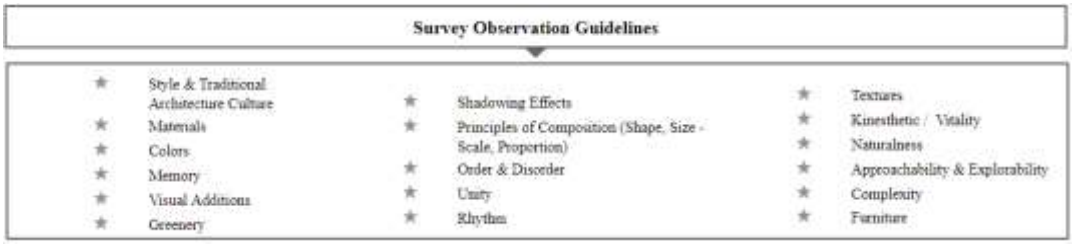

Figure 4. Pre-Analysis Survey Observation Guidelines

The pre-analysis guidelines were mainly based on the neuroscientific model of streetscape architecture, which was adopted from the Aesthetic Triad of Chatterjee and Vartanian (2014). See **figure 5**.

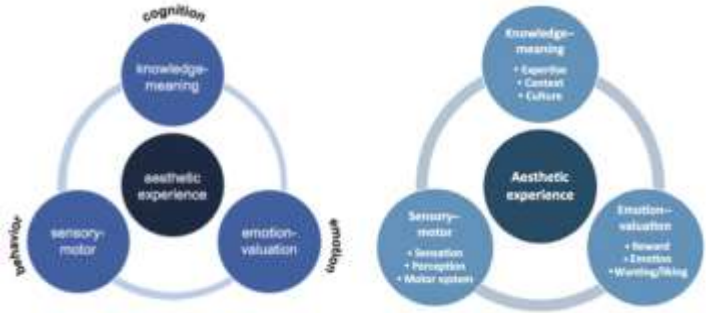

Figure 5. The Neuroscientific model of streetscape architecture Adopted from the Aesthetic triad of Chatterjee and Vartanian (2014).

Neuroaesthetics is an emerging discipline within cognitive neuroscience that is concerned with understanding the biological basis of aesthetic experiences. These experiences involve appraisals of natural objects, artifacts, and environments. Because aesthetic encounters are common in everyday life, exploration of their biological basis can deepen our understanding of human

behavior in important domains such as mate selection, consumer behavior, communication, and art. (Anjan Chatterjee and Oshin Vartanian, 2014).

A burgeoning interest in the intersection of neuroscience and architecture promises to offer biologically inspired insights into the design of spaces. The goal of such interdisciplinary approaches to architecture is to motivate the construction of environments that would contribute to people's flourishing in behavior, health, and well-being. (A. Coburn, O. Vartanian, and A. Chatterjee, 2017)

The design of places and spaces that provide a context for human experiences—architecture—has a long and often distinguished history. The conscious, frontal lobe processes of shaping this context are only partially understood by architects and have yet to surface in the roiling waters of neuroscience studies. Even less well understood is the role of architecture in shaping human experiences. Social and behavioral scientists have explored this terrain over the past 50 years, but the results of their work are shallow knowledge.

3.1.1 Visual Additions

Visual additions are anything that has been added to the streetscape buildings post-construction. These visual additions are:

1. Signs that cover buildings' architectural features, such as windows, doors...
2. Banners are not unified in size, shape, and design.
3. Signs and flags cover the stone.
4. Exposed A/C boxes.
5. Random cables.
6. Un-unified lighting fixtures.
7. Awnings that cover buildings' architectural features.
8. Blocked entrances.
9. Unpreserved structures.
10. Exposed satellite dishes and water tanks.
11. Exposed sewage ducts and gutters.
12. Paint covers the originality of the building.

3.1.2 Materials

Building materials play a major role in affecting the observer's mind. It is an aesthetic quality that can be explained in many different ways. According to Santayana (1896), building materials are one of the variables that carry meanings in the building environment. Moreover, he also mentioned that materials have a formal value.

3.1.3 Colors

Berleant (2020) mentioned that color is one of the features that excites certain perceptual responses in the viewer. Neither inhering in objects nor originating in consciousness, such invitational qualities are rather characteristics to which perceptual awareness is receptive and to which it responds. They emerge only in the intimate reciprocity that is central to aesthetic engagement. Furthermore, Santayana (1896) mentioned that colors are one of the guidelines that carry meaning in the building environment, in addition to their concern with the appreciation of shapes and structures in response to certain patterns.

3.1.4 Approachability & Explorability

Approachability describes the difficulty of arriving at the streetscape and the difficulty of walking between the buildings inside the streetscape itself. According to Coburn et al. (2020), the approachability guideline is one of the behavioral measures that may be, to a first approximation, linked to sensorimotor processing in the brain. Another important behavioral response to architecture is "the need to explore, to find out more about what is going on in one's surroundings" (Kaplan & Kaplan, 1989, p. 51). Like valence and beauty, approachability describes a global psychological response that is likely modulated by cognitive and emotional processes.

3.1.5 Style & Culture

An architectural style is characterized by the features that make a building or other structure notable and historically identifiable. A style may include such elements as form, method of construction, building materials, and regional character. However, culture represents the amount of visual respect that the streetscape has for its environment.

3.1.6 Principles of Composition (Shape, Size - Scale, Proportion)

According to Santayana (1896), principles of design guidelines are concerned with the appreciation of shapes and structures of the environment in response to certain patterns, proportions, or shapes that are not biologically based but rather based on self-conscious and intellectual reasoning. It is also connected to Gestalt theories.

3.1.7 Complexity

Visual complexity has drawn attention from many architectural theorists (Alexander, 2002a; Kroll, 1987; Salingaros, 2007; Venturi, Scully, & Drexler, 1977), environmental psychologists (Kaplan & Kaplan, 1989; Kaplan, Kaplan, & Wendt, 1972; Ulrich, 1983), and aesthetics researchers (Berlyne, 1971; Frith & Nias, 1974). Visual complexity refers to "the volume of information present in a space" (Dosen & Ostwald, 2016, p.3) and the informational "richness" of acene (Kaplan & Kaplan, 1989, p. 53). Positive, linear correlations between complexity and preference have been found in various contexts, including the evaluation of artwork (Day, 1967; Leder et al., 2004; Taylor, Micolich, & Jonas, 1999), natural landscapes (Kaplan, 1987; Ulrich, 1977, 1983), and built environments (Imamoglu, 2000; Kaplan et al., 1972). (Coburn, 2020).

3.1.8 Shadowing Effects

According to Santayana (1896), shadowing effects are one of the formal aesthetic guidelines. This guideline evaluates the shadowing techniques on the buildings in the streetscape. Where shadowing effects are defined as the effects obtained as a result of using shadowing techniques.

3.1.9 Order & Disorder

In architecture, "order" refers to a system of rules that structure the shape, structure, layout, and proportions of a design. Order is an indispensable function of any organized system. As maintained by Santayana (1896), order and disorder guidelines are concerned with the appreciation of shapes and structures of the environment in response to certain patterns, proportions, or shapes that are not biologically based but rather based on self-awareness and intellectual reasoning. It is also connected to Gestalt theories.

3.1.10 Unity & Rhythm

Coburn (2020) claimed that unity is a formal aesthetic variable. The guideline of unity deals with visual composition in design, where its elements should be both visually and conceptually harmonious. In this paper, unity is applied to the streetscapes, utilizing repeating styles to maintain visual consistency. Whereas, rhythm in streetscapes takes concrete forms. It involves movement or the perception of movement as suggested by bodies, objects, or surface patterns in space.

3.1.11 Textures

The word "texture" generally refers to the designed appearance and feel of a surface material. However, it could also mean the physical composition or structure of something, especially with respect to its size, shape, and arrangement of its parts. As stated by Santayana (1896), pleasurable sensations can be obtained from texture.

3.1.12 Vitality/ Kinesthetic

Vitality is the streetscape aesthetic of being energetic, lively, and active. As stated by Coburn (2020), scholars have also measured the impact of environmental design on vitality (Ryan et al., 2010; Tyrvainen € et al., 2014), which covaries with important physiological and psychological health measures (Ryan & Deci, 2008; Ryan & Frederick, 1997). Vitality has been defined as "a positive sense of aliveness and energy" (Nix, Ryan, Manly, & Deci, 1999, p. 530) and is closely related to the Chinese concept of chi, which Nix and colleagues defined as a source of calm energy that "can be more or less accessed by individuals depending on their lifestyles and personal practices" (Nix et al., 1999, p. 268).

Kinesthetic is the basic aesthetic appeal of the city to the person as a pedestrian, and this appeal takes the form of an attraction to the moving body, enticing one to follow along a street in relaxed rhythms of stopping and starting and wandering along. Also, the meaningful relationships that are generated by the person-in-motion His movement is the purpose of the space, and it should function to activate his kinesthetic experience in a series of interesting rhythms and variations in speed and force. (Berleant, 2004).

3.1.13 Naturalness

The results of a final experiment suggest that preferences for nature-like architectural patterns may be associated with feelings of comfort and excitement that such patterns generate. (Coburn, 2018). Interacting the streetscape with natural environments enhances many aspects of psychological functioning (Berman et al., 2012; Berto, 2005; Bratman, Daily, Levy, & Gross, 2015; Kaplan, 1995; Ryan, Weinstein, Bernstein, & Brown, 2010). Naturalness appears to be a salient measure of environmental judgement (Berman et al., 2014; Kotabe, 2016) that correlates highly with scene preference ratings (Kardan, Demiralp, et al., 2015). Recent studies also show that the perception of naturalness is not merely determined by natural content (e.g., recognition of trees and vegetation) but is also predicted by specific low-level visual patterns that can occur in both natural and man-made objects and environments (Berman et al., 2014; Coburn et al., 2017; Kardan, Demiralp, et al., 2015; Kotabe, 2016).

3.1.14 Memory

Memory refers to the processes that are used to acquire, store, retain, and later retrieve information. It involves the ability to both preserve and recovers information that they have learned or experienced. Education, memories, and the context in which a person encounters an aesthetic object or a built environment can have an impact on the person's experience (Coburn et al. 2020). In this research, the memory measure studies the shared memory that is related to a streetscape for a majority of people, showing the relationship between people and the history of the place that concerns community identity.

3.1.15 Greenery

According to Moztarzadeh (2014), the existence and accessibility to greenery create a sense of belonging and unity to the place. Such places can help relieve the person's tiredness. Some others believe that green spaces are a cause of people's gathering, which helps them have social interactions, dialogue, and discussion.

3.1.16 Furniture

According to Moztarzadeh (2014), diversity, functionality, adaptability, and beauty of furniture are factors that help people stay in their places and create a sense of belonging for individuals toward the environment. Most researchers believe that the most important factor in staying in a place is efficient and appropriate furniture.

3.2 Observations Analysis

The most significant pre-analysis image observation is going to be connected with the most appropriate mental reaction. The application mainly consists of three mental reactions: visual comfort, sense of belonging, and fascination. These mental reactions have a positive linear correlation with aesthetics (Coburn et al. 2020); Coburn et al. (2018) recruited 798 US-based adults (391 women, 401 men, and 6 others) from Amazon's Mechanical Turk to participate in a study to rate 200 images of architectural interiors on 16 psychological dimensions that capture the three aspects of the aesthetic triad. Their demographic data was collected in order to verify that the sample group was comprised of a diverse pool of participants representing a randomly-selected sample from the US adult population. The final step is to classify these data outcomes into the three aesthetic qualities: formal, sensory, and symbolic.

3.2.1 Visual Comfort

It is already known that the shape of a building and its form, design, patterns, colors, and daylighting can affect the visual comfort of people (Belichambers & Godby, 1972; Shen et al., 2014). Also, as stated by (Ilvitskaya et al., 2020), architecture should

not only have functional value; it should also create emotional comfort for a person. At the same time, the issue of a favorable perception of the architectural environment is closely related to the quality of the visual aspect of the surrounding space.

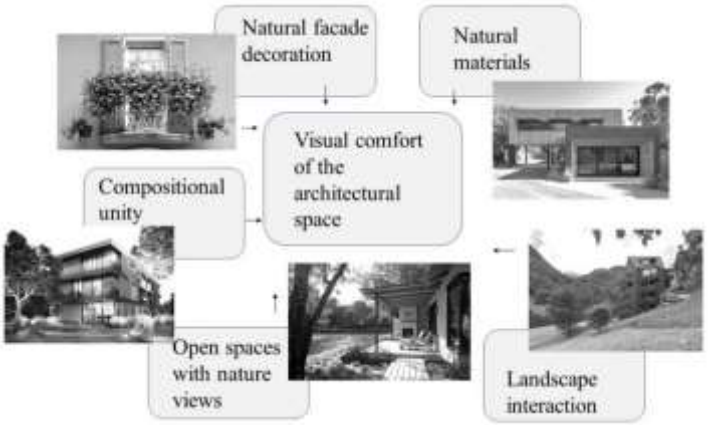

Figure 6. Visual comfort of the architectural space. (Ilvitskaya et. al, 2020).

For the visual space of the interior, natural elements can appear in a color scheme that matches the natural colors of nature; in the formation of open structural elements (for example, supporting columns, supplemented by curved elements in the likeness of natural elements); in solving a system of natural lighting, taking into account the area of the glazed surface, the shape of the window opening, and the presence of a second light. For example, ribbon glazing or panoramic windows allow not only enough sunlight to penetrate, but also open the inner space of the environment as much as possible. Sunlight can further enrich the interior with an ornament if it passes through carved decorative surfaces. A sufficient amount of space also creates a favorable perception of the interior. The interior of the "Houses on the Lake" room combines several techniques for creating a positive internal space in harmony with the external natural environment. The visibility of the background emphasizes the contrast with the natural environment and, at the same time, combines the interior and landscape into a single whole. This technique especially enhances the plasticity of the interior space. Natural materials and natural colors in the room are also complemented by the natural colors of the exterior, which creates the impression of common composition and merging of spaces. (Ilvitskaya et al., 2020).

For a household territory, the natural component is manifested primarily in the merger of the architectural complex of buildings with the landscape and the surrounding landscape, and in the presence of house gardening. The effect of the visual interaction of the house with nature can be enhanced by compositional unity in architecture, where all elements of the building complement each other. An interesting technique may be the unity of the material for the facade and interior, visually combining the interior with the exterior. Representatives of organic architecture concluded that an environment that is as close to nature as possible has a positive visual effect. (Ilvitskaya et al., 2020).

To systematize the visual activity of the natural environment, we should consider the features of the relationship between architecture and nature from the point of view of visual auspiciousness. In the architecture of a residential building, the natural component is manifested as following: (Ilvitskaya et. al, 2020)

- Arrangement of open terraces, patios
- Dividing the space of the house into volumes of different sizes and shapes
- Local materials
- Curved shapes, lines, pathways
- Natural color approximation of facades.

Several studies have tried to evaluate aesthetic preferences for visual quality in architecture. From these studies, it has been found that primary factors such as balance, symmetry, regularity, and unity have a low effect, while distinctive factors such as asymmetry, complexity, spontaneity activity could influence the analytical mind of an observer (Keshtkaran et al., 2017).

High-contrast regions often capture visual attention and interest because they contain a high density of useful visual information for object identification (Hagerhall, Purcell, & Taylor, 2004). On the other hand, excessive architectural complexity may also overwhelm the visual system, particularly if the information is experienced as disorganized (Kotabe et al., 2016; Salingaros, 2003, 2007). People generally prefer at least a moderate level of visual complexity when viewing both art and architectural interiors (Dosen & Ostwald, 2016). Common styles of architecture are full of irregularities, using a series of geometric constructions that parametrically repeat themselves to produce complex images that could be defined as fractal. (El-Darwish, 2019).

Balance, of which symmetry is the most straightforward example, also contributes to fluency and aesthetic preference (Wilson & Chatterjee, 2005). The evolutionary importance of symmetrical information as a reproductive fitness indicator for human survival may underlie experimentally observed preferences for more symmetrical faces and geometric shapes (Jacobsen, Schubotz, Höfel, & Cramon, 2006; Ramachandran & Hirstein, 1999; Rhodes, Proffitt, Grady, & Sumich, 1998; Frith & Nias, 1974). Alexander and Carey reported that the number of local symmetries in a given pattern strongly predicts the ease with which a participant can find, describe, and remember that pattern (Alexander & Carey, 1968).

Vartanian conducted in (2013) a functional magnetic resonance imaging experiment on 18 (12 females, 6 males) neurologically healthy participants (M = 23.39 y, SD = 4.49) with normal or corrected-to-normal vision. The participants were

recruited to examine how systematic variation in contour impacts aesthetic judgments and approach-avoidance decisions, outcome measures of interest to both architects and users of spaces alike.

Curvature, has generated much interest from aesthetics and architectural researchers. In many contexts, people have exhibited greater preferences for curvilinear objects than their rectilinear objects (Bar & Neta, 2006; Dazkir & Read, 2012; Leder & Carbon, 2005). Rectilinear shapes and patterns have also been shown to evoke more unpleasant emotions compared to curvilinear forms (Hevner, 1935; Lundholm, 1921; Poffenberger & Barrows, 1924). These perceptual trends may also extend to the built environment. A study on the perception of architectural contour, for instance, found that curved building interiors were judged as more beautiful than rectilinear spaces. Curved buildings also activated key areas of the visual cortex, including the lingual and calcarine gyrus, when subjects made approach-avoidance decisions (Vartanian et al., 2013).

3.2.1.1 Gestalt Theories

Understanding how the human brain works and then exploiting a person's natural tendencies can help us create a more seamless, understandable, and therefore more comfortable visual-mental interaction with buildings we observe in streetscapes.

Gestalt psychology, or Gestaltism, is a theory of mind developed by the Berlin School. It is a study of the laws of our mind's ability to acquire and maintain complicated and meaningful inputs (stimuli). It is also a form of psychology that focuses on cognitive behaviors (Arnheim, 1970). The theory goes that our mind inclines to understand and identify complex external stimuli by grouping its parts into wholes instead of separate elements, theorizing that the whole is greater and more harmonized in our perceptual system than the sum of its parts. The group of stimuli is structured and organized in our perceptual system following the six laws of Gestalt as they were introduced by the prominent founders of Gestalt: Max Wertheimer, Wolfgang Köhler, Wolfgang Metzger, and Kurt Koffka. The laws are also called the laws of simplicity, which refer to "pragnanz" a German word that means pithiness (Arnheim, 1970; Wertheimer, 1938).

The six laws of simplicity are the law of proximity, the law of similarity, the law of closure, the law of continuation, the law of symmetry & order, and last but not least, the law of figure & ground. All the laws, however, refer to one fact: our mind handles every complicated stimulus by combining its objects into groups in order to get a more simplified input (Arnheim, 1970; Wertheimer, 1938).

Gestalt principles are human perception principles or laws that describe how people perceive objects by grouping similar elements, recognizing patterns, and simplifying complex images. In general, the theory explains how the human brain tends to order visual input in a manner to make it more regular, simplified, and recognizable.

Gestalt theory interpretations have been explained to facilitate how understandable and comfortable the visual image (streetscape) is. According to this research, the six laws of simplicity can be explained under the title of "visual comfort" as follows:

a. Law of Similarity

The principle of similarity states that those objects or elements that share the same visual appearance characteristics, such as color, size, shape, texture, etc., will be seen as belonging to each other instead of being separate. In turn, this leads to seeing it in one group even though in reality, they are different in kind.

Observing similar buildings along one streetscape is more visually comfortable for the viewer. However, observing a different building would be confusing for the observer's mind.

To put it another way, when one object looks similar to another one close to it, viewers will often see the individual elements as part of a pattern or a group. This effect can be used to create one single image, interpretation, or message from a series of separate elements and objects that are similar. The law of similarity holds that a person can normally recognize stimuli that have a physical resemblance as a part of a whole. An example of the law of similarity is putting different flowers of varied colors in a large flower bed. The brain utilizes this principle to consider flowers with a similar appearance, as in one bunch of flowers instead of two or more.

b. Law of Symmetry & Order

Symmetric objects or arrangements share positive features such as stability, consistency, and structure. On the other hand, asymmetric arrangements give a slightly undesirable impression—something is missing or unbalanced. Symmetry does not essentially have to be shaped by other elements such as aesthetics, including color and texture, because they can effectively fulfill the desired kind of balance that the symmetrical elements have. (Idler, 2011). The gestalt law of symmetry indicates that those objects that are symmetrical to each other are easily and innately perceived as a unified group. The law is similar to the law of similarity. However, this rule implies that objects that appear symmetrical to one another will be more strongly grouped together than objects that appear asymmetrical to one another. Accordingly, when the object is symmetrical with another one, it will form one strong whole composition instead of two separate objects.

When symmetrical objects get in order, they will even appear as a stronger unified group. However, when something unexpected and disrupts that order, the group will be separated into more than one instead of one, even though they are symmetrical. Moreover, the separated groups are not symmetrical nor similar anymore on the side.

c. Law of Proximity

The law of proximity states that humans innately perceive stimuli that are close to each other by grouping them and recognizing them as part of the same object instead of being separated. Therefore, stimuli that are far from one another are parts of two or more different objects. The distance that defines how close or far the stimuli are from each other is dependent on every individual. If they are also similar in appearance, this strengthens the connection even more. Moreover, the principle of proximity enables us to group elements together into a unified group instead. In addition, this principle relieves us from having to process complicated scenes that hold many elements.

In other words, the more proximate the buildings are, the more comfortable the observer's mind would be.

d. Law of Continuation

A Gestalt principle interprets objects that are innately grouped as a whole by our minds if they are co-linear or follow a specific direction. This natural innate tendency's intention is also to simplify the complicated stimuli. Accordingly, the direction or the path is considered as a hanger copula that holds different objects together, forming one whole instead (Staff, 2015; Hampton-Smith, 2015; Wertheimer 1938).

The law of continuity can also be defined in another way; the points or objects on a physical or nonphysical path are seen in a way that follows and belongs to that path instead of being separated (Staff, 2015; Grais 2015). The patch, however, unintentionally draws the eye toward a specific element in the scene.

The observer's mind tends to see the whole streetscape as one group. This is the way the mind simplifies the scene. Whenever there is a different building that disturbs this continuation, the observer's mind will be confused.

e. Law of Closure

The law of closure interprets the eye's tendency to understand the unclosed shapes as closed instead. This innately happens using the human visual experience to fill in the missing information. This comes across as the open shapes (unfinished shapes) make the individual observe that the visual pattern is unfinished, so it serves as a distraction to the perceiver. Accordingly, our minds will tend to close the gaps created by the stimuli and complete the unfinished shapes. (Chang & Dooley & Tuovinen, 2002; Fisher & Smith-Gratto, 1999; Fultz, 1999).

f. Law of Figure & Ground

This law describes the eye's tendency to distinguish objects separately from their background. This is based on one or more variables, such as color, size, contrast, etc. In some complicated cases, however, the distinction may sometimes lead to visual confusion by having a natural difficulty in distinguishing the figure or determining the figure outline. (Grais, 2015). If one building in the streetscape is hugely different from the other buildings, the observer's mind sees this building as the figure and the whole streetscape as the ground. The more diverse the buildings in the streetscape, the more confusing it is to the observer's mind.

Reviewing all relevant references that were cited above, visual comfort measures have been pointed in the following table to be used midst applying the neuroaesthetical model on streetscapes to arrive at data. **See table 2**.

Table 2. Visual Comfort Aesthetic Measures

	Mesures
Visual Comfort	1. Gestalt Theory 2. Naturalness 3. Compositional unity 4. Openness 5. Landscape interaction 6. Symmetry 7. Visual Spontaneity 8. Color 9. Complexity 10. Curvature

3.2.2 Sense of Belonging

Belonging to a place is a cognitive and symbiotic relationship with the place, which contains a common, sentimental, and cultural meaning to create a specific space. Therefore, attachment to a place is more than an emotional and cognitive experience and includes the cultural beliefs of the people attached to it, too. (Altman & Setha, 1992).

Belonging to a place is a higher level of sense of place, which plays a decisive role in benefiting and sustaining human presence in the place. It is based on a sense of place that goes beyond the awareness of the settlement there. This sense results in linking the person to the place, which he finds himself as a part of and is based on his experience of signs, meanings, functions, and

Different levels of "Sense of place Place	Being indifference toward the place	This level is usually not considered as sense of place in literature, but can be used to measure sense of place.
	Awareness of the settlement in the place	In this level, a person knows that he lives in a distinct place and understands the symbols of that location, but there is no emotion to attach him to the place. In this case, a person may know that he settles in a place, but doesn't know that he is a part of the place.
	Belonging to the place	In this level, the person is aware of not only the names and symbols, but also he has a sense of shared destinies to the place. The symbols are respected and where it occurs to the place, is important to him
	Attachment to the place	The person has a complex feeling to place, and the place is an axis of individuality .His common experiences and identity combined with symbols and meanings identify the place. This case emphasizes on the uniqueness of the places and its difference from other places.
	Unifying with the aims of the place	This level represents the continuity and mixing the person with the needs of place. In this case, the person realizes and accords himself with these needs and obeys them. There is also a sense of enthusiasm, love, support and devotion toward the place.
	Being in the place	This level attends to the active role of the individual in society, which is a result of the commitment to the place. In contrast to all the previous levels, which have a theoretical basis, this level is understood from the real behavior of a person.
	Sacrificing for the place	This level is the highest level, the person has the deepest commitment to the place and has Great devotion for the attitudes, values, freedoms and prosperity in different situations.There is a readiness here to abandon the individual and common interests in order to gain the greater ones toward the places.

personalities, which he considers a role for the place in his mind, and the place becomes respectable for him (Moztarzadeh, 2014). See following **Table 3**.

The symbolic qualities of urban design are vital in establishing a sense of belonging to a place and its inhabitants' pride in it. (Lang, 2015).

Place attachment is the emotional bond between a person and a place and is a main concept in environmental psychology. It is highly influenced by an individual and his or her personal experiences. Place attachments provide a wider range of positive experiences, such as security, self-esteem, a sense of belonging, etc. (Altman & Setha, 1992).

Moztarzadeh's study in (2014) collected some questions based on the theories and views of Fritz Steel, Mc Donald and salvesen to provide a questionnaire in statistical population of 150 educated persons [undergraduate to Ph.D]. The research explored users environment preferences in term of sense of belonging; spending more time in the place for studying and researching in particular.

A desirable place is a place in which people have a sense of satisfaction, and it is created by the physical and social factors that help to achieve a sense of belonging to a place. The physical factors of the environment affect the person's feelings and behaviors by providing specific activities and meanings that are effective in promoting the spirit of place and inducing a sense of place. Cognition and emotion toward the place are obtained and identified by the space's meaning perception, symbols, form, and semantic aesthetics. (Moztarzadeh, 2014).

Fritz Steel mentions the most important physical factors affecting perception and sense of place, such as the size of the location, restriction degree, contrast, scale, proportion, human scale, distance, texture, color, smell, sound, and visual diversity. He also believes that features such as identity, history, fiction and fantasy, mystery, joy, surprise, security, vitality, passion, and memories lead to an intensive relationship with the place. (Moztarzadeh, 2014).

According to Salvesen, a sense of place occurs through the interaction of three elements: location, landscape, and personal interconnectedness; each of them alone is not enough to create a sense of place. Various factors, such as impatience, the monotony of buildings, and the advent of the digital age, can be counted as threats to the sense of place. He believes that his physical characteristics, ownership, authenticity, residents, and comforts of nature, such as water, plants, sky, sun, and private and common spaces, are components of a place, which are effective in creating a sense of place. According to (Linnet, 2012), Personal spaces feel warm and intimate (L. T. raham et al., 2015; Sommer, 1969) and generate feelings of "depth, tenderness, and longing" (Alexander, 2002a, p. 302), whereas impersonal spaces often feel cold and standardized. (Salvesen, 2002).

The degree to which an architectural space makes a person feel cozy or "at home" (Daniels, 2015; L. T. Graham et al., 2015; Ritterfeld & Cupchik, 1996) is captured by the Canadian concept of hominess (Linnet, 2012; Wiking, 2017).

Color is the most important factor that helps a person have a sense of belonging to a place. The results indicate that most

Figure 7. combine of warm colors and cool colors make contrast sense and it helps to stay in place

people believe warm colors are symbols of calmness and safety in the workplace, while they find cool colors boring and dull. On the other hand, statistics imply that using warm and cool colors in the environment creates a sense of conflict and contrast, and most people are in favor of this sensory conflict. It also helps a person to stay longer in places and creates a sense of belonging for them in the environment. (Moztarzadeh, 2014).

Furniture and plants lead to the creation of perceptual and cognitive factors that result in a sense of belonging to a place in a research center and help a person's long survival in the environment. Furniture's diversity, functionality, adaptability, and beauty help people stay in their places and create a sense of belonging for individuals towards the environment. Most researchers believe that efficient and appropriate furniture is the most important factor for staying in a place. They also believe that the adaptability and variety of furniture for discussion rooms or private reading rooms has been very significant. (Moztarzadeh, 2014).

Statistics believe that the existence and accessibility of plants create a sense of vitality and freshness in a place. Such places can help relieve the person's tiredness. In addition, green spaces encourage people to gather, which helps them have social interactions, dialogue, and discussion. This kind of relationship with the place creates a sense of belonging and unity with the place. (Moztarzadeh, 2014).

Reviewing all relevant references that were cited above, sense of belonging measures have been pointed in the following table to be used midst applying the neuroaesthetical model on streetscapes to arrive at data. See **table 4**.

Table 4. Sense of Belonging Aesthetic Measures

	Mesures
Sense of Belonging	1. Style & Culture 2. Naturalness 3. Monotony 4. Approachability 5. Color & Texture 6. Size, Scale 7. Restrictment degree 8. Contrast 9. Proportion 10. Visual diversity 11. Vitality 12. Security 13. History 14. Memory 15. Furniture 16. Plants

3.2.3 Fascination

Fascination is attraction and holding attentively by a unique power, personal charm, unusual nature, or some other special quality. It is a scene's informational richness and generated interest; it refers to the visual richness and complexity of space and is closely linked to a viewer's sense of excitement and desire to explore it (Coburn, 2018). In addition to that, and according to Coburn experiment in (2018) curved interior scenes yielded significantly higher fascination scores than rectilinear scenes, and scenes showing rooms with high ceilings likewise resulted in significantly higher fascination scores than those showing rooms with low ceilings.

Also, in the same study of (Coburn, 2018) The third principal component from the PCA, fascination, explained 24% and 20% of the variance in image ratings in Experiments 1 and 2, respectively. In both studies, this component represented the vector sum of two variables, complexity and interest. In Experiment 1, explorability and stimulation also exhibited such high bivariate correlations with interest that they were considered redundant variables. A close relationship emerged between these four measures are identified.

A study gave rise to some attractive places "historical-cultural places" "recreational places", and "panoramic places". On the other hand, next to "housing areas" a new category emerged from the most unattractive places of the city, i.e. "administrative/service places" (this category includes places such as bus or train stations and administrative buildings). (Hidalgo et al., 2006)

Regarding restorative power, the most attractive places were perceived as more restorative than the most unattractive ones. Indeed, the results suggest that restorativeness is a significant predictor of a place's attractiveness. (Hidalgo et al., 2006). Moreover, researchers in environmental psychology and social epidemiology has tried to identify design characteristics that might improve our physical and mental health. Increasing evidence from these investigations suggests that "attractiveness is a key element in how the built environment affects our wellbeing" (Cooper & Burton, 2014, p. 13).

In Hidalgo's research, (2006), the mean score for each of the aesthetic attributes was calculated for the most attractive and the most unattractive place. A paired t-test was carried out for each attribute, taking into account that the places considered most attractive obtained the highest scores in all the 11-battery items when compared to the most unattractive. All the differences were statistically significant ($p<0.0001$): novel place, $t(57)=4.89$; facilities for leisure activities, $t(57)=3.94$; presence of vegetation, $t(57)=4.89$; meeting place, $t(57)=5.09$; cleanliness, $t(56)=8.37$; upkeep/maintenance, $t(55)=8.10$; congruence of scenic elements, $t(57)=10.89$; visual diversity, $t(57)=14.45$); luminosity, $t(57)=4.63$; historic or emblematic place, $t(57)=8.14$, and openness, $t(57)=5.87$. These results suggest that for the participants, the most attractive and unattractive places in the city differed regarding all the attributes. See **Table 5**.

Table 5. Mean score (standard deviation in parenthesis) of the 11 aesthetic attributes of the most attractive and the most unattractive places of Malaga (Hidalgo, 2007)

	Attractive Place	Unattractive Place
Novel place	2.96 (1.13)	1.91 (1.11)
Leisure	3.10 (1.26)	2.22 (1.14)
Vegetation	2.72 (1.28)	1.63 (0.71)
Meeting place	3.44 (1.44)	2.32 (1.31)
Cleanliness	3.63 (0.83)	2.24 (1.03)
Maintenance	3.69 (0.89)	2.26 (1.15)
Congruence	3.89 (0.78)	2.10 (0.91)
Visual richness	4.06 (0.83)	1.75 (0.80)
Luminosity	4.10 (0.89)	3.18 (1.14)
Historic place	4.05 (1.22)	2.22 (1.25)
Openness	4.17 (0.77)	3.05 (1.06)

The most attractive urban environments differ significantly from the more unattractive ones regarding several aesthetic attributes: vegetation, visual diversity, congruence, openness, luminosity, historical places, cleanliness, maintenance, places for leisure activities, meeting places, and novel places. This demonstrates their suitability in the field of aesthetic preference studies and

suggests that these attributes, together with restorativeness, constitute important criteria for determining scenic quality. Nevertheless, these differences are not enough to predict the classification of a place as attractive or unattractive. (Hidalgo et al., 2006).

Reviewing all relevant references that were cited above, Fascination measures have been pointed in the following table to be used midst applying the neuroaesthetical model on streetscapes to arrive at data. See **table 6**.

3.3 Data Classification

Table 6. Fascination Aesthetic Measures

	Mesures
Fascination	1. Visual Richness 2. Interest 3. Complexity 4. Historical Cultural places 5. Openness 6. Cleanliness 7. Maintenance 8. Congruence 9. Luminosity 10. Curvature

The materials that need to be gathered for the framework are relegated into two forms: firstly, images in the form of pictures that can be accumulated by the author's camera and online image resources; and secondly, online image resources. Secondly, images in the form of drawings (maps, graphs, etc.) that can be accumulated from online resources such as Google Maps and Open Street Maps. The images are going to be observed in order to extract useful actionable information with higher accuracy and observe aesthetics to study their relation to mental reactions. The outcome relation presents this research's data that are classified according to aesthetic qualities as described by Santayana (1896); formal, sensory, and symbolic qualities.

According to Santayana, (1896), symbolic aesthetics is concerned with associational meanings of the patterns of the environment that give people pleasure through significance, meanings, and feelings. Symbolic aesthetic variables are: (a) Image, sign, and symbol. (b) Variables in the built environment that carry meaning (building configuration, spatial configuration, materials, nature of illumination, and color) (Santayana,1896).

Formal aesthetics is concerned with the appreciation of shapes and structures in the environment in response to certain patterns, proportions, or shapes that are not biologically based but rather based on self-conscious and intellectual reasoning based on the Gestalt theory of perception. Formal values arise from the order of sensory material, perception of the system, and relationships that exist in the patterns, proportions, and ordering principles. (Santayana, 1896).

Formal aesthetic variables are: (a) The shapes, proportions, rhythms, scale, degree of harmony, color harmony, illumination, and shadowing effects of the built and natural worlds. (b) Elements of design: dots, lines, planes, and volumes. (c) Principles of composition: simple or complex. (d) Order and disorder: perceptual order and proportional schemata. (Santayana, 1896).

We know very little about sensory aesthetics. Speculations on the topic (for instance, Rasmussen, 1959 and Heschong, 1979) are largely based on highly subjective and fascinating introspective analysis (Santayana, 1896). Sensory aesthetical variables are: (a) Sensory values are those generated by pleasurable sensations. (b) They are obtained from the textures, smells, tastes, sounds, and sights of the world. We are more concerned with sights and hearing. (Santayana, 1896)

RESULTS & CONCLUSION, LIMITATIONS & RECOMMENDATIONS

The framework—the neuroaesthetic model—and its explored data that comes out it, present guidelines that have a high potential to neuroaesthetically improve architects and urban designers' existing outcomes or elevate the quality of their future outcomes to make them more aesthetically positioned toward one clear positive mental effect. Moreover, the framework raises architects' and urban designers' awareness of such an emergent domain by calling their attention to different psychological dimensions in streetscape design.

The framework includes a neuroaesthetic model that is going to be applied to the observations to arrive at data that can be explained as follows: The most significant image observation is going to be connected with the most appropriate mental reaction. The application mainly consists of three mental reactions: visual comfort, a sense of belonging, and fascination. These mental reactions have a positive linear correlation with aesthetics (Coburn et al. 2020). Each of the mental reactions has been studied intensely from a certain reference: (a) Visual comfort: according to Ilvitskaya et. al, (2020) (b) Sense of belonging: according Moztarzadeh, (2014). (c) fascination, as stated in Hidalgo et al. (2006). The final step is to classify these data outcomes into three aesthetic qualities as described by Santayana, (1896); formal, sensory, and symbolic qualities.

The neuroaesthetic model's connections can significantly alert architects and urban designers to the three qualities of aesthetics in their streetscape designs while linking them with the three mental reactions. Hence, they can deal with the pre-analysis survey observations more neuroaesthetically.

A contradictive hypothesis presents future research that significantly can either support the current research hypothesis

including the model or supporting the contradiction. The contradicting hypothesis can be stated as that the streetscape aesthetics have a less psychological or neurological effect on street users including perceivers and observers than the designed functional operation of the street.

REFERENCES

1. Ahmad Nia, H., & Atun, R. A. (2016). Aesthetic design thinking model for urban environments: A survey based on a review of the literature. *URBAN DESIGN International, 21*(3), 195-212. doi:10.1057/udi.2015.25
2. Alex Coburn, Oshin Vartanian, and Anjan Chatterjee (2017b). Buildings, Beauty, and Brain: A Neuroscience of Architectural Experience. Journal of Cognitive Neuroscience. Published.
3. Alkhalifa, F., Wilkins, A., Almurbati, N., & Pinelo, J. (2020). Examining The Visual Effect Of Trypophobic Repetitive Pattern In Contemporary Urban Environments: Bahrain As A Case For Middle East Countries. Journal Of Architecture And Urbanism, 44(1), 44–51. doi: 10.3846/jau.2020.11142Allen, B.P., 1994. Personality Theories. Western Illinois University, Allyn and Bacon, USA.
4. Altman, I., & Zube, E. H. (1989). Human behavior and environment. New York: Plenum.
5. Altman, I., & Zube, E. H. (1989). Public places and spaces. New York: Plenum Press.
6. Altman, I., L. Setha, 1992Place Attachment, Plenum Press, New York.
7. Alyssa, (2013) Interior Design Basics: Psychological Effects of a Line | RC Willey Blog. 2018. RC Willey Home Furnishings. Retrieved 31 December 2018, from https://www.rcwilley.com/blogs/Room-To-Talk/34/2013/5/4327/Interior-Design-Basics-Psychological-Effects-of-a-Line
8. Anjan Chatterjee and Oshin Vartanian(2016a). Neuroscience of aesthetics. ANNALS OF THE NEW YORK ACADEMY OF SCIENCES. Published.
9. Arnheim, R. (1943). Gestalt and Art. The Journal of Aesthetics and Art Criticism, 2(8), 71-75.
10. Arnheim, R. (1974). Art and visual perception: A psychology of the creative eye. Berkeley: University of California Press.
11. Bar, M. and Neta, M.. (2008), The proactive brain: Using rudimentary information to make predictive judgments. Journal of Consumer Behavior, 7(4-5), 319-330.
12. Bechtel, W. (2013). Philosophy of mind: An overview for cognitive science. New York: Psychology Press.
13. Beck, A.T., Epstein, N., Brown, G., & Steer, R.A. (1988). An inventory for measuring clinical anxiety: Psychometric properties. Journal of Consulting and Clinical Psychology, 56, 893-897.
14. Belcher, M.C. and Kluczny, R.M., 1987, the effects of light on decision making: Some experimental results. Proceedings of the CIE 21st Session, volume I. (Venice and Vienna: International Commission on Illumination), pp. 354–357.
15. Bell, P. A. (2011). Environmental psychology. New York: Psychology Press.
16. Berleant, A. (2004). Aesthetics and environment: Theme and variations on art and culture. Aldershot, Hants, England: Ashgate Pub.
17. Best, J. (2012). Color design theories and application. Cambridge: Woodhead Pub Ltd.
18. Bhatt, M., Holscher, C. and F. Shipley, T.: 2011, Spatial Cognition for Architectural Design SCAD conference, New York, 16–19.
19. Boray, P., Gifford, R. and Rosenblood, L., 1989, Effects of warm white, cool white and full-spectrum fluorescent lighting on simple cognitive performance, mood, and ratings of others. Journal of Environmental Psychology, 9, 297–308.
20. Botton, A. D. (2008). The architecture of happiness. New York, NY: Vintage International.
21. Brachmann & Redies (2017a). Computational and Experimental Approaches to Visual Aesthetics. Experimental Aesthetics Group, Institute of Anatomy, Jena University Hospital, School of Medicine, University of Jena, Jena, Germany. Published.
22. Broady, M. (1966). Social Theory in Architectural Design. Arena, 81, 149-154.
23. Cela-Conde, C. J., Agnati, L., Huston, J. P., Mora, F., and Nadal, M. (2011). The neural foundations of aesthetic appreciation. *Progr. Neurobiol.* 94, 39–48. doi: 10.1016/j.pneurobio.2011.03.003
24. Chatterjee, A.; Vartanian, O. (2016). Neuroaesthetics. Trends in Cognitive Sciences, 18(7), 370-375. doi:10.1016/j.tics.2014.03.003
25. Clark, D. B., & Donovan, J. E. (1994). Reliability and validity of the Hamilton Anxiety Rating Scale in an adolescent sample. Journal of the American Academy of Child and Adolescent Psychiatry, 33(3), 354–360. https://doi.org/10.1097/00004583-199403000-00009
26. Clemons, S. A. (2017). *Interior design*. Tinley Park, IL: The Goodheart-Willcox Company, Inc. Could bad buildings damage your mental health? (2016, September 16). Retrieved October 03, 2017, from https://www.architecturelab.net/bad-buildings-damagemental-health/
27. Coburn A, Vartanian O, Kenett YN, Nadal M, Hartung F, Hayn-Leichsenring G, Navarrete G, González-Mora JL, Chatterjee A (2020) Psychological and neural responses to architectural interiors. Cortex 126:217–241.
28. Coburn, A., Vartanian, O., & Chatterjee, A. (2017). Buildings, Beauty, and the Brain: A Neuroscience of Architectural Experience. Journal of Cognitive Neuroscience, 29(9), 1521–1531. doi: 10.1162/jocn_a_01146
29. Coburn, A., Vartanian, O., Kenett, Y. N., Nadal, M., Hartung, F., Hayn-Leichsenring, G., Navarrete, G., González-Mora, J. L., & Chatterjee, A. (2020). Psychological and neural responses to architectural interiors. Cortex; a journal devoted to the study of the nervous system and behavior, 126, 217–241. https://doi.org/10.1016/j.cortex.2020.01.009
30. Cupchik, G. C. (1986). A decade after Berlyne: new directions in experimental aesthetics. Poetics 15, 345–369.
31. Damasio, A. (1994). Descartes' Error. New York: New York: Grosset/Putnam.
32. Daurat, A., Aguirre, A., Foret, J., Gonnet, P., Keromes, A. And Benoit, O., (1993), Bright light affects alertness and performance rhythms during a 24-h constant routine. Physiology and Behavior, 53, 929–936.

33. Dazkir, S. S. & Read, M. A. (2011) Furniture Forms and Their Influence on Our Emotional Responses toward Interior Environments. Environment and Behavior 20(10), 1–13.
34. DETR (2000) Department of the Environment, Transport and the Regions. Design Council. Retrieved October 2, 2015, from By Design Urban Design in the Planning System towards Better Practice: http://www.designcouncil.org.uk/sites/default/files/asset/document/bydesign_ 0.pdf, 2-10-2015
35. Diemer, J., Alpers, G. W., Peperkorn, H. M., Shiban, Y., & Mã¼Hlberger, A. (2015). The impact of perception and presence on emotional reactions: A review of research in virtual reality. Frontiers in Psychology, 6. doi:10.3389/fpsyg.2015.00026
36. Dosen, A. S., & Ostwald, M. J. (2016). Evidence for prospectrefuge theory: A meta-analysis of the findings of environmental preference research. City, Territory and Architecture, 3, 1–14.
37. Douchová, Veronika. (2016). Birkhoff's aesthetic measure. AUC PHILOSOPHICA ET HISTORICA. 2015. 39-53. 10.14712/24647055.2016.8.
38. Douglass, M. (2015, September 16). Earth - Nine incredible buildings inspired by nature Retrieved October 02, 2017, from http://www.bbc.com/earth/story/20150913-nine-incredible-buildings-inspired-by-nature
39. Ellard, C., & Montgomery, C. (2011). Testing! Testing! A psychological study on city spaces and how they affect our bodies and minds. Retrieved October 3, 2017, from http://cdn.bmwguggenheimlab.org/TESTING_TESTING_BMW_
40. Estren, M. J., & Potter, B. A. (2013). *Healing hormones: how to turn on naturalchemicals to reduce stress*. Berkeley, CA: Ronin Pub.
41. Falahat, M.S., 2006. "The Concept of Sense of Place and Its Forming Factors" The Fine Arts Magazine, No. 27.
42. Farah M. J., Rabinowitz C., Quinn G. E., Liu G. T. (2000). Early commitment of neural substrates for face recognition. Cogn. Neuropsychol. 17, 117–123. 10.1080/026432900380526
43. Fechner, G. T. (1876). Vorschule der Aesthetik, Vol. 1. Leipzig: Breitkopf & Härtel.
44. Frumkin, H. (2002). Urban sprawl and public health. Public Health Reports, 117, 201–217.
45. Fydrich, T., Dowdall, D., & Chambless, D. (1992). Reliability and validity of the beck anxiety inventory. Journal Of Anxiety Disorders, 6(1), 55-61. doi: 10.1016/0887-6185(92)90026-4
46. Garner, W.R.: 1974, The processing of information and structure. Lawrence Erlbaum Associates Potomac, MD.
47. Gehl, J. (2011), Life Between Buildings: Using Public Space. Island Press, Washington. Holmqvist, K., Nyström, M., Andersson, R., Dewhurst, R., Jarodzka, H. & Van De
48. Glover, T. D. (2006). Toward a critical examination of social capital within leisure contexts From production and maintenance to distribution. Leisure/Loisir, 30(2), 357–367. doi:10.1080/14927713.2006.9651357
49. Gourav et. Al, (2017). Application of Aesthetics in Architecture and Design. International Journal of Engineering Research and Technology. Published.
50. Graves, M. (1941). The art of color and design. 2d ed. New York, N.Y.: McGraw-Hill
51. Green, C. D. (1995). All that glitters: a review of psychological research on the aesthetics of the golden section. Perception 24, 937–968.
52. Grove, J.R., & Prapavessis, H. (1992). Preliminary evidence for the reliability and validity of an abbreviated Profile of Mood States. International Journal of Sport Psychology, 23, 93-109.
53. Gubbels, J., Kremers, S., Droomers, M., Hoefnagels, C., Stronks, K., Hosman, C., & de Vries, S. (2016). The impact of greenery on physical activity and mental health of adolescent and adult residents of deprived neighborhoods: A longitudinal study. Health & Place, 40, 153-160. doi:10.1016/j.healthplace.2016.06.002
54. Hagerhall, C. M., Purcell, T., & Taylor, R. (2004). Fractal dimension of landscape silhouette outlines as a predictor of landscape preference. Journal of Environmental Psychology, 24, 247–255.
55. Hjelle, L.A., & Ziegler, D.J., 1981. Personality Theories. NcGraw-Hill book company, NY.
56. Hover over the menu items to seBruce, V., Georgeson, M. A., & Green, P. R. (2014). Visual Perception Physiology, Psychology and Ecology. Hoboken: Taylor and Francis.
57. Hutchison, E. D. (2008). Dimensions of human behavior. Thousand Oaks, CA: Sage Publications.
58. Hutchison, E. D. (2015). Dimensions of human behavior: person and environment. Los Angeles: SAGE.
59. Hutchison, E. D. (2019). Dimensions of human behavior: person and environment. Los Angeles: SAGE.
60. Ingy Ibrahim El-Darwish (2019). Fractal design in streetscape: Rethinking the visual aesthetics of building elevation composition. Https://Www.Sciencedirect.Com/.
61. Interior Design Basics: Psychological Effects of a Line | RC Willey Blog. (2018). RC Willey Home Furnishings. Retrieved 30 December 2018, from https://www.rcwilley.com/blogs/Room-To-Talk/34/2013/5/4327/Interior-Design-Basics-Psychological-Effects-of-a-Line
62. Jackson, R. J., & Kochtitzky, C. (n.d.). Creating A Healthy Environment: The Impact of the Built Environment on Public Health. *Sprawl Watch.* Retrieved October 2, 2017, from http://www.sprawlwatch.org/health.pdf
63. Jacobsen, T., Schubotz, R. I., Höfel, L., & Cramon, D. Y. (2006). Brain correlates of aesthetic judgment of beauty. Neuroimage, 29, 276–285.
64. Jerald, J. (2016). The VR book: Human-centered design for Virtual Reality. San Rafael: ACM; M&C.
65. K. Aysha Jennath and Nidhish P. J.b (2016). Aesthetic judgement and visual impact of architectural forms: a study of library buildings. ScienceDirect. Published.
66. Kasper, S., Wehr, T.A., Bartko, J.J., Gaist, P.A. and Rosenthal, N.E., (1989), Epidemiological findings of seasonal changes in mood and behavior. A telephone survey of Montgomery County, Maryland. Archives of General Psychiatry, 46, 823–

833.
67. Knez, I. and Kers, C., (2000), Effects of indoor lighting, gender, and age on mood and cognitive performance. Environment and Behavior, 32, 817–831.
68. Kotabe, H. P., Kardan, O., & Berman, M. G. (2016). The order of disorder: Deconstructing visual disorder and its effect on rule-breaking. Journal of Experimental Psychology: General, 145(12), 1713–1727.
69. Kuller, R. and Mikellides, B., (1993), Simulated studies of color, arousal, and comfort. In Environmental Simulation. Research and Policy Issue, R.W. Marans and D. Stokols (Eds.), pp. 163–190 (New York: Plenum Press).
70. Kuller, R. and Wetterberg, L., (1996), the subterranean work environment: Impact on well-being and health. Environment International, 22, 33–52.
71. Kuller, R., (2002), the influence of light on circarhythms in humans. Journal of Physiological Anthropology and Applied Human Science, 21, 87–91.
72. Kwallek, N., Lewis, C.M., Lin-Hsiao, J.W.D. and Woodson, H., (1996), Effects of nine monochromatic office interior colors on clerical tasks and worker mood. Color Research and Application, 21, 448–458.
73. Lang, J (1987). "Creating Architectural Theory: The Role of the Behavioral Sciences in Environmental Design", Van Nostrand Reinhold Company: USA.
74. Lang, J. 1974. Designing for Human Behavior: Architecture and the Behavior al Sciences. Pennsylvania: Dowden, Hutchinson and Ross.
75. Lang, J. (1988) Environmental Aesthetics: Theory, Research and Applications. New York: Cambridge University Press.
76. Lang, J. (1988) Symbolic aesthetics in architecture: toward a research agenda; pp. 11–26 in J.L. Nasar (ed) Environmental Aesthetics. Cambridge; Cambridge University Press.
77. Lang, J. (2015). International urban design: theory and practice. ICE Virtual Library. Published. https://doi.org/10.1680/udap.2009.162.1.7
78. Li, D., & Sullivan, W. (2016). Impact of views to school landscapes on recovery from stress and mental fatigue. Landscape And Urban Planning, 148, 149-158. doi:10.1016/j.landurbplan.2015.12.015
79. Linnet, J. T. (2012). The social-material performance of cozy interiority. In Presented at the Ambiances in action/Ambiances en acte(s) - international Congress on Ambiances, Montreal 2012 (pp. 403e408). International Ambiances Network
80. Low, S. M., & Altman, I. (1992). Place attachment: A conceptual inquiry. In I. Altman & S. M. Low (Eds.), Place attachment: Human behavior and environment (Vol. 12, pp. 1–12). New York, NY: Plenum Press.
81. Lundin, K. (2018). The Psychology of Logo Design: How Fonts, Colors, Shapes and Lines Influence Purchasing Decisions - crowdspring Blog. crowdspring Blog. Retrieved 12 June 2019, from https://www.crowdspring.com/blog/logo-design-psychology/
82. M. Carmen Hidalgo, Rita Berto, Maria Paz Galindo y Anna Getrevi (2006). Identifying attractive and unattractive urban places: categories, restorativeness and aesthetic attributes. Medio Ambiente y Comportamiento Humano. Published. https://mach.webs.ull.es/PDFS/Vol7_2/Vol7_2_f.pdf
83. Madani Nejad, K. (2007). Curvilinearity in architecture: Emotional effect of curvilinear forms in interior design. Unpublished doctoral dissertation, Texas A&M University. Retrieved from http://repository.tamu.edu/handle/1969.1/5750?show = full
84. Maslow, A. H. (2015). A theory of human motivation. United States: BNPublishing.
85. 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-
86. Mccloughan, C.L.B., Aspinall, P.A. and Webb, R.S., (1999), the impact of lighting on mood. Lighting Research and Technology, 31, 81–88.
87. McNair, D.; Lorr, M.; Doppleman, L. (1971). POMS Manual for the Profile of Mood States. San Diego, CA: Educational and Industrial Testing Service
88. Mehta, V. (2013). The street: A quintessential social public space. London: Routledge.
89. Merrifield, C. (2010). *Characterizing the psychophysiological signature of boredom*.
90. Montello, D. and Sas, C. (2013). Human Factors of way-finding in Navigation. Department of geography and psychology, university of California, CA 93106, USA.
91. Montello, Daniel. (2007). The contribution of space syntax to a comprehensive theory of environmental psychology. Proceedings. 6.
92. Moore G. (1979). Architecture and human behavior: the place of environment-behavior studies in architecture. Wisconsin: the University of Sydney
93. Nasar, J. L. (1988). Environmental aesthetics theory, research, and applications. Cambridge: Cambridge University Press.
94. Nasar, J. L. (1989). Perception, Cognition, and Evaluation of Urban Places. Public Places and Spaces, 31-56. doi:10.1007/978-1-4684-5601-1_3
95. Navarrete, G., Vartanian, O., Chatterjee, A., Fich, L.B., Leder, H., Modrono, C. and Skov, M.: 2013, "Impact of Contour on Aesthetic Judgments and Approach-Avoidance Deci- sions in Architecture." Proceedings of the National Academy of Sciences of the United States of America, 110.Suppl 2 (2013): 10446–10453. PMC. Web. 11 Dec. 2014.
96. Niedenthal, P. M. (2007). Embodying emotion. Science, 316(5827), 1002-1005.
97. Noe, A.: 2004, Action in perception. MIT Press.
98. OED (2017). *Oxford English Dictionary Online*. Available online at: http://www.oed.com/viewdictionaryentry/Entry/293508 (Accessed May 24, 2017).

99. Pallasmaa, J. (2005), The Eyes Of The Skin, Architecture And The Senses. Academy Press, Hoboken, Nj.
100. Pi, Y., Lu, J., Liu, M., & Liao, W. (2008). *Theory of Cognitive Pattern Recognition*. INTECH Open Access Publisher.
101. Piepers D. W., Robbins R. A. (2012). A review and clarification on the terms holistic, configural and relational in the face perception literature. Front. Psychol. 3:559. 10.3389/fpsyg.2012.00559
102. Porteous, J. D. (2007). Environmental aesthetics: Ideas, politics and planning. London: Routledge.
103. Quintão, Sónia, Delgado, Ana R., & Prieto, Gerardo. (2013). Validity study of the Beck Anxiety Inventory (Portuguese version) by the Rasch Rating Scale model. Psicologia: Reflexão e Crítica, 26(2), 305-310. https://doi.org/10.1590/S0102-79722013000200010
104. R. Keshtkaran et al, Aesthetic preferences for visual quality of urban landscape in Derak high-rise buildings, J. Sustain.Develop. 10 (5) (2017) 94–104.
105. Rawal, S. O. (2016). Impact of Urban Park Design on Recovery from Stress: An experimental approach using physiological biomarkers (PhD's thesis, North Carolina State University). North Carolina: North Carolina State University.
106. Reber, R., Schwarz, N. and Winkielman, P.: 2004, Processing fluency and aesthetic pleasure: is beauty in the perceiver's processing experience? Personality and social psychology review, 8(4), 364-382.
107. Roberts, M. N. (2007). COMPLEXITY AND AESTHETIC PREFERENCE FOR DIVERSE VISUAL STIMULI. Departament de Psicologia Universitat de Les Illes Balears. Published.
108. Ronald, S., California State University, (2001). Learning About Art: A Multicultural Approach (Web. 24, June 2008. ed.).
109. Rossion B., Gauthier I. (2002). How does the brain process upright and inverted faces? Behav. Cogn. Neurosci. Rev. 1, 63–75. 10.1177/1534582302001001004
110. Ruggles, D. (in press). *Beauty, Neuroscience & Architecture*. Denver, CO: Fibonacci, LLC.
111. S V Ilvitskaya et al 2020 IOP Conf. Ser.: Mater. Sci. Eng. 962 032085
112. Sadalla, E.K., Montello, D.R., 1989, "Remembering Changes in Direction", Environment and Behavior, 21, 346-363.
113. Sakoulas, T. (October). The Parthenon. Retrieved December 02, 2017, from http://ancient greece.org/architecture/parthenon.html
114. Salvesen, D., 2002. The making of Place"
115. Santayana, G. (1896). The sense of beauty, being the outlines of aesthetic theory, by George Santayana. C. Scribner's Sons.
116. Santosa et al (2018). Visual quality evaluation of urban commercial streetscape for the development of landscape visual planning system in provincial street corridors in Malang, Indonesia. IOP Conference Series: Earth and Environmental Science. Published.
117. Sascha Mahlke (2008). Visual aesthetics and the user experience. Berlin University of Technology Franklinstrasse 28/29 – FR2-6, 10587 Berlin, Germany. Published.
118. Scott, D. (2019, October 16). What is Shape in Art? Retrieved from https://drawpaintacademy.com/shape/
119. Scruton, R., Gowans, A., Collins, P., & Ackerman, J. S. (2019, October 10). Architecture. Retrieved from https://www.britannica.com/topic/architecture
120. Sewilam M. (2013) Psychiatry made easy. Cairo: Cairo University
121. Shacham, Saya (1983). "A Shortened Version of the Profile of Mood States". Journal of Personality Assessment. 47 (3): 305–306. Doi: 10.1207/s15327752jpa4703_14. PMID 6886962.
122. Skinner B.F., (1974) About Behaviorism. New York: Knopf
123. Spanjar, G., & Suurenbroek, F. (2020). Eye-Tracking the City: Matching the Design of Streetscapes in High-Rise Environments with Users' Visual Experiences. Journal of Digital Landscape Architecture (JoDLA), 5(2020), 374-385. https://gispoint.de/gisopen-paper/6344-eye-tracking-the-city-matching-the-design-of-streetscapes-in-high-rise-environments-with-users-visual-experiences.html?IDjournalTitle=6
124. Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). Manual for the State-Trait Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press.
125. Steel, F., 1981. "The Sense of Place" CBI Publishing Company, Boston.
126. Stone, N.J., (2001), Designing effective study environments. Journal of Environmental Psychology, 21, 179–190.
127. Stone, P.T., (1999), The effects of environmental illumination on melatonin, bodily rhythms and mood states: A review. Lighting Research and Technology, 31, 71–79.
128. Sussman, A., & Hollander, J. B. (2015). *Cognitive architecture: designing for how we respond to the built environment*. New York: Routledge.
129. Tennessen, C.M. and Cimprich, B., (1995), Views to nature. Effects on attention. Journal of Environmental Psychology, 15, 77–85.
130. Veitch, J. and Mccoll, S., (2001), A critical examination of perceptual and cognitive eects attributed to full- spectrum fluorescent lighting. Ergonomics, 44, 255–279.
131. Vartanian, O., Navarrete, G., Chatterjee, A., Fich, L. B., Leder, H., Modrono, C., Nadal, M., Rostrup, N., & Skov, M. (2013). Impact of contour on aesthetic judgments and approach-avoidance decisions in architecture. Proceedings of the National Academy of Sciences, 110(Supplement_2), 10446–10453. https://doi.org/10.1073/pnas.1301227110
132. Wahba, S. M. (2010). Friendly and Beautiful: Environmental Aesthetics in Twenty-First-Century Architecture. Geometries of Rhetoric, 459-469. doi:10.1007/978-3-0346-0522-9_7
133. Weisman, G.D. (1981). Modeling environment-behavior systems: A brief note. Journal of Man-Environment Relations, 1 (2), 21-30
134. Wilson, A., & Chatterjee, A. (2005). The assessment of preference for balance: Introducing a new test. Empirical Studies of the Arts, 23, 165–180.

135.World War II/Post-War Building Styles. (2016, December 07). Retrieved October 02, 2017, from
136.Zajonc, R.B.: 1968, Attitudinal effects of mere exposure. Journal of personality and social psychology, 9(2p2), 1.