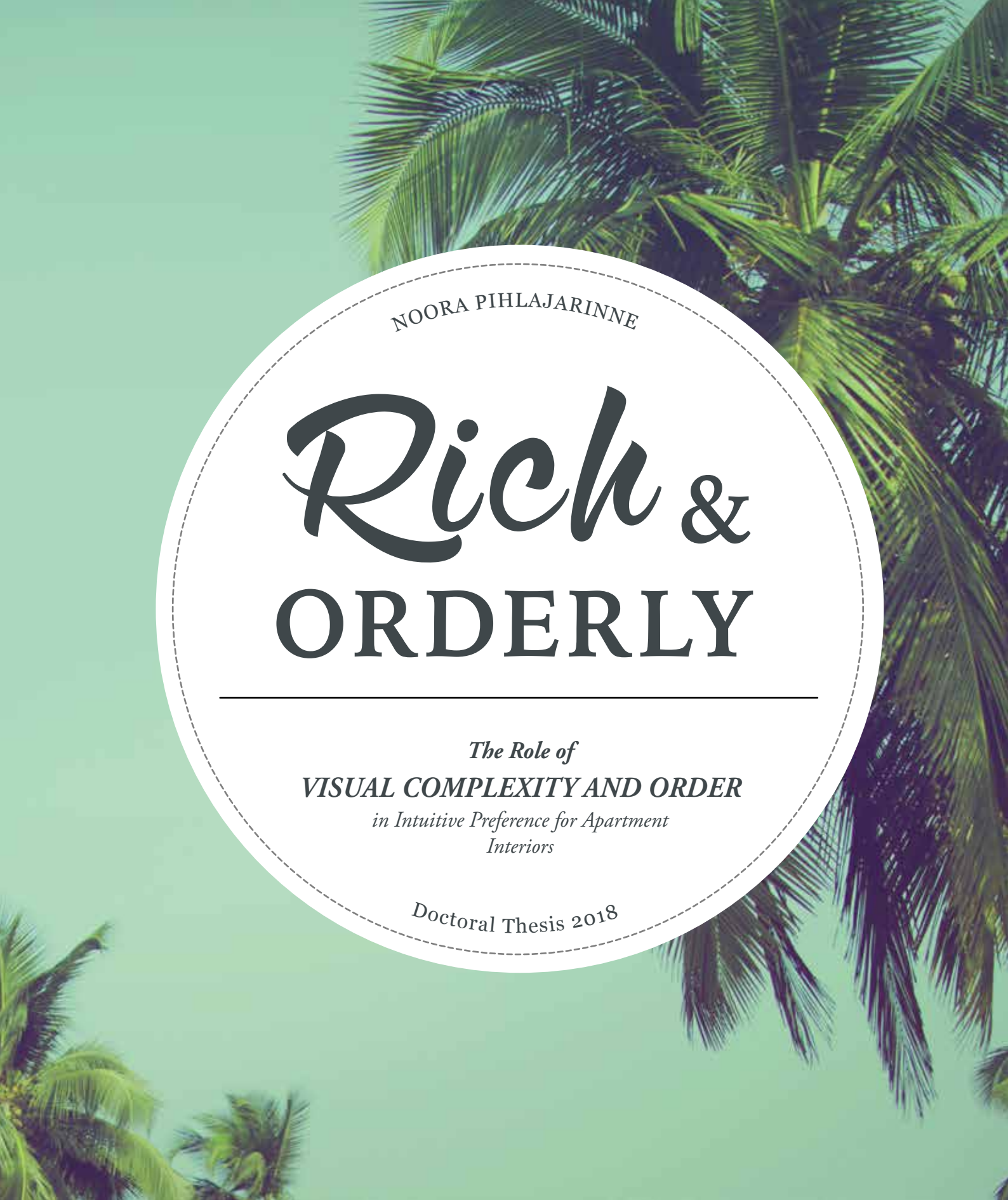

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VISUAL COMPLEXITY AND ORDER

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TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

NOORA PIHLAJARINNE

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The Role of Visual Complexity and Order in Intuitive Preference for Apartment Interiors

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ABSTRACT

Both everyday experience and scientific knowledge have demonstrated the great power of the environment to influence not only our emotions and behaviour but also our well-being and health. There is also reason to believe that intuitive preference exerts a significant influence on choice of apartment. Environmental preferences have been studied widely in both natural and urban contexts as well as in the context of external building styles. However, considering the amount of time that people spend inside buildings, including homes, systematic research on visual preferences for architectural interiors seems to be surprisingly negligible. Therefore, studying architectural characteristics that increase visual preference for apartment interiors has to be considered relevant from the perspective of both the well-being and health of people, and also that of enhancing the quality of apartment stock.

The primary aim of this thesis was to study architectural characteristics that increase the experience of the visual appeal, or pleasantness, of apartment interiors. I have striven to achieve this aim, first by exploring the literature for attributes that may influence visual preference. Based on these findings, I defined several variables that I considered possibly predictive of visual preference for apartment interiors. Finally, the influence of these variables on visual preference for apartment interiors was studied experimentally.

As previous research is scarce on architectural characteristics and their influence on preference in the context of apartment interiors, I ended up searching for characteristics through a broad, interdisciplinary theoretical framework. Two concepts - visual complexity and order - were found to emerge repeatedly from this theoretical framework. In the field of aesthetics, a great number of both theoretical and experimental studies lend support to the assumption that visual aesthetic preference would in one way or another be related to visual complexity and order. Similar results have been obtained in the field of environmental psychology, mainly in the context of outdoor environments; visual elements that promote both exploration and comprehensibility of the environment have been found to increase environmental preference. Besides, several architectural characteristics that can be seen to relate to visual complexity and order are typical of traditional architectural styles, and classical architectural theories emphasize their role in the context of building aesthetics. However, it seems that these concepts have received only minor attention in present-day architectural discourse, research and theory.

Based on the literature, a broad set of architectural variables that were considered to potentially explain visual complexity, order and preference of apartment scenes, was created for use in the experimental part of this thesis. Additionally, a total of forty-three test images - where the architectural variables in question obtained different values - were created for this purpose. In the experiment, 107 medical students, who acted as test subjects, evaluated the images according to their interestingness - the term used in this thesis to describe the level of interest they aroused - (an operationalized measure for complexity), spatial organization (an operationalized measure for order) and pleasantness (an operationalized measure for appeal or preference). The relationships between these evaluations and the architectural variables were then analysed by using regression analysis, by comparing the similarities and differences in the evaluations of four subgroups (males, females, participants with prior artistic training and participants without prior art training) and by visually analysing the images and their ratings. In addition, the different affective qualities that might be related to different architectural characteristics were assessed by using the Circumplex model for affective quality attributed to environments created by Russell, Ward and Pratt (1981).

The most important and the most reliable result of this thesis can be considered to be that the ratings for interestingness and spatial organization of apartment interiors were found to predict the ratings for pleasantness. The same finding was perceived within the whole group as well as within each of the four subgroups. This study thus lends support to the finding that has emerged in research from other disciplines: the environment should be both complex and ordered at the same time in order to be pleasant. In addition, certain physical architectural characteristics were found that predicted the majority of variance of the ratings for interestingness (83%) and spatial organization (87.6%). For instance, the total number of outward directions from the room, the amount of detail (the number of black pixels in the binary image) and the surface area of the windows were found to increase the ratings for interestingness in the regression model of the whole group and in that of at least three subgroups. In the same way, the bilateral symmetry of the room was found to increase and the number of aligned element lines to decrease the ratings for spatial organization. Together with the ratings for interestingness and spatial organization, the use of classical proportions and verticality were found to predict the majority (76.6%) of variance in the ratings for pleasantness. However, creating and defining the architectural variables used in this study was challenging, within certain characteristics in particular, and therefore the results concerning these can only be regarded as preliminary. Studying the phenomena perceived in this study further with both different subject groups and architectural variables provides interesting and important research topics for future studies.

TIIVISTELMÄ

Ympäristön laadun vaikutuksesta paitsi tunteisiimme ja käyttäytymiseemme, myös hyvinvointiimme ja terveyteemme on arkikokemuksen lisäksi paljon tieteellistä näyttöä. On myös syytä uskoa, että intuitiivisella visuaalisen miellyttävyyden kokemuksella on merkittävä vaikutus asunnonvalinnassa. Ympäristöpreferenssejä on tutkittu laajasti sekä luonto- ja kaupunkiympäristöjen sekä ulkoisten rakennustyylien osalta. Kuitenkin suhteutettuna siihen, kuinka paljon ihmiset viettävät aikaa rakennusten sisällä, esimerkiksi kodeissa, systemaattinen tutkimus sisätilojen visuaalisista preferensseistä näyttää olevan hämmästyttävän vähäistä. Niiden arkkitehtonisten ominaisuuksien tutkimista, jotka vaikuttavat positiivisesti asuntojen visuaaliseen miellyttävyyteen, tuleekin pitää tärkeänä sekä hyvinvointimme ja terveytemme että asuntotarjonnan laadun kehittämisen kannalta.

Tämän tutkimuksen päätavoitteena oli tutkia niitä asuntojen sisätilojen arkkitehtonisia ominaisuuksia, jotka vaikuttavat asuntojen kokemiseen visuaalisesti miellyttävinä. Tähän pyrittiin kartoittamalla aluksi kirjallisuudesta mahdollisia visuaaliseen miellyttävyyteen vaikuttavia tekijöitä, joiden perusteella määriteltiin useita asuntotilojen miellyttävyyttä mahdollisesti ennustavia muuttujia. Näiden muuttujien vaikutusta asuntotilojen miellyttävyyteen tutkittiin lopuksi kokeellisella menetelmällä.

Koska tutkimusta asuntojen sisätilojen visuaalisiin preferensseihin vaikuttavista tekijöistä on olemassa vain niukasti, päädyttiin tällaisia ominaisuuksia kartoittamaan laajan, poikkitieteellisen teoreettisen viitekehyksen kautta. Erityisesti kahden ominaisuuden, visuaalisen kompleksisuuden ja järjestyksen, todettiin nousevan toistuvasti esiin kirjallisuudessa. Useat sekä teoreettiset että kokeelliset estetiikan alan tutkimukset tukevat näkemystä, jonka mukaan visuaalinen preferenssi on tavalla tai toisella yhteydessä visuaaliseen kompleksisuuteen ja järjestykseen. Samankaltaisia

tuloksia on saatu myös ympäristöpsykologian alalla, pääasiassa ulkotilojen miellyttävyyden kontekstissa; sellaisten visuaalisten ominaisuuksien, jotka edistävät sekä ympäristön tutkimista että sen ymmärtämistä, on todettu vaikuttavan positiivisesti ympäristöpreferensseihin. Useiden sekä kompleksisuutta että järjestystä tukevien arkkitehtuuripiirteiden voidaan myös nähdä olevan tyypillisiä klassiselle arkkitehtuurille, ja niiden merkitys rakennuksen estetiikassa korostuu klassisen arkkitehtuurin teorioissa. Kuitenkin näyttää siltä, että näiden ominaisuuksien rooli nykyisessä arkkitehtuurikeskustelussa, -tutkimuksessa ja –teoriassa on ollut vähäinen.

Kokeellista osuutta varten luotiin suuri joukko sellaisia arkkitehtuurimuuttujia, joita voitiin kirjallisuuden perusteella pitää mahdollisina asuntotilojen visuaalista kompleksisuutta, selkeyttä ja preferenssiä selittävinä tekijöinä. Koetta varten luotiin yhteensä 43 testikuvaa, joissa kyseessä olevat arkkitehtuurimuuttujat saivat eri arvoja. Koetilaisuudessa 107 koehenkilönä toimivaa lääketieteen opiskelijaa arvioivat kuvat mielenkiintoisuuden (operationalisoitu mittari kompleksisuudelle), tilallisen selkeyden (operationalisoitu mittari järjestykselle) sekä miellyttävyyden (operationalisoitu mittari preferenssille) suhteen. Näiden subjektiivisten arvioiden ja arkkitehtuuriominaisuuksien välisiä yhteyksiä arvioitiin regressioanalyysin keinoin, vertailemalla neljän alaryhmän (miehet, naiset, taidetta harrastaneet ja taidetta harrastamattomat) välisiä samankaltaisuuksia ja eroja sekä kuvia ja niiden saamia arvioita silmämääräisesti analysoiden. Myös erilaisiin arkkitehtuuriominaisuuksiin mahdollisesti liittyviä tunteita arvioitiin käyttäen ympäristöihin liitettyjen tunteiden Circumplex-mallia (Russell, Ward & Pratt 1981).

Tämän tutkimuksen tärkeimpänä ja luotettavimpana tuloksena voidaan pitää sitä, että asuntotilan arvioidun kiinnostavuuden ja tilallisen selkeyden havaittiin ennustavan sen miellyttävyyttä. Tulos havaittiin koko ryhmän lisäksi kaikissa tutkituissa alaryhmissä. Tämä tutkimus antaa näin ollen tukea muiden alojen tutkimuksissa toistuvalle löydökselle siitä, että ympäristön tulee olla yhtä aikaa sekä kompleksinen että selkeä ollakseen mahdollisimman miellyttävä. Lisäksi tässä tutkimuksessa löydettiin joukko sellaisia fyysisiä arkkitehtuuriominaisuuksia, jotka pystyivät ennustamaan suurimman osan sekä tilojen koetusta kiinnostavuudesta (83%) että tilallisesta selkeydestä (87,6%). Tällaisia muuttujia olivat esimerkiksi tilasta ulospäin vievien suuntien määrä, yksityiskohtien määrä (mustien pikseleiden määrä viivapiirustuksessa) sekä ikkunapinta-ala, jotka kaikki lisäsivät kiinnostavuuden arvioita sekä koko ryhmän että vähintään kolmen alaryhmän regressioyhtälöissä. Samalla tavoin tilan symmetrian havaittiin lisäävän ja yhdensuuntaisten elementtilinjojen määrän vähentävän tilallisen selkeyden arvioita. Kiinnostavuuden ja tilallisen selkeyden kanssa yhdessä klassisten mittasuhteiden käyttö sekä vertikaalisuus pystyivät selittämään suurimman osan (76,6%) miellyttävyysarvioiden vaihtelusta. Käytettyjen arkkitehtuurimuuttujien luominen ja määrittely oli kuitenkin varsinkin tiettyjen ominaisuuksien kohdalla haastavaa, joten niistä saatuja tuloksia voidaan pitää ainoastaan suuntaa-antavina. Tässä tutkimuksessa havaittujen ilmiöiden tutkiminen sekä erilaisilla arkkitehtuurimuuttujilla että koeryhmillä tarjoaa mielenkiintoisia jatkotutkimusten aiheita tulevaisuudessa.

TERMS

Aesthetics
"Theory of pleasing and displeasing" (Fechner 1876 p.1). "Intuitive feeling of value" (Birkhoff 1933 p.3). Pleasure is viewed as an important element in the aesthetic experience or even as the essence of it, even though beauty and pleasure cannot be regarded as synonyms (Valentine 1962 pp.6-9). Aesthetic experience cannot be regarded as an emotion by itself, even though it has an influence by itself; "in the moment of true aesthetic appreciation we are not thinking of ourselves or of the cash value of the object" (Valentine 1962 p.9).

Affect
A general valenced feeling state, of which emotion and mood are seen as specific examples (Cohen, Areni 1991, p.191). Also frequently used as a synonym for emotion or feeling in the literature (e.g. Lang 1988, p.19). (See also emotion and mood).

Art Nouveau
An architectural style that prevailed internationally from the late 19th century until the time of the First World War. The style is known by different names: "Art Nouveau" in France, "Jugendstil" in the Northern countries and Germany, "Modern Style" in England, "Stile Liberty" in Italy and "Modernismo" in Spain. The style manifested with plant-like ornaments often realized with modern construction materials such as glass and metal. (Tietz 1999)

Automatic information processing
A type of information processing by the brain that happens automatically and without awareness. Automatic information processing is considered as one of the two information-processing systems in the "dual-processing model" based on current knowledge of human cognition. Compared to the other system - controlled information processing - automatic information processing is believed to be older in the evolutionary sense and to be capable of performing information processing more rapidly and effortlessly. (e.g. Kahneman 2011, Hyppänen 2013) (see also controlled information processing).

Autonomic Nervous System (ANS)
The part of the nervous system that innervates the internal organs, cardiovascular system and glands, and governs many involuntary actions (such as secretion, vasoconstriction, or peristalsis). The ANS consists of the sympathetic and the parasympathetic divisions. (Bear, Connors & Paradiso 2016).

Bauhaus
A German school of art founded in 1919 and ending in 1933, led by directors Walter Gropius, Hannes Meyer and Ludwig Mies van der Rohe. The Bauhaus school has been considered as the key actor in bringing functional modernism into architectural practice. (Tietz 1999, p.112)

Central Nervous System (CNS)
The part of the nervous system comprising the brain, including the retinas, and the spinal cord (Bear, Connors & Paradiso 2016, p.904). It processes sensory information and controls the activity of the entire nervous system, being thus responsible for instance of vital functions, motor activities and higher mental activities such as consciousness, thought, reason and emotion (Bear, Connors & Paradiso 2016).

Cerebral cortex
The surface layer of the cerebrum. The cerebral cortex receives and processes sensory information coming from sensory organs such as the eyes and the ears, forms perceptions and commands voluntary movements (Bear, Connors & Paradiso 2016, pp.198, 208-215).

Cerebrum
The largest part of the forebrain, split into two hemispheres (Bear, Connors & Paradiso 2016, p.183)

Classical Style of Architecture, Classical Architecture
A type of traditional architectural style. The origins of the style are in the architecture of ancient Greece and Rome. Different eras of classical styles, such as Antiquity, the Renaissance or Neoclassicism, can be identified from their stylistic and structural gestures, but acknowledgement of Antiquity as their ideal and stylistic point of reference links them all. (e.g. Kruft 1994)

Controlled information processing
A type of information processing by the brain that is related to controlled, conscious thought. Controlled information processing is considered as one of the two information-processing systems in the "dual-processing model" based on current knowledge of human cognition. The requirement of controlled information processing is attention directed to the subject that is being processed. (e.g. Kahneman 2011) (See also Automatic Information Processing).

Decoration
In modern language, decoration is often used as a synonym for ornamentation (Merriam-Webster 2016a, Oxford Dictionaries 2016a). Architectural decoration is often associated with additive building elements that are not directly necessary to the structure or the function of the building. (See also Ornament).

Dependent Variable, DV
An event or phenomenon studied in a scientific experiment and statistical analysis. In a scientific experiment a dependent variable is the target of interest, which the independent variables (IV's) are employed to explain. (Metsämuuronen 2009, p.1197).

Early Modern Architecture
A trend in architecture initiated around the 1920's involving a self-conscious separation from previous architectural styles, grounding architectural ideology and practice on new principles and forms of expression such as functionality, purity of materials, increased amounts of fresh air and space, absence of ornament, and free-form design. (e.g. Kruft 1994, Mako, Lazar & Blagojević 2014, p.25). (See also Classical Style of Architecture)

Emotion
A conscious, intensive affective state such as anger or fear that requires attention and is usually directed towards a specific object. Emotions also typically include physiological and behavioural changes in the body. (Merriam-Webster 2017a, Stanley, Phelps & Banaji 2008) (See also Affect and Mood).

Experiential Consumption Perspective
A field of consumption research that emphasizes the importance of emotional and experiential aspects of shopping that focus for instance on symbolic, hedonic and aesthetic motivations of consumer purchasing behaviour (Holbrook, Hirschman 1982). (see also Traditional Consumption Perspective).

Exposure effect
A principle according to which preference towards a stimulus increases progressively along with the number of encounters with it (Zajonc 1968, Whitfield, Slatter 1979).

Functionalism
One central idea of early modern architecture stating that the function of a building should be the primary basis of its design (Tietz 1999, p.113).

Golden Ratio
"The division of a line so that the whole is to the greater part as that part is to the smaller part (i.e. in a ratio of 1 to 1/2 ($\sqrt{5}$ + 1), or approximately to 1.618), a proportion which is considered to be particularly pleasing to the eye" (Oxford Dictionaries 2016b)

Ideology
A set of ideas, symbolic representations, values, beliefs and forms of thoughts, behaviours, expressions, representations and acts that are characteristic of a social group (Suvakovic 2014, p.2).

Independent Variable (IV)
A factor whose values are intentionally altered during a scientific experiment to observe its effect on the event or phenomenon of interest assigned as the dependent variable (DV). (Metsämuuronen 2009, p. 1197)

Interestingness
A variable used in this study to measure the level of attention and arousal that a scene generates in the viewer. Interestingness in this research is an operationalized term for "complexity", transformed to more familiar language to be effortlessly and intuitively understood by the respondents in the experiment.

Intuition
"Immediate apprehension or cognition without reasoning or inferring" (Merriam-Webster 2017b).

Limbic system
A group of brain structures, including for instance the amygdala and hippocampus, that are interconnected and considered to be involved in processing emotions and memory (Bear, Connors & Paradiso 2016).

Mood
Long-lasting affective state that can be generated and maintained without conscious awareness of its existence, cause or influence on current behaviour. A mood can be a residue of a fading emotion. (Cohen, Areni 1991). (See also Emotion and Affect).

Orbitofrontal cortex
A brain cortex area at the base of the frontmost part of the frontal lobes (Dictionary of Psychology 2015).

Ornament
“A thing used or serving to make something look more attractive but usually having no practical purpose, especially a small object such as a figurine” (Oxford Dictionaries 2016c). “A small, fancy object that is put on something else to make it more attractive” (Merriam-Webster 2016b).

Perception
“The physiological and psychological process of obtaining information from the environment” (Lang 1987, p.79). A conscious sensory experience (Goldstein 2002, p.6).

Pleasantness
A variable used in this study as the operationalized term for “preference” or appeal. In the general meaning the sense of satisfaction or enjoyment. The terms “pleasantness” and “preference” are often used as synonyms and the correlation of the terms has been experimentally proved to be high among public opinion (Stamps, Nasar 1997).

Preference
A feeling of liking one object more than others. The tendency of generating preferences has been considered to be developed initially to provide quick and efficient ways to react towards events in the world, such as approaching beneficial stimuli or avoiding harmful stimuli (Stanley, Phelps & Banaji 2008).

Primary visual cortex
The sensory area for visual information in the cerebral cortex located in the occipital lobe of the brain; also called Brodmann’s area 17, the striate cortex and V1. Information received by the retina is constructed as a retinotopic map in the primary visual cortex, where different neural cells are specialized to process different aspects such as colour, edges and orientations of a viewed scene. (Bear, Connors & Paradiso 2016, pp.347-356)

Schema
A pattern of thought or behaviour, “a template of action” created in the mind when confronted frequently in similar situations. Schemas are said to facilitate the processing of new information by automating their recognition and interpretation. (e.g. Lang 1987 p. 94)

Spatial Organization
A term used in this study to measure the legibility of a scene, in the sense of the ability to scan and visually or mentally process features of a scene. Spatial Organization in this research is an operationalized term for “order”, transformed to fit in the context of the architectural space.

Traditional Consumption Perspective
A traditional outlook on consumption research, where the consumer is assumed to process purchasing information rationally, basing decisions on weighting the benefits and disadvantages attained from a purchase, and to aim for a decision that provides maximal utility value (Holbrook, Hirschman 1982).

Visual Complexity
The visual character of a scene that makes the effort of attention increase (Birkhoff 1933 p.3). An object must possess a certain degree of complexity to hold the attention longer than just a very short time (Valentine 1962 p.9). In this study, visual complexity is understood as a visual characteristic that burdens the information-processing capacity of the brain.

Visual Order
The visual properties of a scene that facilitate its visual processing and therefore make it easier to comprehend.

Visual System
The part of the central nervous system involved in processing visual stimuli. The main components of the visual system are the eye, the lateral geniculate nucleus in the thalamus, the primary visual cortex and the extrastriate cortex in the occipital lobe, as well as regions in the temporal, parietal and frontal lobes. (Goldstein 2002, p.39). After the primary visual cortex, higher-level visual processing occurs primarily through two cortical streams that are called the ventral “what” pathway and the dorsal “where” pathway. The “what” pathway bends ventrally towards the temporal lobe and is responsible for recognition of objects, whereas the “where” pathway runs dorsally towards the parietal lobe and is essential in processing motion and spatial information, such as in detecting the location of an object in space. (Bear, Connors & Paradiso 2016, p. 356-362).

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1

INTRODUCTION

In this first chapter, I present the major drives for conducting this study, as well as its aspired purpose and potential significance in the field of architecture. At the end of this chapter, the research questions are presented, the limitations of the study are discussed and the structure of the study is introduced.

The influence of the environment on human behaviour is frequently self-evident from everyday life. An intense feeling of amazement when entering a colossal space is familiar to most; throughout history, monumentality has also been used intentionally to convey societal, political or religious power (e.g. Tietz 1999). Dark places usually make us feel, if not scared, at least to some extent uncomfortable. Children are usually fond of playing in tiny spaces such as under tables, and many of us feel relaxed when staring far away to a spacious field, lake or the sea. In recent decades, the effect of environmental quality on human well-being has gained substantial interest in several fields of study, too. Increased daylight in schoolrooms has shown to lead to an increase in learning results (Heschong 1999). An example of a more alarming, grimmer result is that unstimulating solitary prison cells have been reported to cause adverse mental effects such as disorientation and hallucinations (Grassian 2006). One of the most frequently mentioned examples of environmental impact on human physiology may be an experiment by Roger Ulrich (1984), where two groups of patients were surveyed after surgery. All patients were placed in hospital rooms similar in dimensions, window size, arrangement of furniture and other main physical characteristics. Virtually the only difference between the rooms of the two groups was the view through the window; one group had a window facing a brick wall, whereas the window of the other group looked out on a natural scene. The results are well acknowledged: the patients with a view on the natural scene spent a shorter time in total in the hospital (7.96 days on average compared with 8.70 days on average for the patients whose window faced the brick wall), and requested fewer painkillers during their recovery than the other group.

Feelings of well-being have also been shown to increase in spaces assessed as beautiful rather than ugly. In an experiment by Maslow and Mintz (1956) over a three-week period, greater fatigue, irritability and discontent were reported in an ugly room, whereas feelings of comfort, enjoyment, and energy were reported more often in a beautiful room. Access to nature has been reported to improve both physiological and psychological health outcomes with patients suffering from post-traumatic stress disorder in a study by Wagenfeld, Roy-Fisher and Mitchell (2013). The quality of the built environment has been regarded as essential to views on the quality of life

itself (Lang 1987, p.106). Housing quality has also been found influential to the well-being of residents; for instance, high-rise occupancy has been found to be associated with increased distress among children, whereas good housing quality has been found to be associated with tight social relations with neighbours, improved school performance of children and decreased levels of psychological distress (e.g. Evans et al. 2000). Attractive appearance together with perceived safety of housing neighbourhoods was found to be the most essential feature for neighbourhood satisfaction in a study by Lovejoy and colleagues (Lovejoy, Handy & Mokhtarian 2010).

> ***“From the body of both everyday experience and experimental evidence it can easily be surmised that environmental quality exerts a significant impact on human well-being***

From the body of both everyday experience and experimental evidence, of which only a fraction can be reported here, it can easily be surmised that environmental quality exerts a significant impact on human well-being. Since the majority of people today live in the built environment, architects can be seen as among the critical actors for maintaining good quality of the environment. Thus a central motivation of this study is to increase knowledge that can be used for designing built environments that meet people’s needs appropriately and that can contribute to increased well-being.

Environmental preferences have been studied widely concerning outdoor scenes; both natural and urban scenes (e.g Kaplan, Kaplan 1989, Kaplan, Kaplan & Wendt 1972, Nasar, Kang 1989, Ulrich 1981, Krampen 1979) and through evaluation of facades and building styles (e.g Stamps 1999a, Stamps, Nasar 1997, Nasar, Devlin 2000, Akalin et al. 2009, Nasar, Kang 1999, Stamps 1998b, Stamps 1999b, Oostendorp, Berlyne 1988, Groat 1988, Krampen 1979). However, fewer studies have been conducted on visual preferences for architectural interiors (Valentine 1962 p. 180, Maslow, Mintz 1956), and even fewer that focus on apartment interiors (Kaye, Murray 1982, Baird, Cassidy & Kurr 1978).

Even though research on outdoor scenes has detected several important visual preference patterns, these theories and observations cannot be directly applied to the context of apartment design. I assume this for several reasons. First, visual attributes, or visual “construction blocks”, clearly differ between natural environments and architectural interiors; but they may also differ between architectural exteriors and interiors. Therefore, in order to apply theories of visual preference developed for outdoor scenes, the need arises to find analogs for their attributes in interior scenes - in this case, in scenes of apartment interiors. Second, it is highly possible that individuals may differ in their assessments of different architectural environments, even with similar visual characteristics, according to the use of those environments. Intuitively, this seems to make sense: a street scene, a museum or a house have different meanings to people and thus might represent different behavioural patterns for them. For these reasons, I assert the need to study preferences for different kinds of environment separately.

Last, even though studies on environmental preferences have been quite frequent in recent decades, many ambiguities and much vagueness in their terminology and concepts still obstruct use of their results in the practical design profession. Many studies on environmental preference use a general, indefinite form of terminology to describe environmental characteristics (Groat 1988), such as “identity”, “naturalness” or “unity” (Nasar 1983, Gärling 1976). These kinds of descriptive measures unfortunately allow little understanding of what their actual equivalents might be in terms of physical, architectural measures. I maintain that it would be essential to gain knowledge for architects in design practice not only of visual attributes that contribute to environmental preferences but also of physical architectural measures that contribute to those attributes themselves. Although fully achieving this goal may certainly be difficult, pursuing these issues in order to provide tools for architects nonetheless seems a worthwhile activity.

Arguably, choosing an apartment would, at least partly, be based on immediate attraction to it. In traditional consumption research, the consumer has been seen as a conscious thinker whose decisions are grounded in rational comparison of the gains and losses attained from a purchase (e.g. Vakratsas, Ambler 1999). However, research has presented findings that are in many ways supplementary, and in some cases even contradictory, to the traditional view (e.g. Cohen, Areni 1991, Bechara, Damasio 2005, Ambler, Ionnides & Rose 2000, Dijksterhuis, Nordgren 2006, Dijksterhuis et al. 2006, Dijksterhuis, van Olden 2006). In fact, the purchasing behaviour of consumers has been found to be frequently irrational (Bettman, Johnson & Payne 1991, Kahneman 2011) and emotions and intuition have been shown to play a central role in the decision-making process (Bechara, Damasio 2005, Dagher 2007, Ambler, Ionnides & Rose 2000, Holbrook, Batra 1987). It has been theorized that, when solving a problem, people tend to ultimately choose the option that makes them feel better, and as problem-solving always involves a choice this would even become impossible if no feelings were involved (Overskeid 2000). The “experiential perspective” (Holbrook, Hirschman 1982) of consumption research argues convincingly against the traditional view of purchasing as an objective act that is focused merely on gaining maximum utility value, and instead emphasizes the importance of emotional and experiential aspects that focus on symbolic, hedonic and aesthetic matters.

Automatic information-processing, whose actions could be called intuition, has been claimed to have several advantages for which it would be used primarily in decision-making. It has been claimed to be fast, and capable of working with several subjects in parallel, thus being efficient when dealing with large amounts of information, in contrast to controlled information processing, which depends on directed attention and is thus forced to process subjects in series (Kahneman

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THE PURCHASING BEHAVIOUR OF CONSUMERS HAS BEEN FOUND TO BE FREQUENTLY IRRATIONAL

And emotions and intuition have been shown to play a central role in the decision-making process

2011). Intuition or “gut feeling” has been suggested as being a result of bodily feelings created by the autonomic nervous system that are associated with emotions. When confronted with a problem, these feelings accumulate and result in “a gut feeling” that aims to bias choice in a favourable direction. (Bechara, Damasio 2005, Bechara 2004). The orbitofrontal cortex of the brain has been assigned as an important factor in initiating this “gut feeling” (Bechara 2004); for instance it seems to automatically direct attention to emotional stimuli, even when these stimuli are not related to the task at hand (Hartikainen, Ogawa & Knight 2012). Conversely, patients with orbitofrontal lesion have been shown to ignore irrelevant emotional stimuli, which makes them perform well in experimental tasks and neuropsychological tests (Hartikainen, Ogawa & Knight 2012), but which in real life may cause severe impairment in decision-making and lead to choices that damage their life (Bechara 2004).

If there are several ways to accomplish a task, the brain has been described as instinctively using the way that requires the minimum effort (Kahneman 2011, p.35); consequently, in a problematic decision-making task to strive to use a fast, low-effort intuitive, automatic system rather than an effortful, slow, controlled system. Indeed, there is some evidence of the important, perhaps even prior, role of automatic information-processing, especially when dealing with complex decisions (Dijksterhuis, Nordgren 2006) such as in business management (Burke, Miller 1999, Sinclair, Ashkanasy 2005, Hyppänen 2013), when selecting a car (Dijksterhuis et al. 2006) or choosing an apartment (Dijksterhuis 2004). Undeniably, apartment choice is a complex decision; it involves a large amount of information such as various sensational stimuli, mental visions of different possible situations of life, quality classifications, numbers and economic figures, with very different interrelated significances. Indeed, apartment buyers have been reported to rely strongly on their intuition with apartment choice (Hasu 2010, p.80). “It just felt right” is an often-heard comment after a successful apartment choice.

Existing studies give broad support to the fact that automatic information-processing significantly affects our thoughts, decisions, attitudes, behaviour and preferences (Creswell, Bursley & Satpute 2013, Edwards, Jacobs 2003, p. 12, Stanley, Phelps & Banaji 2008, p. 164, Damasio 1994, Ranganath, Nosek 2008, Nosek, Greenwald & Banaji 2007, Freud

Intuitive thinking	Rational thinking
Unconscious	*Requires directed attention*
Parallel processing	*Serial processing*
Fast	*Slow*

1978a, 1955, 1978b, Bear, Connors & Paradiso 2016, p.619). However, it seems that even though the automatic information processing system can form complex patterns of ideas effectively, these can only enter into awareness through the slower, controlled system. Consequently, this can blur the impression of how decisions are made; the controlled information processing system has been suggested as rationalizing ideas that actually have intuitive origins. Language is commonly controlled by the left hemisphere of the brain (Bear, Connors & Paradiso 2016, p.695-705). In the light of current knowledge, the left hemisphere is also called "the great interpreter"; it has been suggested as seeking logical explanations for our experiences, emotions and actions, and as constructing a feasible story in order to provide a sense of unity to our experiences (Gazzaniga 2000, Reuter-Lorenz, Gazzaniga 2010). This phenomenon was first observed with split-brain patients who have their interhemispheric connections removed; these patients usually construct a logical story to explain actions that were actually initiated by the isolated right hemisphere, which is no longer connected to the areas that involve language production (Gazzaniga 1989). Consequently, it has been presented that when people are asked to reason their decisions, they easily present rationalized reasons that do not necessarily correspond to the initial reasons (Kahneman 2011, Cohen, Areni 1991). This is apt to lead astray consumer studies where consumers are asked to give verbal reports on their preferences.

Architecture as a profession has traditionally been practical, and essentially it still is. Until recently, the role of scientific research has been minor in both the education and the practice of architects, and it is still quite rare, for example, to measure the effects of buildings after the design and building processes are over. To a great extent, architectural education is based on the transformation of practical know-how from teachers to students, in a master-journeyman kind of style. After graduation, this still continues for years in architectural offices where young architects work with more experienced practitioners. This method finally develops expertise in design of "good architecture", in terms of both utility and appearance.

Sadly, it seems that the subject matter of this transferred know-how has faced much disapproval, at least in contemporary times. Architectural practice has been criticized as being based on "beliefs" or "abstract speculation" rather than on systematic knowledge (Lang 1987, p.12). It has also been stated that current architectural theory would be highly normative: grounded on value-laden statements that have been commonly agreed by practitioners rather than on facts (Lang 1987, p.13-17). In addition, it has been claimed that the ideological basis of contemporary architectural designs is often unclear (Lang 1987, p.16). On the other hand, it has been claimed that architecture is essentially an ideological practice (Mako, Lazar & Blagojević 2014) and even that architecture would be better described as a "tradition" rather than a discipline (Picon 2013). One might argue that architecture, being a form of art, cannot be approached by scientific methods. It could be said that the

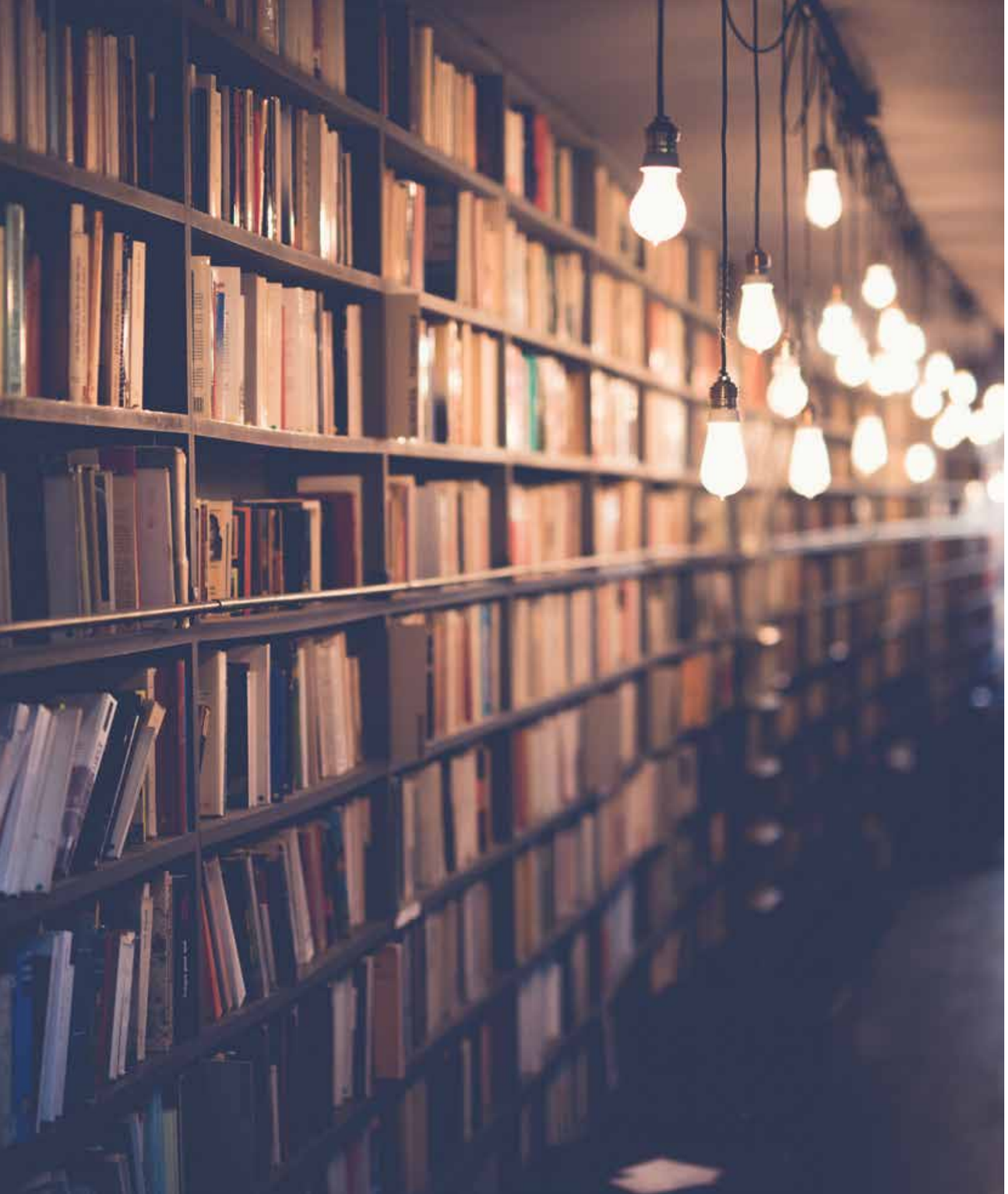
> ***"Architectural practice has been criticized as being based on "beliefs" or "abstract speculation" rather than on systematic knowledge***

architectural experience is always subjective, depending on the viewer's taste, personality and previous experiences. These are all undoubtedly true. Still, that might not explain the entire truth. Even though people have different tastes, most of us experience a multitude of things in a similar way, such as smelling a rose or viewing furry animals, usually as positive events. Even though people have many differences, they also share many things in common, for instance, due to our shared evolutionary history. It is thus possible that judgements of art and architecture might also include a solid component that could be studied by systematic, scientific methods.

The question then arises whether, even though this kind of systematic study of architecture would be possible, it would be of any benefit. For instance this study may present findings that architects already know. In that case, the benefit is to turn the intuitive information that derives from the talent of architects – such as know-how to design vistas in an apartment just the right way or to choose just the right form of window to suit the rooms – into evidence-based facts that can be used to back up these design decisions. This should be useful, for instance, when the need arises to convince constructors or clients of suitable design solutions.

> ***"Using exact methods to study the reactions of people to architecture can provide more objective and precise information on the behaviour, emotions and motivations of people***

However, it is also likely that the systematic, scientific approach may reveal formerly unexplored facts on the architecture-human relationship, which then can be used in architectural practice to design even better environments. Using exact methods to study the reactions of people to architecture can provide more objective and precise information on the behaviour, emotions and motivations of people and therefore give tools to efficiently improve the quality of the built environment and human well-being. Thus combining the two perspectives - ideological intuitive and evidence-based -holds the prospect of providing a more profound understanding and the power to control the consequences of architectural experiences to human emotions and behaviour.



1.1

RESEARCH QUESTIONS AND SCOPE

As described in the previous section, the quality of the environment has a significant influence on human well-being and health. As people spend a considerable amount of time in architectural interiors, such as homes, identifying the factors that influence the perceived quality of those places can be considered important. An intuitive attraction to apartment interior spaces is likely to exercise a significant influence on apartment choice, too. However, research on architectural characteristics of apartment interiors that influence visual preference seems negligible. Based on this gap in research, three general research questions for this study are defined as follows:

1. What does previous research suggest to be critical factors in the visual preferences of people in general, in environmental and architectural contexts?
2. How might these factors be applied to the characteristics of apartment architecture?
3. Does the empirical evidence lend support to the influence of these characteristics?

The first of these questions will be answered by reviewing literature from several fields, such as from general aesthetic research and preference studies on architecture and environmental psychology. Based on the findings from the reviewed literature, the second research question will be answered by synthesizing possible applications of these theories and findings in the context of apartment architecture. The third question will be answered by empirical examination of the influence of these synthesized applications.

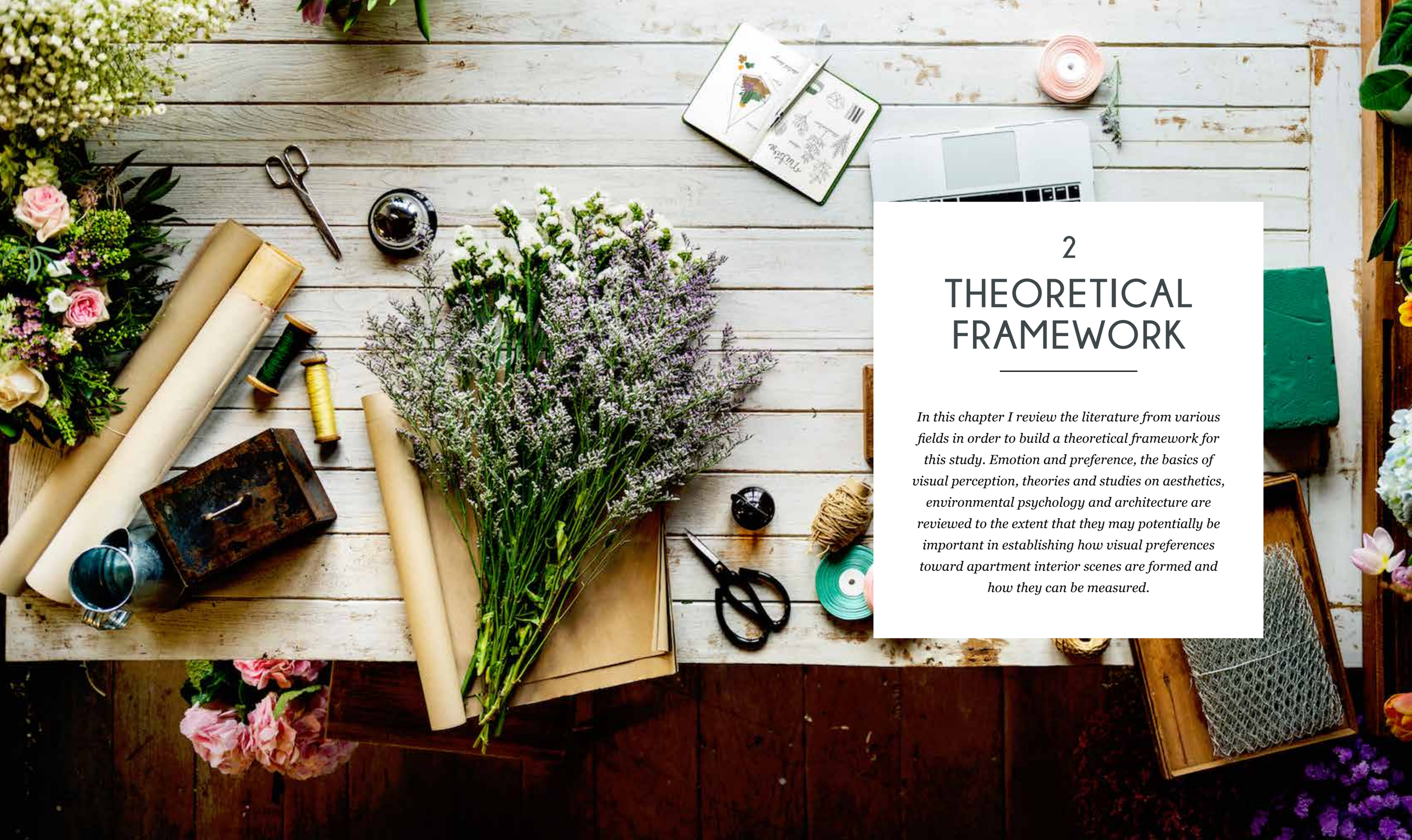
In an individual study like this one, it is usually possible to present only one perspective on the matter in question; others must be excluded from examination. Consequently, interpretation of the results of only one individual study alone can create an incorrect impression of the whole. Berlyne (1971) tells of an apt example about a bridge engineer, who, in his work, mainly

considers human beings as mere weights in certain locations on the bridge. Naturally, this does not indicate that he sees people without other important features, but those are the features that are relevant in designing a footbridge over which human beings can walk safely.

The same thing applies to this study, in many ways. The research scope of this study is narrowed to consider only the visual sensation of an apartment experience. Consequently, the literature is examined only within the scope that is relevant to environmental experiences and on their themes related to visual stimuli. I have had many reasons for choosing sight as the main target. Vision has frequently been described as the most important of the human senses (Sussman, Hollander 2015, pp.56-57). It has more surface area in the cerebral cortex of the brain than any other sense (Bear, Connors & Paradiso 2016, p. 294), which can be considered as a sign of its significant role both in our daily lives and in our evolution. Human behaviour in our surroundings has been described as being mainly based on signs of visual information (Appleton 1988, p. 33). For these reasons, even though other senses such as touch, hearing or the bodily feeling of spatiality are also likely to play significant roles in the architectural experience, the influence of these sensations is left out of the scope of this study. In addition, even though the environmental experience is clearly a sum of both formal and symbolic properties, the considerable lack of experimental research on symbolic properties (Nasar 1988a, p.101) inclines the focus of this research to formal properties. Visual appearance represents only a small fraction of everything that relates to apartment architecture; it includes many other important - some might say more important - aspects such as functionality, accessibility or safety. These topics have been studied recently, for instance by my colleagues (e.g. Tarpio 2015, Bordas Eddy 2017). However, it has been suggested that, for instance, where no apparent problems exist with the functionality of a building, the majority of users' attention would be targeted at its visual appearance (Valentine 1962 p.165-166). For all these reasons together, I direct the scope of this study at the visual appearance of apartment spaces.

1.2
STRUCTURE OF STUDY

The first (1) section of this thesis introduced its major motivations, its purpose, its potential significance and its research questions. The objective of the second (2) section is to construct the theoretical framework by exploring the literature on topics related to the subject of this thesis: the structure of emotions, knowledge of visual perception, studies on aesthetics and environmental psychology and architectural theories related to aesthetics, and by reviewing the research so far conducted on architectural preferences. In the third (3) section, conclusions are drawn from this theoretical basis and the following question is asked: what does the existing literature as a whole imply for the visual preferences of people? Based on these conclusions, the fourth (4) section presents the experimental part of this thesis; its design, construction of test materials and the variables under examination, its implementation, data analyses and results. Finally, in the fifth (5) section the main results are highlighted and reflected on, the strengths and limitations of the study are considered and future research topics are recommended.



2
THEORETICAL FRAMEWORK

In this chapter I review the literature from various fields in order to build a theoretical framework for this study. Emotion and preference, the basics of visual perception, theories and studies on aesthetics, environmental psychology and architecture are reviewed to the extent that they may potentially be important in establishing how visual preferences toward apartment interior scenes are formed and how they can be measured.

2.1
EMOTION AND PREFERENCE

Preference is the primary focus of this thesis and the key dependent variable in its experimental part. Because preference is strongly related to the emotions and in this study is defined as the "feeling of liking one object more than others", I consider it essential to explore the fundamental characteristics of emotions here at the beginning of the theoretical framework of this study. Reviewing theoretical models of emotion also helps to build the terminology and dimensions to be used in the study; the Circumplex Model for instance, one of the theoretical models of emotion, will be used in the experimental part of this thesis to study the affective qualities that might possibly be related to apartment scenes.

Generating preference towards the events of the world seems to be a fundamental characteristic of any living organism (Stanley, Phelps & Banaji 2008, p. 164); flowers turn towards the sun and animals flee quickly from threatening environments. Preference has been seen as an aid for the survival of the individual, and a strong guide of behaviour (Kaplan 1988b, pp. 60, 63). Emotions allow the brain to evaluate events and to predict what will be rewarding, and preferences

enable decision-making and choosing between things (e.g. Overskeid 2000). With such simple organisms as plants or animals, the quite basic automatic processes are described as generating preferences, whereas the preferences of human beings are increased by more complex, controlled mental processes (Stanley, Phelps & Banaji 2008, p. 164). However, it has been claimed that as primitive, automatic preferences are one of the most fundamental actions developed initially to provide quick and efficient ways to react towards the events of the world, they are said to be still largely involved in the everyday behaviour of modern human beings, too (Stanley, Phelps & Banaji 2008).

Many theorists use the term "affect" to describe a general valenced feeling state, of which emotion and mood are seen as specific examples (Cohen, Areni 1991, p.191). Emotions are regarded as having shorter duration and to be more attention-requiring, whereas moods are seen as long-lasting affective states that can be generated and maintained without conscious awareness of their existence, cause or influence on current behaviour. Moods often result from emotions occurring after the intensive state; a fading emotion can leave a residue that we call a mood. Moods can then move away from awareness but still be influential on behaviour. Moods have also been demonstrated as being effective in leaving *affective traces*, which can be recalled afterwards and be influential, for instance, in later decisions. (Cohen, Areni 1991).

2.1.1 **CORE EMOTIONS** MODEL

Some literature suggests the existence of a small number of biologically determined "core emotions" whose expression and recognition is fundamentally similar in all human beings regardless of ethnic or cultural differences (e.g. Ekman, Friesen 1971). The number of core emotions is still a subject of debate among researchers. One widely-accepted division is proposed by Paul Ekman (1999), including anger, disgust, fear, happiness, sadness and surprise. However, recently it has been claimed that some of these emotions might actually be joined (such as fear with surprise, and anger with disgust) (Jack, Garrod & Schyns 2014), decreasing the number of core emotions to four. Different combinations and strengths of these core emotions are believed to produce

Anger
Disgust
Fear
Happiness
Sadness
Surprise

Core emotions by Paul Ekman (1999)

the wide scale of feelings that an individual experiences every day. Antonio Damasio (1994), on the other hand, divides emotions into primary and secondary. He defines primary emotions as those concerned with fear, resulting in automatic reactions of the body such as blushing. In contrast, secondary emotions are defined as those following right after primary emotions, relating memories and cognition to experience. That is to say, secondary emotions are those that enable the personal past experiences of the individual to influence their current experiences.

However, it has been claimed that even though animal studies have given support for core emotion theories, the assumptions drawn from them have proven inconsistent with later human studies (Posner, Russell & Peterson 2005, p.717). It also seems that the theory of core emotion would be poorly supported by recent findings of behavioural, physiological and neuroscientific studies (Posner, Russell & Peterson 2005, pp. 715-718). Thus, despite its important contribution in studying emotions, the theory of core emotions still seems to be quite open to question.

2.1.2 DIMENSIONAL MODELS OF EMOTION

Instead of seeing emotions as independent, monopolar factors such as in the core emotions model, the literature also provides another perspective for categorizing emotions. In this system, called the dimensional model, the whole range of emotions is seen as constructs of only two or three bipolar factors. This would mean that all the emotions would be dependent on each other in a systematic way. The dimensional model provides a system where the individual emotions are organized in a circular arrangement in two- or three-dimensional space formed by these bipolar factors. (Rubin, Talarico 2009, Weiner et al. 2003, pp.352-362). Wundt (1897, p. 83) originally introduced three dimensions: pleasurable-unpleasurable, arousing-subduing

and strain-relaxation. Three dimensions were also suggested later by Schlosberg (1954): pleasantness-unpleasantness, attention-rejection and level of activation. However, more recent models with only two dimensions seem to have become typical. Despite differences in their structures and emphases, the majority of models end up using the same two basic dimensions: a measure of valence or pleasantness and a measure of arousal, intensity or alertness (Rubin, Talarico 2009, p. 802, Posner, Russell & Peterson 2005, Lang 1995). Mandler (1975) has suggested that an emotional response would at first be initiated by arousal of the autonomic nervous system alone.

In the dimensional model, the whole range of emotions is seen as constructs of only two or three bipolar factors.

This would mean that all the emotions would be dependent on each other in a systematic way.

Currently, it seems that three specific models dominate the field (e.g Rubin, Talarico 2009); the circumplex model originally presented by Russell (1980), the positive activation-negative activation (PANA) model originally proposed by Watson and Tellegen (1985) and the vector model originally proposed by Bradley, Greenwald, Petry and Lang (1992). In the circumplex model (Diagram 1), emotions are seen as linear combinations of valence and arousal, distributed in a circular arrangement (Russell 1980, Posner, Russell & Peterson 2005, Russell, Ward & Pratt 1981). The vector model involves a continuous dimension of arousal and a binary measure of valence (either positive or negative), thus with valence determining the direction of the vector and arousal its strength (Rubin, Talarico 2009). In the PANA model (Diagram 2), the vertical axis presents positive affect and the horizontal axis negative affect, whereas the dimensions of valence and arousal are situated in 45° rotation from them (Watson, Tellegen 1985). The PANA model has been described as a rotated version of the circumplex model, but also being actually closer to the vector model as its ends of low arousal are neutral in valence, while the ends of high arousal are differentiated basically by their positive or negative valence states (Rubin, Talarico 2009, p. 803).

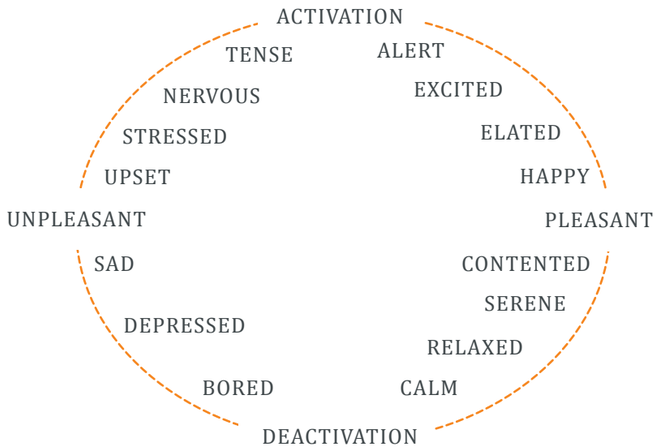


Diagram 1. Circumplex model of affect according to Posner et al. 2005. Emotions are distributed circularly around the dimensions of valence and arousal.

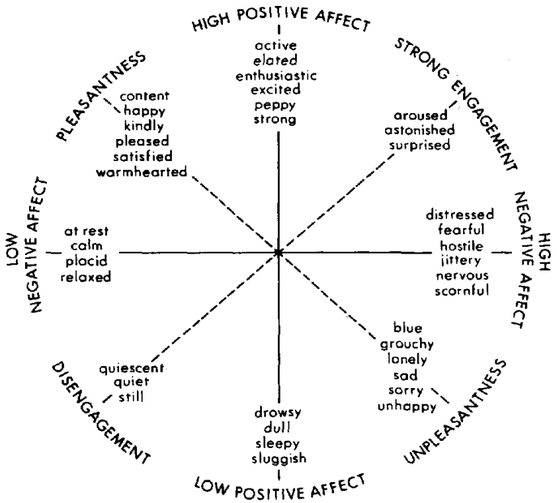


Diagram 2. Positive affect-negative affect (PANA) model of affect by Watson & Tellegen (1985). Emotions are distributed around the dimensions of positive affect and negative affect.

> ***The majority of models end up using the same two basic dimensions: a measure of valence or pleasantness and a measure of arousal, intensity or alertness***

The circumplex model is the framework for the International Affective Picture System (IAPS), a set of images created to provide a standardized set of emotional stimuli for researchers studying emotions and behaviour (Diagram 3). Physiological measures of emotion, such as facial muscle activity, heart rate and skin conductance have also been shown to co-vary well with the parameters of valence and arousal (Lang 1995, Posner, Russell & Peterson 2005, p.720), thus providing support for the reliability of the model. In a study by Russell and Pratt (1981), twenty-one adjectives by which test subjects described the affective meanings of environments were factor analysed, and the resulting two-factor model was found to stand behind the circumplex model (Diagram 4). This gives some support to the presumption according to which emotions arising from environments could also be defined as constructs of valence and arousal.

Both valence and arousal have been claimed to be driven essentially by the two primary motivational systems of the brain: the appetite system and the aversive system. The final behavioural outcome is believed to be determined by a competition between the two motivational systems, of which the one signalling more strongly will determine the final course of behaviour. The appetite system has been described as appearing typically as a behaviour directed to pleasure, such as eating or exploring the environment, and expressed by the behavioural approach. The aversive system, on the other hand, has been described as being shown as protective or defensive actions, expressed typically by avoidance. (Lang 1995). These simple drives of behaviour have been said to be the most clearly seen in primitive organisms, such as amoebas, whose behaviour consists almost solely of the approach towards appetitive stimuli and withdrawal from nociceptive stimuli (Lang 1995, p. 373). The negative affect associated with withdrawal behaviour has been demonstrated as being accompanied by right-

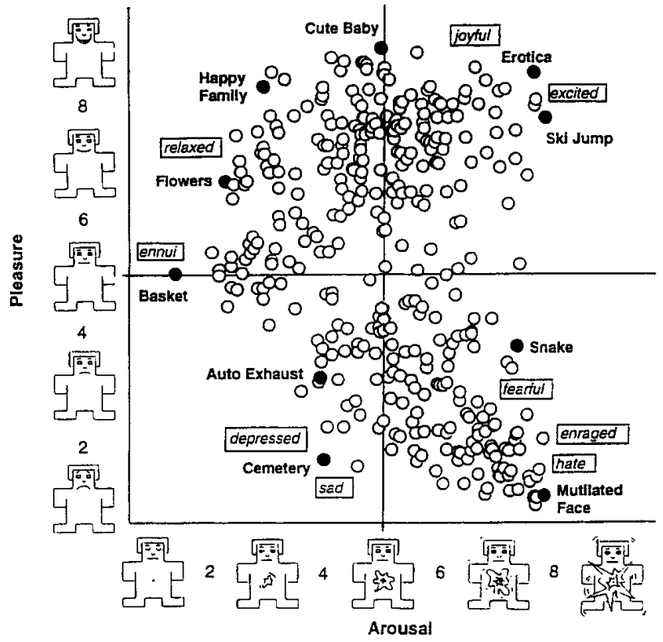


Diagram 3. Distribution of 360 photographic images from IAPS (Lang 1995).

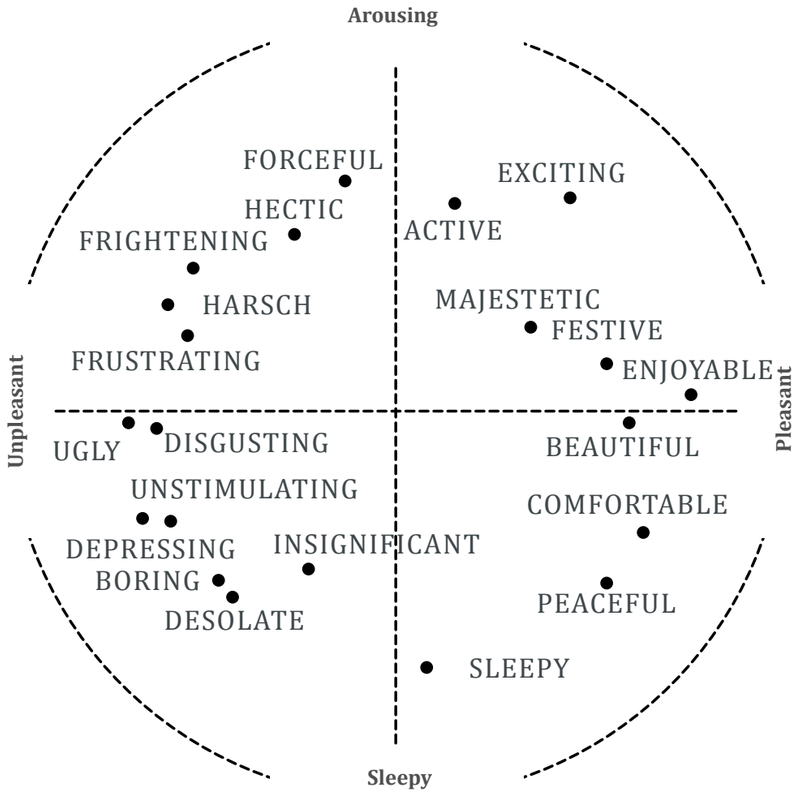
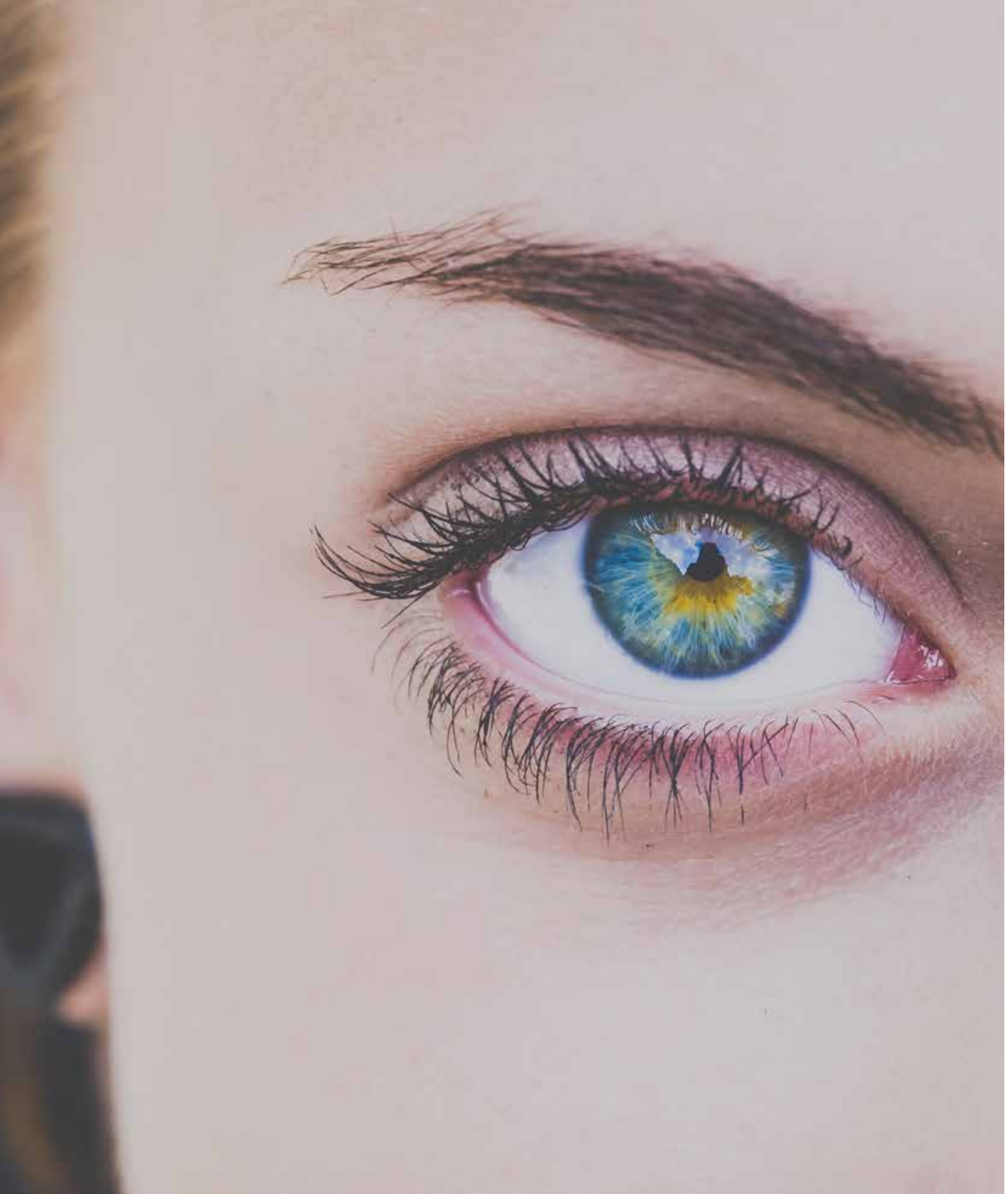


Diagram 4. 21 adjectives describing affective quality of environments presented in the affective space model by Russell and Pratt (1980)

sided frontal brain activation (Davidson et al. 1990), whereas the positive affect and approach behaviour are associated with activation of the left frontal hemisphere (e.g. Spielberg et al. 2008). Affective valence has been described as being determined by the currently dominating motivational system and arousal by the level of activation of either or both of these systems (Lang 1995, p.374).

Preference, a rough evaluation of valence (judging stimuli as pleasing or displeasing) has been demonstrated as being achieved very quickly and often automatically (Zajonc 1980). The decision whether to withdraw or step closer to the stimulus, an action that has been of essential importance in evolutionary survival, has been suggested as being made in mere milliseconds (Sussman, Hollander 2015, p.107). This quick evaluative action, which happens automatically before any controlled reflection, is sometimes referred to as an implicit attitude (Stanley, Phelps & Banaji 2008, Ranganath, Nosek 2008, Nosek, Greenwald & Banaji 2007). Supporting Damasio's (1994) theory of fear-related primary emotions, implicit attitudes and fear learning have been suggested as having common neural roots; there is some proof that the amygdala, the part of the limbic system known to process fear and surprise, in particular, is the main initiator of implicit attitudes, too (Stanley, Phelps & Banaji 2008, p. 165). Besides, this fact has been regarded as demonstrating that implicit attitudes have strong origins in human evolutionary development (Stanley, Phelps & Banaji 2008).

Contrary to primitive organisms, human beings can regulate and change their implicit attitudes consciously if they wish. None the less, it has been claimed that when there is no apparent need to do so, implicit attitudes will influence and guide behaviour automatically, sometimes even contrary to the conscious objectives and wishes of individuals (Stanley, Phelps & Banaji 2008, p. 169). It has been speculated that, when giving reasons for liking or disliking objects, people tend to mention matters that would actually require longer reflection and viewing times, even though it is actually the first, automatic and implicit evaluation that remains and influences these judgements (Valentine 1962 p.139-140). Implicit preferences have been shown as reliable predictors of further behaviour, such as choices or later judgements, and thus studying them instead of explicit statements has been suggested to be more revealing (Stanley, Phelps & Banaji 2008).



2.2
VISUAL PERCEPTION

In this chapter I explore the basic principles, structures and patterns of visual perception. It is likely that the way we perceive environments influences whether we like them or not. The purpose of this chapter is thus to establish features related to visual perception that could potentially influence visual preference.

The human perceptual system has often been thought to have evolved to prioritize vision over the four other senses (e.g. Sussman, Hollander 2015, pp. 56-57, Bear, Connors & Paradiso 2016, p. 294). From a simplified view, visual experience can be seen as an information-handling process (e.g Vitz 1966, Purcell 1986, Ittelson et al. 1974, pp. 109-113), and at the end of the day nothing but chemical and electrical reactions of the nervous system. The visual experience begins with light stimulating the eyes and then continues with processes in various parts of the brain.

2.2.1 **MANAGEMENT** OF VISUAL INFORMATION

Collecting and organizing visual information is an unceasing, automatic process of the body. Seeing is thought to be a constructive process, which means that the different elements of visual perception are processed in different regions of the central nervous system, and the final experience is the sum of all these complex activities. At the most basic level, seeing is due to light photons that are reflected on material surfaces that hit the retina within the eye and cause action potentials in the sensory cells. (e.g. Purves et al. 2008, p. 258-287, Goldstein 2002, pp. 37-48). As a consequence, neural signals are sent towards the cerebral cortex, with the primary visual area as their main target. Specific cortical regions and pathways are used for analysing various properties such as distance and depth, colour, motion, brightness and contrast of the visual scene and for creating stereovision by comparing sensory information from both eyes (e.g

> ***“Converting information from single light photons into holistic visual perception starts by breaking the scene into its minor visual elements and then reassembling them in the brain***

Carter 2009, pp. 80-81). Visual information analysed in that way is then compared with memory traces of similar objects seen before, and after memories have been found that allow understanding what has been seen, the object is recognized in the temporal lobe of the brain by the ventral “what”-pathway (Purves et al. 2008, p. 308-309, Carter 2009, p.82).

Technically, converting information from single light photons into holistic visual perception starts by breaking the scene into its minor visual elements and then reassembling them in the brain. Even before entering the cerebral cortex, visual information has been processed by the neural cells in the retina by, for instance, emphasizing important features such as areas with strong luminance contrasts, that is, contours (Purves et al. 2008, p. 277-287). The primary visual cortex contains a remarkably organized layered structure of neurons that form a “visual map” out of the elements separated from a viewed scene. Different types of neurons have evolved to respond to specific aspects of visual information; some of them have specialized in activating only when a certain orientation, such as horizontality or verticality, appears in the visual field. Other similar neurons respond correspondingly to a slightly different orientation, so that all the possible angles that exist in a visual scene are represented by a group of neurons. Still other types of neurons, called “spatial frequency analysers”, activate correspondingly to different sizes of visual elements. Similarly, some cells respond only to the particular shape of an object, while other, more complex cells activate only if an object with a certain orientation and shape is moving in a certain direction in the visual field. (Goldstein 2002, pp. 83-95, Purves et al. 2008, p. 297-303).

2.2.2 GESTALT, PERCEPTUAL GROUPING AND FORM PREDICTION

Visual perception involves not only passively seeing individual elements but also actively organizing objects that are seen. The Gestalt school of psychology was initiated by a group of German psychologists (including Koffka, Köhler, and Wertheimer) who migrated to the United States between the two World Wars (Eysenck, Keane 2000, p. 28). They developed principles of vision that are accepted to this day (Eysenck, Keane 2000, p. 30-31). Gestalt psychology developed two important notions of significance in visual perception. The first and lesser known is what is called "physiognomics": that nonhuman objects may evoke the same kinds of emotional responses in human beings as do human postures; for example a collapsed roof might evoke feelings of sadness because it expresses the same kind of form as a person with collapsed posture. In the same way, it can be understood why, for example, trees with weeping branches tend to look sad: people may identify with a posture of "passive hanging" (Berlyne 1971 p.16).

Another, perhaps more crucial idea concerning visual perception is the concept of "Gestalt", a German term having no exact equivalent in English but meaning something like "form", "shape", or "configuration" (Ittelson et al. 1974, p.67). The concept consists of several principles called "Gestalt laws" on how the human perceptual system is assumed to bind single objects into groups, and by which perception changes from seeing single elements into seeing patterns. This kind of grouping is claimed to facilitate prediction of environmental signs and therefore to

ease and speed stimulus-processing and -detection; for example, the regularity of a shape contour would make it easier to predict further changes in it. In Gestalt principles, separating a visual scene into "figures" and "ground" is essential: elements grouped by Gestalt laws are seen as figures and the rest of the configuration is understood as less interesting ground that lacks contours. (e.g. Lang 1987, p.86). It is unclear whether these perceptual rules are a result of evolution or learning, but there are indications that they reflect the universal way people perceive the environment (Goldstein 2002, p.155). Gestalt theory has been said to have strongly influenced thinking in the early Modernist period and especially education in the Bauhaus School of Architecture (Lang 1987, p.85-86).

> ***"A collapsed roof might evoke feelings of sadness because it expresses the same kind of form as a person with collapsed posture***

1) Law of Prägnanz

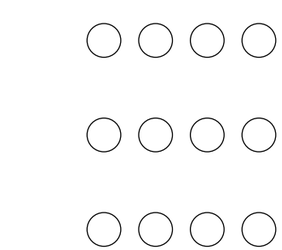
The law of *Prägnanz* (“Conciseness”) is also known as the “law of good figure”, “the law of simplicity” or the principle of “goodness of configuration” (Goldstein 2002, p.148-149, Berlyne 1971, p.16). This states that “every stimulus pattern is seen in such a way that the resulting structure is as simple as possible” (Goldstein 2002, p.148). For instance the Olympic symbol is seen as five circles and not as a more complex set of figures.

2) Law of Proximity

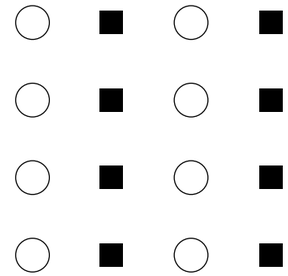
The law of proximity indicates that visual grouping tends to occur with elements that are close to each other (e.g. Eysenck, Keane 2000, p. 29, Lang 1987, p.86). For instance, in Figure 1a the circles are seen to form three horizontal rows rather than vertical ones. The law of proximity is suggested and demonstrated as being the most influential principle of visual grouping (e.g. Kubovy, Holcombe & Wagemans 1998).

3) Law of Similarity

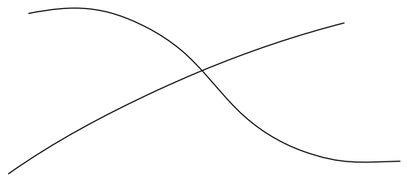
The law of similarity suggests that objects similar to each other, in terms of - for example - form, lightness, hue, size or orientation, are perceptually grouped (e.g. Goldstein 2002, p.150, Lang 1987, p.86). In Figure 1b the rows are now perceived to be formed in the vertical direction as a result of form and colour similarity.



(a)



(b)



(c)

Figure 1. Gestalt laws of Proximity (a), Similarity (b) and Good Continuation (c) exemplified in simple patterns (Eysenck, Keane 2000, p. 80).

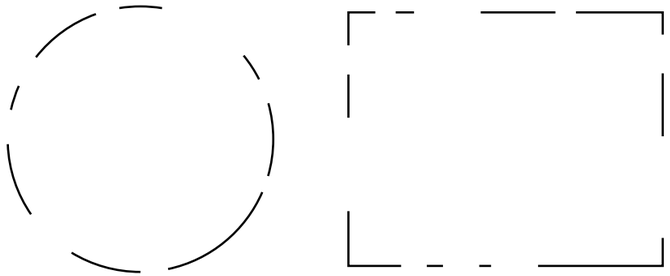


Figure 2. Gestalt law of Closure exemplified in two simple patterns

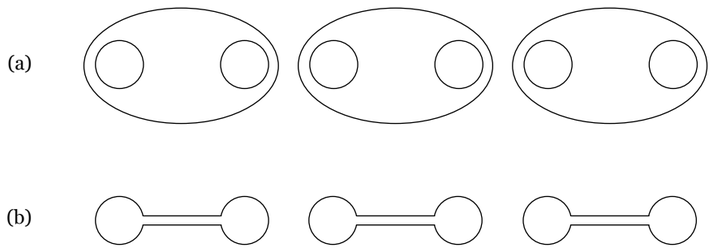


Figure 3. A principle of Common Region (a) and element connectedness (b) preented with simplified figures (Goldstein 2002, p. 155)

4) Law of Good Continuation

The course of a contour that changes with a fixed ratio, such as that of an arch, has been noticed to be more easily predicted than that of irregular forms (Attneave 1954). The law of good continuation postulates that straight or smoothly curving lines tend to be perceived in such way that requires minimal change in their initial direction; it is assumed that they would follow the smoothest path (e.g. Goldstein 2002, p.151, Lang 1987, p. 86-87). For instance, Figure 1c is perceived as two crossing lines rather than two arrowhead lines touching each other at their tips. (Eysenck, Keane 2000, p. 29).

5) Law of Closure

The law of closure means that the missing parts of a picture are added perceptually to form a complete image (e.g. Lang 1987, p. 86). If the law of closure did not exist, the figures in Figure 2 would be seen as a series of individual sections of lines.

6) Law of Common Fate

The law of common fate indicates that elements that seem to move together are visually grouped (Goldstein 2002, p.151).

It has been suggested that the law of proximity would be used primarily, and the additional grouping laws would be used when the elements differ within this cluster (Eysenck, Keane 2000 ref. Quinlan, Wilton 1998). However, several even stronger grouping principles have been introduced by researchers other than those of the Gestalt school. The principle of *common region* means that elements that are placed in the same visual region would be grouped together (Goldstein 2002, p.155) even if they were grouped otherwise according to the law of proximity, as in Figure 3a. Additionally, element connectedness, which means that elements are physically connected, seems to override the law of proximity (Goldstein 2002, p.155), as presented in Figure 3b. Even though the Gestalt laws are without a doubt intuitively understood when presented in simplified figures, it is true that it can be hard to find an unambiguous way to apply and combine them, for instance, to environmental scenes as noted for example by Lang (1987, p.195).

It has been claimed that succeeding in mental activities would be one of the basic sources of pleasure; in other words, a mental activity would be pleasant when it is effortless and successful (Valentine 1962 p. 80). Objects arranged according to Gestalt laws are demonstrated as being extracted more quickly from the visual field (Goldstein 2002, p.156), which could therefore indicate that they would be more pleasing than randomly arranged figures.

It has been speculated that people would have an inherent expectation of regularity and order, developed for the sake of survival in a hazardous environment, which would make people automatically seek order from visual information (Padovan 1999, p.41). When a form initiates as regular, a person would automatically seek the principle of its change, such as by the law of good continuation, and would be “disappointed” if, unlike in Figure 4a, regularity ceases or a curve changes to obey another pattern, as in Figure 4b, which then would result in a feeling of displeasure (Valentine 1962 p. 80). Regularity of form could thus be seen as a source of pleasure as it may facilitate the process of interpretation. For instance, pleasure from the golden ratio has been explained as being a result of ease of its interpretation; in Figure 5, evaluation of the ratio between the shorter part C and the longer part B of the line would facilitate assessment of the ratio of the whole line A to the longer part B because the ratio is the same in both cases (Valentine 1962 p.93).

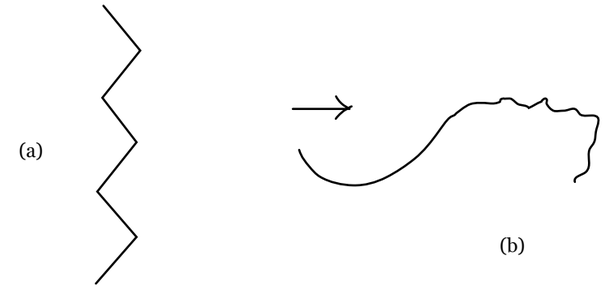


Figure 4. Figures which either obey (a) a regular pattern or suddenly cease obeying it (b) (Valentine 1962 p.80-81)

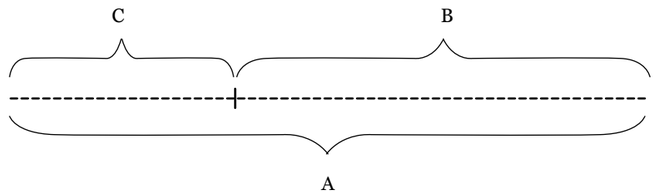


Figure 5. A line divided according to the Golden Ratio. The ratio between C and B is the same as the ratio between A and B.

2.2.3 SYMMETRY

It has been demonstrated that people react inherently more strongly to symmetrical objects than asymmetrical ones (Tyler 2000). Symmetry seems to contribute to comprehension of visual information in a very profound way; the brain detects the symmetry axis very fast, as quickly as within 0.05 seconds, and applies it as a landmark when exploring a scene (Tyler 2000, Locher, Nodine 1989, Ramachandran, Hirstein 1999). Symmetry thus seems to provide a systematic and effective way to explore the visual field throughout. The high speed of processing symmetrical objects has been suggested as being due to the fact that once the brain has interpreted half the information in a symmetrical scene it is easily and effectively able to predict the rest. (Sussman, Hollander 2015, p.122). The high speed of detecting symmetry suggests that it would not only be important but also evolutionally an old ability of human beings. Moreover, as 0.05 seconds is too short a time for any controlled cognitive processes, the special reaction for symmetry seems to be a global, hardwired brain activity (Tyler 2000).

The literature indicates that people would also prefer symmetrical objects to asymmetrical ones. Symmetry is, for instance, one of the eight laws of aesthetic experience defined by Ramachandran and Hirstein (1999, p.27). Observing symmetrical rather than asymmetrical objects has been shown to activate the facial muscles responsible for smiling (Makin et al. 2012, p.3253-3254), which may in itself induce positive sensations. Ratings of attractiveness of objects have been demonstrated to be enhanced when they are supplemented with symmetrical decorations, which people have shown to prefer systematically over asymmetrical ones (Cárdenas, Harris 2006). The fact that preference for symmetry seems to be unaffected by learning and that symmetrical objects have been used independently across cultures, even in those separated either geographically or temporally, has been claimed to favour the idea of the global nature of the phenomenon (Cárdenas, Harris 2006, p.3). The global preference for symmetry has even been suggested as proof that aesthetic experience is essentially rooted on biology (Sussman, Hollander 2015, p. 109).

The brain detects the symmetry axis very fast,

AS QUICKLY AS WITHIN 0.05 SECONDS,

and applies it as a landmark when exploring a scene.

Interestingly, symmetry in nature, as in the anatomy of animals and plants, occurs mainly in the horizontal direction: for instance the right and left sides of the human body are symmetrical, whereas in the vertical direction the body is asymmetrical. The same phenomenon is easily found in other living organisms, such as animals or trees. That is to say, the symmetry of natural organisms is *bilateral*. Correspondingly, symmetry around the vertical axis (occurring in the horizontal direction) has been demonstrated to be preferred over symmetry around other axes (Cárdenas, Harris 2006, p.12-15). Vertical and horizontal directions also have other peculiarities in human perception. It has been suggested, for instance, that vertical visual elements would be frequently overplayed: to illustrate, we would tend to evaluate vertical lines as longer than horizontal lines of equal length. One explanation proposed is that eye movements in the vertical level would require more muscle tension that in the horizontal level. (Petrovski 1973 p.328). The organization of the eyes in the head, parallel to the horizontal axis, might also explain this "vertical bias" (Sussman, Hollander 2015, p.122).

> **"Symmetry in nature, as in the anatomy of animals and plants, is bilateral**

The reason for the seemingly special role of symmetry in human perception is not known, but several potential explanations have been proposed. It has been suggested that the ability to quickly detect symmetry would have facilitated the separation of inanimate and animate objects, such as rocks and stones, from animals and plants (Tyler 2000, Eberhard 2008 p.69, Sussman, Hollander 2015, p.114). Thus the pleasure from seeing a symmetrical object rather than an asymmetrical one perhaps occurs because symmetry is associated with living organisms, causing a reaction of empathy. Face recognition is known to play a very special role in visual perception; faces tend to grab attention, and our central nervous system has evolved to recognize and interpret them quickly (e.g. Bear, Connors & Paradiso 2016, pp. 360-361, Carter 2009). Thus it might well also be that we would associate bilateral symmetry with faces, and therefore prefer looking at bilaterally symmetrical objects (Sussman, Hollander 2015, p.120). The preference for symmetrical forms has also been suggested as having roots in partner choice; a symmetrical face would indicate stable development and flawless genes, and thus signal the good health of a potential partner (Ramachandran, Hirstein 1999, p.27, Zaidel, Aarde & Baig 2005, e.g. Sussman, Hollander 2015, p.120). Preference for symmetrical faces

over asymmetrical ones is demonstrated by several studies (e.g. Cárdenas, Harris 2006, Perrett et al. 1999), and it has been suggested that this sense of robustness caused by facial symmetry would generalize to other objects as well.

In architectural form, too, symmetry can be regarded as one of the most obvious and oldest sources of visual order. It is also often the most striking visual characteristic of traditional architecture; for instance, classical architects maintained that buildings should reflect the symmetry of the human body, as well as that they should reflect its proportions (e.g. Alberti 1986, p.675). Classical architects have also been described as having maintained axial symmetry as a "decisive, almost indispensable criterion for beauty" (Kruft 1994, p. 134). Over the centuries, architects have used symmetry intentionally to convey power, prestige and might (Sussman, Hollander 2015, p.106-131, Tietz 1999, p.54).

2.2.4 THE SCHEMA THEORY AND THE **EXPOSURE EFFECT**

Frequently the repetitive and routine actions of human life, such as ongoing interpretation of our everyday environment, normally require little, if any, attention or controlled mental effort. On the contrary, they happen quite automatically unless they are in the focus of attention for a particular reason. According to the schema theory, a large part of the automation of these kinds of mental processes can be explained by a construction of automatic mental patterns, "templates of action", called schemas (e.g. Lang 1987 p. 94). Schemas are created from the regularities of the previous experiences of the individual. The schema theory also

suggests that similar, often-repeated visual perceptions are recorded as patterns in order to automate their future recognition and interpretation. For instance, in the case of built environments, even though differing from each other in many ways, buildings may share certain common regularities, which are recorded as such mental schemas. Even though the way each individual perceives their environment is unique, the common neural mechanisms of perception and other evolutionary traces are innate in all people (Ittelson et al. 1974, p. 68). This is a potential explainer of similarities in the schemas between individuals.

Repeated exposure to a stimulus seems to increase affective preference towards it (Zajonc 1968), and people are shown to prefer objects that most closely resemble stereotypes (Whitfield, Slatter 1979). The phenomenon has been called "the mere exposure effect" in the literature. Stimuli that are encountered daily are said to sculpt preferences, including aesthetic ones. In other words, perception of the environment would be affected by things that people are accustomed to. (Lang 1987, p.102). As an example, people are said to prefer visual arrangements where stronger and heavier elements are placed below weaker and lighter ones, also termed "the weight principle" by Valentine (1962). In the physical world, gravity pulls everything towards the ground and therefore everything indeed seems to grow heavier near the ground, and to become lighter with increasing height from it; the trunks of trees are stronger than their foliage. This also emphasizes the vertical direction. It is also known from everyday physics that piles of objects are more likely to collapse if heavier elements are placed above lighter ones, such as thick books piled on top of thin ones. It has thus been speculated that these kinds of everyday stereotypes would influence visual appreciations, showing themselves as preference patterns like Valentine's "weight principle" (Valentine 1962) noted above. Objects that have been seen before are re-identified faster, which has been speculated as reducing the effort needed to process them in the nervous system (Eberhard 2008, p.120-121). The exposure effect also agrees well with the evolutionary point of view; it has probably been beneficial to like familiar objects that have already been found to be harmless rather than novel, potentially harmful ones.

2.3

AESTHETICS

As aesthetics essentially studies beauty (Oxford Dictionaries 2015), its focus is notably close to the subject of this thesis examining visual preference. However, aesthetics is commonly concerned with concepts of a more general level, whereas the focus of this research is narrowed to visual preference for apartment interior scenes. Nevertheless, reviewing existing studies on aesthetics can provide valuable findings on visual preferences in general that may be used in the experimental part of this thesis.

Aesthetics has been an issue of contemplation in the literature for at least a millennium. Early literature on aesthetics has been described as having been written in all the major ancient civilizations, such as China, Japan and India (Berlyne 1971). In Western civilizations, early aesthetic discourse seems to have been long - nearly 2000 years - governed by the writings of Plato, after which the writings of Kant added significantly to the conversation (Scruton 1979, p.1). The term “aesthetics” is said to have been first introduced by Alexander Baumgarten in 1750 (Lang 1987, p.179).

Today, aesthetics is a wide-ranging research field, varying from philosophy to precisely targeted neurophysiological experiments. Research on aesthetic experiences uses methods originating from many disciplines, such as perceptual psychology, neuroscience and evolutionary studies. Throughout history, and still today, the most common method of studying aesthetic experiences seems to have been by observing subjects viewing different aesthetic stimuli and surveying their behaviour in one way or another.

Aesthetic experiences are strongly related to the sensation of pleasantness. The Oxford dictionary defines aesthetic as "concerned with beauty or the appreciation of beauty" but also as "giving or designed to give pleasure through beauty" (Oxford Dictionaries 2015). Indeed, the judgement of beauty has been demonstrated to activate the same brain areas that are commonly known to be involved in the perception of rewarding stimuli (Hideaki, Zeki 2004). Aesthetic experiences are strongly related to affective stimuli, and indeed, affect is often described as the ground of aesthetic experience (Valentine 1962 p.8). Aesthetic experience seems to be mostly automatic; the pleasure of viewing a beautiful object is rarely a result of controlled analysis of its visual arrangement, yet a visual professional may be able to perform that sort of controlled assessment, too. Similarly to implicit attitudes, it has been shown that initial, automatic aesthetic judgements also seem to well prefigure final, knowingly pondered judgements on the rated beauty of objects (Mastandrea, Bartoli & Carrus 2011).

Studies have approached aesthetic experience from many perspectives to find some rules of aesthetic appreciation, ranging from studying the appreciation of separate, simple visual elements such as individual lines and shapes (Valentine 1962

"Judgement of beauty has been demonstrated to activate the same brain areas that are commonly known to be involved in the perception of rewarding stimuli

pp.71-92) to studying complex visual objects, such as paintings (Birkhoff 1933, Roberts 2007). It seems that studying individual visual objects, such as lines or simple shapes, apart from their context yields less distinct results and more unexplainable variety between individuals than studying more complex visual scenes, such as paintings or architecture (e.g. Eysenck 1940, Valentine 1962, Nasar 1983).

2.3.1 **SUBJECTIVITY** OF AESTHETIC EXPERIENCE

"Beauty is in the eye of the beholder","visual preferences are a matter of taste" and "preferences are subjective" are frequently heard and generally well-agreed phrases. However, how accurate can these proverbs be considered? Over the course of time, outlook on the subjectivity of aesthetic experience has varied. In pre-modern times, even though both subjective and objective outlooks were acknowledged to contribute to aesthetic experience, the objective outlook has been described as dominating (e.g. Kruft 1994, p.147). For instance, the well-known Renaissance architect Leon Battista Alberti (1986, p.113) proclaimed beauty to be the result of an objective "inborn insight". Beauty was seen as fundamentally emanating from nature and, as a consequence, having a direct effect on people by means of biology (e.g. Kruft 1994, p.156). However, in modern times, the subjective view of beauty has been claimed as having become more dominating. (Tatarkiewicz 1963, Padovan 1999, p. 272).

When explored, the body of research on aesthetic preferences seems to show surprisingly little variance between the aesthetic judgements of different samples of people. Actually, research seems to indicate quite the opposite; numerous studies demonstrate that public opinion seems to be quite consistent in terms of questions of visual preference (e.g Yi 1992,

Stamps, Nasar 1997, Strumse 1996, Nasar, Kang 1999, Nasar 1983, Berlyne, Robbins & Thompson 1974, Valentine 1962 p. 169-180, Roberts 2007). This preference consensus of public opinion has been demonstrated with a variety of objects, such as sculptures (Di Dio, Macaluso & Rizzolatti 2007), paintings (Cattaneo et al. 2015), design competition entries (Nasar, Kang 1989), urban street scenes (e.g. Nasar 1988d), natural scenes (e.g. Kaplan, Herbert 1988) as well as with different styles of buildings (Stamps, Nasar 1997 p.14, Oostendorp, Berlyne 1988, Groat 1988). For instance, in these studies, the correlation between the aesthetic evaluations of males and females (e.g Stamps 1999b, Roberts 2007, Wilson 1939), as well as those of cross-cultural representatives (e.g. Yi 1992, Nasar 1988d, Berlyne, Robbins & Thompson 1974) have been shown to be high.

To illustrate, a highly interesting study was conducted by Yi (1992), where the aesthetic judgement of landscapes was shown to be mostly independent of the cultural (Koreans vs. Texans) or social (farmers, non-farmers and university students) backgrounds of the subjects. The experiment demonstrated more similarities than differences in aesthetic experiences towards landscape scenes. Moreover, the adjudged beauty of the landscape was shown to be the dominant factor for environmental interaction. Scenes judged as beautiful were also those that subjects would prefer to *use* for a range of activities such as housing or picnicking. The meaning of the scene to the representatives of different cultures increased preference in scenes that were judged less beautiful but had less significance in scenes that were judged to be beautiful. In contrast, when subjects were asked to evaluate the suitability of scenes for different activities such as housing or picnicking, the answers were more affected by cultural differences. (Yi 1992).

In the light of the research findings, it seems inevitable that at least some general principles for visual preferences would exist; preference judgements are at least not totally random. It has been claimed that this general tendency would be partly due to our shared evolutionary heritage (Kaplan 1988a, p. 53) and it has been regarded as evidence of the underlying significance of aesthetic experiences to human beings (Kaplan 1988, p. 46). However, it is commonly known from experimental studies and from everyday life that individual differences in preference exist as well. These differences may arise

> ***When explored, the body of research on aesthetic preferences seems to show surprisingly little variance between the aesthetic judgements of different samples of people***

from earlier personal experiences, in other words, what individuals have learned, as well as from differences in their personality; for instance it has been suggested that introvert and extrovert personalities would differ in their aesthetic appreciation so that extroverts might prefer more complex stimuli as they might tolerate more uncertainty (Eysenck 1973, p.148-151, Berlyne 1974b p.326). It has also been speculated that first-born children would prefer less ambiguous stimuli than their siblings, and that creative people would also prefer more complex stimuli (Lang 1987, p.199).

A model in which aesthetic evaluation would be processed from three different dimensions - evolutionary, cultural-social and personal - has been suggested (Yi 1992). The evolutionary dimension, based on human development as a species, should be somewhat similar in all of us, whereas the other two dimensions may vary according to cultural and individual differences. According to this model, both differences and similarities in aesthetic judgements could be explained; stimuli that induce reactions within the evolutionary dimension would result in similar evaluations, whereas cultural elements or elements that have special meanings to the individual would cause differences in aesthetic evaluation. (Yi 1992).

Even though environmental influence on brain development initiates to some extent even before birth, the nervous system is mainly constructed on a biological basis dictated by genetics. Genes contain information on how to build up systems that enable the most basic feelings such as satisfaction and hunger or the ability to distinguish between good and bad tastes. Genes also contain the recipes for building up systems for walking, breathing, and for

instance, obtaining and processing sensory information and further transforming it into behaviour, systems which are mainly constructed the same way in all individuals. Furthermore, all mammals are found to share the same evolutionary origins, and even though the evolutionary path of human beings diverged from that of chimpanzees over five million years ago, we still share about 98 % of our genes (Alberts et al. 2014, p.219). When it comes to primitive reactions, people may thus differ surprisingly little, for instance, even from cats or rats. It thus seems quite understandable that similarities could be found between the reactions of individuals to different environments. These underlying systems and primitive models of behaviour can be seen as the basis for the evolutionary dimensions of the aesthetic experience.

However, contact with the environment also shapes the nervous system. In the brain some neural connections are strengthened, new ones are created and some are discarded as useless, a process that operates continuously according to the increasing experiences of each individual. This development can be seen to make up the cultural and personal dimensions of the aesthetic experience. Emotional learning means that when emotions once arise on certain types of things, they are automatically reflected in similar things that are faced. For instance, when visiting a certain type of house, it is likely that the first judgements are partly made on the basis of some previous experiences in similar kinds of houses. Therefore, pleasure can be found from scenes that relate to happy experiences in the past, which leads to arguments such as “I like this because it reminds me of the old house of my grandparents”. (Eberhard 2008, p.122-123). The judgements of other people have also been demonstrated to exert a strong influence on reported preferences; in an illustrative experiment conducted by Valentine (1962 p. 137-138) aesthetic judgements of paintings varied considerably depending on whether the experimenter had told subjects that a particular painting was highly appreciated by art critics or not; the effect of suggestion was revealed in as many as seven paintings out of ten.

2.3.2 AESTHETIC **STUDIES**

Like virtually all fields of science, aesthetics also began as a field of philosophy. Research was then mainly based on personal reflections, focusing on surveying the aesthetic appreciations of other people as well as those of the authors themselves. From the first steps of aesthetics as a research field, there seems to have been a desire to define some measurable number of features that would contribute to the experience of beauty. One example of early philosophical theories of aesthetics is that of William Hogarth, an English painter, who explains his view on beauty and aesthetics in his classic book “The Analysis of Beauty” (1753). In Hogarth’s (1753) view, aesthetics was separated into five basic elements:

1) **Fitness**, meaning how the parts fit in their purpose
2) **Variety** in as many ways as possible
3) **Uniformity, regularity or symmetry,** which can only please as they serve to give the idea of fitness. Sameness and strict regularity are to be avoided and modified by turnings, contrasts, and motion.
4) **Simplicity or distinctness**, which gives pleasure not by itself, but by enabling the eye to enjoy variety with ease
5) **Intricacy**, which provides employment for active energies, leading the eye on "a wanton kind of chase”
6) **Quantity or magnitude**, which draws the attention and produces admiration and awe

The credit of turning aesthetics into empirical research is usually given to German doctor and psychologist, Gustav Fechner (e.g. Lang 1987, p. 182). It is proclaimed that, with Fechner, the scope of the study expanded from philosophy to the field of psychology (e.g. Smith, Tinio 2014). Aesthetics became one of the first research subjects in psychology that was studied experimentally. Fechner is probably best known for his early experiments where he asked subjects to judge how the proportions of length and height of rectangles influenced their preferences (Figure 6) (Fechner 1876, Valentine 1962 p. 93). In this experiment he demonstrated the rectangle with the proportions of "a golden ratio" to be the most preferred; the result has later been supported by experimental studies conducted with other stimuli as well (e.g. Di Dio, Macaluso & Rizzolatti 2007). Fechner's early model of aesthetic appreciation, presented in his books "Elemente der Psychophysik" (Elements of Psychophysics) (1860) and "Vorschule der Ästhetic" (Elementary Aesthetics) (1876), consisted of two main principles. The principle of "aesthetic centre" means that people would tolerate intermediate visual activation more frequently and for a longer time than either strong or weak activation, as it keeps them neither over-stimulated nor unsatisfied for lack of stimulation. The second principle, "unitary connection" presents the idea that a pleasant aesthetic stimulus would have to provide a balance between activation and order. (Roberts 2007).

> ***"From the first steps of aesthetics as a research field, there seems to have been a desire to define some measurable number of features that would contribute to the experience of beauty***

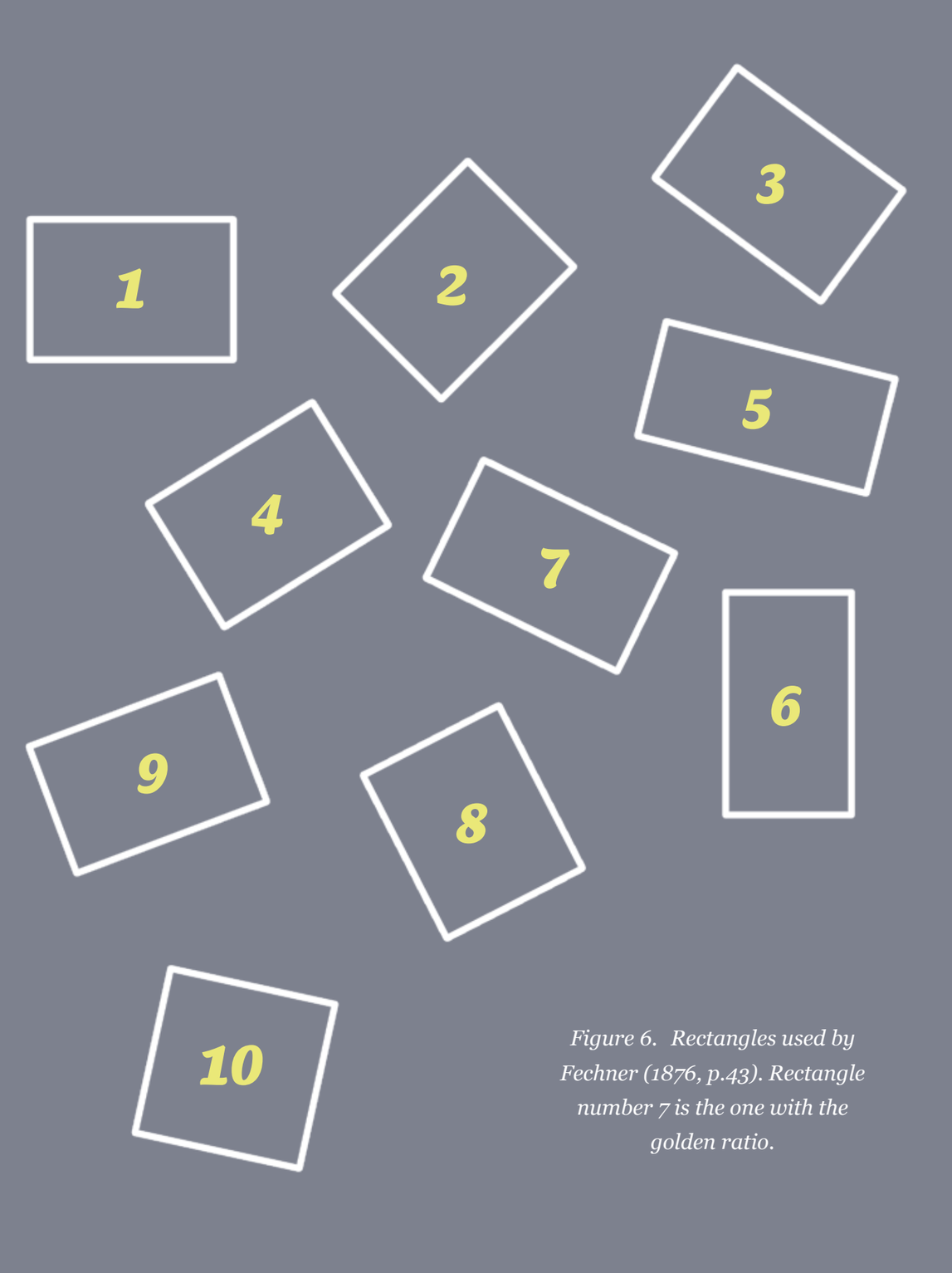


Figure 6. Rectangles used by Fechner (1876, p.43). Rectangle number 7 is the one with the golden ratio.

Over history, several attempts have also been made to find mathematical equations to define beauty. An early mathematical model from George Birkhoff is from 1933 (Birkhoff 1933):

$$M = \frac{O}{C}$$

Where:
M is aesthetic measure or value
O is order
C is complexity

Birkhoff saw aesthetic experience as being essentially constructed by three variables: 1) “a preliminary effort of attention” which is “rewarded by feeling the value of 2) aesthetic measure” (M). The effort of attention was seen to increase by the level of complexity (C) of the view. The third variable, order (O), was also seen as necessary to the aesthetic effect: “a relation that the object is characterized by a certain harmony, symmetry, or order, more or less concealed”. (Birkhoff 1933 p. 3-4). The model was initially used for measuring the aesthetic of two-dimensional polygons. As can be read from the equation, according to the model the aesthetic measure increases as order increases or complexity decreases. Thus Birkhoff’s model gives much appreciation to an object’s order and little to its complexity; much effort required to process an aesthetic object was seen to have a negative rather than a positive influence. The equation was used by defining numerical measures for both order and complexity, and besides polygons, it was applied to poetry and music (Birkhoff 1933, pp. 87-190). With polygons, order (O) was measured by first summing the positive elements of order: an “object’s vertical symmetry”, “equilibrium”,

“rotational symmetry” and “relation of the object to a horizontal-vertical network,” and then decreasing some attributes of unsatisfactory elements, such as “angles too close to 0º or 180º” (Birkhoff 1933, p. 33-34). Complexity (C) was defined by counting the number of “indefinitely extended straight lines which contain all the sides of the polygon” (Birkhoff 1933, p. 34). However, several experimental studies (e.g Wilson 1939, Eysenck 1941) have not provided empirical evidence to support Birkhoff’s theory on which the formula is based.

Eysenck (1941) continued Birkhoff’s work by remodeling his theory on the basis of empirical findings. Based on empirical testing of aesthetic preferences for polygons of different forms, he ended up by formulating the following equation:

$$M = 20x_1 + 24x_2 + 8x_3 + 7x_4 + 5x_5 + 3x_6 + 3x_7 + 2x_8 + 1x_9 - 2x_{10} - 8x_{11} - 15x_{12}$$

where :
X_1 is Vertical or Horizontal Symmetry
X_2 is Rotational Symmetry
X_3 is Equilibrium
X_4 is Repetition
X_5 is Compact Figure
X_6 is Complexity; Six or more parallel sides
X_7 is Both Vertical and Horizontal Symmetry
X_8 is Pointed Top and/or Base
X_9 is Complexity; Three or more parallel sides
X_{10} is Complexity; Two parallel sides
X_{11} is Re-entrant Angles
X_{12} is Angles close to 90 degrees or 180 degrees

A more profound look at the attributes in Eysenck's equation shows that they can essentially be regarded as constructions of the same two principles of Birkhoff: order and complexity. However, the result of the greatest contrast to Birkhoff's theory was the relationship between complexity and aesthetic preference, since the correlation between complexity and aesthetic preference was positive, contrary to Birkhoff's premises. Later, Eysenck refuted his complex equation, and ended up reforming Birkhoff's equation into the following form (Eysenck 1942):

$$M = O \times C$$

Daniel Berlyne (1957, 1958, 1963, 1964, 1971, 1974b, 1974, 1974c, 1974a) has perhaps contributed the most to experimental research on aesthetic preference so far, and his theories still seem to largely dominate in the field; even new studies refer to his work on a regular basis (e.g. Silvia 2005, Roberts 2007). Berlyne's original physiological arousal theory (Berlyne 1960) included a wide range of motivational, emotional and cognitive phenomena, aesthetics being a part of them. The central idea of Berlyne's aesthetic model was that pleasure from the stimulus acted as a function of arousal of the individual; in other words: by adjusting stimulus intensity to an optimal level, the arousal of the individual, and therefore visual pleasure, would also be optimal.

Berlyne classified the features of aesthetic variables that would have potential to influence the arousal level of individuals into three categories: psychophysical, ecological and collative variables (Berlyne 1971, pp. 175-220). Psychophysical variables refer to those stimulus qualities that increase the arousal of the individual by physiological means, such as by electrocortical, electrocutaneous, pupillary or cardiovascular activation. For instance, size, intensity, colour, brightness or auditory pitch are defined as psychophysical variables. (Berlyne 1971, pp. 177-180). Ecological variables refer to the elements that relate meaning or conditioned reward value to the object (Berlyne 1971, pp. 180-181). Finally collative variables,

The central idea of Berlyne's aesthetic model was that pleasure from the stimulus acted as a function of arousal of the individual

which Berlyne rated the most important of the three, were structural or formal aspects of stimulus patterns such as complexity, novelty, predictability or the amount of information (Berlyne 1971, pp. 181-220). Together these three categories of variables formed what is called arousal potential, which would influence preference according to a parable usually called the Wundt curve or the inverted-U curve (e.g. Berlyne 1971). The figure rises first to a peak and by increasing arousal falls, which indicates that the most pleasing stimulus would be of an intermediate level of arousal (Diagram 5). An optimal level of arousal can thus be obtained in two ways; either increasing it if the initial level is under the optimal level or, on the contrary, by decreasing it if the initial arousal level is too high. (Berlyne 1974b p.9).

Several experiments have aimed to verify different parts of Berlyne's theory (e.g Vitz 1966, Sluckin, Colman & Hargreaves 1980, Akalin et al. 2009, Berlyne 1974b) including a broad scope of different contexts, such as website design (Geissler, Zinkhan & Watson 2006). However, many studies have been unsupportive of Berlyne's theory. Martindale and his colleagues (1988, Martindale, Moore & Borkum 1990) review several studies and findings that do not support the Berlyne model. For instance, they review experiments where preference was unable to follow Wundt's curve, including for instance the number of turns in polygons or sensory qualities other than vision, such as taste for glucose, saltiness or sourness (Martindale 1988, p. 9-10, Martindale, Moore & Borkum 1990, p. 55). Additionally, the significance of collative variables has been questioned as many studies have found prototypicality to correlate to preference over complexity (Martindale 1988, p. 11). Further, they criticize Berlyne for not being able to present convincing proof that ecological variables would be related to preference in an inverted-U fashion (Martindale, Moore & Borkum 1990, p. 56).

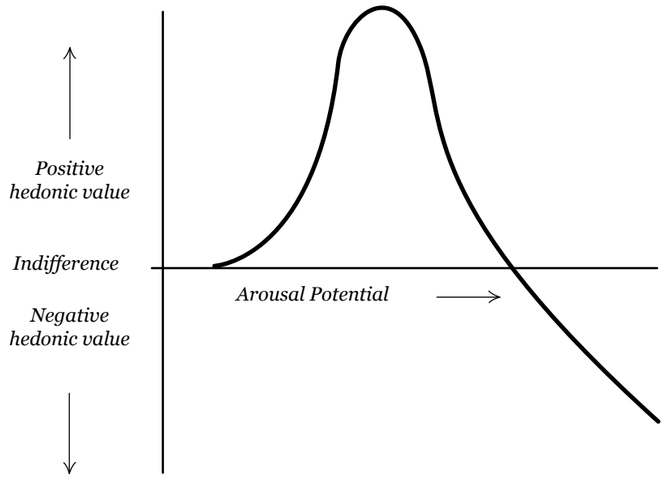


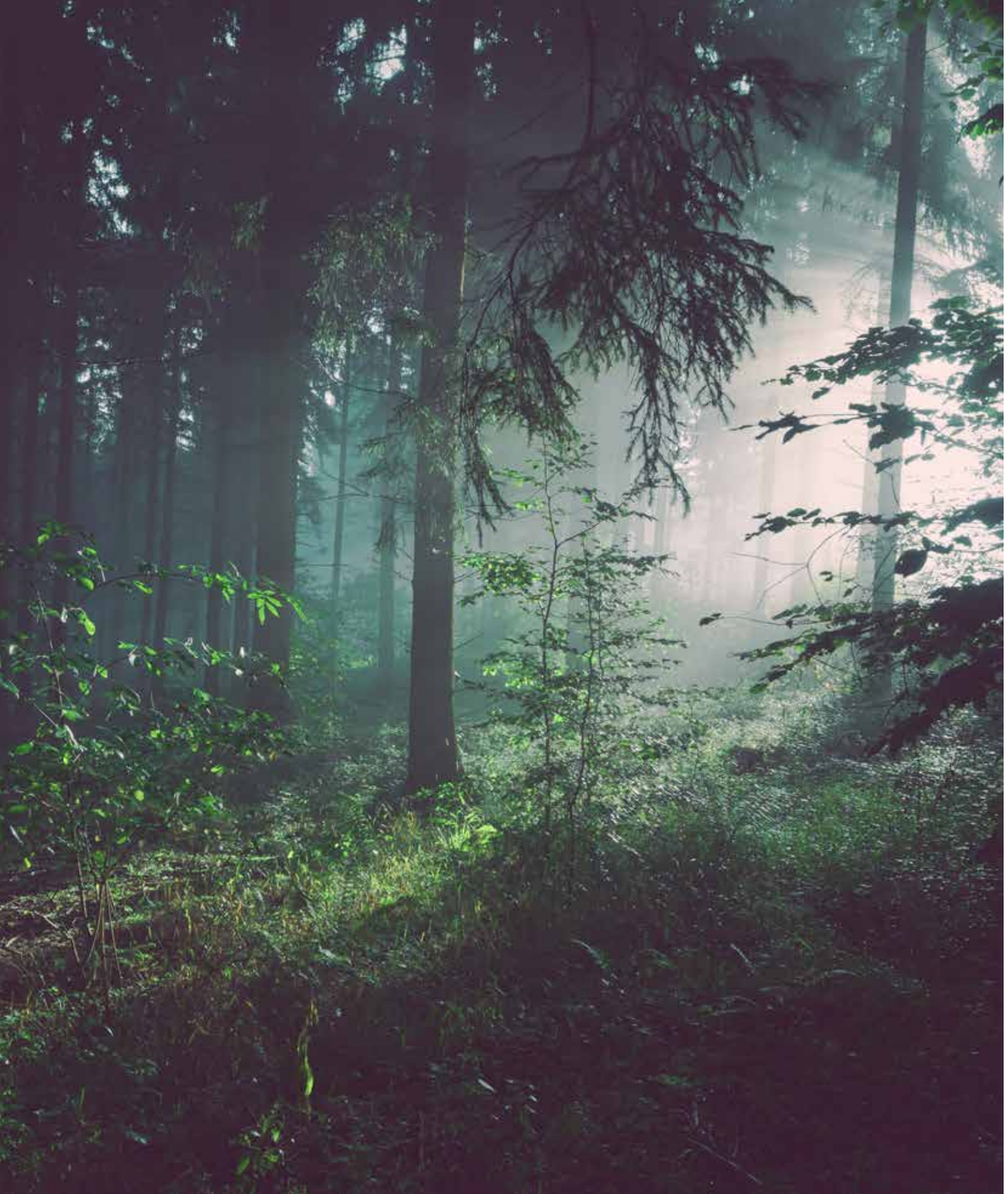
Diagram 5. The Wundt Curve. According to Berlyne (1971), the preference would increase along the increasing level of arousal potential up to its intermediate level, after which the preference would begin to decrease.

As already noted in Chapter 2.2.4, schemas are said to facilitate recognition and interpretation of objects, and therefore some researchers have suggested that individuals would strive to prefer objects that fit their schemas, or as could also be understood, prototypes (e.g. Martindale 1988). On the contrary, following Berlyne's idea it has also been suggested that moderate to low *variance* from a learned schema would increase preference by evoking interest and arousal (Purcell 1986, Purcell, Peron & Berto 2001). The tendency of sensation-seeking or the level of exploratory behaviour varying between individuals has been suggested as explaining variance in novelty / familiarity-

related preference. It has been suggested that the individual level of sensation-seeking would result either from previous exposure to a large quantity of different visual stimuli or from an innate tendency to like high levels of sensory input (Stamps, Nasar 1997). The age of subjects has also been presented as a possible determiner for the level of exploratory behaviour - and thus liking of familiar or novel stimuli - even though some studies have failed to support this idea (Bragg, Crozier 1974). As already noted, it has been suggested that an extrovert / introvert orientation of the personality could influence exploratory behaviour, so that introverts would be more easily aroused, thus preferring less novel or complex stimuli (Eysenck 1973, p.148-151, Berlyne 1974b p.326).

A model by Martindale (1988), also called the "preference for prototypes model" by North and Hargreaves (2000), has been considered to represent a competing view to that of Berlyne. The preference for a prototypes model shows that preference would be positively related to prototypicality, that is, to the extent of how typical a stimulus is in its class. However, many studies have shown the opposite; for instance, a study by Nasar (1988d) showed that novel and unfamiliar urban scenes were preferred over familiar ones. It has also been suggested that people would tend to like "moderate discrepancies from the prototypes of common styles" (Smith 2014 p.406) which, again, reminds us of the inverted-U relationship presented by Berlyne. The same suggestion is made, for example, by Purcell (1986). As both Berlyne's arousal-valence model and Martindale's preference-for-prototypes model are supported by empirical evidence, the question whether one of them will clearly show as the dominant model, or whether they will merge into one holistic theory - as suggested, for example by North and Hargreaves (2000) - remains open.

"Some researchers have suggested that individuals would strive to prefer objects that fit their schemas; prototypes



2.4 ENVIRONMENTAL **PSYCHOLOGY**

Environmental psychology studies the interaction between individuals and their environment, in both natural and built contexts (Gifford 2014). It is a multidisciplinary field; even though a minor field in psychology with not many specialized researchers (Gifford 2014, p.543), its contribution to other fields, such as architecture, is substantial. Indeed, many architectural faculties include courses on environmental psychology in their curriculums. Research in the field of environmental psychology examines the interplay between humans and their surroundings from varying perspectives. Traditionally, the emphasis in the field has been described as having been in studying problems in the built environment and ways to humanize it (Ittelson et al. 1974, p. 6-7), but to have later expanded to questions such as environmental behaviour and climate change (Gifford 2014, p.543). Environmental perception, social interaction and social processes between individuals and groups, territoriality, the experience of privacy and the role of the environment in individual and human

development are also examples of topics covered by the field (Ittelson et al. 1974). A fraction of research on environmental psychology is concentrated on environmental preferences and environmental aesthetics, which are the most relevant themes to the research questions of this thesis. Thus, in this chapter I will focus on reviewing prevailing research findings from the field of environmental psychology on what kinds of environments people prefer, and theories on what the underlying factors might be to make such environments preferable to others.

2.4.1 PREFERENCE FOR NATURE **AND RESTORATIVE QUALITIES**

Preference for natural over urban scenes has repeatedly been demonstrated (e.g Kaplan, Kaplan 1989 p.42-45, Kaplan, Kaplan & Wendt 1972, Ulrich 1981). Green areas and closeness to nature are also shown consistently to be appreciated features among residents of housing environments (Koistinen, Tuorila 2008, p. 17-18), and neighbourhoods close to nature to have less criminality and reported fear by their inhabitants (Kuo, Sullivan 2001). Green places seem to draw people in a special way; public green outdoor spaces have been found to be more used and to involve more social activity than less green ones (Sullivan, Kuo & Depooter 2004). Nature has also been found to be an effective source of restorative qualities (e.g. Kaplan 1995, Ulrich 1984). Despite a substantial evidential basis for the restorative effects of natural environments, it is not excluded that built environments could provide similar experiences of

relaxation and recovery as well. For instance, churches have been found to induce the same kind of restorative effects as natural environments (Herzog et al. 2010).

Attention restoration theory (ART) (Kaplan, Kaplan 1989) proposes that people would need certain types of visual stimuli to recover from fatigue due to prolonged directed attention. Directed attention is considered as a type of attention that needs effort and therefore leads to fatigue, which then results in several disadvantages such as an inability to focus the attention properly, performance errors and irritation (Kaplan, Kaplan 1989, pp. 180-182). Attention restoration theory includes several environmental properties that are suggested to facilitate successful restoration: "being away", "extent", "fascination" and "compatibility".

"*Being away*" refers to moving to an environment that is different from the one that led to the fatigue in the first place, an environment that provides escape, either physical or mental, from everyday life (Kaplan, Kaplan 1989, pp. 189-190). According to ART, a restorative environment should also provide a sense of connectedness or a hint that "there might be more to explore than is immediately evident" (Kaplan, Kaplan 1989, p. 191), described by the term "*extent*". "*Extent*" can be realized,

> ***Restorativeness of the environment has been found to correlate strongly with preference judgements***
>
> ***implying that expectations for restoration might provide a basis for environmental preferences***

BEING AWAY

Refers to moving to an environment that provides escape, either physical or mental, from everyday life

EXTENT

Refers to the environmental features hinting that "there might be more to explore than is immediately evident"

FASCINATION

Refers to such experiences that hold the viewer's attention without requiring much top-down effort

COMPATIBILITY

Refers to how well the environment's opportunities or demands fit to what the individual wishes to do

The environmental features that facilitate restoration according to the Attention Restoration Theory (Kaplan, Kaplan 1989)

for instance, by the mere physical size of the scene, a broad visual scope or elements that provide a cognitive sense of connectedness such as cues of former generations or times. (Kaplan, Kaplan 1989, pp. 190-192).

According to ART, important features in recovering environments are those that provide activities that permit the directed attention to rest. In contrast, the involvement of involuntary, automatic attention, the type of attention that does not require top-down effort, is beneficial. "*Fascination*" refers to experiences that hold the viewer's attention without requiring much top-down effort, such as watching the sunset or clouds moving in the sky. The Kaplans distinguish "hard" and "soft" fascination from each other; "hard fascination" referring to an intensive activity that allows directed attention to rest but leaves no room for other thoughts, whereas "soft fascination" refers to a moderate level of intensity, being strong enough to hold the attention but also leaving room for reflection. The Kaplans note that soft fascination usually involves an aesthetic component. (Kaplan, Kaplan 1989, pp. 192-193). Last, "*compatibility*" refers to how well the environment supports one's inclinations and purposes; that is, how well the environment's opportunities or demands fit with what the individual wishes to do. (Kaplan, Kaplan 1989, pp. 193-195).

Restorativeness of the environment has been found to correlate strongly (R=.81) with preference judgements (Purcell, Peron & Berto 2001, Staats, Kieviet & Hartig 2003), implying that expectations for restoration might provide a basis for environmental preferences. ART's similarity to other arousal-related theories (e.g. Berlyne 1971) is indeed notable.

2.4.2 ENVIRONMENTAL **PREFERENCES**

Undeniably, the leading specialists in the field of environmental preference studies have long been Stephen and Rachel Kaplan. Their main postulation is that environmental preference would be based on two basic human behavioural needs; the need to understand the environment but also to explore it (Kaplan, Kaplan 1989). It can be assumed that both exploring and understanding the environment have played crucial roles in ensuring evolutionary continuity; individuals who have possessed good abilities in both investigating and comprehending the environment have probably been more likely to survive and reproduce.

First, understanding or correctly interpreting the environment is clearly one of the profound necessities for humans. It is thus understandable that environmental elements that facilitate understanding the environment would indeed be preferred. In contrast, *inability* to understand the environment leads easily to frustration, irritation and negative mood, such as when viewing art that "makes no sense" to the individual. (Kaplan, Kaplan 1989 p. 51). Visual agnosia is a neurological condition where the ability to perceive visual objects, for instance to group visual elements according to Gestalt laws, is impaired in spite of the intact ability of seeing. An even more specific type of agnosia, environmental agnosia, involves the inability to comprehend and recognize cues from the environment. Patients with visual agnosia are confronted with difficulties in interpreting visual contours, surfaces and three-dimensional shapes, while patients with environmental agnosia have trouble in finding and orienting themselves in the environment; impairments that have drastic disabling effects on their daily lives. (Farah 2004, Landis et al. 1986). Exploring, correspondingly, refers to activities by which people familiarize themselves with their surroundings and for example search for resources for living. Circumstances where people have opportunities for enrichment

both

EXPLORING

and

UNDERSTANDING

THE ENVIRONMENT

Have probably had crucial roles to ensure evolutionary continuity;

Individuals who have possessed good abilities in both investigating and comprehending the environment have probably been more likely to survive and reproduce

(Kaplan, Kaplan 1989)

and possibilities to "expand their horizons" (Kaplan, Kaplan 1989, p.51) are seen as supportive to exploratory behaviour and to increasing preference. (Kaplan, Kaplan 1989, pp.51-52).

The preference matrix suggested by the Kaplans (1989, pp. 52-57) presents two pairs of properties of which the first, called "coherence" and "complexity", concern the immediate condition, and two others, called "legibility" and "mystery", concern possible conditions or conditions of the near future. According to the preference matrix, *complexity* is defined by the number of different visual elements in the scene (Kaplan, Kaplan 1989, p. 53). The role of complexity is to provide "things to think about" (Kaplan, Kaplan 1989, p. 54); keep the viewer's attention at an intermediate level causing neither boredom nor overstimulation. Complexity is claimed to enhance exploration directly, and has been referred to as the most important of the four variables. (Kaplan, Kaplan 1989 pp. 53-54).

"*Mystery*" refers to the hinted continuity of new things to explore in the environment, indicating that more stimuli can be obtained if one moved deeper into the scene; to "learn something that is not immediately apparent from the original vantage point" (Kaplan, Kaplan 1989, p.55). In the Kaplans' experiments, mystery is typically presented by a winding pathway or through part of the scene being hidden by tree foliage. Elements that partially mask the scene beyond the range of vision or that indicate a further continuum are found to be preferred (Kaplan, Kaplan 1989 p. 57-58). Like that of complexity, the role of mystery is to enhance exploration by catching attention and increasing motivation to study the scene further. (Kaplan, Kaplan 1989 pp. 55-57). Natural scenes have been found to be considerably higher in mystery judgements than urban scenes (Kaplan, Kaplan 1989, p. 62).

"Coherence" and "legibility", in contrast, are properties of understanding the environment. "*Coherence*" refers to the immediate visual setting of a scene; features that provide a "sense of order" and help to direct attention coherently (Kaplan, Kaplan 1989, p.54). According to the theory, coherence of the scene can be achieved, for example, by repetitive elements or a manageable number of major visual regions. Besides, when changes of texture or brightness focus on the important parts of the scene, for example on a pathway, the scene's comprehensiveness increases. (Kaplan, Kaplan 1989, p. 54). "*Legibility*", again, refers further in time than coherence;

	Immediate	Near future
Exploration	**Complexity** *Provides "things to think about"; keeps the viewer's attention at an intermediate level causing neither boredom nor overstimulation*	**Mystery** *Hints continuity of new things to explore in the environment, indicating that more stimuli can be obtained if one moved deeper into the scene*
Understanding	**Coherence** *Features that provide a "sense of order" and help to direct attention coherently*	**Legibility** *Hints of the ease of finding the way, the ability to predict and orientate oneself in the scene*

Preference Matrix by the Kaplans (1989, pp. 52-57)

it refers to hints of the ease of finding the way, the ability to predict and orient oneself in the scene, for example by an expected continuation of repetitive elements. Legibility concerns the easy formation of a cognitive map of the environment. (Kaplan, Kaplan 1989 p. 55).

Experimental studies on the Kaplans' preference matrix have suggested that, for understanding, immediately available properties (coherence) would have a stronger connection to preference than predicted ones (legibility), whereas for exploration it would be the predicted (mystery) rather than the immediate (complexity) ones that influence preference more strongly (Kaplan, Kaplan 1989, pp. 66-67). According to experimental findings on the four dimensions reviewed by the Kaplans (1989, pp. 62-67) it seems that most support is given to the role of coherence, which has been found to be a significant predictor of preference in most of the studies reviewed, whereas the role of legibility has remained the most ambiguous.

Jay Appleton (1975) suggested that the basis for environmental preference would be grounded not on the need to understand and explore, but on two other biological, pervasive purposes, those of "prospect" and "refuge". His prospect-refuge theory suggests that opportunities given by the environment and the safety that it provides would be the basis for environmental preferences. However, the experimental evidence for Appleton's theory has been claimed to be contradictory (Nasar 1988a, p. 103). According to the theory, for instance, broad vistas would increase preference because they provide prospects, whereas tree trunks or caves would provide places for refuge, thus increasing preferences as well (Appleton 1975). Notably, these preferred visual elements seem to share many similarities with the elements in the Kaplans' framework for preference; the major difference seems to be in the explanation of why certain elements are preferred and others are not.

The Kaplans' theory has been described as emphasizing prospect more than refuge (Greenbie 1988, p. 66).

Studies on environmental aesthetics have included studies of collative variables as termed by Berlyne (1971) as well as the influence of familiarity and prototypicality as proposed by Martindale (1988) and the schema theory (Zajonc 1968, Whitfield, Slatter 1979, Lang 1987). The positive influence of visual complexity on environmental preference has repeatedly been shown (e.g. Kaplan, Kaplan & Wendt 1972, Oostendorp, Berlyne 1988, Nasar 1988d, 1988b), as well as that of a feature called order, coherence, clarity or organization (e.g. Oostendorp, Berlyne 1988, Groat 1988, Nasar 1988d, Nasar 1988b). In contrast, examinations of familiarity, prototypicality and novelty as predictors of environmental preference have yielded more conflicting results. For instance, in Orland's study of rural landscapes (1988), familiarity was found to increase preference judgements, whereas in another study subjects from Japan and the United States judged foreign and thus unfamiliar street scenes as more pleasant (Nasar 1988d). In addition, no significant difference in response related to local experience could be found in a study by Nasar and Devlin (2000), suggesting a stronger role of global features of houses in preference judgements than local experiences of individuals.

2.5
ARCHITECTURE

The built environment is probably the type of environmental aesthetics that people, especially those living in cities, encounter most in their daily lives. The aesthetics of homes, schools, offices and markets impact the behaviour and mood of people every day. Yet the aesthetics of architecture has long been a target of - even severe – criticism (e.g. Scruton 2009, Stamps, Nasar 1997, Mastandrea, Bartoli & Carrus 2011, Blake 1977, The Prince of Wales 2014, Nyman 2008). In this chapter, I will review the findings that existing research points out as to people's architectural preferences and explore some approaches that architects have used in their designs to express aesthetics and elicit appreciation from the public. To give an impression of the diversity of the latter, I will review two historical architectural styles, the classical and the early modern, which represent almost diametrically opposite examples in this sense. The major characteristics of these modes of expression and the architectural characteristics found to be preferred by people will be incorporated in the experimental part of this study.

2.5.1 STUDIES ON **AESTHETIC ARCHITECTURAL PREFERENCES**

2.5.1.1 PREFERENCES FOR TRADITIONAL AND CONTEMPORARY ARCHITECTURE

Perhaps surprising to many, several studies indicate a preference on the part of the general public for traditional architectural styles over contemporary ones (Stamps, Nasar 1997, Mastandrea, Bartoli & Carrus 2011, Stamps 1994). A similar effect is found in the field of the arts; older artworks are demonstrated as being highly appreciated and admired among both art professionals and laypeople, whereas modern artists have been described as having difficulties in transmitting their ideas to the public (Lang 1987, p.10, Mastandrea, Bartoli & Carrus 2011). In addition, people who report a preference for modern, abstract art are shown to belong more frequently to specific sociodemographic classes; usually possessing high socioeconomic status and a high level of education, often with some training in the visual arts (Mastandrea, Bartoli & Carrus 2011). A couple of possible explanations for this phenomenon suggest themselves. First, it might be that there is something in "oldness" itself, such as nostalgia, that would incline a preference in the direction of buildings from earlier times, or second, it might be that traditional style would possess some characteristics that would match general aesthetic taste. In an experiment, Stamps (1991) studied the hypothesis that a random sample of a city population would prefer old high-rise brick buildings outright over new ones. As expected by the researchers, the responders preferred older brick buildings to *visually simpler* modern buildings.

However, the sample was also quite united in their preference for *visually complex new buildings* over visually simple old buildings. Visually complex new buildings were also preferred over visually simple new buildings. (Stamps 1991 p.841). Here it seems that in this case preference was more closely related to complexity than to the mere age of the buildings, providing some support for the assumption that preference for traditional buildings might be associated with stylistic characteristics rather than mere "oldness" of buildings as such.

> ***Several studies indicate a preference on the part of the general public for traditional architectural styles over contemporary ones***

2.5.1.2 PREFERENCES OF PROFESSIONALS AND THE GENERAL PUBLIC

Some studies entail the idea that architects, as well as other artistic professionals, would differ in their evaluations of the built environment's aesthetics compared to laypeople (e.g. Wilson 1996, Gifford et al. 2000, Ghomeshi, Jusan 2013, Akalin et al. 2009, Nasar, Kang 1989, Kaplan 1988a, p.53, Devlin, Nasar 1989). "One way or another, it is now well established that design professionals in general, and architects in particular, hold a different system of constructs through which they understand and evaluate the environment" (Wilson 1996 p.33). The literature reveals some highly unfortunate findings and claims. For example in one study (Nasar, Kang 1989) an architectural competition entry chosen as the best by a jury composed of architects was found among the least liked by the public. Meanings that architects aim to transmit by their architectural expression have often in fact been found to be poorly passed on to laypeople (Hershberger 1988, Groat 1982). What designers perceive as good design has even been claimed to appear "cold, inhuman and boring" to laypeople (Lang 1987, p.1). The role of the architect as a link between the user and other parties to the construction process is important, as sometimes the architect can even be the only one representing the desires of the user in a complicated building process, such as in the case of design of an apartment block where the dwellers are as yet unknown. That is why differences between aesthetic appreciation by architects on the one hand and the general public on the other cannot be regarded as insignificant. Even so, modern-day architects have also often been severely criticized as designing not for users but for their own colleagues (Wilson 1996).

This change in outlook and preferences of architects is suggested as taking place during architectural education. It is assumed that in the course of education architectural students gradually socialize to the characteristic vision of the profession; indeed, whereas the judgements of pre-architects and non-architects have been found quite homogenous (Hershberger 1988), during architectural studies the preferences of students are shown to systematically move apart from the preferences of the general public (Wilson 1996). In evaluating buildings, architects have been found to use different criteria from laypeople (Groat 1982). They have also been found to have a different way of arguing their preferences; they might judge architecture by the way a building demonstrates its function, the use of materials or its contextual fitness. Notably, these kinds of arguments seem to represent objective, not affective, perspectives. In contrast, laypeople usually reason their preferences through affective argumentation, such as liking or disliking, or describing buildings as beautiful or ugly. Most interestingly, however, when taking a closer look at architects' preferences it also seems that more subjective motives (such as liking of style) would in fact underlie expressed objective rationales. (Wilson 1996).

Some support is available for the assumption that laypeople would pay more attention to detail than to the overall architectural setting. For instance, the results of a study on housing style preferences by Nasar and Devlin (2000, p. 61) indicate that laypeople focused considerably on details (columns, brick, porch, embellishments) when reasoning their preferences. Moreover, in a study by Groat (1988, p. 253) small-scale façade details and ornaments were found be "critical elements" of the experience of good contextual architectural fit among laypeople, whereas site organization and massing were considered as key elements by architects. In a study by Nasar and Devlin (1989), architects were demonstrated as appreciating more the kind of architecture with "fewer materials, more concrete, simpler forms, more white, and off-

In evaluating buildings, architects have been found to use different criteria from laypeople

center entrances", whereas laypeople were shown to prefer architecture with "more building materials, horizontal orientation, hip roofs, framed windows, centered entrances, and warm colours". In a study by Ghomeshi and Jusan (2013) non-architects were found to prefer curved and polygonal forms, columns, arches and sculptures more than architects, whereas architects were found more likely to favour vegetation and rectangular forms than non-architects in façade designs. There is also some evidence that laypeople would put more emphasis on typicality in their architectural preference judgements, whereas architects would prefer buildings with more variation from familiarity (Purcell 1986 p.27).

One explanation for different preferences between architects and the general public is related to what is called *"perceptual learning"*. This means that people seem to learn to discriminate certain visual stimuli better with practice. Thus for example an architect, who is practiced in viewing and recognizing buildings and their elements, may actually see buildings differently from those without that professional practice. People can learn to distinguish patterns, textures, line orientations and other rather simple visual elements through actual

"
An architect, who is

PRACTICED IN VIEWING AND RECOGNIZING BUILDINGS AND THEIR ELEMENTS

may actually see buildings differently from those without that professional practice

structural changes in the brain resulting from training. (Eberhard 2008, p.121-122). In their education and practice, architects are constantly exposed to novel forms of buildings and thus might find a larger scale of building appearances pleasant. Apparently this exposure may have quite solid consequences; it has been argued (Eberhard 2008 p.85) that architects would actually have more surface area on their visual cortex to process images of buildings than people without architectural education. That is to say: architects may have exercised their visual system to process images of buildings more effectively than other people. Vitz (1966) also notes that, on the question of stimulus complexity, the preferred amount depends on individual experience in processing stimulus material. This would mean that when an individual is constantly exposed to complex visual material, their preferred level of complexity will increase. Interestingly, the "tolerance" of complexity seems to be modality-dependent; for instance, professional musicians are shown to prefer more complex auditory stimuli than people without musical training, but the difference is shown to disappear with visual stimuli; there, their preference seems to be parallel with the general public (Hare 1974a p. 167).

Vitz (1966) also notes that, on the question

2.5.1.3 HOUSING PREFERENCES

Studies of general housing preferences have focused on multiple subjects such as the type of housing environment, neighbourhood, social atmosphere, availability of services, housing type, size, room number and equipment that subjects prefer or would prefer in their homes in the near future. Location seems still to have the greatest impact on apartment prices, so that often it seems one of the main choice criteria when searching for a new apartment. Besides, people with tight social connections to a certain area usually try to find an apartment from the same location. (Juntto 2010). Wishes as to privacy, spaciousness and loosely populated living environments

are frequently repeated (Koistinen, Tuorila 2008, p.16, Ilozor 2009, Gao et al. 2013). Tidiness and security of the environment, as well as effective traffic arrangements and a close network of retail services are valued (Koistinen, Tuorila 2008, p. 19, Nasar 1988d). Technical problems of buildings, such as malfunctioning ventilation, heating or plumbing as well as the size of an apartment being too small seem to have a negative influence on preferences (Koistinen, Tuorila 2008, p. 17). Liveliness and diversity in housing neighbourhoods seem to be quite universal wishes for the housing environment (Lovejoy, Handy & Mokhtarian 2010).

It seems that most of the studies conducted on general housing preferences focus on matters that people are supposed to reflect rationally. For instance, far fewer systematic studies focus on experiential purchase motivations for houses or apartments, such as aesthetics, than traditional ones. One of the few studies on experiential housing preferences is that by Nylander (2002) who studied the qualitative attributes of homes using interviews and case studies. By analysing apartments and interviewing their residents and architects he recognized seven non-measurable architectural features that would contribute to the experience of the quality of apartments: “materials and detailing”, “axiality”, “enclosure”, “movement”, “spatial figure”, “daylight” and “organization of spaces” (Nylander 2002). Some rare experimental studies on apartment interior preferences have shown subjects to prefer rooms that are higher than normal (Baird, Cassidy & Kurr 1978) and the presence of windows to be an important factor in apartment interior preference (Kaye, Murray 1982). Besides, some popular literature exists written by architects on these aspects (e.g Nyman 2008). In addition, an interesting Finnish study found architectural quality, as measured by education, experience and the merits of the designer and by the architectural style and appreciation of the building, to correlate with apartment prices in Helsinki (Pihlajaniemi 2014). Despite the lack of more such systematic research in the field, the aesthetics of living environments and buildings seem to be matters highly appreciated by residents. Buildings are not expected or hoped to be copies of each other, but diversity among them is a desired feature. For instance, residents have reported considering Finnish suburban housing blocks from the 1960s and 1970s as “ugly”, “boxlike constructions similar to each other”, whose “designers have paid no attention to (buildings’) aesthetic values”. (Koistinen, Tuorila 2008, p. 17-18). Residents seem to set “verdant and garden-like” housing environments as the

Materials and detailing

Axiality

Enclosure

Movement

Spatial Figure

Daylight

Organization of Spaces

Non-measurable architectural features of attractive home by Ola Nylander (2002)

preference in most cases, and own yards are highly appreciated (Kuoppa, Mäntysalo 2010, Ilozor 2009).

The literature on housing preferences reports contrasting findings on how consistent preferences are between individuals. Kuoppa and Mäntysalo (2010) report the results from a Finnish research project, according to which a large part of general housing preferences seems to be varied among individuals. They report people as differing in their preferred lifestyles and whether they want to live in urban or rural environments (Kuoppa, Mäntysalo 2010, p.22). Preferred environment, location and housing type are also reported to vary according to personal features such as age, life situation and social position (Kuoppa, Mäntysalo 2010, p. 23). Satisfaction with an apartment seems naturally to be highly dependent on how its size, environment (safety, level of urbanization, closeness to neighbours), floor plan and price suit individuals' current social and economic situation and personality (Gao et al. 2013). In contrast, studies on aesthetic preferences within the built environment, as already noted in previous chapters, imply a more heterogeneous field of preferences. For instance, Nasar (1989, Nasar, Devlin 2000) has demonstrated a strong agreement in subjective preferences on housing styles. In a study by Nasar and Devlin (2000), the subjects were living in two different regions with different local architectural environments and no significant difference in their house style preferences could be found. The findings of Lovejoy et al. (2010) were similar: subjects from different local housing environments (traditional, urban) did not differ in their preferences for housing, either. Besides, Ilozor (2009) found general apartment preferences to be unrelated either to the gender or the income level of dwellers.

Another type of gap within housing preference studies seems to be of a methodological kind. Housing preference studies have been conducted mostly by interviews, both structured (Strandell 2011, Strandell 1999) and unstructured (Juntto 2010) as well as among individuals and households (Juntto 2010). The research material has been collected by ready-made paper questionnaires (Strandell 1999, Ilozor 2009) and on the phone (Strandell 2011) as well as in face-to-face interviews (Juntto 2010) and by interpreting narratives written by residents (Koistinen, Tuorila 2008). However, the assumption that verbal reports by individuals would correspond to their attitudes and preferences may not always be right. The limitations of such methods are acknowledged for example by Oostendorp and Berlyne (1988). First, people may not

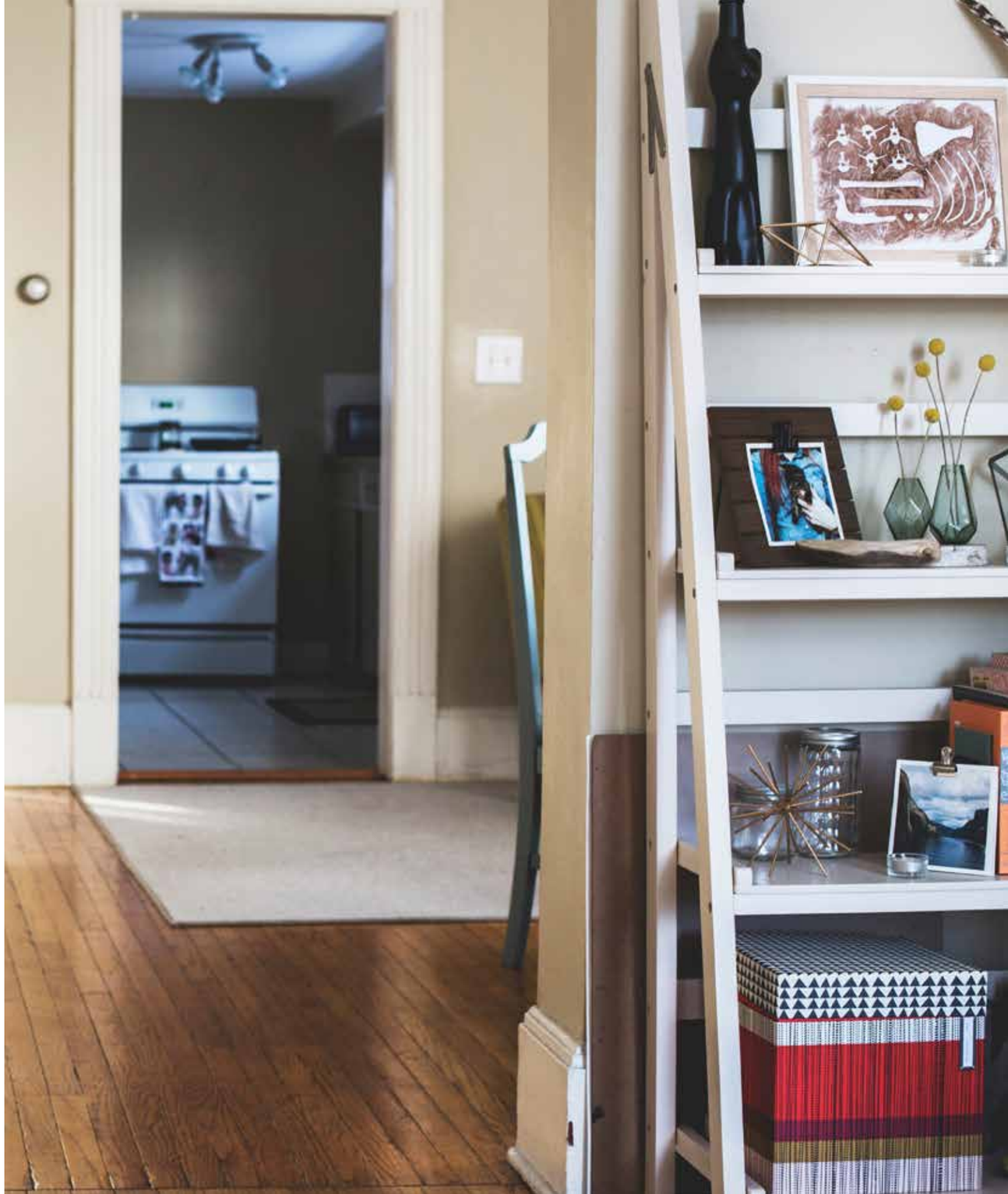
be entirely aware of the motives that influence their emotions, thoughts and actions, and self-reports may exclude those motives that are generated automatically. A self-report requires a translation of one's own mental state, and it is therefore claimed that this may be inconsistent with the real inner states of respondents (Bagozzi 1991). Results yielded by self-reports have also often found to be distorted, for example by respondents' strategic behaviour or social expectations and desires (Hubert, Kenning 2008). Consequently, methods that rely solely on the ability of respondents to describe their thoughts may yield unsound information, as they measure only controlled and intentional delivery of information. Besides, significant nonverbal attributes are related to housing that have to be seen or felt to be acknowledged. Thus, methods that concentrate solely on self-reports regarding preferred housing characteristics may provide a one-dimensional picture of actual individual preferences.

2.5.2 ARCHITECTURAL **STYLES**

Considering the number of studies (e.g. Mastandrea, Bartoli & Carrus 2011, Stamps, Nasar 1997, Stamps 1994) that indicate an inclination of public preference on average toward traditional rather than contemporary architecture, I consider it beneficial to explore differences in their visual expression. Since analysing the entire range of historical architectural styles with their expressive manners and relations to aesthetics would be, and already is, a subject of hefty history books (e.g. Musgrove et al. 1987), I have decided to examine and compare only two of them, which I consider will sufficiently serve for this thesis. These two styles are the classical style and the early modernist style, which I have chosen for comparison for a couple of reasons. First, it could be said that they are culminating representatives of both traditional and contemporary architectural styles. They typically differ extensively from

each other in their ideology, architectural expression and their standpoint with regard to aesthetics. Second, the visual features that they manifest can be observed in a broad range of other architectural genres as well; for instance, features characteristic of classical architecture, such as the use of symmetry and ornamentation, are also typical of almost any architectural style prior to the 20th century. Consequently, for example asymmetric and free-form designs as well as emphasis on function, which are characteristic of early modernism, are also typical of contemporary architecture up to the present day. These two styles can thus be seen almost as archetypes of very different ways of architectural expression, so that comparing them covers a broad set of ways to approach architectural design visually.

Architecture as a practice has been described as being based essentially on ideologies (Mako, Lazar & Blagojević 2014). Ideology is defined as a set of ideas, symbolic representations, values, beliefs and forms of thought, behaviours, expressions, representations and acts that are characteristic of a social group (Suvakovic 2014, p.2). Architecture has over time been designed from the premises of ideologies characteristic of the prevailing time and society, so that the architectural style of a certain epoch would be difficult to be understood without knowledge of the ideology behind it. However, the development of even the two exemplary architectural ideologies, classical style and early modernism, is impossible to describe all-inclusively, as they are not straightforward streams but continuums where ideas constantly overlap and take side-tracks. However, I will next review some major principles that help to understand the typical modes of expression of the two examples, to the extent that is most relevant to the subject of this thesis.



2.5.2.1 AN EXAMPLE OF TRADITIONAL ARCHITECTURE: CLASSICAL STYLE

2.5.2.1.1 Origins

The classical style of architecture has its roots in ancient Greece and Rome (e.g. Musgrove et al. 1987, Summerson 1980, p.7). However, the only piece of actual written architectural theory from classical Antiquity, in about 33-14 BC, is *De Architectura*, written by Roman architect Vitruvius (1914), which was rediscovered as late as 1414 (Kruft 1994, p.21, Summerson 1980, p. 10, Wiebenson 1983). The theory gained from De Architectura was later broadened and remodeled according to observations made on buildings from Antiquity. This was already done to some extent in the Middle Ages (Kruft 1994, p.30-40), but most importantly in the Renaissance, chiefly by the Italian architects Leon Battista Alberti (1404-1472), Sebastiano Serlio (1475-1554), Vignola (1507-1573) and Andrea Palladio (1508-1580) (Summerson 1980, Musgrove et al. 1987). Even though the architects of the time introduced new styles, gestures and innovations, among the most important innovators being Donato Bramante (1444-1514) and Michelangelo (1475-1564), the basic architectural "language" and its elements remained quite constant over the decades (Summerson 1980). One curious example of this modification is a trend called Mannerism from the 16th century, where classical elements were intentionally applied in unusual and strange ways (Curl, Wilson 2015).

Pantheon, Rome
Built during the reign of Hadrian, c. AD 118-128

Texts on classical architectural theory have a strong emphasis of outer appearance and aesthetic matters of design; for instance, Alberti describes “beauty” and “ornament” as the “chief of all the rest” over other aspects of architecture (Alberti 1986, p. 359). Much of the original architectural writings from the classical period (Alberti 1986, Vitruvius 1914) concentrate on the question how to create harmony and beauty. However, beauty is only one of the three well-known Vitruvian virtues: *Firmitas*, *Utilitas* and *Venustas* (solidity, usefulness and beauty) by which Vitruvius defined the main qualities of good architecture and which later theorists have echoed to a great extent (Vitruvius 1914, Kruft 1994). The role of function, “Utilitas”, is pervasive in classical texts as well (Kruft 1994, p.45) even though its role has been emphasized particularly in modern architectural ideology (e.g. Blake 1977, p.16).

According to classical architectural writings, the beauty of a building was seen to arise principally from two things: the harmony of proportions across the whole building and appropriate use of ornament (Kruft 1994, p. 25-29, Vitruvius 1914, p.13-16, Alberti 1986, p.112-113). In Vitruvius’s terms, “ordinatio” meant the harmony of proportions, whereas the appropriate way of using ornament was the rightful use of orders (“decor”) and other elements to suit the occupant (“distributio”) (Vitruvius 1914, p. 13.16, Kruft 1994, p.25-27). Alberti called them simply “Beauty” and “Ornament”. “Beauty”, he defined as a perfect composition of visual elements, such an arrangement that could not be changed except for the worse, while by ornament he meant additional elements whose role was to improve and enrich “beauty” (Alberti 1986, p.130). It has been observed that beauty was essentially considered to be a law of nature and thus the ultimate aim of any creation, including architecture (Kruft 1994, p.47). “There can be no greater security for any work against violence and injury than beauty and dignity” (Alberti 1986, p.113).

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the

HARMONY OF PROPORTIONS

across the whole building

and

appropriate use of

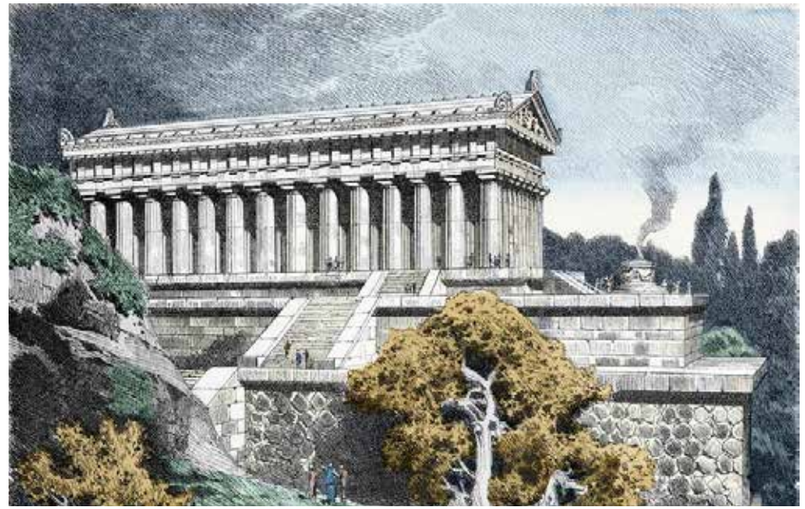
ORNAMENT

2.5.2.1.2 Harmony

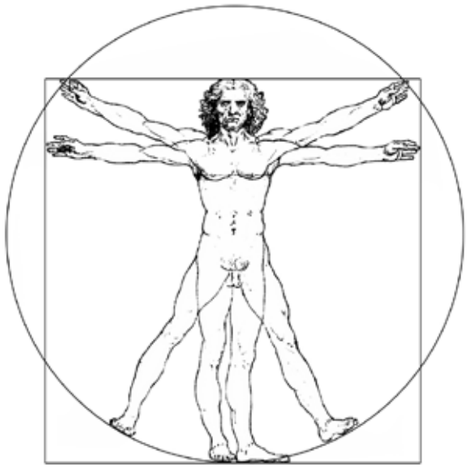
Even though the theory of classical architecture was not a strictly coherent and consistent entity, since naturally there were many writers and ways of thinking, some basic principles seem to have remained quite unchanged across times and theorists. Typical of them is the concept of all-encompassing harmony; it has even been defined as the principal aim of the classical architects (Summerson 1980, p.8). Classical artists and architects seem to have believed strongly in the Pythagorean ideal of the mathematical nature of harmony. According to Pythagoras, an ancient Greek mathematician, beauty derived from harmony, harmony from order, order from proportion, proportion from measure and measure from number. (Tatarkiewicz 1980, p. 200, Kruft 1994, p. 36). Classical theorists found the same mathematical proportions to repeat in natural organisms, in the human body as well as in the spiral of a snail (Figure 7), and it was believed that the proportions of architecture and art should express the same, "universal cosmic order" (Wittkower 1998, p.104, Kruft 1994, p.36, Padovan 1999). Indeed, many elements in the classical style of architecture can be seen to have similarities with the human body. For instance the majority of building elements of the classical style tend to comprise three parts; head, shaft and base - reflecting the essential parts of the body. Besides, an even number was ideally adopted as the number of columns as every living creature has an even number of feet, whereas the number of apertures could be uneven as living creatures often also have an uneven

> ***Much of the original architectural writings from the classical period concentrate on the question how to create harmony and beauty***

number of these, too: one mouth, for example (Kruft 1994, p.46). The idea has been claimed to be based on a belief that if a building was built according to the same mathematical structures that kept the whole universe together, the viewer would intrinsically feel in tune with the world and respond to that sensation by experiencing an enjoyable feeling of harmony and beauty (Wittkower 1998, p. 38). That being so, Alberti and Leonardo da Vinci (1452-1519), as icons of Renaissance architecture, are among others said to have seen architecture fundamentally as a mathematical practice (Wittkower 1998, p. 39).



Temple of Artemis, Ephesus, Turkey (prior Greece), built in c. 323 BC.
Reconstruct by Ferdinand Knab (1886)



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Classical theorists believed that the proportions of architecture and art should express the same, “universal cosmic order” as natural organisms

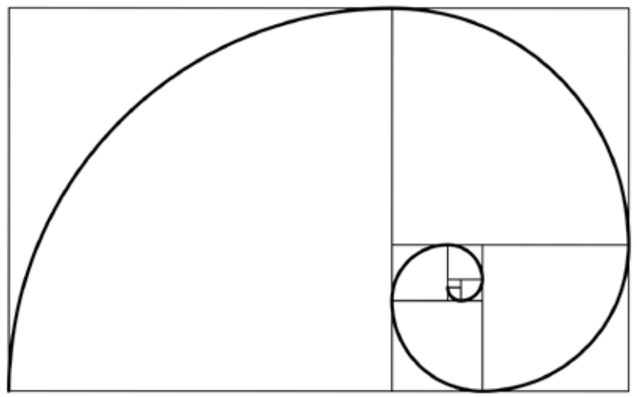

Figure 7. Mathematical proportions repeating in natural organisms such as in the human body or in the spiral of a snail.

2.5.2.1.2.1 Proportions

A great axiom of aesthetics within the classical style of architecture seems to have been that visual harmony would be the result of a uniform system of proportions extending to all parts of the building, “ordinatio” as termed by Vitruvius (Vitruvius 1914, Alberti 1986, Wittkower 1998, Summerson 1980, p.8). This meant the correct relationship of building elements to each other and to the whole - so that for instance all the ratios in a building would be simple mathematical functions (Summerson 1980, p.8). The same theoretical basis is seen in music; it is believed to have been Pythagoras who originally discovered the dependence of musical tones on ratios of small whole numbers (Wittkower 1998, p.105, Padovan 1999, p.63-64). In fact, the human perceptual system was later demonstrated as using the same

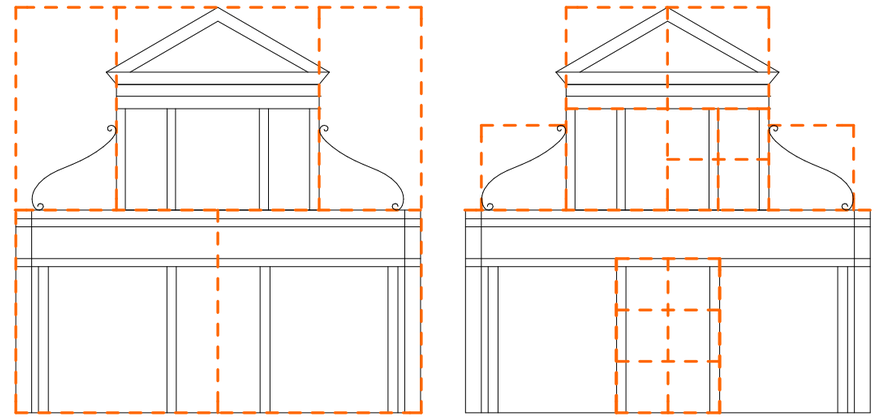

Figure 8. Mathematical proportions applied schematically in a building facade (Wittkower 1998, p.51)

kind of grouping principles for sounds as it was introduced to using with visual stimuli in the form of Gestalt principles in Chapter 2.2.2 (Goldstein 2002, pp. 396-401). In music, the ratio between two pitches, the sonic frequencies produced by a musical instrument, is called an interval. Certain intervals produce audible consonance, or harmony, on which classical music in particular is based. Two strings are said to vibrate *an octave* apart if the longer one is twice the length of the shorter one, that is, if their ratio is 1:2. Consequently, if the ratio of their lengths is 2:3, their pitches are said to be a *fifth* apart, and a *fourth* if their ratio is 3:4. (Padovan 1999, p.64). Alberti (1986, p. 194-200) recommended that the same simple ratios be used in architectural proportions: 1:1, 1: 2, 1:3, 2:3 and 3:4. Figure 8 shows an example of how a mathematical series of ratios is applied in a building façade.

2.5.2.1.2.2 The Classical Orders

The orders, meaning the system of columns and their corresponding superstructures, had great importance in classical architectural style. The classical system consisted of "five orders"; Tuscan, Doric, Ionic, Corinthian and Composite (Figure 9), which differed from each other in the height-diameter ratio, the structure of the capital and that of the corresponding entablature (Summerson 1980, p. 7-39, Vignola, Juglaris & Locke 1889). The role of the five orders is considered so essential to the practice of classical architects that they have been compared to the conjugations of verbs in a language; the radius of the lower shaft was usually used as the module for the proportions of the whole building and the different decorative styles were a tool to transmit allegorical and symbolic values (e.g. Summerson 1980, p.11, Kruft 1994p. 81-82). The Doric order was supposed to correspond to the proportions of a male body and the Corinthian to that of a woman; thus giving them masculine and feminine characteristics (Kruft 1994, p. 28). This shows in their advised use for instance

in churches and temples; the first is considered appropriate in those dedicated to male saints and the latter in those dedicated to virgins, for example. The Ionic order often symbolized sophistication and scholarship, and was thus used for buildings dedicated to education or "men of learning". Often, though, it seems that choosing the order was not based on their symbolic value but was rather a matter of taste, need or resources. For instance the simplest Tuscan and Doric have been said to be used when less expensive solutions were needed, whereas Corinthian or Composite were used in cases where the intent was to demonstrate wealth and power. (Summerson 1980, p. 14-15). The majority of buildings where the orders had the real structural purpose of bearing the roof were the temples of ancient Greece; for example, the structural system of ancient Roman architecture was already based on arches and vaults, which made columns structurally useless (Figure 10). Thus, for much of the classical period the purpose of the orders was merely decorative and symbolic, but they continued to dominate and control the structure and appearance of buildings nevertheless. Architects used orders to determine the overall appearance of a building by using them in varying ways; as pilasters embedded entirely into the wall or as one-quarter-, three-quarter- or half-columns in addition to traditional free-standing columns. The different ways of using the orders generated a system for creating protrusions and indentations and thus different strengths of shadows both in building volume and façade, consequently giving the means to make plain walls expressive. (Summerson 1980, p.19-39)

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The role of the five orders is considered so essential to the practice of classical architects that they have been compared to the conjugations of verbs in a language

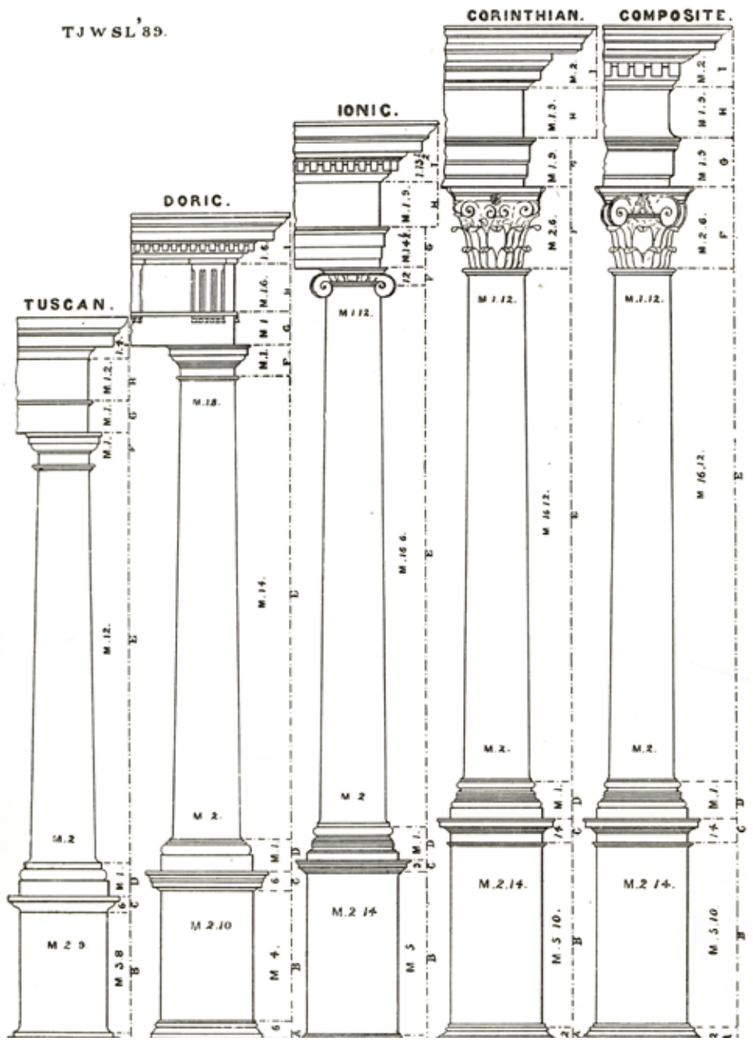


Figure 9. The five orders of Classical architecture presented by Vignola (1889).

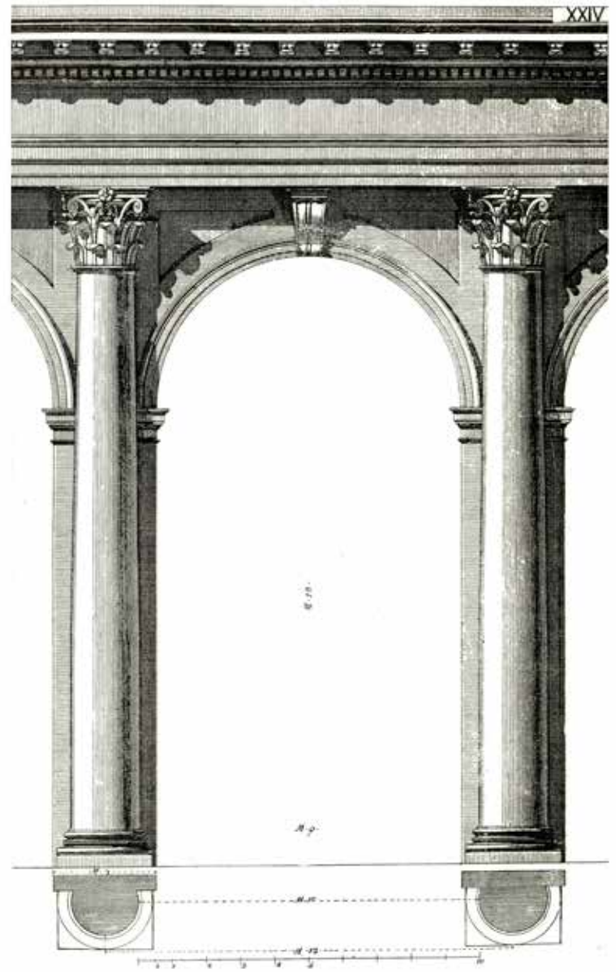


Figure 10. Corinthian three-quarter orders applied to the Roman structural system

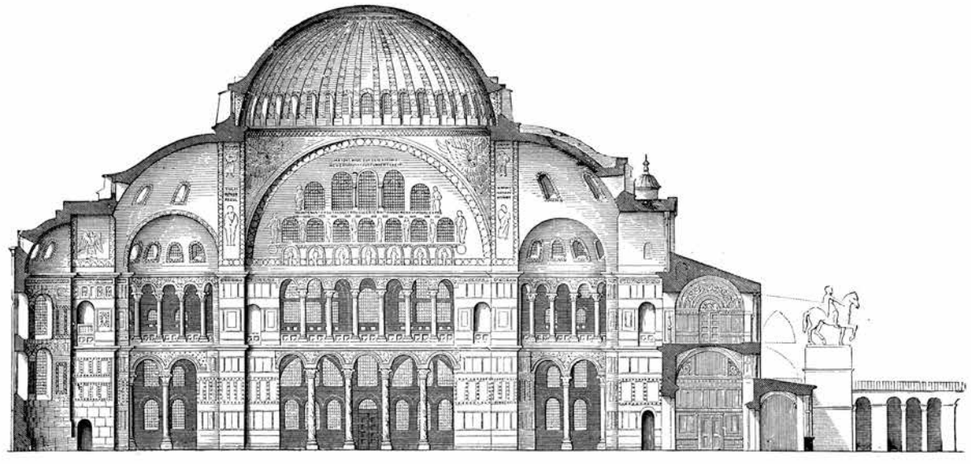
2.5.2.1.3 Ornament

Before modernism, one of the most noticeable visual features of architecture was ornamentation. Ornaments are defined as decorative architectural elements that are not essential to building structure (Curl, Wilson 2015, Tietz 1999). For Alberti, as for many other architects of the period, the principal ornaments were the orders (Alberti 1986, p.130) but he also considered features from the surfaces of stones to candlesticks as ornaments (Alberti 1986, p.113). A building without ornament was seen as "lacking in dignity – like an "outlaw"" (Kruft 1994, p. 96). Besides, ornament was seen as an integral part of the function in reflecting the character of the occupants; a feature that apparently enjoyed great importance in the architectural practice of the time (Kruft 1994, p.45). Ornament was not meant for mere enjoyment but was considered an important signal of a building's use and the status of its inhabitants (Picon 2013, p.11).

2.5.2.1.4 Relation to Other Traditional Styles

Ancient Greek and Roman architecture were substantially influenced by the architecture of ancient Egypt. As with the architecture of ancient Greece, ancient Egyptian architecture was also based on the column-beam structure. (Curl, Wilson 2015). Ornaments were used in great quantities as capital decorations, sculptures (such as in the form of obelisks or sphinxes), wall decorations and hieroglyphs. Ornamental subjects were representational and often symbolic or narrative. Building elements and parts were also generally arranged symmetrically. (Curl, Wilson 2015)

Capitals used in the Ancient Egypt



Cross-section of Byzantian Hagia Sophia, Istanbul, Turkey, built in c. 537. Reconstruction

Byzantine architecture can be considered as a continuum of ancient Roman architecture (Curl, Wilson 2015). It was thus essentially based on the classical building tradition but also other influences, deriving for instance from the East, shaped the style into its distinctive form involving for example the use of capitals of non-classical style (Curl, Wilson 2015). Traditional Islamic architecture also has many similarities with classical architectural style. The structural symmetry, rich ornamentation and the use of columns, arches and domes associate it with the architecture of ancient Greece and Rome. However, it also had its distinctive features, such as the pointed, multifoil or horseshoe forms of arches or special types of ornaments such as patterned tiles (Curl, Wilson 2015).

The Gothic style, with its preceding Romanesque style, prevailed in Europe in the Middle Ages before the Renaissance. Customarily symmetrical plans and facades and the use of columns and arches as well as rich ornamentation are features that relate the Gothic style to the tradition of

Gothic vaults in Salisbury Cathedral, UK, built in 1220-1258.

classical architecture. However, the style is also known for its many novel innovations and features, such as ribbed vaults, large colourful windows, flying buttresses and pinnacles. Gothic style is also properly called "pointed" as its characteristic features were pointed arches, vaults, buttresses, window-tracery designs and overall emphasis on verticality. (Curl, Wilson 2015).

Baroque, a style deriving from the late Renaissance and Mannerism in the 17th and 18th centuries, added to Renaissance expression with characteristically rich and bold elements with curvilinear forms and often optical illusions, while Rococo (in the 18th century) has been described as the descendant of the Baroque, being above all characterized by superfluous amounts of fine naturalistic ornaments used especially in architectural interiors (Musgrove et al. 1987, Curl, Wilson 2015). Consequently, Neoclassicism in the late 18th and early 19th centuries began from a desire to return to the pure Classicism of antiquity; excess decoration was discarded and inspiration was drawn again strongly from archaeological finds (Curl, Wilson 2015). However, Baroque, Rococo and Neoclassicism could in effect all be considered as classical styles since they all acknowledged Antiquity as their ideal and stylistic point of reference, and thus mainly followed its principles (Musgrove et al. 1987, p.805). The time from the early 19th century until the initiation of Modernism was instead characterized by diverse use of historical styles, sometimes referred to as "Revivalism". The new era and technological development brought the need for new types of buildings, such as railway stations and department stores, to which the historical styles were applied in an eclectic way; for instance, a city hall might be designed according to the rules of a classical temple, whereas a church could be designed in Gothic manner and a museum in that of Baroque. (Musgrove et al. 1987, p.1093-1098).

A B C D

A. Baroque interior, Chapel of Versailles, Paris, France, built in 1689-1710.

B. Rococo interior, Palace of Count P. S. Stroganov, St. Petersburg, Russia, built in 1752-1754

C. Neoclassical facade, Altes Museum, Berlin, Germany, built in 1825-1830

D. Neoclassical interior, Altes Museum, Berlin, Germany, 1825-1830

Villa Savoye designed by Le Corbusier (built in 1928-1931) is perhaps one of the most iconic examples of Modern Architecture and the "International Style"

2.5.2.2 AN EXAMPLE OF CONTEMPORARY ARCHITECTURE: EARLY MODERNISM

The transition from traditional architectural expression to that of modernity is seemingly the most radical change in architectural history. However, a single line or thread of development that resulted in this change cannot be precisely defined (Kruft 1994, p. 364, Lang 1987, Summerson 1980, p.106-121). Some notably modernistic ideas were already present in the late 19th century, perhaps most influentially by Eugène-Emmanuel Viollet-le-Duc (1814-1874), Louis Sullivan (1856-1924) and the Chicago school famous for its skyscrapers in the United States (e.g. Kruft 1994, p. 356-363). However, the style of buildings that is today most characteristically recognized as "modern" developed mainly after World War I in the early 20th century, at the heart of the change being a trend called the Modern Movement (Kruft 1994, Summerson 1980, p.106). The Modern Movement progressed as rather heterogeneous trends that undulated in different parts of central Europe and the United States. These - often simultaneous - trends included styles such as Expressionism, particularly in Germany and France, Cubism in Czechoslovakia, Futurism in Italy and De Stijl in the Netherlands (e.g. Tietz 1999, Kruft 1994). The new design ideologies were characteristically spread as design rules and slogans such as Sullivan's "form follows function", Mies van der Rohe's "less is more" and Le Corbusier's "machine for living".

However, by the end of the 1930s modern architectural style had taken a notably coherent mode of expression; the style that finally became the most influential on the further development of contemporary architecture was the one that typically manifested with box-like structures, white concrete, flat roofs and large glass surfaces (Musgrove et al. 1987, p.1323). This style, iconic to early modernism, was named "International Style" by Henry-Russell

Hitchcock and Philip Johnson in their book titled with the same name (Hitchcock, Johnson 1935). The style leant strongly on concepts of functionality, purity of materials and freedom from ornament or other historical residues. Characters often mentioned as leading forces behind the style are the Bauhaus school with Walter Gropius and Ludvig Mies van de Rohe. It has been estimated that after World War II International Style became the dominant ideology of architecture throughout the industrialized world, almost entirely governing architectural development until the 1960s. (Summerson 1980, p.106, Tietz 1999).

2.5.2.2.1 Origins

The roots of early modernism are found in the industrial revolution of the 19th century, which was followed by an overall socio-political change (Lang 1987, p.3). The industrial revolution enabled the use of new construction materials such as large glass panes, steel and concrete. Unlike brick, stone or wood, concrete could be shaped into almost any possible form of buildings, which enabled new freedom in design. However, initially the new materials were applied to designs with more traditional aesthetics, as can be seen for instance in the designs of early skyscrapers, the works of Auguste Perret or in the art nouveau style (Kruft 1994, p. 395-396, Summerson 1980, p.9).

The new design ideology was founded on many societal and political ideals. World War I had left social and economic instability in many European countries, and architects were called on to produce new solutions for problems related to cities, housing and public environments (Lang 1987, p.3-5, Tietz 1999). The industrial revolution was also accompanied by urbanization and its challenges (e.g. Musgrove et al. 1987). One of the main ideals of early modernism was to serve the public rather than people in high positions

in society such as church and state, and to build an environment where the public could live and work efficiently and economically. The general mentality of the time seems to have been characterized by a strong trust in modern technology, and a belief in the changed needs of the "modern man". Admiration of industrial production, machines and vehicles can also be seen in the designs of those days; for instance, designs were increasingly often presented from aerial perspectives and more importance was given to the overall mass of a building, as it was thought that people would more frequently experience architecture from the air, such as from airplanes (Kruft 1994, p.385). Besides, "modern man" living in a modern society was distinguished from his antecedents: he was believed to think rationally and to enjoy abstract and geometrical forms: "winding streets are for donkeys, straight roads are for men" and "the right angle is the necessary and adequate tool for our purposes" as the idea was formulated by Le Corbusier in 1946 (Kruft 1994, p.400).

It seems that views on architectural aesthetics changed with the change of ideology; in early modernity, aesthetics was increasingly seen as a more rational matter than in earlier periods. It has been observed that the sensation of beauty was seen to derive from the satisfaction of reason such as from perceiving a building that fulfilled its function well and was produced efficiently and economically (Kruft 1994, p. 364-446). A radical distinction between art and architecture can be seen in Loos's texts (e.g. Loos 1908), where he describes art as subjective and empty of purpose, contrasting it to architecture which he sees as an embodiment of purpose (Kruft 1994, p. 366). Architect Hannes Meyer, a director of the Bauhaus School, announced that a building should not be aesthetic but solely a technical process, and denied that there should be any artistic aims in architectural practice (Kruft 1994, p. 386). Mies van der Rohe also stated that architecture has little to do with

> ***"Unlike brick, stone or wood, concrete could be shaped into almost any possible form of buildings, which enabled new freedom in design***

> ***World War I had left social and economic instability in many European countries, and architects were called on to produce new solutions for problems related to cities, housing and public environments***

personal preferences; rather, true architecture would always be objective (Kruft 1994, p.388). The admiration of engineering and the mentality of machine building was also reflected in the outlook towards art: as formulated by Gropius, ideal art was "like something produced by an engineer, such as an aeroplane, the obvious purpose of which is to fly" and "free of subjectivity, emotion and nature" (Kruft 1994, pp. 379-385). Given that aesthetic objectivity and social equality were major aims of the Modern Movement, it is no wonder that standardization of buildings and their components became an idea that governed design - especially housing design- in Europe; it is observed that most individuals were seen to have similar needs so that standardized buildings were thus a logical and also an economical solution to the housing problem (Kruft 1994, p.385). International Style, looking everywhere the same, unaffected by cultural, political or geographical influences, can be seen as a kind of embodiment of the objective and rational outlook typical of early modern architecture (Kruft 1994, p. 430).

Woolworth building in New York, US, built in 1910-1920. Even though constructed with modern building materials and incorporating modern functions, architectural expression of the early skyscrapers still reflected the traditional styles

2.5.2.2.2 Rationalism and Functionalism

Functionalism, the idea that architecture should correspond in all-encompassing fashion to its function from its volume to the details has been described as one of the main dogmas of the modern movement (Blake 1977, p.16) and as the major design principle that led to characteristically simplistic architectural expression in early modernity. It has been claimed that the juxtaposition of function and aesthetics was already under way in the 18th century when a distinction was born between *the fine arts (les beaux arts)* and *the useful arts (les arts utiles),* such as architecture. This highlighted the difference between architecture and other forms of art, comprising a statement that the experience of beauty would in fact be a consequence of the perceived utility of a building or space. It has even been alleged that this idea repressed the role of aesthetics to a by-product of functionality in architecture. (Scruton 2009). The origin of the idea of functionalism has often been credited to Sullivan for crystallizing the spirit of the times in the famous proverb "form follows function" (Summerson 1980, p.106). However, it has also been claimed that Sullivan actually did not see function in technical or stylistic terms but more broadly: that function was the sum of natural, social and intellectual human needs (Kruft 1994, p. 357). Seeing symbolism and ornament as also tools to serve the function of a building, it has been claimed that Sullivan's functionalism was thus not as rigorous as the upcoming conceptualization of function, which was based more on the purity of materials and structure (Kruft 1994, p.359).

> ***In early modernity, aesthetics was increasingly seen as a more rational matter than in earlier periods***

Corbusierhaus, Berlin, Germany. Designed by Le Corbusier and built for an international exhibition in 1957.

1908 Adolf Loos: Ornament and crime

Adolf Loos (b.1870 in Brno, d.1933 in Vienna) brought back with him to Vienna from his three-year stay in the United States (1893–6) a remark of Louis Sullivan's: 'It could only benefit us if for a time we were to abandon ornament and concentrate entirely on the erection of buildings that were finely shaped and charming in their sobriety'.
From this Loos developed his radical aesthetic purism, which made him a zealous foe of Art Nouveau and the German Werkbund: 'The German Werkbund has set out to discover the style of our age. This is unnecessary labour. We already have the style of our age.'

The human embryo in the womb passes through all the evolutionary stages of the animal kingdom. When man is born, his sensory impressions are like those of a newborn puppy. His childhood takes him through all the metamorphoses of human history. At 2 he sees with the eyes of a Papuan, at 4 with those of an ancient Teuton, at 6 with those of Socrates, at 8 with those of Voltaire. When he is 8 he becomes aware of violet, the colour discovered by the eighteenth century, because before that the violet was blue and the purple-snail red. The physicist points today to colours in the solar spectrum which already have a name but the knowledge of which is reserved for the men of the future.

The child is amoral. To our eyes, the Papuan is too. The Papuan kills his enemies and eats them. He is not a criminal. But when modern man kills someone and eats him he is either a criminal or a degenerate. The Papuan tattoos his skin, his boat, his paddles, in short everything he can lay hands on. He is not a criminal. The modern man who tattoos himself is either a criminal or a degenerate. There are prisons in which eighty per cent of the inmates show tattoos. The tattooed who are not in prison are latent criminals or degenerate aristocrats. If someone who is tattooed dies at liberty, it means he has died a few years before committing a murder.

The urge to ornament one's face and everything within reach is the start of plastic art. It is the baby talk of painting. All art is erotic.

The first ornament that was born, the cross, was erotic in origin. The first work of art, the first artistic act which the first artist, in order to rid himself of his surplus energy, smeared on the wall. A horizontal dash: the prone woman. A vertical dash: the man penetrating her. The man who created it felt the same urge as Beethoven, he was in the same heaven in which Beethoven created the *Ninth Symphony*.

But the man of our day who, in response to an inner urge, smears the walls with erotic symbols is a criminal or a degenerate. It goes without saying that this impulse most frequently assails people with such symptoms of degeneracy in the lavatory. A country's culture can be assessed by the extent to which its lavatory walls are smeared. In the child this is a natural phenomenon: his

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2.5.2.2.3 Simplicity

Perhaps contrary to some belief (e.g Scruton 2009, p. 21), Sullivan did not seem to oppose ornament as forcefully as did his successors; he declared that form and proportion should be the main media of architectural expression and thus did not see ornament as a necessity. However, he did not advise omitting it entirely, but saw it as an "intellectual luxury", still as a desirable and important element in architecture, but recommended that architects should abstain from using it temporarily for some years to learn how to design buildings with utility as their main target. (Kruft 1994, p. 358-359). Later, however, the juxtaposition between function and ornament became more apparent. One of the most radical actors was John Root (1850-1891) who started already in the late 19th century to use the expression "crime in architecture" when referring to mixing decorative elements with structural ones (Kruft 1994, p. 360-361). Austrian architect Adolf Loos went even further with his well-known provocative and influential essay "Ornament and crime" (1908), where he describes ornaments as childish, unnecessary and even suggests that people favouring and producing them to be actual criminals themselves. Production of ornaments was considered time-consuming and unnecessary, and thus a waste of workforce and "a crime against the national budget". (Loos 1908, p.21). Loos also saw that it was ornamentation that made past styles look old and declared that "the evolution of culture is synonymous with the removal of ornament from utilitarian objects" (Loos 1908, p. 20).

2.5.2.2.4 Criticism

Modern architecture has faced much criticism, perhaps more than any other historical style. Criticism of Modernism has typically been written from the 1970s onwards. Modern architectural ideology was criticized for having an underdeveloped theoretical basis (Lang 1987, p.1). The ideas of most radical writers within the modern movement, such as those of Loos, were influential in their time but were later accused of internal contradictions and of being based on scattered observations, thus never achieving the form of a consistent theory (Kruft 1994, p. 366). It has been claimed that humane intentions, whence the Modern Movement partly arose, were poorly communicated by the cold and uninteresting appearance of buildings (Summerson 1980, p. 114). Despite the movement's roots being in socialistic reformation, modernism has also been claimed as being a product of capitalism created by the consumer society and of having ended up by being "formalism while rejecting form" (Kruft 1994, pp. 440-441). Modern architecture has also been accused of being too centred in the architect's own idealistic expression, and it has been claimed that the blame for general dislike of it is put on poor comprehension, poor education or poor taste of the public (e.g. Lang 1987, p. 16).

The aims of the Modern Movement, such as a high degree of prefabrication or use of materials capable of maintaining their smoothness and purity, have been argued as being based on unsound fantasies about future technology that later turned out to be impossible to realize, thus making the whole movement based on biased premises (Blake 1977, p.39-82). The whole idea of functionalism has been questioned by arguing that old buildings which have been altered from their earlier use would actually often suit a new function better and endure longer as a less frequent target of vandalism and demolition (Blake 1977, p.15-28, Scruton 2009, p. 22). Even though functionalist buildings have been designed with their supposed function as their aim, users have been reported as ending up using them very differently and making their own

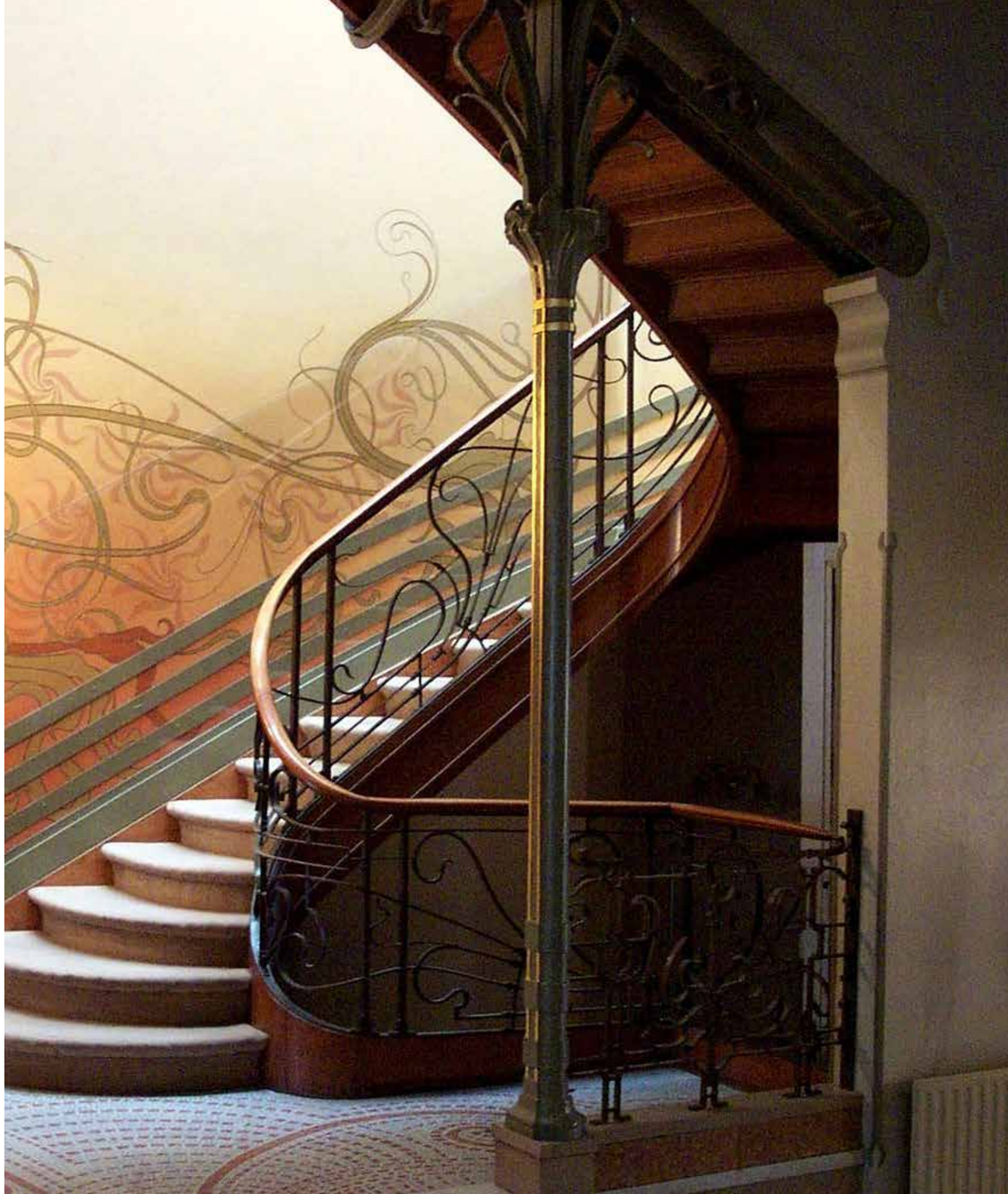
> ***"Modern architecture has faced much criticism, perhaps more than any other historical style***

Farnsworth House, Plano, Illinois, US, built in 1945-1951. A house designed by Mies Van Der Rohe

modifications to buildings in order to make them better correspond to their needs (Blake 1977, p.15-28). Besides, the concept of “function” has been claimed as becoming mainly limited to efficiency of construction, thus disregarding other human needs such as those for identity, self-expression or aesthetics (Lang 1987, p. 6-8). Aesthetically, the architecture of the Modern Movement has been claimed as appearing boring and flavourless, “the boredom of hygiene” as Aldo van Eyck observed in 1959 (Summerson 1980, p. 114, Lang 1987, p.6, Brolin 1976). Most radically, it has been claimed by many theorists that functional modernism has been an unsuccessful period in architectural history, even a serious failure that has driven architectural theory and practice into a crisis (e.g. Kruft 1994, p.446, Blake 1977). Equally, however, these judgements have also themselves been criticized for giving no answers or suggestions for alternative solutions (Kruft 1994, p. 443-446).

2.5.2.2.5 Relation to other contemporary styles

The style called by different names in different countries, such as “Jugendstil” in Germany and Scandinavia, “Art Nouveau” in France or “Modernismo” in Italy, is an interesting trend that is situated in time between the industrial revolution and early modernity (c.1888–1914) (Curl, Wilson 2015, Tietz 1999). Typical of that style is the use of modern building materials, which were in any case applied to architecture in a way that more resembles the traditional way of architectural expression (Kruft 1994, p. 395-396, Summerson 1980, p.9, Tietz 1999, p.10-13). Rich ornamentation, which drew inspiration from nature and vegetation in particular, is a typical characteristic of the style. Traditional constructs, such as arches and columns, were customary, but ornamentation in particular was often asymmetric (Curl, Wilson 2015). The use of glass and iron also led to the style’s distinctive appearance. (Tietz 1999, p. 10-11).



Interior of Hôtel Tassel, Brussels, Belgium, built in 1893-1894. A townhouse designed by Victor Horta represents the Art Nouveau style

Already, development of the early modern style was quite inconsistent; for instance, views on the role of ornamentation and the relationship between art and architecture varied constantly even within individual movements and thinkers (Kruft 1994, p.364-392). For instance, contrary to the admiration of industrial standardization and mass production in Europe, in the United States Frank Lloyd Wright spoke on behalf of the individuality and personality of the inhabitants, stating that a house should strongly reflect the features of its residents. Even though he saw formal simplicity and unity of form and function as essential, Wright's attitude towards ornament has also been described as tolerant, and he was cautious towards the idea of "international style". (Kruft 1994, p.425-427). Many similarities can thus be seen between Wright's thoughts and those of Sullivan. Other examples of the expressional variety of early modern architecture are the works of Finnish architect Alvar Aalto (1898-1976). In particular, his later designs from the 1940s onward manifest material richness involving brick and wood in special, single-slope roofs, curved surfaces, the influence of nature and particular consideration of details (Curl, Wilson 2015).

> **"Already the development of the early modern style was quite inconsistent**

Some writers have declared Post-Modernism as having begun dramatically at the "moment of death of modern architecture" (Jencks 2002, p.9) in 1972 when several housing blocks of modernistic Pruitt-Igoe Housing in St. Louis were dynamited after their inhabitants had refused to live there any longer (Curl, Wilson 2015). The origins of Post-Modernism have been described as lying in the critique of the ideals of early modernism (Tietz 1999, p.82-86). Among others, architect Philip Johnson (1906 - 2005) challenged the ideas of pre-war European functionalism and argued on behalf of mere architectural appearance and aesthetic quality of buildings (Kruft 1994, p.438).

Post-modernists rejected the ideal of "box architecture" and used playful forms and sculpture-like volumes in their designs. Like many others, Louis Kahn (1901-1974) adopted a post-modernistic ideology emphasizing the importance of architectural expression, and drew inspiration again from nature and the architecture of ancient Greece and Rome, still maintaining a more tolerant attitude to functionalism than Johnson (Kruft 1994, p.438). In contrast, some postmodernists took opposition of functionalism even further. The architecture of the post-modernistic architect Charles Moore is known from its arbitrary combination of historical styles and new materials and functions, the result of which is described as ironical, superficial and impermanent (Kruft 1994, p. 442). Robert Venturi (1925-) rose up especially against oversimplification and the idea of "less is more" (Venturi 1977). Even though Venturi

Säynätsalo Town Hall by Alvar Aalto in Jyväskylä, Finland, built in 1949-1952.

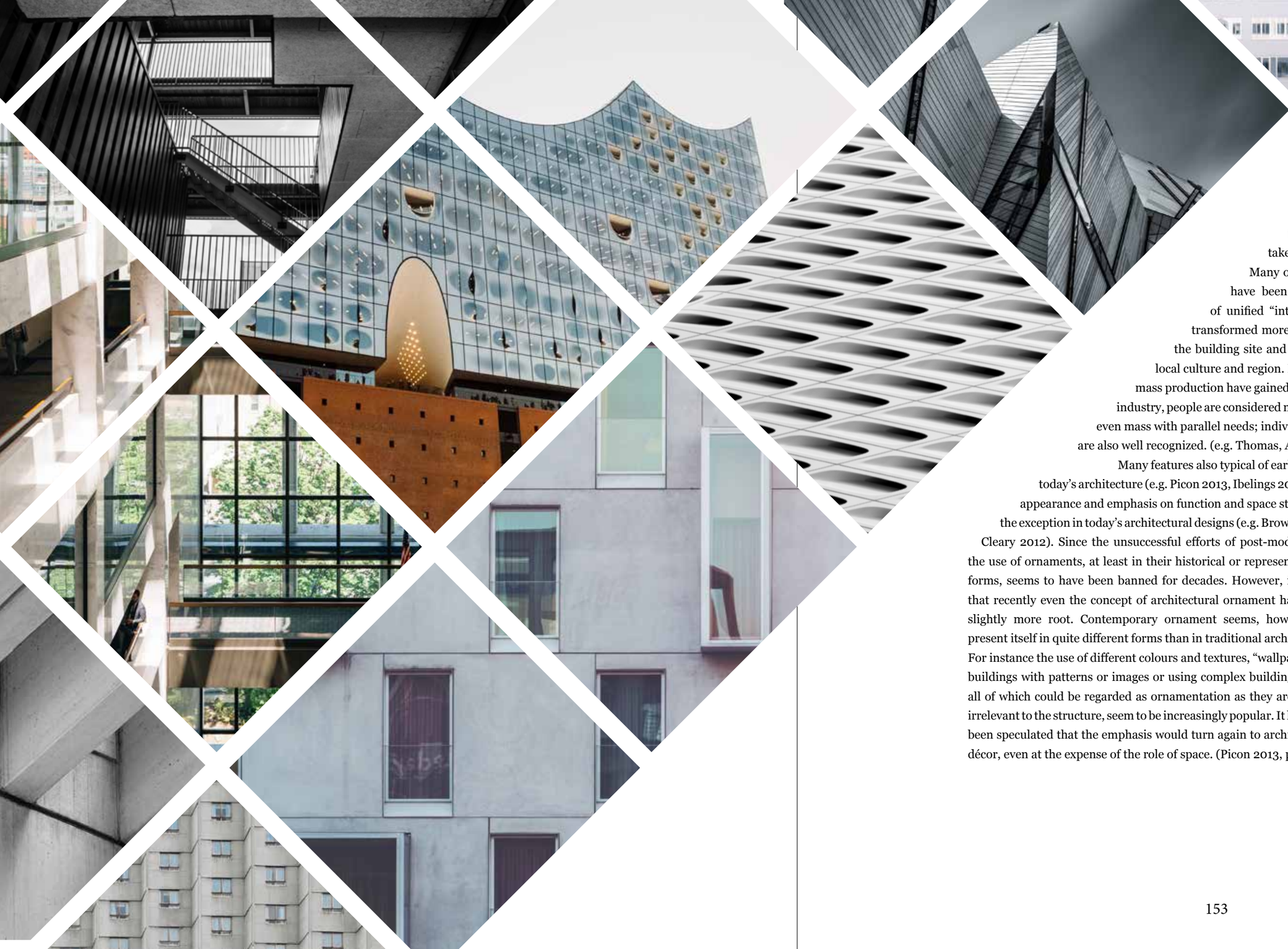
Piazza d'Italia, New Orleans, US, built in 1978. An urban plaza designed by Charles Moore represents an extreme trend of postmodernism

Sainte Marie de La Tourette, Lyon, France, built in 1960. A convent design by Le Corbusier as an example of Brutalism

A series of photographs showing the demolition of a Pruitt-Igoe building. Pruitt-Igoe housing area was finished in 1956 and the last buildings were demolished in 1976.

emphasized the roles of complexity, contradiction and ambiguity, he also writes that "superficially complex forms will not work" (Venturi 1977, p. 19), an idea that can be seen to identify with Berlyne's idea of the inverted U-curve relationship between complexity and aesthetic appreciation. Interestingly, despite the aims of the post-modernists to diverge from modern architecture, it seems that the general public did not necessarily even perceive the difference between modern and post-modern buildings (Groat 1982).

At the other extreme of post-modernism was a trend called brutalism, which went even further towards the modernistic aims of refusal of traditional aesthetics and admiration of material purity; brutalist buildings typically manifest with raw concrete finishes and other deliberately unpolished materials and outstandingly monumental, block-like designs (Curl, Wilson 2015, Blake 1977, p. 40-41). Brutalism was highly influenced by the works and ideas of Le Corbusier and was especially popular in the 1950's (Curl, Wilson 2015).



Since post-modernism, thoughts on architectural theory and expression have taken many different directions. Many original ideas of early modernism have been abandoned. Today, admiration of unified “international style” seems to have transformed more into emphasis on fittingness for the building site and a building’s association with the local culture and region. Even though standardization and mass production have gained an important role in the building industry, people are considered more extensively than simply as an even mass with parallel needs; individuality and personal preferences are also well recognized. (e.g. Thomas, Amhoff & Beech 2016).

Many features also typical of early modernism are still manifest in today’s architecture (e.g. Picon 2013, Ibelings 2014). Asymmetry, simplistic visual appearance and emphasis on function and space still seem to be the rule rather than the exception in today’s architectural designs (e.g. Browne 2011, Cleary 2012). Since the unsuccessful efforts of post-modernism, the use of ornaments, at least in their historical or representational forms, seems to have been banned for decades. However, it seems that recently even the concept of architectural ornament has taken slightly more root. Contemporary ornament seems, however, to present itself in quite different forms than in traditional architecture. For instance the use of different colours and textures, “wallpapering” buildings with patterns or images or using complex building forms, all of which could be regarded as ornamentation as they are chiefly irrelevant to the structure, seem to be increasingly popular. It has even been speculated that the emphasis would turn again to architectural décor, even at the expense of the role of space. (Picon 2013, p.15).

> “
> ***Many features also typical of early modernism are still manifest in today’s architecture***

2.5.3 SYMBOLIC VALUES IN ARCHITECTURE

As much as the human perceptual world is physical, it is also symbolic. The architectural environment provides a variety of meanings to the perceiver, such as utility or symbolic meanings (Lang 1987, p.94-96). Large rooms and high ceilings have been claimed to represent not only physical qualities, such as spaciousness and lightness, but also symbolic values such as dignity, freedom or high social status (Lang 1988, p.17). Sublime architecture, characterized by extremely large dimensions, is said to lead the viewer to feelings of astonishment, admiration and respect (Mako, Lazar & Blagojević 2014, p.14). Architecture and the style of the built environment are also said to convey implicit cues as to how to behave and what to expect (Nasar, Devlin 2000, p.43). Material objects and possessions are found important in developing and maintaining individual identity, and possessed objects are used to symbolize the individual identity to others (Gentry, Baker & Kraft 1995).

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A well-known, though provocative, distinction of architectural symbolism is that of Venturi, Brown and Izenour (1977) who defined two ways to introduce symbolism in architecture: “the duck” and “the decorated shed”. The duck, named after a duck-shaped drive-in to sell ducks and ducks’ eggs in New York built in the 1930’s, represents architectural symbolism where the entire space, structure and program of a building is constructed as a symbol. The symbolism of contemporary architecture is said to typically be of the duck-type. The “decorated shed” describes the way in which symbolism is brought

in by independent symbolic elements such as ornaments, which is typical for instance of traditional architectural styles. (Venturi, Brown & Izenour 1977, p.87). It has been claimed that understanding the symbolism of the ducks demands that the intentions and design philosophy of the architect be transmitted to the viewer, whereas the symbolism of decorated sheds tends to be more easily understood as it relates to everyday experience and the broader cultural context (Lang 1987, p.206-207).

Arnheim (1977, p.207-217) divides architectural symbolism into “conventional” and “spontaneous”. By conventional symbolism he means the kind of symbolism that needs intellectual thought to be understood. As an example he uses the Lincoln Memorial, which encompasses 36 columns as a symbol for the number of states in the United States at the time Lincoln died (Arnheim 1977, p.207). Architectural forms, such as circles or symmetry, may in themselves bear associative meanings in certain cultures, though these have been said

“The Big Duck”, a duck-shaped drive-in in New York, US, built in 1931.

to have largely lost their symbolic value in contemporary western cultures (Lang 1988). In contrast, in classical architecture the circle, regarded as the most perfect of all geometrical forms, is a common plan form for numerous churches as a symbol of God (Wittkower 1998, p. 38-40). Even today, the plan form of western churches is often symbolic; the cross, as the symbol of Christ crucified. Spontaneous symbolism, on the other hand, is defined by Arnheim (1977, p.210-217) as involving meanings that are inherent, automatic and based on empathy experienced toward certain forms. Spontaneous symbolism is said to arise from perceived analogies, such as those from the natural world or the proportions of the human body (Lang 1987, p.210). For instance, the symbolism of classical churches was also based on the idea of all-encompassing mathematical harmony that kept the whole universe together. When the same harmony was applied to church architecture, it was believed that the souls of people would acknowledge it and they would feel in tune with the divinity and the forces of the universe. (Wittkower 1998, p.38).

Periodical architectural styles are also strong symbols of the societies they represent; buildings from traditional architectural styles are associated with the era before industrialization, while modern buildings illustrate strongly the societal values of the post-industrial era (Lang 1988, p.16). People are also said to choose living environments that reflect their perception of who they are or whom they wish to be. Besides, apartment preferences have been described as having a strong connection to the self-image of the individual, and the home itself can be seen as a symbolization of the personality of its residents. (Juntto 2010). Indeed, housing architecture has consistently been proven to signal strong social expectations (Nasar, Devlin 2000 p. 43). The same seems also to apply to other buildings and for instance to the facilities of business companies. (Lang 1987, p.205). The mere size of a home has been proposed as being a strong symbol of social status; people in high social positions tend to inhabit large spaces whereas the residences of people with lower social status are smaller (Lang 1988, p.17). Moreover, the mere height of a space can carry symbolic meanings such as those of liberty and freedom (Proshansky, Ittelson & Rivlin 1970). Building materials such as wood, marble or steel, as well as the type of lighting and colours also carry different symbolic meanings (e.g. Lang 1987, p.206-208). It has also been demonstrated that “newness” easily coincides with judged attractiveness; “new” facades have been demonstrated as being judged as more attractive than corresponding “old” facades (Krampen 1979, p. 205-243).

3

CONCLUSIONS FROM THE LITERATURE

In this section of the thesis, the main findings from the reviewed literature are assembled and several similarities and dissimilarities in findings from different fields of research are pointed out. The use and meanings of the concepts of complexity and order in previous studies are reflected, and how they are measured and their relation to visual preference are studied.

In this thesis, my fundamental aim is to study visual preferences for architectural features appearing in apartment interiors. On the grounds of the research reviewed in the previous chapters, it can be seen that limited knowledge is available on the aesthetics of apartment interiors. Not enough systematic research has been conducted on aesthetic preferences - either in the general context of architectural interiors or in the specific context of apartment interiors - to draw any reliable conclusions, not to mention recommendations for use in architectural practice. In addition, research on housing preferences that would use an experimental approach rather than interview as a method is, to my knowledge, almost non-existent. Considering the importance of the environment to the well-being, and given that people spend probably more time inside their houses or apartments than looking at them from outside, it could be assumed that the quality of house and apartment interiors would be highly influential to well-being. The great lack of systematic research on aesthetic preferences of apartment interiors is thus quite surprising.

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There is also some inconsistency in theories from fields other than architecture concerning the relation between complexity, order and aesthetic preference. Moreover, the matter has played a minor role in discussion in contemporary architectural literature. The literature implies at least to some extent dissatisfaction among the general public with contemporary building aesthetics. It is likely that a relationship exists between apartment choice and intuitive decision-making, where intuitive preference must be seen as a key factor. Therefore, studying those architectural features of apartment interiors that may affect this intuitive preference is beneficial to architects and property developers, as well as to all the other actors in the housing construction field.

The literature reviewed shows that previous research on aesthetics in general, and especially on environmental aesthetics, has frequently demonstrated high levels of consensus among individuals’ aesthetic preferences (e.g Yi 1992, Stamps, Nasar 1997, Strumse 1996, Nasar, Kang 1999, Nasar 1983, Berlyne, Robbins & Thompson 1974, Valentine 1962 p. 169-180, Roberts 2007), a major potential exception being between the preferences of professionals in visually artistic fields - such as architects - and laypeople (e.g. Wilson 1996, Gifford et al. 2000, Ghomeshi, Jusan 2013, Akalin et al. 2009, Nasar, Kang 1989, Kaplan 1988a, p.53, Devlin, Nasar 1989).

The literature reviewed also gives the impression that aesthetic preference has over history been explained primarily by two factors. The first is often described by such terms as “order”, “unity” or “harmony”, and other terms such as “complexity”, “diversity” or “variety”. Visual experience can fundamentally be seen as the final outcome of visual information processing by the brain. From the perspective of mental effort, visual complexity and order can be seen as two extremes; increased visual complexity burdens information-processing capacity, whereas visual order can be seen to facilitate the interpretation and comprehension of visual information. Stimulus complexity has been described as a major determinant of attention and thus as an important independent variable for exploratory behaviour and an initiator of curiosity (Vitz 1966 p. 105, Berlyne 1958, Kaplan, Kaplan 1989). On the other hand, Gestalt laws and symmetry, for example, are features that seem to facilitate comprehension of visual information, thus being potential factors of order.

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3.1

TERMINOLOGY

The literature reviewed reveals that aesthetic preference has repeatedly been explained essentially by two terms: complexity and order. While many theorists, Birkhoff (1933) for instance, have used the two terms exactly, some have used other terms which, on a closer look, appear to be essentially quite parallel only emphasizing slightly different aspects or expanding the scope of their meanings. For instance, the Kaplans' "coherence" and "complexity" have in later literature been used directly as synonyms for "order" and "complexity", and "legibility" and "mystery" as their direct extensions in the future (Heath 1988, p.7).

In light of the literature, it could be argued that the critical element of the concept "complexity" would be engaging attention and mental activity, and that of "order" would be ease of comprehending visual information; their basis lying in the basic human need to "explore" and "understand" as described by the Kaplans (1989). Birkhoff (1933 p.3) defined complexity as "a visual character of the scene that makes the effort of attention to increase", while Valentine (1962 p.9) as something that can hold the attention longer than just for a short time. "Complexity" itself appears as one of the elements in the Kaplans' Preference Matrix (1989, pp. 52-57). Its complement, "mystery" - which plays the same role as "complexity" but hints further at the future - also relates strongly to increased mental activity, arousal and attention. Both "being away" and "fascination" from attention restoration theory (Kaplan, Kaplan 1989, Kaplan 1995) also derive from increased mental activity; "being away" separating the mind from the ordinary by taking it to other thoughts and associations, and "fascination" being simply something that catches the viewer's involuntary attention. The Kaplans' "extent" can also be seen as a more cognitive form of complexity, resulting in a certain type of increased mental activity, as defined by elements that offer associations to other cultures or to past generations that "promote a sense of being connected to past eras and past environments and thus to a larger world" (Kaplan 1995, p.174). Terms such as "tension" and "the amount of variety" (Berlyne 1971) as well as "uncertainty" (Berlyne 1974a p.19) have also been similarly used in the previous literature to express how complexity is understood in this thesis. Even "novelty" or "unfamiliarity" could be regarded as derivatives of complexity in the sense that inspecting unfamiliar objects requires often increased attention and mental effort.

Similarly, several terms are found in the literature that are used in parallel with "order". They are "coherence" and "legibility" (Kaplan, Kaplan 1989), "organization" (Hershberger 1988), "goodness of form", "structure" or "unity" (Valentine 1962, Birkhoff 1933). The Kaplans' "coherence" refers directly to order: it is defined by features that provide a "sense of order" and help to "direct attention coherently" (Kaplan, Kaplan 1989, p.54). "Legibility" refers to the same elements as coherence, but again, further in time. For instance, legibility exists through "expected continuation of the repetitive elements" and concerns the "promise of easy formation of the cognitive map of the environment" (Kaplan, Kaplan 1989 p. 55), thus helping to organize and understand the environment.

Besides, features such as "openness", "spaciousness" or "depth of the scene" seem to repeat regularly in the literature concerning environmental preferences (Nasar 1983, Kaplan, Kaplan 1989). "Extent" in attention restoration theory (Kaplan, Kaplan 1989, Kaplan 1995), in its physical interpretation, also relates directly to the openness of the environment. The depth of a view is one embodiment of the Kaplans' "mystery", the possibility to gain more information on the environment by moving further to the scene, thus implying a degree of openness in the scene (Kaplan, Kaplan 1989, pp. 55-56). An open view has been regarded as an evolutionary benefit that enables detection of potential threats from a long distance and thus gives time to hide or run from predators or other threats, as suggested in prospect-refuge theory by Jay Appleton (1975). "Openness" or the "depth of the scene" can also be considered to relate directly to ease of comprehending the environment; having visual access to a wide scope of the scene allows its broad exploration and facilitates orienting oneself in the larger context of the environment.

"It could be argued that the critical element of the concept "complexity" would be engaging attention and mental activity, and that of "order" would be ease of comprehending visual information

Besides measures of complexity and order, studies have also introduced other features to predict environmental preferences, such as "naturalness" or "nuisance", the latter meaning the existence of distractive elements such as poles, wires or signs in the urban scene. It has been suggested that these features would contribute to preference primarily through the meanings they are associated with, such as social class or safety (Nasar 1988b) but not as intuitive preference.

In conclusion, the literature points towards two main characteristics, complexity and order, as being critical factors predicting intuitive visual preference. Therefore, I will choose them to use as the main concepts in studying visual preferences for the architectural features of apartment interiors in this thesis.

3.2
RELATION AND MEASURES OF **COMPLEXITY** AND **ORDER**

The relation between visual complexity and order seems to have played a significant role in the discussion since the very beginning of aesthetic research. However, the two measures have not always been presented together, but sometimes either complexity or order has been studied to predict aesthetic preference alone; examples include complexity in Berlyne's arousal-valence model (Berlyne 1971) or order in the theories of the Gestalt school (Goldstein 2002, Eysenck, Keane 2000). Additionally, Vitz (1966 p. 105) has suggested that people would automatically prefer a level of stimulus complexity that approaches their maximal information-processing capacity. Complexity and order have also sometimes been presented as each other's extremes, as in a study by Roberts (2007) where some measures that could be regarded as those of order were considered as inverse measures of complexity.

Yet some theorists have regarded complexity and order as separate elements which would both contribute to aesthetic preference independently; “Unity in Variety” is an old aesthetic principle presented by the early Romans (Nasar 1988c), “a principle that aesthetic value or beauty in art depends on the fusion of various elements into an organic whole which produces a single impression” (Merriam-Webster 2016c). The two characteristic features kept as the basis of aesthetics of classical architecture, “ornament” and “harmony” (Vitruvius 1914, Alberti 1986, Kruft 1994, Summerson 1980) can also be seen as measures of complexity and order. The Kaplans (1989, p. 54) have noted that a scene can be high in both complexity and order at the same time. The two variables of aesthetic appreciation by Fechner (1860, 1876), the “aesthetic centre” and “unitary connection” already refer to the concepts of complexity and order. Valentine (1962 p.81) also noted that aesthetic appreciation requires both “stimulation and repose” and that mental excitement would be necessary to catch enough attention and interest, but only so that the mainstream of attention would not be seriously distracted. In the equations of Birkhoff, both complexity and order were considered independent factors of aesthetic measure (Birkhoff 1933). Additionally, Arnheim (1977) has noted that visual scenes high in complexity are more strongly preferred with - rather than without - perceivable levels of order. It has also been aptly noted that without some amount of complexity, there can be no perceivable order either (Padovan 1999, p. 41).

> **“Ornament” and “harmony” can also be seen as measures of complexity and order**

Several studies show that a level of visual complexity can be found that seems to be preferred by people on average; stimuli of which the complexity level is under or above this level have many times been shown to be less strongly preferred (Vitz 1966, Berlyne 1971, Akalin et al. 2009). Berlyne (1960) was one of the first to suggest this inverted U-curve - or Wundt’s curve - relationship between complexity

and aesthetic preference. Later on, a mass of studies have supported Berlyne’s model (e.g. Wohlwill 1968, Berlyne 1974b, Sluckin, Colman & Hargreaves 1980, Akalin et al. 2009). However, instead of a U-shaped valence-arousal relationship, several studies (e.g Kaplan, Kaplan & Wendt 1972, Nasar 1983, Nasar 1988b) have found a positive *linear* relationship between complexity and preference in both urban and natural environments. For instance, in the environmental context, Nasar (1988d) found that preference of city scenes is predicted by increasing complexity and increasing order for both American (R=.66) and Japanese (R=.58) subjects. Even though Nasar (1983) has suggested that a linear relationship could be something unique to residential scenes, it is possible that excluding extreme examples from the test material would have skewed the results to show up as a linear relationship. In contrast, a study by Russell, Ward and Pratt (1981 p. 276) demonstrated that pleasure is entirely independent of arousal and did not show any U-shaped correlation. It seems that a clear U-shaped correlation has been obtained when measuring simple visual stimuli, such as the complexity of line drawings or simple shapes (e.g. Vitz 1966). In contrast, studies that could not have verified the U-shaped relationship (e.g Kaplan, Kaplan & Wendt 1972, Russell, Ward & Pratt 1981, Nasar 1983) have been conducted by using real environments (in the form of photographs or actual site evaluations) as stimulus material; it may be that it has been more difficult to embed extreme amounts of complexity in stimulus material with real environments.

According to Berlyne’s viewpoint (1960, pp. 38-39) complexity would increase along with the *number of elements* when other things are kept equal, but if the number of elements is held constant, then complexity would increase with *dissimilarity between the elements*. He also suggests that complexity would vary inversely with the degree to which several elements are responded to as a unit: basically the same idea as suggested by Gestalt principles. Moreover, the Kaplans have defined complexity as the number of different visual elements in a scene (Kaplan, Kaplan 1989, p. 53). In addition to the number of elements, other factors such as textures, novelty and surprisingness of visual elements have also been used as measures of visual complexity (Lang 1987, p.196). The subjective experience of complexity has been measured by letting individuals evaluate it themselves (with questionnaires) or more indirectly, for instance by measuring spontaneous viewing times of stimuli (e.g. Wohlwill 1968, Berlyne 1974c).

Experimentally, several physical variables have been used as predictors for visual complexity in the architectural context. The complexity of silhouette form (Stamps 1998a) and the amount of detail (the percentage of black pixels in a line drawing) (Stamps 1999a) have been shown to reliably predict subjective measures of complexity in building facades. In addition, Stamps (1998a) found the number of turns in a building silhouette to be the most highly determinant factor for their judged complexity. A method involving counting the number of straight line segments, the number of sloping curved lines (counted twice for coefficiency) and the number of ornamental protrusions (and dividing it by two if the silhouette was symmetrical to a vertical axis) in a facade yielded as much as .91 correlation to subjective measures of complexity (Stamps 1998a). A study by Roberts (2007, p.240) found that the number of visual elements was the best predictor of subjective impression of complexity.

Details can be regarded as one obvious source of complexity in the context of architecture. In addition to their role in visual decoration, they have traditionally been used to cut volume into sections that decrease the impression of a large mass in order to bring it closer to human scale. The phenomenon is also demonstrated empirically; in an experiment studying residential building facades (Stamps 1998b) 77 % of the variance in subjective impression of mass could be explained by variance in the consistency of visual areas, whereas another 2 % could be predicted by the number of windows - also one of the volume-cutting elements. The percentage of black pixels in a line drawing has been demonstrated to correlate highly (R=.88) with subjective judgements of the amount of visual detail (Stamps 1999a). The presence of ornamentation and

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Experimentally, several physical variables have been used as predictors for visual complexity in the architectural context

decoration has been shown to correspond to public preference (Nasar 1983, Krampen 1979, p. 283-299); also considered as the most influential physical feature on preference in residential outdoor scenes (Nasar 1983 p.606-607).

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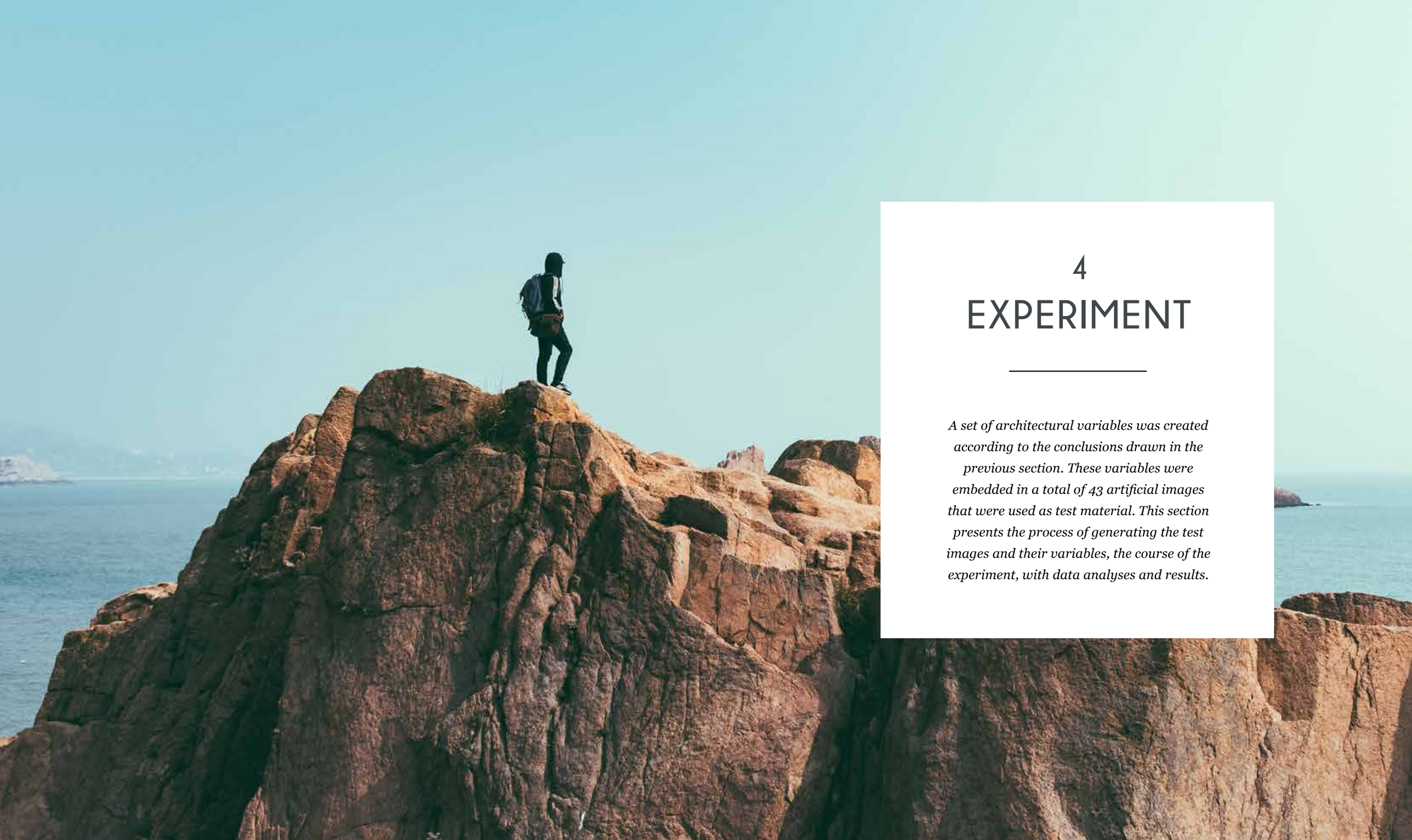
Significantly fewer studies would have physical features of visual order as their target

Significantly fewer studies would have physical features of visual order as their target. In the literature, symmetry has frequently been mentioned as a visual feature that helps to comprehend visual information (Sussman, Hollander 2015, p.122, Tyler 2000, Locher, Nodine 1989, Ramachandran, Hirstein 1999, Cárdenas, Harris 2006). In classical architecture, “harmony” was defined as the correct proportions, meaning for instance simple mathematical ratios such as 1:1, 1: 2, 1:3, 2:3 and 3:4 (Alberti 1986, p. 194-200) extending to all building parts (Summerson 1980, p.8). Additionally, the grouping of elements according to Gestalt laws has on several occasions been presented as a visual-processing facilitating feature (Eysenck, Keane 2000, Goldstein 2002), but I have not found any experimental studies where they would have been used as concrete measures of order. In a study by Roberts (2007, p. 168), the variables “disorganization” and “asymmetry” were considered as measures of complexity, and were defined by the subjective judgements of subjects. In a study by Oostendorp and Berlyne (1988), the variable “order” was defined as subjective judgements of scales “clear-indefinite”, “disorderly-orderly” and “unbalanced-balanced”. The Kaplans’ definitions of “coherence” or “legibility” also give only a few concrete examples of what kind of environmental elements they mean, such as “repetitive elements” and “anything that helps organize the patterns of brightness, size, and texture in the scene into a few major units” (Kaplan, Kaplan 1989, pp. 54-55). In Birkhoff’s original equation for polygons, order was defined by features such as: “repetition”, “similarity”, “equilibrium”, “relation to horizontal-vertical network”, and “unsatisfactory form”, the latter being a negative variable including features such as “diversity of directions” or “angles too near 0° or 180°” (Birkhoff 1933, pp. 9-11, 33-34).



4
EXPERIMENT

A set of architectural variables was created according to the conclusions drawn in the previous section. These variables were embedded in a total of 43 artificial images that were used as test material. This section presents the process of generating the test images and their variables, the course of the experiment, with data analyses and results.

The purpose of the experimental part of the thesis was first to examine whether similar agreement exists in subjective judgements on apartment interior aesthetics as has been found to exist in other aesthetic fields. The focus of the experiment was then further directed to examine whether particular architectural features can be found that contribute significantly to general experiences of visual complexity, order and preference of apartment interior scenes, and how strong their impact is. Finally, the study examined whether visual preference of apartment interiors can be considered as a construct of visual complexity and order, as suggested by the literature in other fields. In addition, affective qualities related to different architectural characteristics were evaluated by using the Affective Space Model developed by Russell, Ward and Pratt (1981).

The main aims of the experiment can be presented by the following research questions:

1. Can preference for an apartment interior be expressed as a construct of its visual complexity and order?
2. Can any physical architectural features of apartment interior design be found that could explain judgements of complexity, order and preference of an apartment interior scene?
3. How consistent are subjects in their evaluations of complexity, order and preference of apartment interiors?
4. Do different kinds of architectural features relate to any general affective qualities, and if so, what kind of qualities?

4.1
METHODOLOGY

In many fields of science, the research subjects, approaches and methods are largely determined by the traditions of the field; for instance, qualitative research methods seem to be rather common in the social sciences, whereas the tradition of psychological or medical research is largely based on quantitative research methods. However, the case of architectural research is quite different; the range of different research topics, approaches and methods is broad (Groat, Wang 2013). Thus a single researcher often cannot lean merely on academic tradition when choosing their methods. Even though in a way architectural research seems to have been conducted for as long as architecture has been practised, such as in the form of a practical trial-error type of structural development, on the other hand architectural research can be considered

as a relatively new field as a large-scale practice, independent of single-building projects. Still, the variety of architectural research topics is breathtaking; it covers technical subjects related to different building systems, sustainability and energy conservation, those related to architectural practice itself, such as studies on the design process or practices of architectural firms, as well as behavioural issues and architectural history, to mention only a few. (Groat, Wang 2013). These divergent subjects naturally need different research approaches, which, together with the novelty of the field, possibly explain the large variation in the research methods used in architectural research.

4.1.1 QUALITATIVE AND QUANTITATIVE APPROACHES

A common division of research methods is that between quantitative and qualitative. However, many methodologists emphasize that these two should not be regarded as strictly distinct research approaches, but as the opposites of a continuum. Besides, it has been pointed out that neither should be ranked above the other but they should be treated as complementary; their varying use can help to expose different facets of reality. (Creswell 2014, Metsämuuronen 2009).

The qualitative research approach is typically used for studying the meanings people give to certain phenomena under study. Distinctive of qualitative research is a focus on individual experiences and meanings, and recognition of the complexity of situations. Data analysis is typically inductive; the researcher aims to approach the research questions with few

preconceptions and draws interpretations from the emerging data. (Creswell 2014, p.32). A common data-collection method in qualitative research, for instance, is a face-to-face interview carried out by open-ended questions, the answers to which are transcribed and further classified and interpreted by the researcher. Qualitative research has been described as being typically concerned with individual narratives; what people say, how they say it and how much they say it, for instance. Qualitative data have been described as being essentially a sort of speech and qualitative analysis as typically aiming at examining the different structures of the meanings of that speech. (Töttö 2000, p.85). Today, many different qualitative research methods are available, some of the most common examples being narrative research, phenomenological research, grounded theory, ethnography and case studies.

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> ***Distinctive to the qualitative research is the focus on the individual experiences and meanings, and the recognition of the complexity of the situations***

In contrast, the quantitative research approach is typically used for testing fixed hypotheses by studying the relationships between the variables; the approach is therefore often described as deductive. “Variables” means a set of characteristics that vary within the phenomenon under study. Providing protection against bias and alternative explanations as well as the ability to generalize and reproduce findings: these are considered to be the general ideals of quantitative research. The objective role of the researcher towards the data remains highly important: to produce well-founded knowledge the researcher must aim to control and reflect the possibility of bias resulting from their own actions and other confounding factors as carefully as possible. (Creswell 2014, Groat, Wang 2013). Collecting data by surveys and experiments is common, and statistical analyses are typically used for modelling the

phenomena under study. Statistical analyses enable exposure of the relationships and their strengths between the variables as well as providing control against bias. As only numerical data can be analysed by statistical methods, a general prerequisite for using quantitative research methods is that matters examined should be measurable. (Metsämuuronen 2009). The quantitative research approach dominated scientific research from the late 19th century until the 20th century, since when an increase in qualitative and mixed methods has occurred (Creswell 2014, p. 32).

The different approaches to research also embody different philosophical ways of perceiving the world. The quantitative approach is often related to a post-positivist worldview, also called the scientific method, scientific research or empirical research (Creswell 2014). Positivism as a worldview emerged in the 19th century and is defined as the "view that there is a single measurable reality and that questions of cause and effect can only be investigated empirically" (A Dictionary of Social Research Methods 2016), meaning an outlook that assumes the existence of the kind of reality that can be objectively described and measured (Groat, Wang 2013, p.77). The difference between positivism and post-positivism is that the latter acknowledges the practical impossibility of finding the absolute truth, which makes research findings always more or less imperfect.

Typical of post-positivism and positivism is the need to recognize and define the causes that influence outcomes. It is considered that knowledge is essentially based on objective observation and measurement of the world; as the world is

Providing protection against bias and alternative explanations as well as the ability to generalize and reproduce findings: these are considered to be the general ideals of quantitative research

seen as ruled by specific laws, understanding the world involves testing and exposing them. The outlook also typically embodies the idea of reductionism, according to which phenomena can be divided into smaller entities that can be studied separately. According to positivist and post-positivist worldviews, acquiring knowledge begins by forming a theory and testing it with a sample. The results of the test then either agree with or contradict the theory, which is then either verified or further remodelled and retested. Conducting research is thus seen as a progressive formation of statements; original statements are refined or rejected, thus making way for new statements that better reflect the truth, which are again maintained until they are replaced by new, even more accurate statements. Data, evidence and rational reasoning are seen to shape knowledge. The aim of post-positivist research is to develop close-to-truth statements of which the purpose is to explain the phenomenon under examination and its causal relations. (Creswell 2014).

While post-positivism can be regarded as occupying the objective end of philosophical worldviews, at the subjective end sits a worldview called constructivism. The constructivist worldview is typically considered as the basis for the qualitative research approach. The key concept of constructivism is that, instead of the existence of one objective truth, individuals construct varying subjective meanings according to their experiences in the world, and the researcher focuses on this variety of different meanings and views rather than aiming to reduce them into a limited set of categories. Researchers using the qualitative approach thus aim typically at understanding the personal views of individuals as well as their cultural, social and historical backgrounds, usually by collecting data from individuals personally. Generally, the researchers themselves also interpret the information emerging from the data, and accept that their own personal history, worldview and experiences possibly influence that interpretation. (Creswell 2014, p.37-38).

In conclusion, one way of describing the difference between the quantitative and the qualitative approaches is that the quantitative approach focuses typically on studying the relationships of fewer qualities in a large sample of cases, whereas the focus of the qualitative approach is on a greater number of qualities in a fairly small sample of cases. In other words, quantitative research is typically concerned with plenty of cases but with few studiable characteristics,

> ***The quantitative approach focuses typically on studying the relationships of fewer qualities in a large sample of cases, whereas the focus of the qualitative approach is on a greater number of qualities in a fairly small sample of cases***

whereas qualitative research typically addresses fewer cases but many studiable characteristics. It is often observed that the advantage of the quantitative approach is the possibility to generalize the results, and that of the qualitative approach to provide a more holistic picture of a phenomenon. (Groat, Wang 2013, Töttö 2000). In addition to the use of large samples, the generalizability of the results of quantitative research is due to the use of mathematical means to determine probabilities and the objective role of the researcher.

Essentially, it is observed that the quantitative and the qualitative approaches are used for finding answers to different research questions (Creswell 2014, Groat, Wang 2013, Töttö 2000). Thus it is fundamentally the research question that should determine which approach should be used. The choice is then not determined by the type of phenomenon studied, the research topic, the scientific field and not even by the type of research data. (Töttö 2000, p.66). The research data can be refined into studiable form for either of these approaches; in the quantitative approach this is done by registering the numerical values of variables whereas in the qualitative approach this is usually done by means of language (Töttö 2000, p.67). Often the difference between the two approaches is indeed defined in such a way that the quantitative approach uses numbers whereas the qualitative approach uses words (Creswell 2014, p.32).

4.1.2 **ARCHITECTURAL PREFERENCE** AND THE **QUANTITATIVE** APPROACH

The qualitative research approach is often described as in-depth, flexible and human-centred whereas the quantitative research approach can sometimes be perceived as superficial, formalistic and limited (Töttö 2000). Thus a question arises: can the quantitative approach be used for studying architectural experiences such as preference, which are such diverse, holistic and vague research subjects? The first thought may be that in architectural preference "everything influences everything". Architecture itself is an entity; is it sensible or even possible to split it into measurable units of which influence on subjective experiences could be studied by statistical methods? Does the quantitative approach not fit better with constant, non-human subjects such as for studying the laws of physics?

With the question of holism in mind, quantitative methods as we know them today have been described, in fact, as initially being developed for psychological research, which focuses on studying human behaviour and the psyche (Creswell 2014, p. 41). Illustrative of this is that even today the volume "Research Methods in Psychology" (Weiner et al. 2003), one of the 12 volumes of the "Handbook of Psychology", focuses almost exclusively on quantitative research methods. In addition to psychological research, experimental, quantitative methods are customary in medical research, where meta-analyses of multiple randomized controlled experiments are considered as the strongest and the most qualified evidence on which standards of medical practice are based (Ackley, Ackley 2008, p. 7). Yet both human behaviour and physiology are extremely complicated systems consisting of a multitude of interrelated features acting simultaneously. "Everything influences everything" is an apt characterization of both of them: personal

> ***Quantitative methods as we know them today have been described as initially being developed for psychological research***

experience and character influence behaviour, while the acts of different organic systems, such as the hormonal or nervous systems, influence one another. Thus the idea that architectural experience or preference would be holistic to the extent that it would be unreachable by quantitative methods which govern the methodology in other holistic branches of science does not alone appear particularly plausible. In addition, unlike the human psyche or physiology, architecture is human-made; the appearance of a design is determined by the set of choices made by the designer. Thus the idea that these choices could be traced, identified and measured, and further that the relationship of these choices to the subjective experiences of people could be examined by statistical methods, does not alone appear *impossible*.

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> **The idea that architectural experience would be holistic to the extent that it would be unreachable by quantitative methods does not alone appear particularly plausible**

At the same time, it seems clear that by reducing architectural design into a set of variables, many characteristics that possibly influence preference are lost from examination. However, that seems to be true regardless of the chosen research approach; research never seems to achieve to express the truth perfectly. In both quantitative and qualitative research methods, the data are always limited both at the levels of the aspects studied and the size of the sample. Research data are always between the world and the researcher, and can only be a noted, narrow representation of the actual truth. (Töttö 2000). In a sense, choosing a methodological approach is thus also choosing a method of reduction; both limiting examination to fixed variables in the quantitative approach and classifying the findings of an in-depth interview into themes or categories in the qualitative approach, are reductions of reality (Groat, Wang 2013). Fortunately, however, it seems that as research advances, ever more aspects can be included in examination. For example, in the early days of experimental psychology, the first experiments were conducted

with only small sample sizes in psychological laboratories. Today, however, it is possible to conduct experiments with large samples in real environments outside laboratories, which essentially improves the practical significance of individual studies. Better identification and control over confounding factors, development of more coherent statistical methods and the opportunity to collect larger samples have played key roles in this development. However, none of the previous achievements could have been realized without years of building knowledge by the mass of modest experiments in the past. (Weiner et al. 2003).

Even though the qualitative approach enables the researcher to approach their subject holistically without fixed presuppositions and to explore the multiple sides of a phenomenon as they emerge from the data, it has its weaknesses as well. The inadequate preconception for generalizing its results is one of the most criticized features: it has been observed that the information produced by qualitative methods can only cover the particular cases being studied, but more general conclusions remain at the level of mere hypotheses. Contrastingly, the quantitative approach has to be used for verifying which of those hypotheses are true. (Töttö 2000). Even though standards have been developed for evaluating the validity of the results yielded by qualitative studies, they still seem to remain quite unsettled in comparison with the set of quality standards of quantitative research (Groat, Wang 2013). One of the major subjects of dispute with the qualitative approach is the personal influence of the researcher: the risk is that intentional or unintentional preconceptions of the researcher determine how data are interpreted, which again sets challenges for verifying and replicating the results (Metsämuuronen 2009, p.80). Without common, explicit quality standards, comparing and combining the results of individual studies is also problematic.

While quantitative methods involve the difficulty of describing the variables by numerical values and often using a reduced, pre-fixed set of studied variables, they provide better control for the problems mentioned above. Examining the reliability of results is an essential part of statistical analyses and several tools are available for controlling for false conclusions (Metsämuuronen 2009, p.35). Statistical analysis facilitates evaluation of the validity of results, by making it possible for instance to determine whether the findings are connected to the phenomenon in question or if they are only a consequence of random

variation (Metsämuuronen 2009, p.80). “Statistical significance” is a characteristic of a research finding that indicates its reliability and generalizability; it enables the researcher to unravel how likely it is that the result is a consequence of pure chance. Statistical significance is defined by the p-value (probability value) of the result and a predetermined significance level; when the p-value is smaller than the significance level the result is said to be statistically significant. A p-value of 0.05 for instance means that there is a 5% likelihood that the result appears in the sample only due to chance, and thus, in reality, is unrelated to the phenomena under study. A significance level of 0.05 is generally considered as the minimum standard for generalization to a larger population than the sample under study. (Groat, Wang 2013, Metsämuuronen 2009).

The quality standards, procedures and rules of quantitative methods are advanced, and in wide uniform use across researchers, which facilitates comparison and combination of the results of individual studies (Groat, Wang 2013, Creswell 2014). Similarly defined statistical parameters make the results of individual studies comparable to each other. Due to this comparability, combining information from single studies can also be done reliably. Conclusions can then be more reliably drawn from these meta-analyses than from single studies, resulting in the efficient accumulation and refinement of knowledge (Churchman, Bechtel 2002, p. 222-232).

The use of both qualitative and quantitative approaches in architectural research is important; results from the different types of studies can expose the different sides of reality and help to build diverse architectural knowledge. For now, even though the methods within architectural research are diverse, apart from technical research topics the clear emphasis has been on the use of qualitative methods (Groat, Wang 2013). However, narrowing research to a single approach automatically limits the variety of research questions that can be asked; as noted before, the qualitative and quantitative approaches are essentially used for answering different questions (Creswell 2014, Groat, Wang 2013, Töttö 2000). For instance, the question whether a relationship exists between two or more phenomena is best answered by quantitative methods (Töttö 2000, Creswell 2014). As Creswell (2014, p.50) mentions, in terms of the “identification of factors that influence an outcome or understanding the best predictors of outcomes, then a quantitative approach is best”. As for Töttö (2000), he provides the following explanation. The prerequisite for a relationship is that the factors vary together, or in other words correlate. By the qualitative approach it is possible to note the frequent appearance of factors in the data, for instance certain words or themes repeating in an interview, and thus to assume such a relationship. However, verifying whether the kind of relationship really exists between the factors requires the quantitative approach, because the correlation between the factors cannot be confirmed in any other manner. For instance, there is no method of determining how likely it is that the repetition of certain factors in an interview occurs only due to chance. (Töttö 2000).

Results from the different types of studies can expose the different sides of reality and help to build diverse architectural knowledge

Demonstrating relationships is precisely the aim of this study: to explore how certain architectural characteristics influence the experience of preference among people. In other words: does individual preference relate to the presence of certain architectural features, or even, can a correlation be found between certain architectural features and preference? My objective is to study the possible existence of such general regularities that can explain the inclination of people's preference toward certain kinds of architectural scenes. The main focus of this study is not therefore to map out the differences in the architectural preferences of individuals, but rather to find their general similarities. Consequently, for the reasons described previously, I consider the quantitative approach to best fit my research questions.

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> ***Demonstrating relationships is precisely the aim of this study***

I also consider the experimental approach as the most reliable way to collect data in this context. Naturally, many other possible data-collection methods would be possible, but they seem to have more deficits. First, I could interview people on their architectural preferences, but as pointed out in the introduction, verbal self-reports cannot always expose the actual reasons for preference. Even if the interviews were conducted in real apartment environments or by showing people photographs of them, people would still not necessarily be able to verbally define the specific features which make them like some apartments more than others. Therefore the kinds of data-collection methods where the information would emerge freely from the participants themselves would, in my opinion, be non-viable in this case. Besides, collecting data by observing people would certainly be problematic. First, it would be difficult to create circumstances where I could discreetly observe people in apartment environments. In public sales

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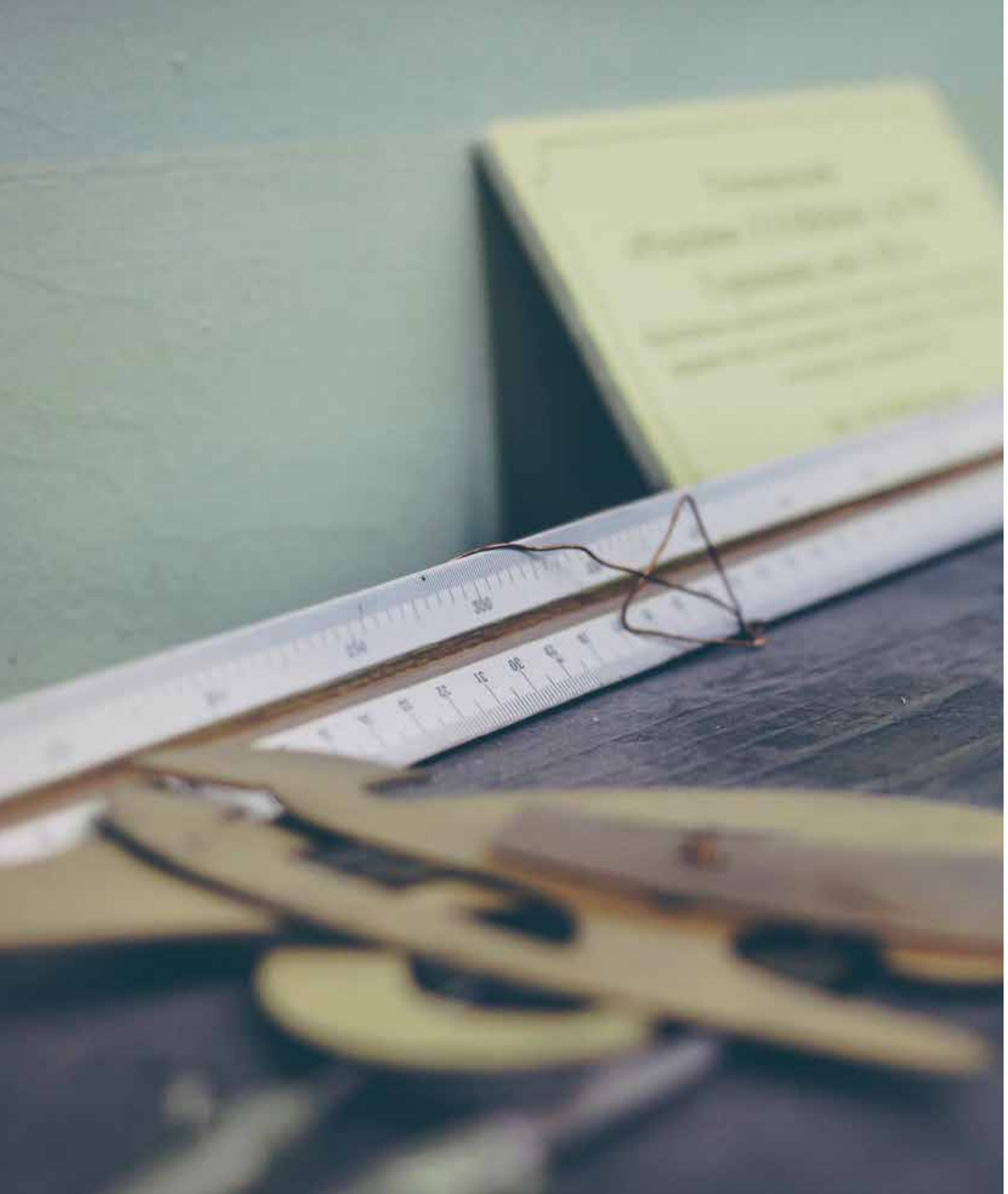
> ***Verbal self-reports cannot always expose the actual reasons for preference***

demonstrations this might be possible, but nevertheless it would be difficult to define the kind of behaviour that indicates visual preference towards certain visual features.

After careful reflection, I have come to the conclusion that the most feasible method to collect data for this study is by using the experimental approach. In this way, it is possible to create specific test material where the presence of the architectural features under study may be controlled and possibly isolated from each other. Consequently, this enables examination of their individual influence on people's experiences. The simplest way to do this is in the form of test images that participants are asked to judge according to their subjective experiences. Statistical analyses can then be used for detecting possible significant correlations between the evaluations of participants and the architectural features studied, stated as architectural variables. In addition, statistical analyses can be used for evaluating the consistency of participants' answers, and the reliability of results obtained. The task of forming a set of images and giving numerical values to architectural features will certainly be challenging. However, as values for architectural variables will be defined by the same rules in every image, an objective way to explore their influence is provided. Even though a multitude of possible ways is available to define the values of architectural characteristics in the images, one way will be chosen and this will be applied systematically the same way to each image.



4.2 RESEARCH **DESIGN**

4.2.1 TEST IMAGES

I generated a total of 43 test images (see Appendix 1) to be used as test material. The images were created by computer software commonly used by architects; Graphisoft Archicad (version 18), Artlantis Studio by Abvent (version 6) and Adobe Photoshop (version CS6) (Figures 11-12). Creating the images especially for the experiment instead of using photographs from real apartments had several advantages. First, the amounts and combinations of architectural features (Table 1) could be adjusted in the images so that their effect could be examined and compared. In addition, it was possible to embed in them extreme amounts of complexity which would have been difficult if not impossible by using real environments. Second, it was possible to control for environmental conditions (geographical orientation, amount of lighting, time of day) and to avoid bias coming

from differences in them. Third, the image quality, such as the number of pixels, contrast, lightness or sharpness, was easy to control for, which resulted in images of the same size and with the same resolution, contrast and brightness. The same camera angle, lightning, geographical orientation and window scene were used for all of the images created. An eye-level view (160 cm height) was adopted for all the images. Additionally, using artificial images instead of real environments decreased the chance that the spaces would be recognized by subjects or that these would be familiar to them, thus avoiding specific associations with memories that would affect preferences.

> **“The images were constructed so that, apart from the feature that was to be measured by the image, other architectural features endeavoured to remain constant**

The images were constructed so that, apart from the feature that was to be measured by the image, other architectural features endeavoured to remain constant. For instance, when measuring the impact of mere window size, other attributes such as room size, level of detail or symmetry value remained the same. Therefore window size was the only attribute to change throughout the image series, and the impact of that attribute alone was measurable. Nevertheless, it was not always possible to change only one attribute, as many of the chosen attributes were strongly interconnected. For example, when studying the impact of difference in building element types (images 29-32), reducing the number of windows unavoidably reduced window surface size, too, as the number of elements and single window sizes were kept constant.

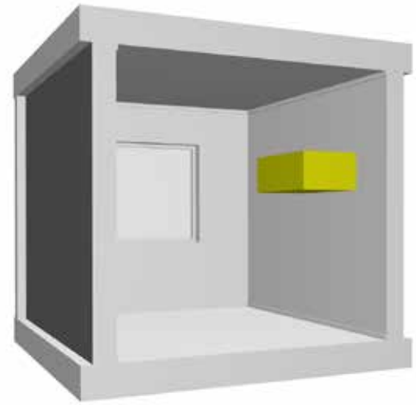


Figure 11. An example of an Archicad model of one of the test rooms. The yellow box is used for positioning the camera to the same location in each room in Artlantis.

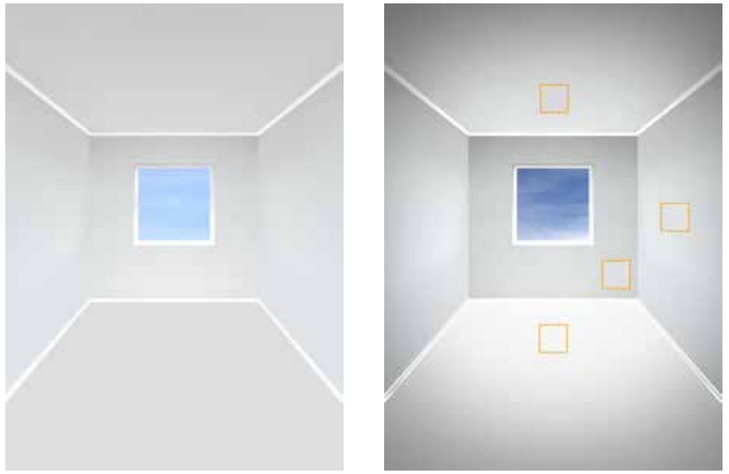


Figure 12. Left: The rendered image from Artlantis. Right: The same image refined in Photoshop. The background picture has been changed, contrast added, and color swatches (here framed for the visibility) used for adjusting the color and luminance the same in every image

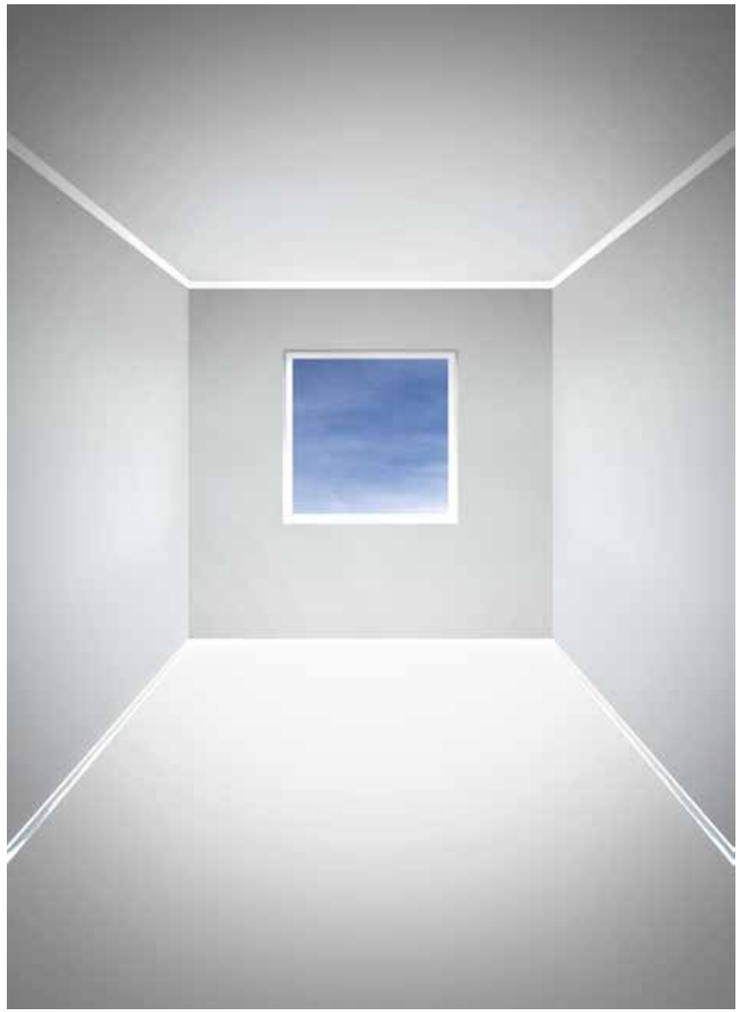


Figure 13. Image 1 that acted as the basis for all other images in the set

4.2.1.1 ARCHITECTURAL VARIABLES IN TEST IMAGES

As described in the introduction, one general limitation in the research findings on environmental preferences seems to be a lack of concrete physical, applicable architectural measurements. This is perhaps also an obstacle explaining lack of use of these research findings in architectural education and practice. To my knowledge, no particular instrument to measure the visual features of apartments yet exists. Forming these measurements for this study is thus a great challenge; the amount of possible ways to define and separate architectural features in an apartment scene seems to be infinite. In addition, the variables have to be simple enough so that they can be described by numerical values and so that their correlations to subjective evaluations of preference, complexity and order can be examined. This also sets limitations on the images: they have to be simple enough so that the variables can be defined from them as explicitly as possible.

Eventually, I considered the best approach was to construct an extensive, mixed collection of different architectural variables, including any that I regarded as potential. A large set of variables would be more likely to establish potential variables that can be further used and examined in future research. From the multitude of possible ways to define individual architectural features, I had to choose those that appeared the most useful, and apply them to every image as systematically as possible (Appendix 2). Some of the variables were easier to define than others. For instance, it was quite easy to determine whether an image was symmetrical or not, whereas it was much more difficult to define the presence of Gestalt principles or classical proportions. Consequently, for the latter cases I considered the best approach would be to create several different variables to find out which of them, if any, would show out to be the best predictors. Nevertheless, the set of variables created for this study presents only one way to categorize architectural features in architectural scenes and cannot

be considered as definitive. However, I hope that it will provide a useful basis for similar studies in the future.

The reader may notice that the appearance of apartment interiors presented by images deviates from that of ordinary apartment stock and is quite unusual compared to what people may typically be accustomed to seeing. The intention here is to avoid associations with existing apartments; for instance, if some of the images were to strongly resemble the home of a subject, or the living room of a subject's parents, the subject might evaluate it differently for these reasons and not on the basis of the pure visual characteristics of the space. The same applies to intentionally avoiding use of identifiable architectural styles; because the influence of certain building styles is not the focus of this study, associations of styles with certain periods, locations or social matters might also bias the results. An exception to this is the series of images created to study the influence of decoration, where classical style is intentionally adopted. Perhaps a better choice would have been to create a style of decoration that does not resemble any existing decorative style. However, in addition it would have been very difficult, while the subjects might not have identified it as decoration. Therefore I found it better to use classical decorative style, which most likely would be intuitively identified as decoration by the subjects.

The basis for all the images is Image 1 (Figure 13), which is modified according to each variable. Image 1 aims to be neutral and typical in every aspect; its room height corresponds to the typical room height in current apartment production in Finland (2700 mm), and it has one medium-sized window with a standard amount of detail and with only one windowpane. As decorative elements there are only simple mouldings on the ceiling and on the floor, again being considered as a typical amount of decoration in current housing production. The cross-sectional shape of the room is a square, as is also the shape of the window, in order not to emphasize any direction in particular. For the same reason, the window is situated at the horizontal centre of the room. Vertically, a height of 900 mm is adopted for the bottom of the window, which again could be said to be typical of current domestic housing production.

4.2.1.1.1 Room Height

As the literature indicates that features such as "openness", "extent" or "prospect" (Kaplan, Kaplan 1989, Appleton 1975) are predictive of environmental preference, I considered room height to be one fitting equivalent to these measures in the apartment context. A desire for high rooms is also commonly perceived as well as experimentally demonstrated (Baird, Cassidy & Kurr 1978). I thus created three images to measure room height in particular; one with excessive room height (3700 mm, Image 2), one with a room height standard to current Finnish housing construction (2700 mm, Image 1) and one with the lowest permitted room height under Finnish building law (G1 Suomen rakentamismääräyskokoelma 2004, p. 5) (2500 mm, Image 3). The window in all of the images was the same size, shape and equidistant from the floor.

Image 1

Image 2

Image 3

4.2.1.1.2 Verticality and Horizontality

The vertical layout of windows and vertical emphasis in room shape seem to be rather typical in traditional architecture, whereas horizontal elements such as ribbon windows could easily be argued as being typical of housing production at least in early modernism. It is also suggested that horizontal and vertical axes would not be managed perceptually in an equal manner, but the vertical elements would be overplayed (Petrovski 1973 p.328).

The impact of mere verticality and horizontality appeared in the images in two ways: first at the building element level by creating one image with a horizontal window (Image 6) and one with a vertical window (Image 4). The images were otherwise similar to Image 1. Second, the horizontal or vertical direction was emphasized within the room form that was adapted in the same direction as the window, whether horizontal (Image 7) or vertical (Image 5). Images with both window and room form shaped in the same direction can also be considered as obeying the Gestalt law of form similarity. In all of these cases, the window surface area remained the same as in other comparable images.

The variables "Verticality in Windows" and "Horizontality in Windows" were created to indicate the directional appearance of windows, while "Horizontality in Room Shape" and "Verticality in Room Shape" indicated an emphasis on room form. The sum variables "Verticality" and "Horizontality" were also created, and these were given the value "yes" whenever the emphasis was on the image on either of the directions. The variables "Neutral Window Shape" and "Neutral Room Shape" were included to indicate the absence of emphasis on any direction.

4.2.1.1.3 Vistas

Long vistas - either from room to room or room to outside - have been considered important features in apartment preference (Nylander 2002, p. 25-33). Vistas can also be interpreted as corresponding to the measures of "openness" and "extent" from attention restoration theory (Kaplan,

Image 4

Image 6

Image 5

Image 7

Image 8

Image 9

Image 10

Image 11

Image 12

Image 13

Kaplan 1989) as well as those of "prospect" from prospect and refuge theory (Appleton 1975) as they broaden the visual scope. Vistas can also be thought to be associated with the Kaplans' (1989) "mystery" by its definition; vistas can hint that there is more to be seen than is immediately apparent when moving towards the windows or doors that provide the vistas.

I considered every image with one or more windows or doors to have vistas. I created variables for each of these types; the "Number of Doors" and "Number of Window Directions" measure directly the impact of the mere number of vistas within both building element categories. I also created a sum variable "Total Number of Directions" of the first two variables to measure the overall effect of any type of vista.

In addition, I created a set of five images to study the mere impact of the directions of vistas through doors. I considered a door to be a better supplier of vista than a window because it conveys a possibility to move in space and thus potentially contribute to the Kaplans' mystery. The images were constructed by placing a doorway in one or more of the walls. This way vistas to one side (right, Image 8), both sides (left and right, Image 9), front (Image 10), to one side (right) and front (Image 11) and both sides and front (Image 12) were tested. Additionally, a vertical vista was included by adding an image with an opening in the ceiling (Image 13). Corresponding variables are "Passage Direction to the Front", "Passage Direction to the Left", "Passage Direction to the Right" and "Direction Up". The images of this series are the only images where windows are excluded entirely. This was done because showing a window on any of the walls would have placed the vistas in an unequal position, as perhaps a direction with a window would have biased the evaluation.

The set of variables concerning vistas may seem complicated but overall it enabled examination of both the impact of the mere number of vistas from the room, ignoring their directions or types, as well as the impact of mere directions but ignoring their total number.

4.2.1.1.4 Window Surface Area

The presence of windows in a room has been demonstrated to associate positively with preference ratings (Kaye, Murray 1982). Window size can also be seen to relate to the measures "openness", "extent" and "mystery" for the same reasons as discussed previously with vistas. Window surface area might associate with the strength of these measures. Large windows are also typical and valued elements in contemporary architecture.

The total window surface area in the images was measured by the variable "Window Surface Area" with four categories: "No windows", "Small window surface area" (< 1m²), "Medium window surface area" (1m²-2m²) and "Large window surface area" (> 2m²). In addition to all the other images with different amounts of window surface areas, I created three images to study mere window size alone; one with a small window (Image 14), one with a medium-sized window (Image 1) and one with a large window (Image 20). All the windows in this series were of the same shape (square) and placed in the horizontal centre of the opposite wall.

4.2.1.1.5 Visual Grouping of Elements

Visual grouping relates directly to Gestalt laws and to the concept of comprehending the environment. The Kaplans' "coherence", for instance, refers to a manageable number of major visual regions in a scene (Kaplan, Kaplan 1989, p. 54). In the literature it has been suggested that visually grouped elements would be extracted faster from the visual field (Goldstein 2002, p.156) than non-grouped ones and their visual processing would require less effort, which might again lead them to be judged as more pleasant than randomly arranged figures.

Image 14

Image 1

Image 20

I created two image pairs to test the possible effect of grouping in particular. One of the pairs examined the grouping of elements (windows) and the other the grouping of surface decoration. In the case of window grouping, the image with non-grouped elements included separate windows differing in size and orientation placed randomly on every wall of the room (Image 15). In the image of grouped elements, the same windows on each wall were grouped so that they fitted inside a common frame and their outer contours formed one rectangle, thus expressing the Gestalt principle of a common visual region (Image 16). The reader might feel disturbed about the obvious clumsiness of the composition of windows in Image 15. This is probably due to avoiding use of any classical proportions in the relations of the individual windows as well as in their relations to each other or the room shape (read more at Chapter 4.2.1.1.7)

In the image pair where the grouping of decorative elements was supposed to be examined, the image with non-grouped elements had decorative elements (thin wall mouldings) placed randomly on the walls and on the ceiling of the room. In addition, the floor was segmented into randomly-sized sections (Image 39). Contrastingly, in the image with grouped elements (Image 40) the decorative mouldings were arranged so that they formed regular rectangles on the walls and on the ceiling. As the moldings were thus connected to each other and of the same shape and size, the arrangement could thus be seen to obey

Image 15

Image 16

Image 39

Image 40

the Gestalt laws of connectedness and similarity. The mouldings were all of the same length, number and thickness that in its non-grouped equivalent (Image 39). Additionally, the segmentation of the floor was made out of equal-sized pieces, grouped thus by the Gestalt law of similarity (Image 40). Room size and height remained the same in both images, as did window shape, size and position.

I thus created a variable "Grouping" to measure the effect of visual grouping, which adopted the value "yes" whenever a grouping in the sense defined above was present. Consequently, any window divided into windowpanes as well as a regular rectangle formed from the surface mouldings were considered as grouped elements, and their presence in an image automatically resulted in a "yes" value in the variable. Images that contained only one building element (such as only one window) were also given the value "yes", because it was considered as forming only one visual region. In order to study the Gestalt law of similarity, in particular "Size Differences Between Visual Elements" was also introduced in the variable set; elements with different sizes follow the law of similarity poorly. Also a variable called "Miscellaneous Window Forms" was created to study this effect on windows.

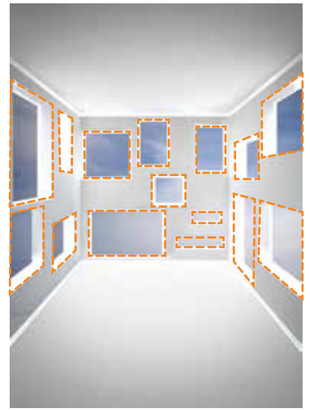


Figure 14. "Element Levels" signifies the total amount of horizontal element levels

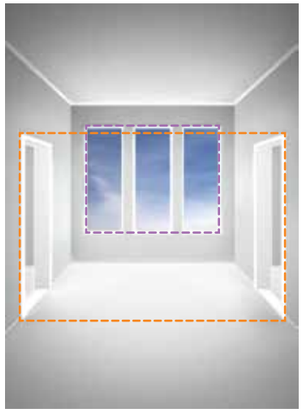


Figure 15. "Element Alignments" signifies the amount of aligned levels of elements

Still two more variables to measure the visual grouping were created, called “Element Levels” (Figure 14) and “Element Alignments” (Figure 15). With these variables, I aimed to examine the influence of the Gestalt laws of the good continuation and closure in particular. “Element Levels” indicates the number of horizontal levels on which the elements are situated, and “Element Alignments” specifies the number of those levels that are aligned. Thus, if the elements are situated on many different levels in the image, the variables have high values. Consequently, these kinds of layouts can be considered as inadequately following the Gestalt laws of good continuation and closure.

4.2.1.1.6 Bilateral Symmetry

I considered “Bilateral Symmetry” an essential variable to be included in the experiment, as it has been demonstrated to facilitate comprehension of visual information (Tyler 2000, Locher, Nodine 1989, Ramachandran, Hirstein 1999). In addition, the presence of bilateral symmetry is a striking difference in the typical expression of traditional and contemporary architecture, and thus has to be considered as a potential explainer for the tendency of people to prefer traditional styles. To make the definition as unambiguous as possible, I decided to give the variable “Bilateral Symmetry” the value “yes” whenever there was an absolute bilateral symmetry in the image.

Because the images aimed to be similar in every other aspect except for the variable under examination, most of the images were symmetrical, as was Image 1. However, I created seven bilaterally asymmetrical images, of which three had equal symmetrical counterparts. In the first pair, an equal number of random-sized windows were placed on three walls. In the asymmetrical image they were randomly arranged on each wall (Image 15), and in the symmetrical image they were arranged according to bilateral symmetry (Image 17). In the second pair studying symmetry, there were three windows of the same size and outer contour, as well as of the same number of windowpanes, placed one on each of the three visible walls. In the asymmetrical image, the windows were placed at the horizontal axis randomly; thus

Image 15

Image 16

Image 26

Image 17

Image 18

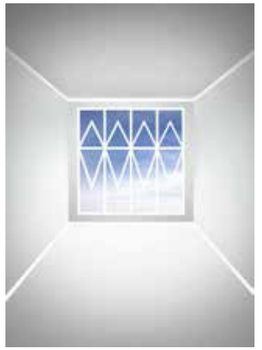


Image 25

no bilateral symmetry was obtained. In addition, the segmentation of the windows was random (Image 16). In its symmetrical counterpart, the windows were placed symmetrically on the walls and their segmentation was bilaterally symmetrical, too (Image 18). The third image pair examined the impact of symmetry on the level of detail, here in the case of windowpanes. In both images there was a large window on the opposing wall. This was divided into rectangular and rhombus-shaped windowpanes; the difference being that in the asymmetrical image one rhombus-shaped windowpane was placed upside down and moved lower, thus breaking the bilateral symmetry (Image 26), whereas in the symmetrical image the arrangement was symmetrical (Image 25). In both images, the window had a total of sixteen windowpanes, and the size and position of the window was the same.

4.2.1.1.7 Classical Proportions

Harmony of proportions has been described as being one of the major principles of architectural aesthetics, especially concerning the architecture of the classical period. This praxis, at least intentionally applied, seems to have disappeared to a great degree in contemporary practice. Certain simple proportions, such as the golden ratio, have been suggested as facilitating interpretation of visual information.

In this study, I defined harmonious, classical proportions as the simple ratios of small whole numbers (1:1, 1:2, 1:3 and 1:4) as well as their combinations (2:3, 3:4) as itemized in the literature. The golden ratio (1.618) was also included in the definition. The variable "Classical Proportions in Elements" measured the impact of classical proportions at the building element level, and was given the value "yes" whenever the width-height ratios of the building elements in the image were classical. In contrast, the variable "Classical Proportions in Element / Room Layout" measured the impact of classical proportions between the elements and the room dimensions. This was given the value "yes" whenever the ratio between the dimensions of the room and the elements was classical, either in the horizontal or vertical direction. The sum variable, "Classical Proportions" was given the value "yes" whenever classical proportions were applied in any previously described way. The way of measuring the proportions is presented in Figure 16.

There were two pairs of images that I created to study the impact of classical proportions in particular. The first pair of images studied the feature in a very simple manner. There was only one rectangular, medium-sized, vertical window with one windowpane on the opposite wall in both images. The surface area of the windows in both images was equal. In the non-classical proportions image (Image 4), the width-height ratio of the window was chosen at random (1:2,5333…), whereas it was classical in the second image (2:3) (Image 37). The second pair of images strives to examine the impact of classical proportions on a slightly more complicated level. In both of the images, there were three windows, one on each of the three visible walls, of the same surface area and the same number of windowpanes. Both were bilaterally symmetrically arranged. In the image with classical proportions, the width-height ratios of the windows (1:2), the

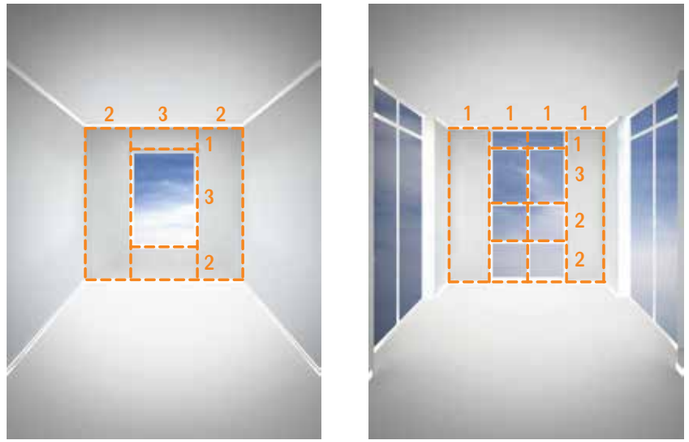


Figure 16. Examples of applications of classical proportions to images

Image 4

Image 18

Image 37

Image 19

ratios of the windowpanes (1:1, 2:3, 1:4) as well as the proportions of the window/room layout at the horizontal level (1:2:1) were all arranged according to classical proportions (Image 19), whereas they were chosen at random in the corresponding image without classical proportions (Image 18). Together with Images 15 and 16, these four images also formed a comparable series to study the composition of elements more broadly: Image 15 without grouping, symmetry or classical proportions, Image 16 with grouping but without symmetry or classical proportions, Image 18 with grouping and symmetry but without classical proportions and Image 19 with grouping, symmetry and classical proportions.

4.2.1.1.8 The Number of Black Pixels

As counting individual line segments, contours or the number of angles from the test images would not have been possible in a reliable way, I considered the other simple, objective measure presented in previous studies, the number of black pixels, to be a potentially useful variable for use in this experiment. The percentage of black pixels in a line drawing has previously been used successfully to predict subjective judgements of the amount of architectural detail (Stamps 1999a). As all the images in this experiment were of the same size and resolution, and of the same contrast and lightness, I could to use the absolute values of black pixels in each image to create the variable “Number of Black Pixels”.

The number of black pixels for each image was computed by transforming the images to binary black and white line pictures. This was done by first changing the colour mode of the images to grayscale, and then using the “find edges” command in Adobe Photoshop CS6. ImageJ software was then used to convert the images to binary mode (including only black and white pixels) and to count the number of black pixels. The range of values of this variable was from 27,887 (Image 36) to 884,835 (Image 43).

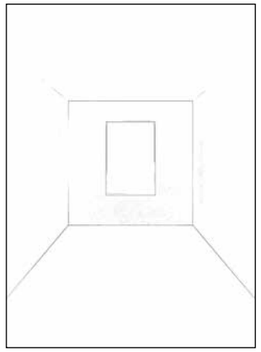


Image 36 (binary)

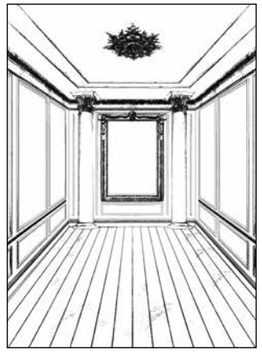


Image 43 (binary)

4.2.1.1.9 The Number of Building Elements

Complexity has often been defined simply as the number of visual elements in the scene (e.g. Kaplan, Kaplan 1989, Birkhoff 1933). The number of visual elements has been considered as an apt predictor of complexity as the more visual elements there are, the more information and possible variation there can be (e.g Berlyne 1958 p.291).

I created several variables to measure the impact of the mere number of visual elements, which I considered equal to the number of building elements in the context of apartments. Variables were created for each building element type that appeared in images. The variables "Number of Windows" and "Number of Windowpanes" were created to study whether one would be a better predictor of complexity than the other. I also created

a sum variable out of the two previously mentioned, called "Number of Windows + Number of Windowpanes" to measure their joint effect, as well as the variable "Number of Windowpanes / Number of Windows" to measure the impact of their ratio. "Number of Doors" has already been discussed along with vistas. "Amount of Ornaments" measured the number of elements that are supplementary to functional elements such as windows and doors. Each element that would have to be individually fixed in place during construction was counted as one; for instance, three mouldings on the ceiling and three mouldings on the floor would result in the value 6 in the variable "Amount of Ornaments". The variable "Number of Building Elements" summed up all the previously presented variables, thus resulting in the total number of building elements in each image. The variable "Number of Building Element Types" indicated how many categories of building elements were present in each image; thus, for instance, an image with three windows and two doors (Image 30) was assigned a value of 5 for "Number of Building Elements" and a value of 2 for "Number of Building Element Types". Images 29, 30, 31 and 32 were created especially to study the impact of building element types. The number of building elements in these images was the same in each, but the number of building element types varied from 1 to 3.

Image 20

Image 21

Image 23

Image 29

Image 30

Image 31

Image 32

4.2.1.1.10 The Number of Forms

One way of managing visual information is through specialized neural cells that respond to the different orientations and shapes that appear in the visual field. The challenge partly emerges at the higher level of visual processing where this information has to be integrated; the more the different visual components, the more burdensome is combining them. Therefore, when looking at environments with several different orientations, such as different diagonals, or forms, such as both curved and rectangular forms, more of these specialized neural cells are activated and thus it could be likely that more perceptual effort would be required. Furthermore, binding more visual information at a higher level of visual processing to form a unitary perception is more effortful the more information needs to be captured. Natural scenes, which have frequently been shown to be preferred over urban ones, contain many different forms. For these reasons, I considered the variety of forms as a potential predictor of complexity in the architectural context, and the variables “Curved Forms” and “Diagonal Forms” were introduced in the images. “Rectangular forms” was not

Image 34

Image 35

Image 33

Image 27

Image 25

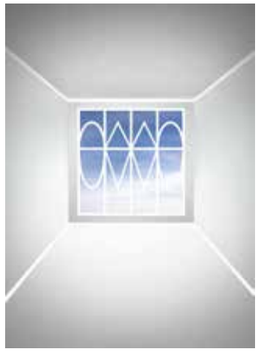


Image 28

Image 24

Image 42

Image 41

included as rectangular forms appeared in all the images (for instance, the plan of the room was always rectangular) and thus the variable would always have obtained the value “yes”. Additionally, the sum variable “Number of Forms” was created to test the effect of the mere amount of different categories of forms that appeared in a scene.

Three series of images were created especially to measure the influence of the variety of forms. The first of these aimed to measure the effect of different forms comprehensively at the level of room and element shapes; the first image with curved shapes on the roof, windows and doors (Image 34) and the second with diagonal shapes in corresponding parts (Image 35). Another image - otherwise similar to the two others - had only rectangular forms (Image 33). The second series of images aimed to study the influence of variety of forms at a more detailed level: in the case of windowpanes. One image was created with round windowpanes (Image 27), one with diagonal windowpanes (Image 25) and one with both (Image 28). There was also a corresponding image with the same number and ratio of rectangular windowpanes (Image 24). The third pair of images measured the influence of different forms at the level of detail; the first image had much decoration consisting of only rectangular forms (Image 42), while the second was otherwise similar but including all three types of form (Image 41).

4.2.1.1.11 Level and Type of Decoration

The discussion about independent decoration and additive ornaments as a source of visual complexity frequently repeats in the literature on environmental aesthetics. The use of ornament is also one of the major features that typically separates traditional and contemporary architectural styles from each other, and thus must be considered as a potential reason for the preference of the general public towards traditional styles. In addition, decorative elements in traditional architecture often carry comprehensible meanings or associations, such as when they take representative - for example, natural - forms. These associative elements might help in "taking one's mind elsewhere", thus supporting the experience of "being away", an element of restorative environments according to attention restoration theory from the Kaplans (1989, 1995). While invoking associations and thoughts of other places, their presence could increase cognitive activity and "fascination" (Kaplan, Kaplan 1989, Kaplan 1995).

I created six images to study the influence of decoration on subjective experiences of complexity, order and preference. As the principles of classical style have been introduced in more detail previously in this book, I adopted the classical style for all the highly decorative elements in the images, too. The variable "Level of Decoration" in fact involved six levels: "none", "normal", "increased", "high 1", "high 2" and "high 3". The value "none" was given to an image with no decorative elements at all (Image 36), "normal" for those with a decoration level typical of contemporary housing architecture (e.g. Image 37), "increased" to those with profiled mouldings (Image 38), "high 1" to images with profiled mouldings and surface decorations (Image 40) or sculptured

Image 36

Image 37

Image 38

Image 40

Image 41

Image 43

elements (Images 31 and 32) and “high 2” to images with profiled mouldings, surface decorations and sculptured elements (Images 41 and 42). The value “high 3” was given to images with the same elements as in “high 2” but instead of the decorative elements being geometric, in “high 3” they were associative, presenting natural and human motifs (Image 43). As sculptured elements such as columns or sculptured motifs are quite unusual in current housing, I created an extra variable “Number of Sculptured Elements” to separate its influence from that of other decorative elements if needed.

Table 1. List of the architectural variables determined for each image

Variable name	*Type*	*Scale*
Number of Black Pixels	Ordinal	27 887 - 884835 (∈ Z)
Number of Building Element Types	Ordinal	0 - 3 (∈ Z)
Number of Doors	Ordinal	0 - 3 (∈ Z)
Number of Windows	Ordinal	0 -15 (∈ Z)
Number of Windowpanes	Ordinal	0 - 16 (∈ Z)
Number of Windows + Number of Windowpanes	Ordinal	0 - 30 (∈ Z)
Number of Windowpanes / Number of Windows	Ordinal	1 -16 (∈ Z)
Amount of Ornaments	Ordinal	0 - 225 (∈ Z)
Number of Sculptured Elements	Ordinal	0 - 11 (∈ Z)
Number of Building Elements	Ordinal	6 - 229 (∈ Z)
Bilateral Symmetry	Dichotomous	Yes, No
Classical Proportions in Element / Room Layout	Dichotomous	Yes, No
Classical Proportions in Elements	Dichotomous	Yes, No
Classical Proportions	Dichotomous	Yes, No
Curved Forms	Dichotomous	Yes, No
Diagonal Forms	Dichotomous	Yes, No
Number of Forms	Ordinal	1 - 3 (∈ Z)
Element Alignments	Ordinal	0 - 6 (∈ Z)
Element Levels	Ordinal	0 - 70 (∈ Z)
Grouping	Dichotomous	Yes, No
Level of Decoration	Ordinal	None, Normal, Increased, High 1, High 2, High 3
Room Height	Ordinal	2500, 2700, 3000, 3700
Horizontality in Room Shape	Dichotomous	Yes, No
Horizontality in Windows	Dichotomous	Yes, No
Horizontality	Dichotomous	Yes, No
Verticality in Room Shape	Dichotomous	Yes, No
Verticality in Windows	Dichotomous	Yes, No
Verticality	Dichotomous	Yes, No
Neutral Room Shape	Dichotomous	Yes, No
Neutral Window Shape	Dichotomous	Yes, No
Miscellaneous Window Forms	Dichotomous	Yes, No
Size Differences Between Visual Elements	Dichotomous	Yes, No
Number of Window Directions	Ordinal	0 - 3 (∈ Z)
Passage Direction to the Front	Dichotomous	Yes, No
Passage Direction to the Left	Dichotomous	Yes, No
Passage Direction to the Right	Dichotomous	Yes, No
Direction up	Dichotomous	Yes, No
Total Number of Directions	Ordinal	1 - 3 (∈ Z)
Window Surface Area	Ordinal	No windows, Small (<1m2), Medium (1-2m2), Large (> 2m2)

4.2.2 EVALUATIVE VARIABLES

Successfully operationalizing the variables is an important precondition for the success of an experiment. Therefore, operationalizing the variables to be measured was done through meticulous reflection. As all the subjects were intended to be Finnish, the questionnaire and instructions were presented in Finnish in order to ensure that subjects would fully comprehend them. As a result, the evaluative variables "complexity" "order" and "preference" had to be translated into Finnish. They also had to be rephrased into colloquial language so that non-architect test subjects would easily understand them, and would then give answers to the questions they were supposed to. Translating "preference" directly into the Finnish language was not successful as "preferenssi" is not considered as good literary language and it cannot be well modified into any bipolar adjectives. Instead, I found the term "Pleasantness" ("miellyttävyys" in Finnish) more fitting.

Nor did I find using mere "complexity" and "order" suitable to be used as evaluative terms directly in this experiment. The term "complexity" describes the amount and variety of visual information well, but it may not be able to sufficiently cover the cognitive levels of "fascination" or "mystery" emphasized by the Kaplans (e.g. 1989) and other environmental psychologists; a line drawing of a face can be visually simple, but it is more likely to catch attention than the same lines arranged into a random figure.

I wanted to choose the term for "complexity" so that it would cover all the features that can hold the viewer's *attention* as extensively as possible. I reflected on several terms to substitute "complexity"

> ***"Interestingness" is a term that has been directly referred to fascination and involuntary attention***

> ***I chose to use the term "Spatial Organization", as I thought it might associate better with the order of spaces presented by the images, not for example the clarity or legibility of the images themselves***

and ended up using "Interestingness" ("mielenkiintoisuus" in Finnish). "Interestingness" is a term that has been directly referred to fascination and involuntary attention by Kaplan (Kaplan 1988b, p.58). Besides, in some previous studies "interestingness" has been strongly linked with arousal (e.g. Lang 1987, p.96), and Lang (1987, p.185) has directly interpreted Berlyne's arousal level to be related to the "interestingness" of the environment. Moreover, Nasar (1988d, p.266) has interpreted "interestingness" to correspond to *attention*. In addition, "interesting-boring" and "interesting-uninteresting" scales have been used in some previous experimental studies on environmental preferences (Nasar 1988b, Hare 1974b). I considered "interestingness" as a good term also because it might be quite intuitively understood by subjects.

The direct translation of "order" into Finnish would be "järjestys" and that of "disorder" would be "epäjärjestys". However, unlike in English, their adjectival versions in Finnish (järjestynyt, epäjärjestynyt) are poor linguistically and probably would not be intuitively quite well understood. I therefore chose to use the term "Spatial Organization" ("tilallinen selkeys" in Finnish), as I thought it might associate better with the order of spaces presented by the images, not for example the clarity or legibility of the images themselves. "Selkeys", the Finnish translation for "organization", might also describe the success of "comprehending the scene" better than the term "järjestys" which might relate more to mere physical arrangements.

As a result, three evaluative variables, by which the images would be assessed by subjects, were formed: "Interestingness", "Spatial Organization" and "Pleasantness", with their corresponding evaluative scales being "boring-interesting" (tylsä – kiinnostava), "disorganized-organized" (sekava – selkeä), and "unpleasant-pleasant" (epämiellyttävä – miellyttävä).

4.2.3 THE QUESTIONNAIRE

On the first page of the questionnaire (see Appendix 3) were questions on the background to the subject. The demographic questions enquired the subject's age, gender and previous education. The subjects were also asked to report whether they had been given any art training in addition to mandatory art training at elementary school. They were also asked to report the duration (in years) and the provider of their artistic training. Within this question, the subjects were further instructed in the experiment to report any art training, including music or dance, and to clearly state the field of art in their answers. Another question asked subjects to estimate their level of interest in the arts, architecture or housing interior design on a scale of 1 to 5 (1= not at all interested, 5=very much interested). Within this question, the subjects were instructed to concentrate especially on visual aesthetics in their answer, so that other art forms, such as music or dance, were not included in their answers. Other pages of the questionnaire contained 5-point likert scales for each image and evaluative variable (Interestingness, Spatial Organization and Pleasantness). During the experiment, the subjects were asked to evaluate each image there according to the three evaluative variables.

Table 2. Frequencies of the highest background education types of subjects (all subjects were also highschool graduates).

	Frequency	***Percent***
University of Applied Sciences	4	3.7
University, Bachelor	8	7.5
University, Master	2	1.9
University, Doctor	2	1.9

4.2.4 THE SUBJECTS

The sample was composed of one hundred and seven (107) students at Tampere University School of Medicine. Fifty of the subjects were female, 57 were male. Their average age was 22 years five months with a range of 18 years (from 19 to 37 years). All the subjects were studying medicine for the first year in Tampere, many of them having moved there from various parts of Finland during the semester. All the subjects had completed high school and in addition 3.7 % (n=4) of them had completed a training programme at a University of Applied Studies, 7.5 % (n=8) were Bachelors of Science, 1.9 % (n=2) were Masters of Science and 1.9 % (n=2) were Doctors of Science as their highest level of background education in a study field other than medicine (Table 2).

As potential homebuyers in the future, young university students were regarded as a suitable subject group for the experiment. Most importantly, the group was considered to be quite heterogeneous in terms of visual preferences, as there was no specific reason to assume that medical students would differ greatly from other people in that sense. I also considered young university students to be suitable for testing intuitive responses to the aesthetics of architecture, as it was unlikely

Table 3. Gender distribution within subjects with freetime artistic training

	Visual arts		Music		Other	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Female	8	80	11	45.8	3	75
Male	2	20	13	54.2	1	25
Total	10	100	24	100	4	100

that they would have much experience from housing construction or the housing business, which would possibly bias their intuition. In addition, they were perhaps the largest group that I had a realistic chance with my resources of gathering in the same test circumstances at the same time.

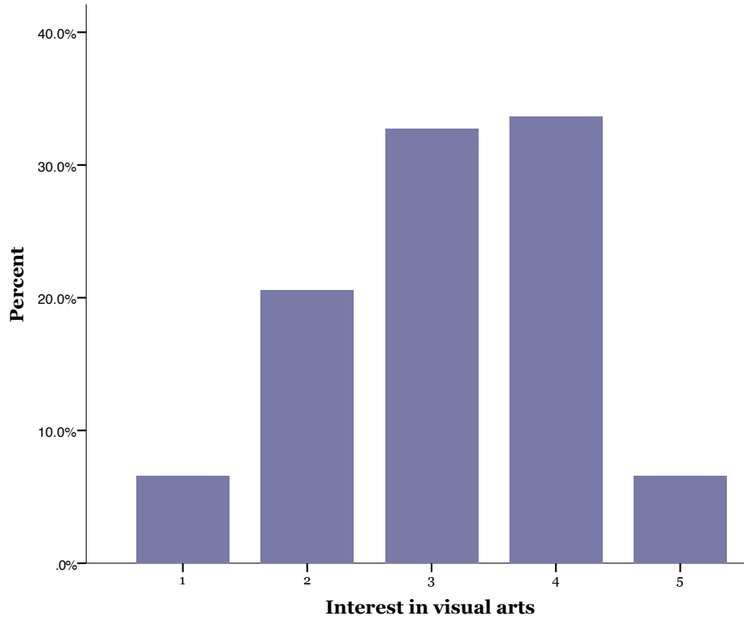


Diagram 6. Distribution of interest in visual arts as reported by the subjects (mean 3.13). 1= not at all interested, 5=very much interested

“

The sample was composed of one hundred and seven (107) students at Tampere University School of Medicine

None of the subjects reported having professional training in architecture or the visual arts. Subjects were asked to report both their level of interest in the visual arts and also whether they had previously had any casual art training. Some 9.3 % (n=10) of the subjects reported having had free-time training in the visual arts, 22.4 % (n=24) in music and 3.7 % (n=4) in some other kind of arts such as dance, theatre or improvisation. Some 64 % (n=69) reported having had no artistic training of any kind. Some of the subjects had participated in artistic leisure activities in several different fields, but only the one with longest duration was taken into account in this examination. As can be seen from Table 3, there were considerably more women (80 %) than men (20 %) in the subgroup of subjects with a visual arts background as well as in the subgroup of subjects with some “other” kind of artistic background (75 % females and 25 % males), whereas in the subgroup of musically artistic people the gender distribution was more even (45.8 % females and 54.2 % males). The distribution of the subjects’ interest in the visual arts is presented in Diagram 6.

In further analyses of the data, four subgroups were studied separately: men, women, subjects with free-time training in the visual arts (from hereon called “subjects with an artistic background”) and subjects with no artistic training of any kind. The sample size of subjects with an artistic background was quite negligible (n=10) but I wanted to conduct some separate analyses with their answers, because some previous studies have indicated preference differences between visually artistic people and laypeople (e.g Wilson 1996, Nasar, Kang 1989, Akalin et al. 2009, Purcell 1986). However, the results of these analyses have to be seen as only preliminary, as the sample size is so small. Subjects with musical or other free-time artistic training were not studied separately.

All the subjects volunteered to participate in the experiment. Students were recruited by asking them to stay in the auditorium after a mandatory lecture to participate in a scientific experiment. As a reward for participating, pizza was served to all subjects who volunteered.

4.3 PROCEDURE

4.3.1 THE **COURSE** OF THE **EXPERIMENT**

The test was organized in a single session, taking place on 13.5.2016 at 11 am. Arranging the experiment in a single session rather than in multiple sessions provided steadiness of the test environment; the subjects were in the same place at the same time of day after the same lecture and heard the same directions and questions as well as their answers. The duration of the test was 24 minutes in total, including the time for giving instructions and answering questions asked by the subjects. The subjects, all students of medicine, were asked to participate in the experiment after a mandatory lecture in a lecture hall in Tampere University School of Medicine. Those who volunteered were asked to stay seated as a signal of their willingness to take part in the experimental part of a doctoral thesis concerning housing architecture.

First, the subjects were given the questionnaires where they were asked to fill in the first page with questions on their background (see Appendix 3). Next, the subjects were given instructions in Finnish. The subjects were informed that they were shortly to be shown some simplified visual material presenting conceptual apartment spaces. As I wished that the subjects would use mostly their intuition and judge the images according to their first impression, they were instructed to base their answers on their immediate emotional reactions and to concentrate on the feelings that the spaces would intuitively evoke in them. It was also emphasized that they did not have to reason their answers or pay attention to the logic of their evaluations. Additionally, they were asked to judge the spaces as if they were inside them, and not the features of the images themselves. Then they were carefully explained how the evaluation should be done in the questionnaire. The examiner then requested the subjects to ask if they had any questions. The questions that emerged concerned mainly the questions on the first page of the questionnaire, such as what was meant by artistic education. I instructed them to report all kinds of artistic education but to carefully specify the type of art field next to the answer. The questions were answered, after which the examiner started the slideshow. The images were projected on to a whiteboard in front of the class.

First, all the slides presenting the spaces were shown rapidly (a fraction of a second per image) to give the subjects an indication of what kind of visual stimuli to expect in the test, and thus to help them to anchor their judgements. Then, the whole set of images was again shown to the subjects three times, but now each slide was on display for six seconds before the next one. In each round, the images were shown in random order. In the first round, the subjects were asked to evaluate the "Interestingness" of the spaces one by one, in the second round "Spatial Organization" correspondingly, and similarly "Pleasantness" in the third round. There was a short pause between each round, within which the instructions were given for the next round and it was ensured that the subjects were on the right page of the questionnaire. A short pause was also kept on each occasion when the subjects had to change the sheet in their questionnaires, and the experiment was continued after it was ensured that all the subjects had the correct sheet in front of them. When the experiment was over, the experimenter collected the papers and served pizza to all the subjects as a reward for participating.

4.3.2 **MANAGEMENT** OF EXPERIMENTAL **DATA**

First I transformed the responses from paper questionnaires into electronic form by using Microsoft Excel 2016 software. In order to prevent errors in the data entry, I adopted working in 45-minute periods with a 10-minute break between each period. All multi-answers and unclear answers were left unentered, leading to a total of 14 missing values (out of a total number of 14110 entered values). While entering the data, I also made regular spot checks to the entered data in order to scan for mistakes, but this procedure exposed no mistakes. I then merged the data from the questionnaires with the data with architectural variables in the images. The excel data was then moved to SPSS software.

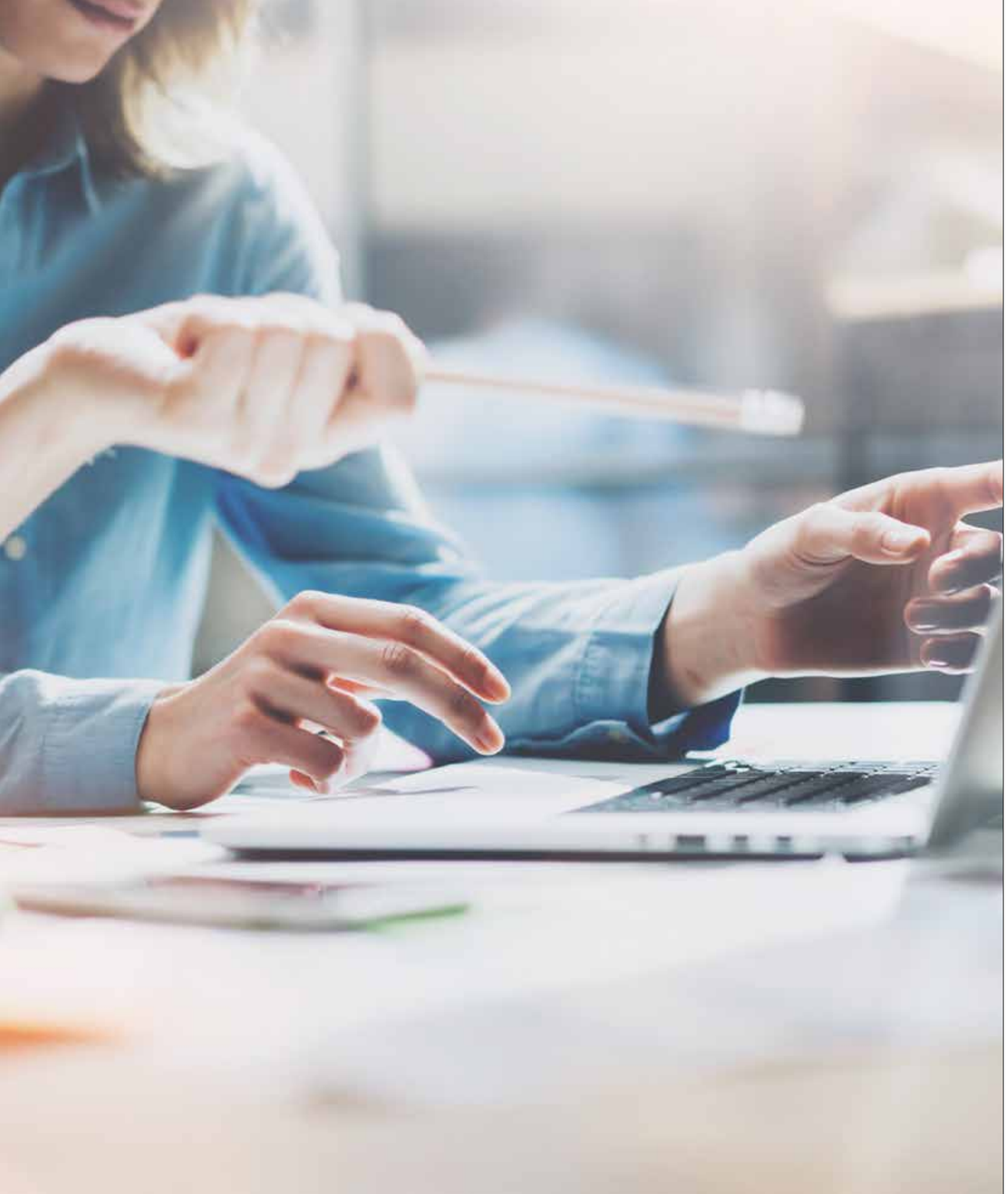
4.3.2.1 RESPONSE BIASES

While entering the experimental data, I noticed some differences in response styles between the subjects; some of the subjects had used mainly either the low or the high extreme of the likert scale, while others had stayed near the middle. Moreover, there were apparent differences in how extreme or modest the variation between the choices of an individual responder were; some of the responders had used a lot of extreme choices in their answers (such as mainly 1 or 5) whereas some of them had used the scale more narrowly (such as from only 2 to 4).

Calculating the ranges in both arithmetical means and standard deviations across the individuals also confirmed the differences; ranges of means between the subjects were 1.997 (Interestingness), 2.659 (Spatial Organization) and 1.818 (Pleasantness), and in the standard deviations correspondingly 1.016 (Interestingness), 1.174 (Spatial Organization) and 1.038 (Pleasantness). Such differences might have unfavourably distorted the statistical properties such as the means and the deviation scores. In order to eliminate the impact of the response styles the data were thus standardized. As the experiment strove to examine trends on how different architectural features affect responses, and not the absolute values of each responder, this procedure was not considered to remove anything substantial from the data, but only to make the data reliably comparable.

The bias from using either end of the scale was corrected by calculating the arithmetical mean of the answers of each subject separately in each of the three test parts (Interestingness, Spatial Organization and Pleasantness), and by subtracting this mean from each answer of the subject in the corresponding test part. This procedure for reducing the acquiescence response bias standardizes the arithmetical means of all the responses to zero (Fischer 2004, p. 266).

The bias from differences in the variation of answers, resulting from the response styles of using the scale either in a modest or an extreme way, was also corrected. This was done by calculating the standard deviation for the answers of each subject in each of the three test parts (Interestingness, Spatial Organization and Pleasantness) individually. The previously mean corrected scores were then divided by this standard deviation of the individual responses in the corresponding test part. This procedure adjusted the standard deviation to one in all the answers across individuals, and thus removed differences in the dispersion of the answers around the means (Fischer 2004, p.266). Altogether, all the answers given by the subjects were thus standardized to hold an arithmetical mean of zero and a standard deviation of one.



4.4 RESULTS

4.4.1 RELIABILITY OF THE INSTRUMENT

The reliability of the instrument was evaluated by a test-retest method so that one of the images (Image 1) was shown twice in each test part; as the first image and again at a random point near the end of each image set. The correlation of answers given to these two cases was analysed by McNemar-Bowker's Test of Symmetry to evaluate the test instrument's reliability.

McNemar's test is commonly used on occasions similar to the current test situation: when the same people are measured with the same thing twice, and it is desired to know if their answers have changed between the two occasions (McNemar 1947, Metsämuuronen 2009, p.1003). McNemar-Bowker's Test of Symmetry is an extension of McNemar's test, which enables use of variables with

several values, whereas McNemar's original test can be used only for dichotomous variables (Bowker 1948). The null hypothesis of both tests is that the scores given by the same people on two different occasions are equal to each other. McNemar-Bowker's test is based on cross-tabulation of frequencies of each answer within an ordinal scale variable, and on comparing their distribution to χ^2 -distribution to test the null hypothesis (Metsämuuronen 2009, 1003-1005). The results of cross-tabulation for the unstandardized data are presented in Tables 4-6. All the asymptotic significances were shown as greater than .05 (Table 7) meaning that the null hypothesis is retained: evaluations by the same people do not differ significantly on the two different occasions. This indicates a good level of agreement of subjects between different evaluation times; even though there is some variance, it occurs symmetrically. Consequently, this indicates the good reliability of the instrument.

4.4.2 CONSISTENCY OF JUDGEMENTS

When examining the distributions of responses it would seem that the subjects would have mostly agreed in their judgements. I first studied the images that yielded the most agreement and the most disagreement in each evaluative measure. These cases are listed in Tables 8-10. When examining overall agreement across all three evaluative measures, the subjects' judgements have been most in line with Images 1, 14, 21, 36, 37, 38 and most variant with Images 13 and 42. The disagreement in the case of Image 13 is quite extreme; two out of three standard deviations on standardized judgement scores are above 1 (1.10 for Interestingness and 1.15 for Pleasantness), and the third measure (.98 for

> "
>
> ***It would seem that the subjects would have mostly agreed in their judgements***

Table 4. Cross-tabulation for McNemar-Bowker Test of Symmetry on two identical rooms when evaluating Interestingness. McNemar-Bowker test studies the symmetry of the values against the diagonal axis.

		Interestingness 1st evaluation				
		1	***2***	***3***	***4***	***5***
Interestingness 2nd evaluation	***1***	41	23	1	1	0
	2	13	14	6	0	0
	3	1	2	1	0	0
	4	1	2	0	0	0
	5	0	0	0	0	0

Table 5. Cross-tabulation for McNemar-Bowker Test of Symmetry on two identical rooms when evaluating Spatial Organization. McNemar-Bowker test studies the symmetry of the values against the diagonal axis.

		Spatial Organization 1st evaluation				
		1	***2***	***3***	***4***	***5***
Spatial Organization 2nd evaluation	***1***	0	1	0	0	0
	2	0	0	1	1	1
	3	0	0	1	4	8
	4	0	0	2	15	9
	5	0	0	0	6	58

Table 6. Cross-tabulation for McNemar-Bowker Test of Symmetry on two identical rooms when evaluating Pleasantness. McNemar-Bowker test studies the symmetry of the values against the diagonal axis.

		Pleasantness 1st evaluation				
		1	***2***	***3***	***4***	***5***
Pleasantness 2nd evaluation	***1***	1	5	1	0	0
	2	1	15	4	1	0
	3	0	6	46	8	1
	4	0	2	7	5	2
	5	1	0	0	1	0

Table 7. Asymptotic significances of the crosstabulations of McNemar-Bowker test

Chi-Square Tests

	Interestingness	*Spatial Organization*	*Pleasantness*
Asymptotic Significance (2-sided)	.238	0.066	.558

Image number	***Interestingness score***	
	μ	σ
3	-1.01	***0.46***
14	-1.19	0.50
36	-1.02	0.51
11	-0.68	0.55
37	-0.85	0.56
38	-0.42	0.57
33	-0.43	0.57
21	0.47	0.58
31	0.55	0.59
34	0.91	0.60
12	-0.21	0.75
15	1.00	0.75
26	0.22	0.75
17	0.63	0.75
42	0.78	0.75
43	1.15	0.78
9	-0.60	0.80
40	0.60	0.80
20	0.57	0.91
13	0.18	***1.10***

Table 8. Images with the lowest (blue) and highest (red) standard deviations in Interestingness scores. Standard deviations lower than .5 and greater than 1 are bolded

Image number	***Spatial Organization score***	
	μ	σ
36	1.01	***0.44***
37	0.90	***0.44***
6	0.84	***0.46***
1	0.97	***0.47***
22	0.49	0.52
21	0.56	0.56
23	0.47	0.56
38	0.59	0.58
14	0.64	0.58
4	0.70	0.60
26	-0.51	0.82
41	-0.74	0.82
42	-0.57	0.82
11	-0.36	0.84
40	-0.48	0.85
16	-0.89	0.86
35	-0.32	0.86
10	-0.14	0.92
39	-0.97	0.92
13	-1.20	0.98

Table 9. Images with the lowest (blue) and highest (red) standard deviations in Spatial Organization scores. Standard deviations lower than .5 and greater than 1 are bolded

Image number	***Pleasantness score***	
	μ	σ
37	0.37	0.63
1	-0.04	0.67
33	0.17	0.67
30	0.62	0.68
14	-0.69	0.68
11	-0.50	0.69
2	-0.39	0.70
22	0.74	0.70
4	0.39	0.71
9	-0.25	0.71
32	-0.05	***1.01***
42	0.35	***1.05***
39	-0.29	***1.07***
34	0.39	***1.10***
16	0.06	***1.11***
15	-0.92	***1.12***
41	0.27	***1.13***
35	0.02	***1.14***
13	-0.67	***1.15***
17	-0.90	***1.16***
43	0.48	***1.20***

Table 10. Images with the lowest (blue) and highest (red) standard deviations in Pleasantness scores. Standard deviations lower than .5 and greater than 1 are bolded

Spatial Organization) is high as well. Many things could explain disagreement in any of the three judgements; however, the variance being so high in every one of them strongly suggests a possible bias within the image itself; the subjects have perhaps had trouble in understanding or reading it. Because of the potentially unreliable information content (quite randomized judgements) that could be obtained from Image 13, I therefore decided to exclude it from further analyses, so that it would not skew the results.

4.4.3 PREDICTORS OF JUDGEMENTS

4.4.3.1 CORRELATIONS

I started studying the statistical relationships between architectural and evaluative variables by calculating the Pearson product-moment correlation coefficients (Pearson's R values) between all the architectural variables and the mean ratings of the images for each evaluative variable (Interestingness, Spatial Organization and Pleasantness). Thus, three kinds of correlation tables were produced: correlations between architectural variables and Interestingness (Table 11), architectural variables and Spatial Organization (Table 12) and architectural variables and Pleasantness (Table 13). Only the variables with significant ($p<.05$) correlations were included in further analyses.

4.4.3.1.1 Multicollinearity

Many multivariate analysis methods, such as regression analysis, are sensitive to a phenomenon called multicollinearity. Multicollinearity means that the variables used in the analysis correlate too much with each other, which may distort the results (Metsämuuronen 2009, p. 645-646). To reduce the number of variables so that only variables that can most reliably explain evaluative variables would be maintained, I studied the internal correlations of those architectural variables that correlated significantly to the evaluative variables.

By studying the correlation matrixes (Appendices 4-6) the variable pairs that correlated strongly with each other ($R > .8$) were identified, and the one with the weaker correlation to the evaluative variable in question was excluded from the final variable set. The final combinations of architectural variables that were thus considered as possible, reliable predictors of Interestingness, Spatial Organization and Pleasantness with the multicollinear variables excluded are shown in Tables 14, 15 and 16.

By studying the correlation matrixes the variable pairs that correlated strongly with each other were identified, and the one with the weaker correlation to the evaluative variable in question was excluded

Table 11. Pearson correlation coefficients for architectural variables and mean scores of Interestingness. Significant, positive (+) R-values are marked by red

Architectural variables	*Pearson correlation to mean ratings for Interestingness* R
Size Differences Between Visual Elements	***.743****
Window Surface Area	***.536****
Element Alignments	***.521****
Number of Black Pixels	***.504****
Number of Window Directions	***.494****
Level of Decoration	***.478****
Number of Building Element Types	***.456****
Number of Windows + Number of Windowpanes	***.450****
Verticality	***.438****
Total Number of Directions	***.438****
Number of Building Elements	***.437****
Amount of Ornaments	***.429****
Number of Sculptured Elements	***.411****
Number of Windowpanes	***.405****
Verticality in Windows	***.403****
Number of Forms	***.398****
Number of Windows	***.356****
Curved Forms	***.350****
Classical Proportions in Element / Room Layout	***-.340****
Diagonal Forms	***.337****
Element Levels	0.269
Miscellaneous Window Forms	0.248
Classical Proportions in Room Shape	0.16
Neutral Room Shape	0.16
Passage Direction to the Left	0.129
Number of Windowpanes / Number of Windows	0.113
Number of Doors	-0.024
Passage Direction to the Right	-0.026
Verticality in Room Shape	-0.027
Classical Proportions in Elements	-0.055
Room Height	-0.072
Bilateral Symmetry	-0.075
Horizontality in Windows	-0.195
Passage Direction to the Front	-0.224
Horizontality in Room Shape	-0.239
Neutral Window Shape	-0.243
Classical Proportions	-0.245
Grouping	-0.276
Horizontality	-0.288

***** Correlation is significant at the 0.01 level (2-tailed).***
**** Correlation is significant at the 0.05 level (2-tailed).***

Table 12. Pearson correlation coefficients for architectural variables and mean scores of Spatial Organization. Significant positive (+) R-values are marked by red, and significant negative (-) R-values are marked by blue

Architectural variables	*Pearson correlation to mean ratings on Spatial Organization* R
Size Differences Between Visual Elements	***-.669****
Number of Windows	***-.611****
Miscellaneous Window Forms	***-.595****
Element Alignments	***-.547****
Number of Windows + Number of Windowpanes	***-.541****
Total Number of Directions	***-.503****
Grouping	***.463****
Classical Proportions	***.453****
Number of Black Pixels	***-.436****
Bilateral Symmetry	***.431****
Number of Window Directions	***-.428****
Number of Windowpanes	***-.399****
Element Levels	***-.397****
Number of Building Elements	***-.396****
Amount of Ornaments	***-.394****
Level of Decoration	***-.384****
Neutral Window Shape	***.351****
Number of Sculptured Elements	***-.320****
Number of Building Element Types	***-.311****
Horizontality	0.281
Horizontality in Windows	0.241
Horizontality in Room Shape	0.208
Classical Proportions in Element / Room Layout	0.2
Classical Proportions in Elements	0.182
Room Height	0.103
Verticality in Room Shape	0.085
Number of Windowpanes / Number of Windows	-0.052
Passage Direction to the Left	-0.083
Passage Direction to the Right	-0.085
Number of Doors	-0.112
Passage Direction to the Front	-0.114
Verticality	-0.146
Verticality in Windows	-0.152
Window Surface Area	-0.152
Neutral Room Shape	-0.192
Curved Forms	-0.22
Diagonal Forms	-0.279
Number of Forms	-0.291

***** Correlation is significant at the 0.01 level (2-tailed).***
**** Correlation is significant at the 0.05 level (2-tailed).***

Table 13. Pearson correlation coefficients for architectural variables and mean scores of Pleasantness. Significant positive (+) R-values are marked by red, and significant negative (-) R-values are marked by blue

Architectural variables	*Pearson correlation to mean ratings on Pleasantness*
	R
Miscellaneous Window Forms	***-.469*****
Bilateral Symmetry	***.465*****
Classical Proportions	***.449*****
Verticality	***.443*****
Verticality in Windows	***.415*****
Number of Windows	***-.322****
Window Surface Area	0.295
Number of Building Element Types	0.27
Number of Sculptured Elements	0.239
Number of Black Pixels	0.208
Level of Decoration	0.199
Element Alignments	0.154
Grouping	0.148
Number of Building Elements	0.146
Amount of Ornaments	0.14
Classical Proportions in Elements	0.139
Room Height	0.106
Passage Direction to the Left	0.088
Number of Window Directions	0.078
Size Differences Between Visual Elements	0.066
Verticality in Room Shape	0.062
Curved Forms	0.032
Classical Proportions in Element / Room Layout	0.031
Total Number of Directions	0.02
Neutral Room Shape	0.004
Neutral Window Shape	-0.032
Passage Direction to the Right	-0.05
Horizontality in Windows	-0.056
Number of Doors	-0.057
Number of Forms	-0.072
Horizontality in Room Shape	-0.1
Horizontality	-0.119
Diagonal Forms	-0.149
Element Levels	-0.171
Number of Windowpanes / Number of Windows	-0.208
Number of Windowpanes	-0.217
Passage Direction to the Front	-0.237
Number of Windows + Number of Windowpanes	-0.291

**** Correlation is significant at the 0.05 level (2-tailed).***
***** Correlation is significant at the 0.01 level (2-tailed).***

Architectural variables	*Pearson correlation to mean ratings for Interestingness*
	R
Size Differences Between Visual Elements	*.743***
Window Surface Area	*.536***
Element Alignments	*.521***
Number of Black Pixels	*.504***
Number of Window Directions	*.494***
Number of Building Element Types	*.456***
Number of Windows + Number of Windowpanes	*.450***
Verticality	*.438***
Total Number of Directions	*.438***
Number of Forms	*.398***
Number of Windows	*.356**
Classical Proportions in Element / Room Layout	*-.340**

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Table 14. Pearson correlation coefficients for final set of variables for Interestingness

Architectural variables	*Pearson correlation to mean ratings for Spatial Organization*
	R
Size Differences Between Visual Elements	*-.669***
Number of Windows	*-.611***
Element Alignments	*-.547***
Number of Windows + Number of Windowpanes	*-.541***
Total Number of Directions	*-.503***
Grouping	*.463***
Classical Proportions	*.453***
Number of Black Pixels	*-.436***
Bilateral Symmetry	*.431***
Number of Window Directions	*-.428***
Element Levels	*-.397***
Neutral Window Shape	*.351**
Number of Building Element Types	*-.311**

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Table 15. Pearson correlation coefficients for final set of variables for Spatial Organization

Table 16. Pearson correlation coefficients for final set of variables for Pleasantness

Architectural variables	*Pearson correlation to mean ratings for Pleasantness*
	R
Miscellaneous Window Forms	*-.469***
Bilateral Symmetry	*.465***
Classical Proportions	*.449***
Verticality	*.443***

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

4.4.3.1.2 Differences between Subgroups

I calculated the correlation tables, studied the correlation matrices and excluded the variables with possible multicollinearity for all four subgroups (males (n=57), females (n=50), subjects with an artistic background (n=10) and subjects without an artistic background (n=69)) the same way as I did with the data of the whole group. For each subgroup, the final sets of potential predictors for the judgements of Interestingness, Spatial Organization and Pleasantness with possible multicollinear variables removed are presented in Appendices 7-18. The comparison of correlation coefficients between different subject subgroups showed few differences that were mostly within their reciprocal strength and whether they were significant ($p<.05$) or not ($p>.05$). However, in each subgroup all the significant correlations of individual architectural variables were of the same direction (positive or negative) and approximately of the same magnitude as within the whole group.

4.4.3.2 MULTIPLE REGRESSION ANALYSIS

Multiple regression analysis has been a popular method for finding predictive features of preference in environmental psychology (Camacho Mtz Vara del Rey, C., Galindo & Arias-Velarde 2001, p. 192-103). Regression analysis has been described as a fundamental analytical method of scientific research and as perhaps the most important method of analysis when modelling reality is the aim. It is also one of the most-used statistical analytical methods in the behavioural sciences. (Metsämuuronen 2009, p.709). In general, regression analysis is used for exposing the factors out of a great number of variables that can together explain the variable that the researcher is interested in. In other words, it finds the variables that can explain the variance of the variable under study. (Metsämuuronen 2009, p.1323, Weiner et al. 2003, pp. 483-507.). Correspondingly, the variables are assigned as either independent variables (IV, predictors) or dependent variables (DV). The R^2 value, or the coefficient of determination, is used for indicating how much in percentage terms the set of independent variables can explain the variance of the dependent variable (Metsämuuronen 2009, p.709). In multiple regression analysis, the independent variables (predictors) can be either continuous or categorical, and further either nominal, ordinal or dichotomous. In the most common form of multiple regression analysis - linear regression - the dependent variable is continuous whereas logistic regression is used when the dependent variable is categorical. (Weiner et al. 2003, pp. 483-507). Multiple regression analysis has been described as being commonly used for three main purposes: to describe phenomena, to predict phenomena, or for theory testing. It can help in describing phenomena by exposing the relationships between predictors and the phenomenon in question, and further to predict the effect of certain factors on the phenomenon. However, The Handbook of Psychology (Weiner et al. 2003, p.484) describes theory testing as the most important application of multiple regression analysis from the viewpoint of development of science; “ideas derived from theory and from previous research can be translated into hypotheses that are tested using multiple regression analysis”. (Weiner et al. 2003).

Multiple regression analysis has several alternative methods for selecting the independent variables to the models. In forward selection, the variable that has the best independent coefficient of determination is chosen first from the set of independent variables. Next, the variable that has the second best significant coefficient of determination, and which also increases the explanatory power of the whole model in a statistically significant way, is chosen as the second variable in the model. This procedure then continues until there are no more such variables left that would increase the coefficient of determination of the whole regression model. The backward selection works in reverse; it first takes all the variables into the model, and then one by one chooses the ones that have the smallest coefficient of determination, and excludes them from the model. The variables that are left in the model then form the regression model that has the best explanatory power. The third method, stepwise selection, combines both forward and backward selections. The selection initiates the same way as in forward selection, but in each step the variables that are already in the model are also tested by excluding them. If excluding a variable increases the explanatory power of the whole model, it is left out. This procedure then continues until the best combination of predictive variables has been found, and no other combination can provide better explanatory power for the model. (Metsämuuronen 2009, p.709).

In this study, I used multiple regression analysis to study which architectural variables (assigned as independent variables or predictors) could best explain the variance in the evaluative variables Interestingness, Spatial Organization and Pleasantness (assigned as dependent variables). As the literature gave a strong indication of Complexity (Interestingness in this study) and Order (Spatial Organization in this study) being predictive of Preference (Pleasantness in this study), the ratings of the subjects on Interestingness and Spatial Organization were also assigned as independent variables in the regression analysis of Pleasantness. I carried out linear multiple regression analysis with the stepwise selection method in SPSS to predict Interestingness, Spatial Organization and Pleasantness by the corresponding architectural variables with no high internal correlations listed in Tables 14-16. As explained previously, in stepwise selection the variables are either taken in or dropped out from the regression model according to their explanatory power. By this method, the following, significant ($p<.05$) regression equations were found:

Interestingness =

-1.619
+ ***0.415 × Total Number of Directions***
- 0.331 x Classical Proportions in Element / Room Layout
+ 0.248 × Window Surface Area
+ 0.232 x Number of Forms
+ ***1.88 × 10^{-6} × Number of Black Pixels***

$\mathbf{R^2 = .830}$, $p < .001$

Spatial Organization =

- 0.332
+ ***0,696 × Bilateral Symmetry***
+ 0.426 × Grouping
- 0.276 × Size Differences Between Visual Elements
- ***0.169 × Element Alignments***
- 0.030 × (Number of Windows + Number of Windowpanes)

$\mathbf{R^2 = .883}$, $p < .001$

Pleasantness =

- 0.35
+ ***0.552 × Mean ratings for Spatial Organization***
+ ***0.506 × Mean ratings for Interestingness***
+ ***0.296 x Classical Proportions***
+ 0.189 × Verticality

$\mathbf{R^2 = .766}$, $p < .001$

The predictors appearing also in the regression models of all the subgoups are bolded

“

I used multiple regression analysis to study which architectural variables could best explain the variance in the evaluative variables Interestingness, Spatial Organization and Pleasantness

R^2 for both the models of Interestingness and Spatial Organization are higher than .80, which means that they explain over 80 % of their variance, expressly for Interestingness 83 % and for Spatial Organization 88.3 %. The mean ratings of Spatial Organization and the mean ratings of Interestingness together with Classical Proportions and Verticality explain 76.6 % of the variance in the Pleasantness variable.

Regression models for Pleasantness with only architectural variables (Table 16) assigned as independent variables and with only mean ratings of Interestingness and Spatial Organization assigned as independent variables are presented in Appendix 19. In the regression analysis where only architectural variables were assigned as predictors, Classical Proportions, Bilateral Symmetry and Verticality were accepted in the model, together explaining 50.2 % of the variance in the Pleasantness variable. In the regression analysis where only the mean ratings of Interestingness and the mean ratings of Spatial Organization were used as predictors, they were both accepted in the model and explained 67.5% of the variance in the Pleasantness variable. These percentages reflect the order of the coefficients in the model where both architectural and evaluative variables (Interestingness and Spatial Organization) are included; the ratings of Interestingness and Spatial Organization seem to be stronger predictors of Pleasantness than are individual architectural variables. Bilateral Symmetry correlates strongly with Spatial Organization, and presumably for that reason stepwise selection has dropped it out from the combined model.

Further studies with subgroups (Appendices 20-23) revealed several similarities. In the equations for Interestingness, “Number of Black Pixels” and “Total Number of Directions” were common predictors that appeared in all of them. Moreover, “Window Surface Area” was included in the models of both men and women, which can be considered the most important subgroups. In the equation for Spatial Organization, “Bilateral Symmetry” and “Element Alignments” were common in all subgroups. Judgements of Interestingness and Spatial Organization were highly explanatory variables for Pleasantness within all subgroups. In addition, “Classical Proportions” was included in each model. “Verticality” also appeared in every equation for Pleasantness except in that of women, where “Verticality in Windows” was included instead.

I attempted to study the influence of demographic factors (age, gender and level of education) as well as visual artistic background and the level of interest in visual arts reported by the subjects by using regression analysis. However, none of them correlated significantly with the ratings of Interestingness, Spatial Organization or Pleasantness, and were excluded from all the regression models. Their influence can, therefore, be considered minor.

4.4.3.3 VISUAL EXAMINATION OF IMAGES

In addition to regression analysis, I also examined possible predictors by studying the rank orders of images. I thus sorted the images by the average judgements of Interestingness (see Appendix 24), Spatial Organization (see Appendix 25) and Pleasantness (see Appendix 26) from high to low scores. The average highest three and lowest three ratings of the whole group are presented in Figures 17-22. By visual examination of the ranking order of the whole group, rooms with a high level of decoration (such as Images 43,41, 39 and 49), with a large number of windows or windowpanes (such as Images 15,19, 16,18 and 17) and with multiple building element types (such as in Images 43, 41, 34, 35, 39, 40, 31, 32 and 30) seem to position high in ratings on Interestingness. Also rooms with curved or diagonal forms - especially in the whole room form (Images 34 and 35) rather than in mere window division (such as Images 28, 26, 27 and 26) - seem to be positioned at the high end of the Interestingness ratings. On the other hand, images with no windows at all (such as Images 8,10, 11, 9 and 12), with a low (Image 36) or ordinary level of decoration

(Images such as 1, 2 and 3), images with only one small (Image 14) or medium-sized window (Images such as 1, 2, 3, 36, 37,6 or 5) seem to position at the low end of the ratings of Interestingness.

In the case of Spatial Organization, all the images at high ranks are images with only one building element (such as Images 36, 1, 37, 20, 6, 4, 7 and 5), and with a low (Image 36) or medium level of decoration (such as Images 1, 37, 20, 6, 4, 7 and 5). Images at the high ratings end of Spatial Organization are all with medium (such as Images 36, 1, 37, 6 and 4), large (Image 20) as well as small (Image 14) window sizes. At the low ratings end of Spatial Organization, images with multiple windows (such as Images 17, 15, 16, 31, 19 and 18), with a high level of decoration (such as Images 39, 43, 41, 42 and 40), with non-grouped elements (Images 17, 15 and 39), with curved or diagonal forms (Images 41, 43, 28, 26, 35 or 34) and with an asymmetric layout (such as in Images 15, 13, 16 and 26) seem to be frequent. Most of the images at the low end of Spatial Organization ratings also have multiple building element types. Notably, it seems that rooms with only one window but with multiple windowpanes with simple rectangular divisions are quite highly rated. Also, all the images with a passage direction to the front are situated more at the low end.

Images with a large amount of window surface (such as Images 22, 29, 20, 30 and 21), seemingly independent on the amount or directions of windows (compare, for example, Images 20, 29 and 18) seem to position at the high end of the Pleasantness ratings. In addition, images with high Pleasantness ratings seem to be mostly bilaterally symmetrical (such as Images 22, 29, 20, 30, 21, 43, 18, 40 or 4). Images with a high decoration level (such as in Images 43, 40 and 42) and vertical elements (such as in Images 29, 30, 43, 18, 40, 4, 37 and 42) also seem to be popular at the high end of the Pleasantness ratings. Images with multiple building elements or building element types seem to position slightly more at the high end (such as Images 29, 30, 43, 18, 40 or 34) than at the low end (such as Images 15, 17, 11 and 39). Notably, the elements in those images at the low end of the ratings are usually non-grouped (Images 15, 16 and 39). Also images with a small window (Image 14) or no windows at all (such as Images 11, 8, 10, 9 and 12) seem to be strikingly frequent at the low end of the Pleasantness ratings. Images with windowpanes of different forms (such as Images 26, 28, 27 and 25), with atypical room height (Images 3 and 2), with non-grouped elements (such as Images 15, 17 and 39) also seem to be situated at the low

Figure 17. The most interesting images evaluated by the subjects on average

Ranking *1*
x̄ *Interestingness* *1.15*
Image Number *43*

Ranking *2*
x̄ *Interestingness* *1.03*
Image Number *41*

Ranking *3*
x̄ *Interestingness* *1.00*
Image Number *15*

Figure 18. The most boring images evaluated by the subjects on average

Ranking *42*
x̄ *Interestingness* *-1.12*
Image Number *14*

Ranking *41*
x̄ *Interestingness* *-1.15*
Image Number *8*

Ranking *40*
x̄ *Interestingness* *-1.19*
Image Number *2*

Figure 19. The most organized images evaluated by the subjects on average

Ranking	*1*
x̄ *SO*	*1.01*
Image Number	*36*

Ranking	*2*
x̄ *SO*	*.97*
Image Number	*1*

Ranking	*3*
x̄ *SO*	*.90*
Image Number	*37*

Figure 20. The most disorganized images evaluated by the subjects on average

Ranking	*42*
x̄ *SO*	*-1.84*
Image Number	*17*

Ranking	*41*
x̄ *SO*	*-1.75*
Image Number	*15*

Ranking	*40*
x̄ *SO*	*-.97*
Image Number	*39*

Figure 21. The most pleasant images evaluated by the subjects on average

Ranking	*1*
x̄ *Pleasantness*	*.74*
Image Number	*22*

Ranking	*2*
x̄ *Pleasantness*	*.68*
Image Number	*29*

Ranking	*3*
x̄ *Pleasantness*	*.67*
Image Number	*20*

Figure 22.The most unpleasant images evaluated by the subjects on average

Ranking	*42*
x̄ *Pleasantness*	*-.92*
Image Number	*15*

Ranking	*41*
x̄ *Pleasantness*	*-.90*
Image Number	*17*

Ranking	*40*
x̄ *Pleasantness*	*-.81*
Image Number	*26*

end of the Pleasantness ratings. Curiously, the image with curved forms across all building elements and room form (Image 34) has been ranked quite high (rank 10/42) in Pleasantness, whereas images with curved forms only in windowpanes (Images 27 and 28) have low ranks (32 and 39 of 42). The image with diagonal forms across all the building elements and room form (Image 35) is in a medium-rank position (rank 23/42). The image otherwise similar to Images 34 and 35 but with rectangular forms across all the building elements and room form is situated between those two (rank 18/42).

The ranking orders of different subgroups are presented in Appendices 27-29, and the differences between the three images at the highest and lowest ranking positions in Appendices 30-35. It could be said that the differences found in these examinations are quite minor. The majority of the images seem to be situated approximately at corresponding ranking positions within all the subgroups (Appendices 27-29). Some exceptions are found from the Pleasantness ratings; the ratings of Images 43, 42 and 5 seem to vary from high to medium rank positions between the different subgroups (Appendix 29). Males and subjects with no artistic background seem to have rated Images 43 and 42 (being ones with a lot of decoration) at high ranks whereas females and subjects with an artistic background are more close to the medium ranks. Image 5 (with a vertical window in a vertical room) has been ranked as the most pleasant image by subjects with an artistic background and it appears to be also situated quite high (5/42) in the rankings of females. In contrast, males and subjects with no artistic background have ordered Image 5 in a medium rank position. However, these observations should be considered only preliminary. In particular, the number of people having prior artistic free-time training was so small, and thus the likelihood of differences emerging only due to chance is increased.

Most of the images at the highest three and lowest three ratings of each subgroup (Appendices 30-35) seem to be the same as those of the whole group and the images that are different are in most cases situated closely at the corresponding end of the average ratings (either close to the highest three or the lowest three ratings). Notably, however, all images at the highest three Pleasantness ratings by subjects with an artistic background differ from the highest three of the whole group (Appendix 34). In contrast, the lowest three of the Pleasantness ratings by the same people are the same as the three lowest ratings of the whole group (Appendix 35).

	High	Low
Interestingness	*High level of decoration* *Multiple windows or windowpanes* *Multiple building element types* *Curved or diagonal forms in the whole room form*	*No windows* *Small / medium sized window* *Low or ordinary level of decoration*
Spatial Organization	*Only one building element* *Low / medium level of decoration*	*Multiple windows* *High level of decoration* *Non-grouped elements* *Curved or diagonal forms* *Asymmetric layout*
Pleasantness	*Much window surface* *Bilateral symmetry* *High level of decoration* *Verticality*	*No windows* *Small windows* *Multiform windowpanes* *Atypical room height* *Non-grouped elements*

Findings from visual examination of ratings orders of images

4.4.4 SUBGROUP DIFFERENCES

I used the independent samples t-test in SPSS to find out whether there were differences in answers given by males and females or people with and without an artistic background. The t-test was executed to standardized data to determine whether the mean scores of different groups differed significantly ($p<.05$) from each other.

“The judgements of Interestingness by both genders are of the same direction (like/dislike), but females seem to have been more extreme in their ratings

4.4.4.1 DIFFERENCES BETWEEN JUDGEMENTS BY MALES AND FEMALES

Interestingness scores given by men (n=57) and women (n=50) differed significantly ($p<.05$) in five images: 1, 16, 17, 28 and 33 (Diagram 7). The mean scores of Interestingness judgements given by males and females of those images where significant differences occurred are presented in Appendix 36 with their corresponding t-test results. The judgements of female subjects seem to be systematically further from the 0-level marked by the horizontal dashed line in Diagram 7, than those of male subjects. That is to say, the judgements of Interestingness by both genders are of the same direction (like/dislike), but females seem to have been more extreme in their ratings. The same kind of behaviour can also be seen in the women’s judgements of Spatial Organization, which differed significantly from those given by men in seven images; 4, 5, 8, 29, 39, 41 and 43 (Diagram 8).

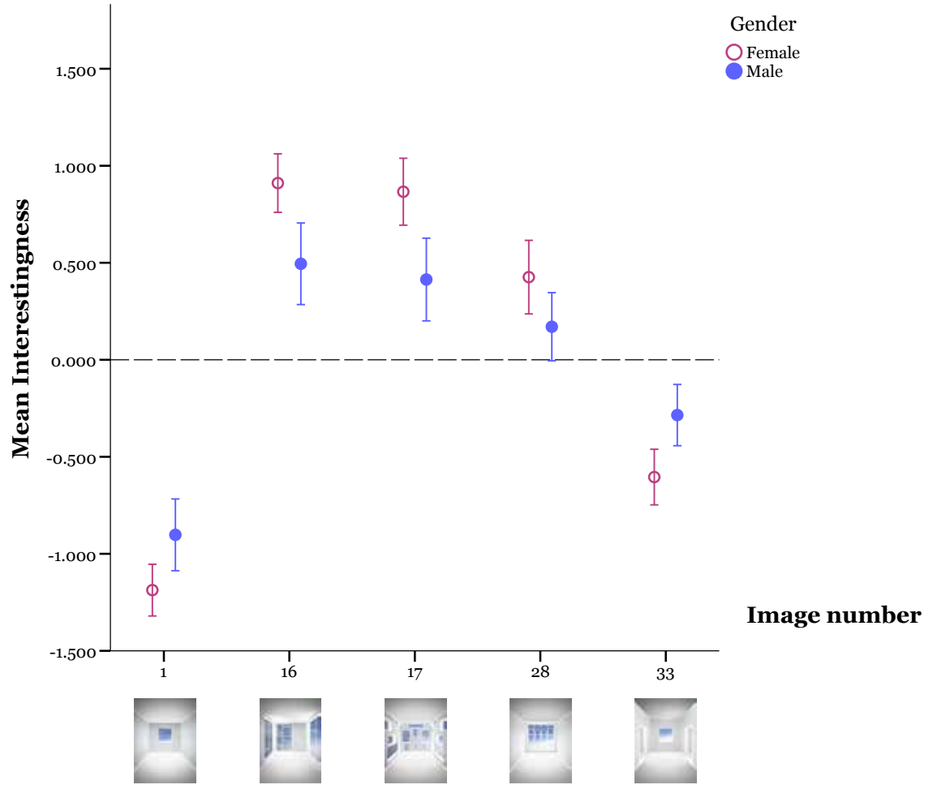


Diagram 7. Mean scores and confidence intervals (95%) for the jugdments of Interestingness that differated between males and females

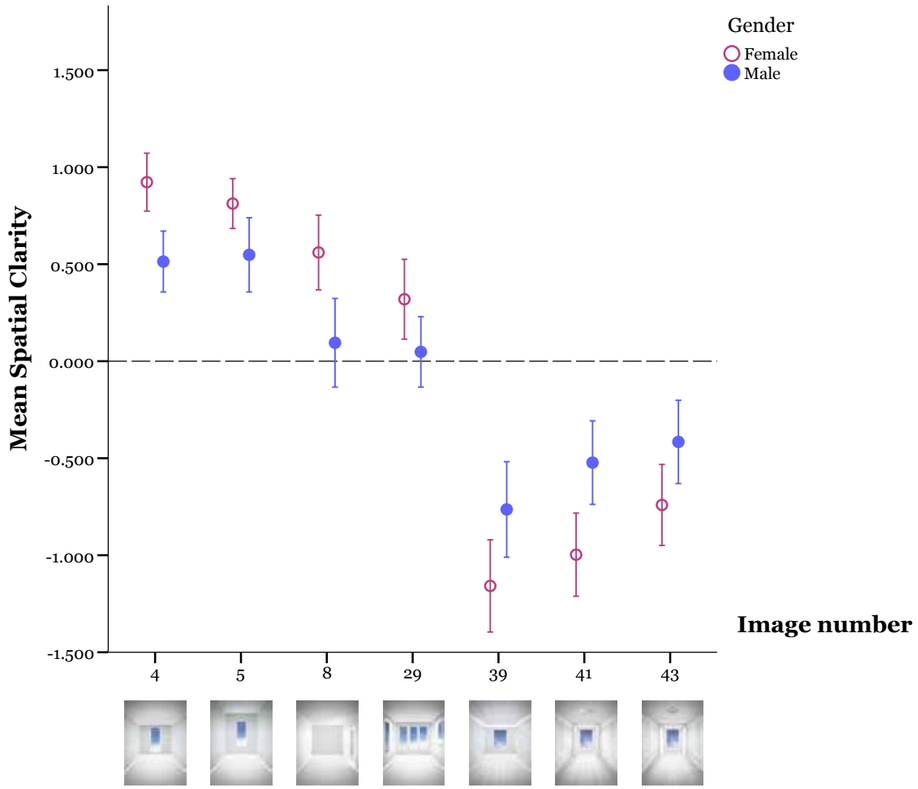


Diagram 8. Mean scores and confidence intervals (95%) for the jugdments of Spatial Organization that differated between males and females

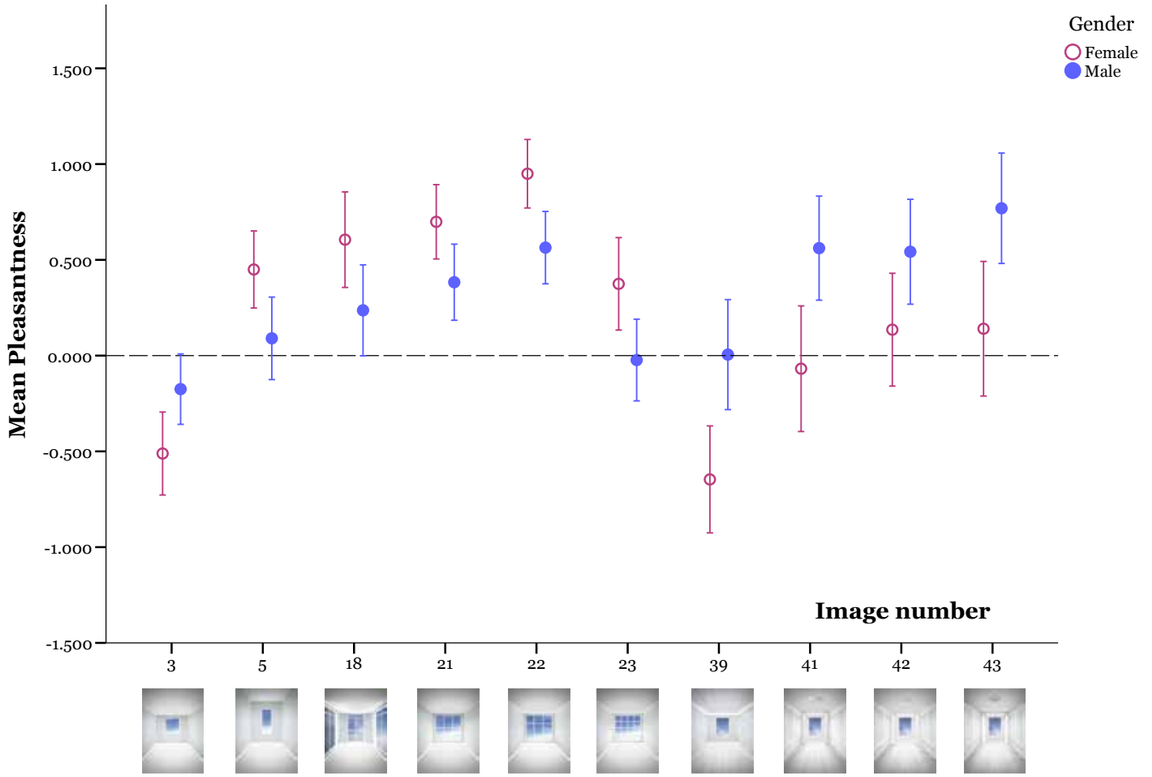


Diagram 9. Mean scores and confidence intervals (95%) for the jugdments of Pleasantness that differated between males and females

The differences between women's and men's judgements of Pleasantness were the most numerous: ten images in total; 3, 5, 18, 21, 22, 23, 39, 41, 42 and 43 (Diagram 9). As can be seen from Diagram 9, most of the differences are of the same kind as in the judgements of Interestingness and Spatial Organization; in Images 3, 5, 18, 21, 22, 23 and 39 the judgements of women seem to have been in the same direction as those of men, but more extreme. However, interesting differences seem to occur with Images 41, 42 and 43, where the judgements of women are lower than those of men. Those images are the ones where the architectural variable "level of decoration" has values "high2" or "high3", which means that they are with highly decorative classical elements: profiled mouldings, surface decorations and sculptured elements.

4.4.4.2 DIFFERENCES BETWEEN JUDGEMENTS BY SUBJECTS WITH AND WITHOUT ARTISTIC FREE-TIME TRAINING

The mean scores and the corresponding t-test results of judgements of images where significant differences occurred between subjects with and without a visual artistic background are presented in Appendix 37. Subjects with an artistic background differed from those having no artistic background in their judgement of Interestingness in only one image, number 29, with five vertical windows of the same shape and size (Diagram 10). There the subjects with an artistic background had judged the scene as less interesting than their peers without any artistic training. In their judgements on Spatial Organization they differed from their peers with no artistic training in three images; 4, 15 and 22 (Diagram 11). There, subjects with an artistic background seem to have judged Spatial Organization with parallel direction but more extremely than their peers. The same tendency can be seen in all of their differing judgements of Pleasantness, which occurred with Images 5, 6, 21 and 36 (Diagram 12). The images that differed in the Pleasantness ratings between

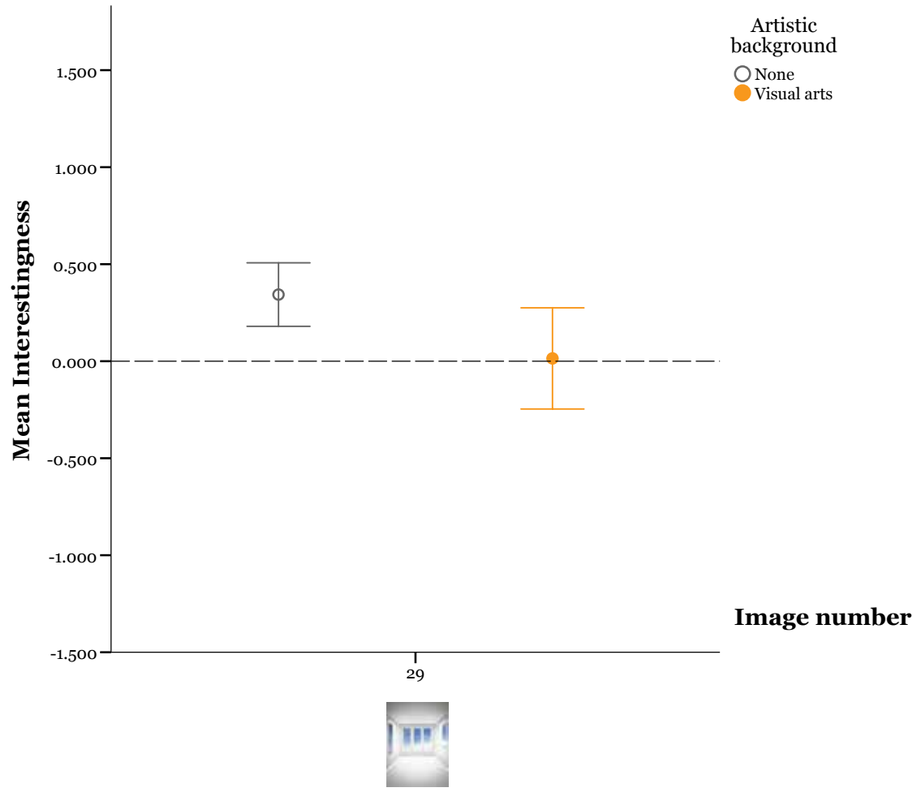


Diagram 10. Mean scores and confidence intervals (95%) for the jugdments of Interestingness that differed between subjects having no artistic background and those having that in visual arts

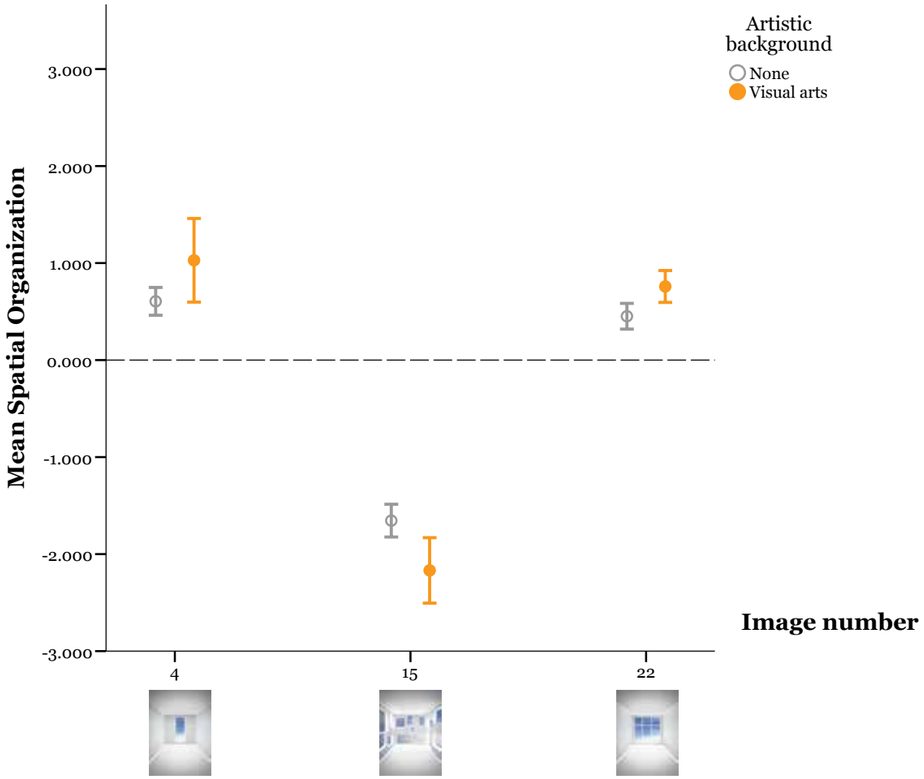


Diagram 11. Mean scores and confidence intervals (95%) for the jugdments of Spatial Organization that differed between subjects having no artistic background and those having that in visual arts

subjects with and without an artistic background are simple (containing only one building element situated centrally in the scene) and the majority of them have been judged more pleasant by subjects with artistic training than those without. The exception is made by Image 6 with a horizontal window in a room of normal width, which has been judged significantly less pleasant by subjects with an artistic background than those without. Interestingly, there is no significant difference in their judgements with Image 7, where the same horizontal window was situated in an equally wide room.

The seeming tendency of subjects with artistic free-time activities to judge some images more extremely than their peers resembles the phenomenon observed with female subjects. As the majority of those subjects were in fact women, it is possible that the tendency could reflect the behaviour of women rather than that of subjects with an artistic background themselves. I therefore decided to examine whether the same tendency occurred within the subjects with a musical background of which there were an approximately equal number of both genders. There were six images whose judgements differed between subjects with a musical background and subjects without an artistic background (Images 4, 12, 33 and 39 in Interestingness and Images 5 and 40 in Spatial Organization), and all of them were also judged with the same direction but more extremely by those with a musical background than their peers with no artistic background.

The seeming tendency of subjects with artistic free-time activities to judge some images more extremely than their peers resembles the phenomenon observed with female subjects

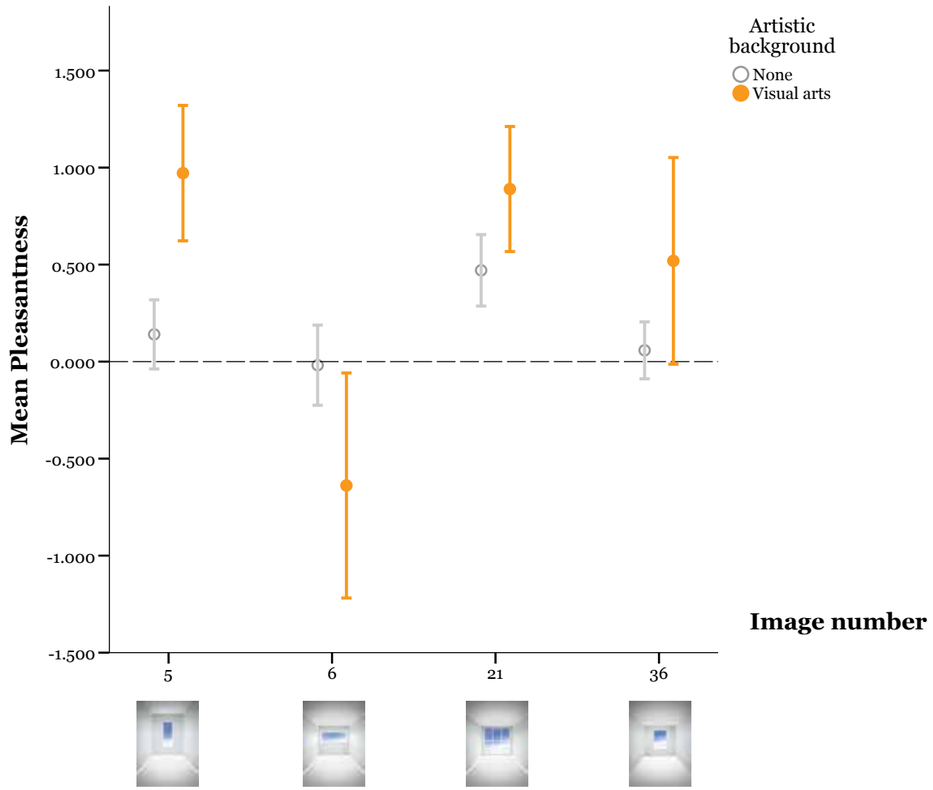


Diagram 12. Mean scores and confidence intervals (95%) for the jugdments of Pleasantness that differed between subjects having no artistic background and those having that in visual arts

4.4.5 THE AFFECTIVE QUALITIES RELATED TO ARCHITECTURAL FEATURES

To form an impression of affective qualities related to the different images, and thus to the architectural variables embedded in them, the images were organized in the two-dimensional affective space for environments proposed by Russell, Ward and Pratt (1981) which was introduced in Chapter 2.1.2. In the affective space model, the affects induced by environments are seen as constructs of two axes; arousing-sleepy and pleasant-unpleasant. In this case, I used the evaluative variable Interestingness (interesting-boring) as a replacement for the arousing-sleepy scale.

First I examined the mean ratings of the whole group by arranging the images in the two-dimensional interesting-boring / pleasant-unpleasant space where the different areas are described by adjectives from the model by Russell, Ward and Pratt (1981). There, the images seem to distribute rather diagonally to the affective space as can be seen from Diagram 13; from the slightly unpleasant-boring to the slightly pleasant-interesting; in other words to cover the boring-unpleasant to the interesting-pleasant axis better than the boring-pleasant to the interesting-unpleasant axis. The interesting-unpleasant quadrant is also quite well covered while a major gap appears at high pleasant-neutral interestingness to boring, perhaps because “boring” as a term easily associates with a low valence value. Another major gap appears in the highly unpleasant-slightly boring section, perhaps for the same reason.

> “
>
> ***Images with curved and diagonal overall spatial forms are on the same axis on interestingness, but the image with the curved forms is rated remarkably more pleasant***

Since the images evaluated as the most pleasant, unpleasant, interesting

> ***In the space described by adjectives such as "frightening", "harsh" and "hectic", are images with random, non-grouped elements***

and boring have already been discussed in previous chapters, the most interesting contribution in this section are the images that appear in the diagonal directions of the affective space. In the highly pleasant-highly interesting space, described by adjectives such as "majestic" and "exciting", are images having large window surface areas (such as Images 20, 18, 21 and 30), several rectangular windowpanes (such as Images 21,18 and 19) and a medium amount of decoration (such as Images 42, 40 and 43). Interestingly, images with curved (no 34) and diagonal (no 35) overall spatial forms are on the same axis on interestingness, but the image with the curved forms is rated remarkably more pleasant.

In the highly unpleasant-highly interesting space, described by adjectives such as "frightening", "harsh" and "hectic", are images with random, non-grouped elements (as in Images 39, 17 and 15). All the images with no windows (Images 14, 8, 10, 11, 9 and 12) seem to have settled in the boring-unpleasant space, described by the adjectives "unstimulating", "depressing", "insignificant" and "desolate", along with images with small windows (Image 14) or horizontal windows (Images 6 and 7). The images that were discovered to be judged differently within the subgroups were studied separately (Appendices 38-39). It seems that most of the images whose ratings had

> ***All the images with no windows seem to have settled in the boring-unpleasant space, described by the adjectives "unstimulating", "depressing", "insignificant" and "desolate"***

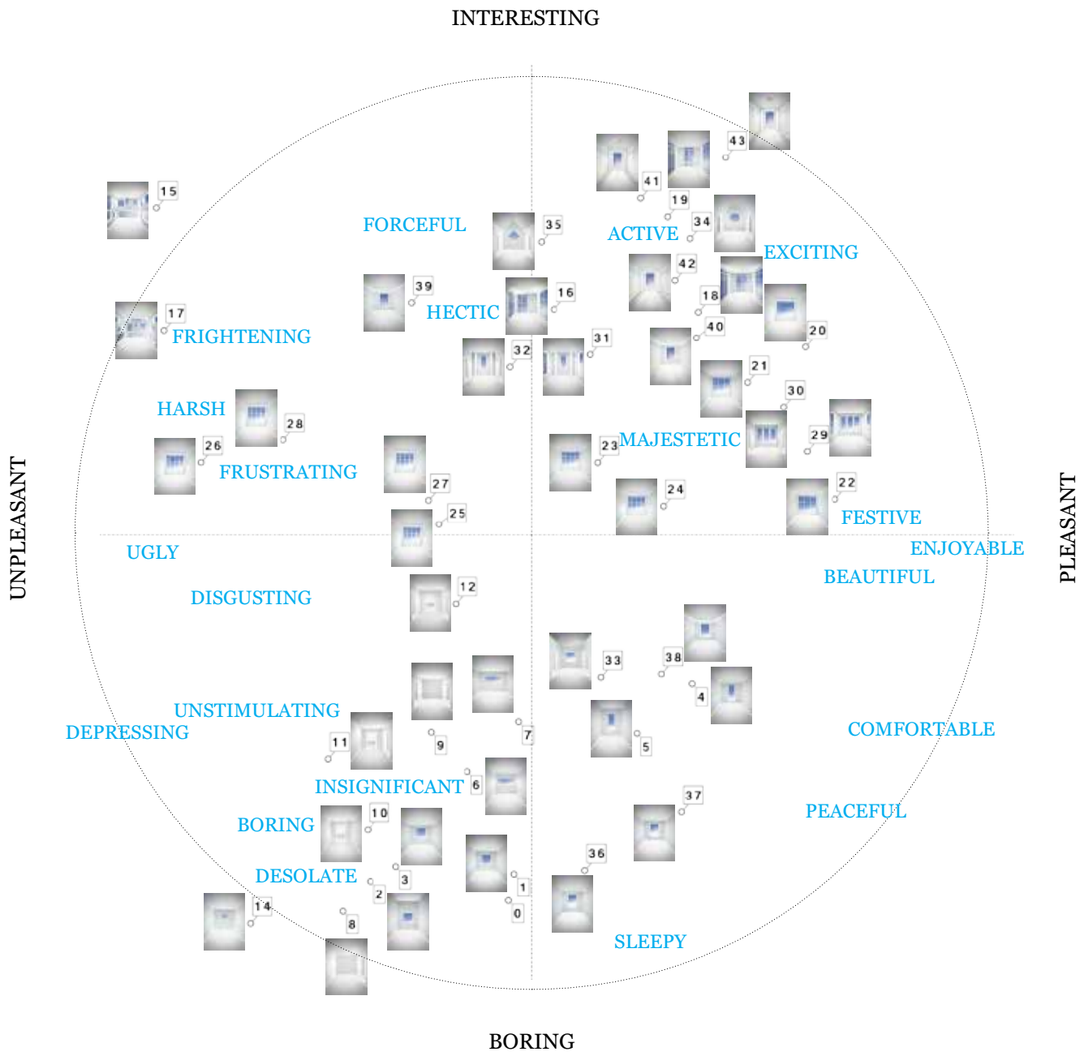


Diagram 13. Circumplex model for affective quality attributed to environments (Russell, Ward and Pratt, 1981) applied to mean evaluations of Pleasantness and Interestingness of the images in the experiment. Adjectives are equal with the original model presented in chapter 2.1.2.

significant subgroup differences are found in the pleasant half of the affective space. In other words, the subjects seem to have agreed more in the ratings of images that they found unpleasant. Interestingly, the differences between the judgements of men and women are found mostly in the pleasant-interesting quadrant.

The tendency to more extreme judgements by both women and subjects with an artistic background is also visible in the affective space layout. The exceptional three images (41,42 and 43) that were judged more pleasant by men than women are found in the areas described by the positive adjectives “exciting” and “active” as rated by males, whereas the ratings of women are closer to less positive adjectives like “hectic” or “forceful”. Simple images (5, 36 and 21) that were judged more pleasant by subjects with an artistic background are situated in the spaces described by the adjectives “comfortable”, “peaceful” and “festive”/”enjoyable” as judged by people with an artistic background and by the adjectives “sleepy” and “active”/”majestic” as judged by people without an artistic background. However, even with the differences in the strength of judgements, most of the ratings even between the subgroups remain mostly in the same quadrants, and in total there seem to be no major differences.

4.4.6 CURVE ESTIMATION

Finally, as previous studies have yielded partly divergent results as to whether the relationship between complexity and preference would be linear or adopt an inverted U-shape, I decided to estimate the type of relationship by curve estimation. The linear and quadric relationships were tested between Pleasantness and Interestingness, and also between Pleasantness and Spatial Organization, because some of the measures used in this study considered to belong to the

dimension “order” or Spatial Organization have in some previous studies been examined as dimensions of “complexity” (e.g. Roberts 2007). The curve estimations were executed by SPSS independently of all the subgroups. When comparing the significance values of both linear and quadric models, the more significant one (with a smaller p-value) was considered to be more reliable. The curve estimation data for both models and the graphs of the more reliable model are presented in Appendices 40-49. The linear relationship was slightly more often (three cases out of five) associated with the Interestingness variable. In contrast, the Spatial Organization ratings were associated with the quadric, inverted-U relationship in four cases out of five. However, in all of those cases the differences in R^2 values between the linear and quadric models seem to be rather small, which implies that the potential quadric effect would not be especially strong.

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The linear relationship was slightly more often associated with the Interestingness variable

In contrast, the Spatial Organization ratings were associated with the quadric, inverted-U relationship in four cases out of five

5
DISCUSSION

This section concludes the main results obtained from the study, considers its main strengths, limitations and the generalizability of its results. Additionally, recommendations are made concerning possible future studies of the same topic. To conclude, some points of view regarding the practical significance of the results of the current study are reflected.

The main aim of this thesis was to examine whether immediate preference judgements of apartment interior scenes could be predicted from their levels of complexity and order, and whether any specific architectural features could be found to predict those judgements. Subjective measures of Interestingness (interesting-boring) were used as the measure of complexity, Spatial Organization (organized-unorganized) as the measure of order and Pleasantness (unpleasant-pleasant) as the measure of preference. I have striven to achieve this aim by first defining a large set of architectural features that I considered as potential predictors on the basis of the reviewed literature and my architectural expertise. These features were embedded in 43 images presenting general apartment spaces, which were then judged by a test group consisting of 107 university students. The affective qualities associated with different architectural features, as well as the influence on the judgements of gender and visual artistic background, were also of interest in this experiment.

Main conclusions from the experiment

1) *The judged Pleasantness of apartment interiors was found to be well predicted by judged Interestingness and Spatial Organization.*

2) *Several physical architectural features of apartment interiors were found to predict the judgements of Interestingness, Spatial Organization and Pleasantness.*

3) *More similarities than differences were found in the judgements of Interestingness, Spatial Organization and Pleasantness between the subgroups.*

4) *Some architectural features of apartment interiors are potentially associated with different types of affective qualities*

5.1 MAIN **RESULTS**

This study showed that the judgement of visual Pleasantness, used as an operationalized measure of preference, of apartment scenes can for the most part be predicted by the judgements of two other features: Interestingness, an operationalized measure of complexity, and Spatial Organization, an operationalized measure of order. I consider this as the most important and the most reliable result of this study. The finding supports the assumption constructed according to the literature from other fields (e.g. Birkhoff 1933, Eysenck 1941): that visual preference judgement can be seen as a construct of the judgements of complexity and order, including in the context of apartment interiors. Moreover, in this study both the ratings of Spatial Organization and Interestingness seemed to increase Pleasantness ratings independently. Thus the results of this study do not support the idea of either complexity or order being a

> ***It seems that a scene can have high levels of complexity and order at the same time, and when both of them increase, preference seems to increase***

predictor for preference alone, or that they would be, at least completely, mere extremes of the same bipolar variable, as proposed by some studies and theories (Roberts 2007, Berlyne 1971). Instead, this study provides more support to those studies that have held them to act conjointly (e.g. Eysenck 1942, Eysenck 1941, Nasar 1988b, Oostendorp, Berlyne 1988, Nasar 1988d, Kaplan, Kaplan 1989). Thus apparently complexity should not outright be confounded with "disorder"; it seems that a scene can have high levels of complexity and order at the same time, and when both of them increase, preference seems to increase.

Another important finding of this study was that it is possible to find several physical architectural characteristics that can explain the majority of variance in both Interestingness and Spatial Organization ratings, and a part of that in Pleasantness ratings, in the context of apartment interiors. Across all the subgroups, the Interestingness of a scene was found to increase significantly by increasing the values of two variables: "Number of Black Pixels" and "Total Number of Directions". In addition, the variable "Window Surface Area" appeared in every regression model except that of participants with an artistic background. "Number of Black Pixels" simply signifies the amount of contours and details of the scene and thus could also be expressed as the amount of visual information contained by the scene. For instance, in this study it was found to correlate strongly with the amounts of building elements, ornaments, sculptured elements and decoration. The number of black pixels has been found to be a good

predictor of judged visual complexity in earlier studies, too (Stamps 1999a). Both the variables "Total Number of Directions" and "Window Surface Area" could be seen as applications of "extent" from attention restoration theory and that of "mystery" from preference matrix theory (Kaplan, Kaplan 1989) in the context of apartment architecture. They could also be considered as measures of "prospect" from prospect and refuge theory (Appleton 1975). In a way, the number of directions and large surface area of windows in apartment scenes could indeed be seen to provide for exploration and to hint that "there might be more to explore than is immediately evident" (Kaplan, Kaplan 1989). Both axial views (Nylander 2002) and the presence of windows (Kaye, Murray 1982) have also been reported as increasing housing preference in earlier studies. The fact that these variables were found particularly to influence the Interestingness ratings in this study might hint that their preference-increasing effect might actually act through their influence on the interestingness of the scene.

Increases Interestingness:

*Number of black pixels**
(amount of contours and details)

*Total number of directions**
(total sum of door and window openings)

*Window surface area***

** features appearing in the regression models of the whole group and all the subgroups*
*** feature appearing in the regression models of the whole group and three subgroups*

Across all four subgroups, "Bilateral Symmetry" was found to increase and "Element Alignments" to decrease the ratings of Spatial Organization. In other contexts than that of apartment interiors, bilateral symmetry has previously been suggested and demonstrated to be a characteristic that facilitates visual information processing (Tyler 2000, Locher, Nodine

1989, Ramachandran, Hirstein 1999), and to be a preferred visual feature (Cárdenas, Harris 2006, Ramachandran, Hirstein 1999, Makin et al. 2012). In this study, "Element Alignments" was in fact an operationalized measure of both Gestalt laws of good continuation and closure, and signified the number of aligned levels of elements. That is to say, the arrangement of elements on many different aligned levels seems to have decreased the experience of Spatial Organization of the subjects in this study. However, the reason why "Element Alignments" was found to explain the rating of Spatial Organization better than the other variable operationalized from the same Gestalt laws, "Element Levels", remains unknown.

In addition to the ratings of Interestingness and Spatial Organization, the variable "Classical Proportions" was found to explain ratings of Pleasantness within all subgroups. Also "Verticality" appeared in the regression equations of every subgroup except that of women, where "Verticality in Windows" was found instead. "Classical Proportions" was defined in this study as a ratio of small whole numbers (such as 1:2 or 2:3) or the golden ratio (1.618) applied either to the dimensions of visual elements or their relations with the dimensions of

Increases Spatial Organization

*Bilateral Symmetry**

Decreases Spatial Organization

*Element Alignments**
(elements situated on many aligned levels)

** feature appearing in the regression models of the whole group and all the subgroups*

Increases Pleasantness:

*Interestingness**

*Spatial Organization**

*Classical Proportions**
(dimensional ratios of the small whole numbers or the golden ratio)

*Verticality***
(in windows or room shape)

** features appearing in the regression models of the whole group and all the subgroups*
*** feature appearing in the regression models of the whole group and three subgroups*

space, or both. In classical architectural theory, harmony of proportions was considered as one of the essential sources of the beauty of a building. According to classical architectural texts, it was believed that if building design would follow the same simple proportions that were found to repeat in nature, the viewer would intrinsically feel in tune with the world and experience a feeling of beauty. (Kruft 1994, p. 25-29, Vitruvius 1914, Alberti 1986, Wittkower 1998, Summerson 1980). The ideal of harmonious architectural proportions was also one of the few aesthetic principles of classical architecture that was long maintained in modernistic architectural theory (Kruft 1994, p. 358-359). The golden ratio has been shown to increase preference both in the very first experiments on aesthetic appreciation (Fechner 1876, Valentine 1962 p. 93) as well as in more recent ones (e.g. Di Dio, Macaluso & Rizzolatti 2007). The reason why "Verticality" was found so commonly in the regression models for Pleasantness remains unknown. It has been suggested that verticality would be overplayed over horizontality in human perception; for instance, we would tend to estimate vertical lines as longer than equally long horizontal lines (Petrovski 1973 p.328). In the physical world, gravity acts on the vertical direction, which makes natural objects more variant in the vertical than in the horizontal dimension, for instance to be

heavier near the ground and to lighten upwards. (Valentine 1962). Also symmetry around the vertical axis has been demonstrated earlier to be preferred more than symmetry around other axes (Cárdenas, Harris 2006, p.12-15).

As the third major discovery of this study, subjects were found to have a considerable level of agreement in their judgements of each evaluative category: Interestingness, Spatial Organization and Pleasantness. A high level of intersubject agreement in aesthetic matters has also been demonstrated previously in studies from other fields (e.g Yi 1992, Stamps, Nasar 1997, Strumse 1996, Nasar, Kang 1999, Nasar 1983, Berlyne, Robbins & Thompson 1974, Valentine 1962 p. 169-180, Roberts 2007). Also in this study, the ratings of the subjects were not random but expressed common inclinations. I could not find any major opposite judgements between the subgroups of males and females or within the subjects with or without an artistic background. Nor could I find subjects' age, gender, level of education, visual artistic background or the level of interest in visual arts to explain the variance of any evaluative variable. However, within some images women showed a tendency to have parallel but more extreme opinions within all the evaluative categories. The only exception to this tendency occurred with spaces containing highly decorative elements of the classical style, which were judged significantly more pleasant by males than by females. The reason for this finding remains unknown. Even though previous studies (e.g. Wilson 1996, Gifford et al. 2000, Ghomeshi, Jusan 2013, Akalin et al. 2009, Nasar, Kang 1989, Kaplan 1988a, p.53, Devlin, Nasar 1989) have found divergent visual judgements by professional artists and laypeople, this finding could not be supported in this study by a small group (n=10) of subjects with a history of only free-time casual art training.

> **Subjects were found to have a considerable level of agreement in their judgments of each evaluative category**

The results of this study thus entail the idea that the aesthetic experience of space is not merely "in the eye of the beholder" or a matter of taste, but it is likely that there is also a collective component that inclines the ratings in the same direction. In Yi's (1992) terms, this might be the culture-social component: all the subjects of this study were Finnish, from the same school and about the same age. It may be that belonging to these cultural or social communities has influenced their judgements to align in the same direction. However, other studies have demonstrated the same phenomenon between subjects from diverging cultural and social backgrounds (e.g. Yi 1992, Nasar 1988d, Berlyne, Robbins & Thompson 1974). For that reason, it is also possible that the people in this study perhaps agreed in their judgements because of some inbuilt component of aesthetic taste, or the evolutionary component as defined by Yi (1992). In a way, this makes sense: the majority of people judge flowers as beautiful, or kittens as cute; why would it not be possible to have some common preferences for architectural features as well?

In this study, the affective qualities associated with the images were studied with the affective space model for environments constructed by Russell, Ward and Pratt (1981). Together with inspection of the mean ratings of the images, several conclusions can be drawn; windowlessness decreased both the Interestingness and the Pleasantness judgements crucially, and thus all the images with no windows appeared in the model area were described as "desolate", "depressing", "unstimulating" or "insignificant". Perhaps surprisingly, images with horizontal elements also appeared in this class. Instead, images with a large amount of window surface area were situated in an affective space described by positive adjectives such as "majestic", "festive" or "exciting" when there was either one large individual window with one or several rectangular windowpanes, or when several windows were placed symmetrically and visually grouped by Gestalt rules. Images with decoration situated in the space were also described by the adjectives "majestic", "festive" or "exciting". A random arrangement of any elements, whether windows or decorative elements, seemed to draw images to the areas described by negative adjectives such as "hectic", "frightening" or "harsh". All the images with either curved or diagonal windowpane elements were also situated close to this area as well. Images with only one window, either square or strongly horizontal or vertical, and

with no special decoration or forms involved, were all situated at the “boring” end of the y-axis. Interestingly, images with horizontal windows were clearly situated on the negative side of the Pleasantness scale, while images with vertical windows on the positive side of the scale.

The results of this study partly support and partly do not support the findings of previous studies. Roberts (2007) ended up suggesting that there would be different kinds of dimensions of complexity, which would be related to beauty ratings in diverging ways. Stimuli with low values in the dimensions “unintelligibility of the elements” and “disorganization” were found to be rated more beautiful than those with intermediate or high values, and, contrastingly, the dimensions “number of elements”, “element heterogeneity”, “variety of colours”, and “three- dimensional appearance” were found to have a positive linear relationship with beauty judgements. In terms of this study, the variables of the first class could be considered as the inverted values of “order” rather than dimensions of complexity. In this study, both order and complexity were found to increase preference judgements independently, which would explain the different relationship of the dimensions found by Roberts. Also, Roberts found “asymmetry” to have an inverted U-shaped relation to beauty judgements, which is in line with the result of this study suggesting an inverted U-shaped relationship between the Spatial Organization and Pleasantness ratings of every subgroup except that of subjects with a visual artistic background. The dimensions “number of elements” and “element heterogeneity” were found to be linearly associated with beauty ratings in Roberts’ study (2007), which is in line with the suggestion of this study of a linear relationship between Interestingness and Pleasantness ratings within the majority (3/5) of the subgroups. Thus this study can

be considered as giving some support to previous studies that have found either a linear (Nasar 1983, 1988d, 1988b, Kaplan, Kaplan & Wendt 1972, Berlyne 1974c) or an inverted U-shaped relationship (e.g. Hare 1974a, Bragg, Crozier 1974, Geissler, Zinkhan & Watson 2006, Akalin et al. 2009, Vitz 1966) between complexity and preference.

The result that no major differences between the judgements of males and females could be found supports the findings of some previous studies (e.g. Roberts 2007, Stamps, Nasar 1997, Nasar 1983, Oostendorp, Berlyne 1988). In contrast, the tendency of women to judge some stimuli with more extreme values was not among the findings of the previous literature reviewed. However, this evidence was obtained only from subgroup analysis with a limited amount of subjects and was only observed with certain images, which both strongly restrict the validity of the finding.

5.2 STRENGTHS AND LIMITATIONS

To my knowledge, this was the first attempt to experimentally study visual preferences of apartment interiors from the perspective of complexity and order with systematically constructed synthetic images. The use of images, which were exclusively constructed to study the influence of specific architectural characteristics, provided a way to reduce several confounding factors. First, variables that were not in the scope of this research, such as the view from the window, the amount of light or geographical orientation, could be standardized and thus could not interfere with judgements. Additionally, using constructed images instead of photographs or real environments enabled simplification of the features under examination, and thus probably decreased the likelihood of the subjects paying attention to irrelevant features. Further, the risk could be decreased that the images would too closely

To my knowledge, this was the first attempt to experimentally study visual preferences of apartment interiors from the perspective of complexity and order with systematically constructed synthetic images

resemble real apartments familiar to subjects, so that their familiarity would confound their judgements. Second, the architectural features that were in the scope of this research could be adjusted in the images so that their amounts and combinations formed a collection where architectural features could be reliably compared. Third, the image quality was easy to equalize, which meant that images were of the same size and with the same resolution, contrast and brightness, which again reduced possible bias from their influence on judgements.

The experiment was conducted on the same occasion for all subjects, which thus equalized the possible influence of the place, time of day, the behaviour and the instructions given by the experimenter and questions asked by the subjects. In addition, all subjects had had the same lecture right before the experiment. The sample size of the experiment (n=107) can be regarded as sufficient, since it was enough to provide statistically significant results from the whole group as well as from the four subgroups by the chosen analytical methods.

The unquestionable strength of this study is that its regression models yielded high coefficients of determination (R^2 values); the selected variables were able to predict up to 83% of the variance in the Interestingness ratings, 88.3 % of the variance in the Spatial Organization ratings and 76.6 % of the variance in the Pleasantness ratings of the whole group. As Metsämuuronen (2009) mentions, in the field of human sciences where experiments are

conducted with ratings by real people, that over 50 % of a phenomenon can often be left as *unexplained*. All three models were obtained with a set of predictor variables that had the multicollinear (with high internal correlations) variables removed. The results thus propose that the chosen approach was beneficial for studying the phenomenon in question.

This study also had several limitations. As the literature suggested that artistic people might differ in their responses to aesthetic issues, I wanted to include some analysis of that topic in this study, too. None of the subjects reported having had professional art training, and therefore the subgroup analyses were conducted with subjects that had obtained previous free-time artistic training in the visual arts. However, because the number of subjects with free-time visual artistic training was minor (n=10) and in addition the majority of them were female (n=8), the results concerning this subgroup may be strongly biased and therefore can only be considered as preliminary. Furthermore, assigning artistic free-time activity as an independent variable in the regression analyses did not reach significance as a predictor in any of the models (p>.05), which also implies its insufficient reliability. Similarly, because of the small number of subjects in the subgroups of males (n=57) and females (n=50) the results concerning them should also be interpreted with caution.

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> ***The selected variables were able to predict up to 83 % of the variance of Interestingness ratings, 88.3 % that of Spatial Organization ratings and 76.6 % that of Pleasantness ratings***

As this was one of the first experimental approaches of its kind to study visual preferences of apartment interiors, the variables and terms used in it were drawn and synthesized from individual studies and theories, mainly from other fields, whose topics related to the topic of this research. Spatial Organization proved the weakest variable in analysis of the reliability of the test instrument; in the McNemar-Bowker test of symmetry its asymptotic significance was only slightly greater than .05 (p=.066). This implies that perhaps it was challenging for the subjects to understand the concept of Spatial Organization as intuitively as those of Interestingness and Pleasantness. Defining the architectural variables was also very challenging and the set created for this study cannot be considered either complete or explicit. First, the definition of some architectural variables was easier than others; for instance, it was easy to determine if an image was symmetrical, whereas for some other variables a multitude of ways of definition was available. Even simple variables such as “Number of Building Elements” raised a surprisingly large number of ambiguities: which elements should be counted as building elements? Should all the mouldings be counted individually, and if so, should the white frames of the windows be counted as well? Should the floor of the next room showing from the door be counted as a new building element or is it an extension to the floor of the room in question? In this case, I ended up defining a building element as any that would have to be individually installed during the construction process. However, that also depends largely on the construction technique. Second, I consider some variables more reliable than others. For instance the “Number of Black Pixels” may perhaps be the most reliable variable of the set; it is explicitly and objectively measured and has a good variance across all the images. In contrast, such variables that attained deviating values only on a few images or that could not be unambiguously measured have to be considered less reliable. For instance, the variable “Horizontality in Windows” had the value “yes” only with two images (6 and 7), which reduces its power compared with variables with wide-ranging variation. The weak explanatory power of such variables in this study may be due to insufficient variance across the images, so that with better distribution of these variables in the images their influence could have shown as greater.

It is possible and desirable that the variables and terms used in this study will be better formulated and new, better ones will be found along with future research. However, this was a preliminary attempt to build this kind of knowledge, which, I hope, will be enhanced by increasing experience from similar attempts. Besides, more research is still needed to expose a more definitive set of architectural characteristics that can predict the subjective experiences of complexity, order and preference, and that can finally be used for evaluating real apartment interiors.

While I consider the use of exclusively produced, artificial test images as a strength, this same factor also yielded some possible limitations. Even though the correlation of preference ratings of full-colour CAD-renderings and photographs presenting the same buildings has previously been found to be high (Stamps 1999b), lack of realism could have disturbed some judgements, especially when some features in the images were intentionally exaggerated in order to expose possible differences. It also remains unknown whether the vertical form of images would have contributed to the preference judgements of vertical and horizontal elements in the images. On the other hand, it is not excluded that the vertical direction would really play a special role in visual perception; it is, for instance, the direction of gravitational force, whereas no significant environmental forces act in the horizontal direction; it could thus influence preference, for example by the exposure effect.

Even though the aim of organizing the experiment in one single session was to decrease the risk of possible confounding factors of the test situation, the approach is also problematic in several ways. Even though the order of the images was randomized between each test part (between judging Interestingness, Spatial Organization and Pleasantness), the order of the test parts was the same for all subjects: first they evaluated the Interestingness of the images, then their Spatial Organization and lastly their Pleasantness. It is therefore possible that previous evaluations influenced the following ones; that is to say, the evaluations of Interestingness might have influenced the Spatial Organization ratings and these two might have influenced the Pleasantness ratings. In addition, even though the duration of the experiment was only 24 minutes in total, fatigue could have occurred among the subjects towards the end of the session. In the case of a single

session, this means that the subjects may have been most fatigued during their ratings of Pleasantness, which could decrease the reliability of those ratings. To prevent these potential risks, the experiment should have been arranged on several different occasions where the order of the test parts would have been randomized in each. However, that could have yielded possible confounding factors due to the different experimental setups.

One possible limitation of this study no doubt concerns the management of the visual features of traditional architectural style, application of which to the images was possibly quite restrained. For an architect like myself, given a contemporary architectural education, the capability to use correctly, for instance, old classical proportional systems would have required massive amounts of time and practice to learn how to apply them appropriately. In this experiment, classical proportions were studied with only the simplest proportional systems based on whole numbers and a simple application of the golden ratio. However, as Padovan (1999) illustrates, several more complex proportional systems are used both in traditional and contemporary architecture, which should be also studied in the future.

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It is possible and desirable that the variables and terms used in this study will be better formulated and new, better ones will be found along with future research

5.3
GENERALIZABILITY AND RECOMMENDATIONS FOR FUTURE RESEARCH

This study was exploratory and small in scope, and thus its results are not directly generalizable. The test images were theoretical and simplified, and the subject group was limited, consisting of quite young (the majority being under 25 years old) Finnish undergraduates studying medicine. Medical students seem to share several similarities but also several differences with their peers of the same age, for instance as to their family background (Lahelma, Broms & Karisto 2003), their views on the future (Opetus- ja kulttuuriministeriö 2014) and their personality traits (Vedel 2016, Lievens et al. 2002).

It is possible that the results of a group of subjects from other professional fields, age groups, socioeconomic classes or nationalities would be different. Even though the results of this study support the findings from previous studies conducted with subjects having different cultural(e.g. Stamps, Nasar 1997, Berlyne, Robbins & Thompson 1974, Nasar 1988d)and socioeconomic (e.g. Nasar 1988b, 1983, Stamps 1999b) backgrounds, further studies should still be conducted with different subject groups, including in the context of apartment architecture, in order to obtain a more generalizable image of the phenomenon. Within the limits of this study, I chose to study differences in responses only within some limited subgroups; males and females and subjects with and without artistic free-time training. An interesting subject for future research would be to examine whether some relations could be found between individuals' different characteristics - such as their personality traits - and their judgements.

> ***Further studies should be conducted with different subject groups***

The purpose of this study was to map out as broadly as possible the potential architectural characteristics that could explain subjective preferences for apartment interiors. Thus the variables in this study can only be considered directional, and perhaps not accurate enough. In the future, similar studies should be conducted concentrating for example on a narrower but more accurate set of variables, and perhaps a larger set of images. Then, for instance, even more alternative variables could be tested for architectural characteristics that appeared important in this study, and the best predictors of those could be found. Besides, characteristics that were excluded from the scope of this study, such as the influence of building materials or different architectural styles, would be highly important and interesting topics in future studies.

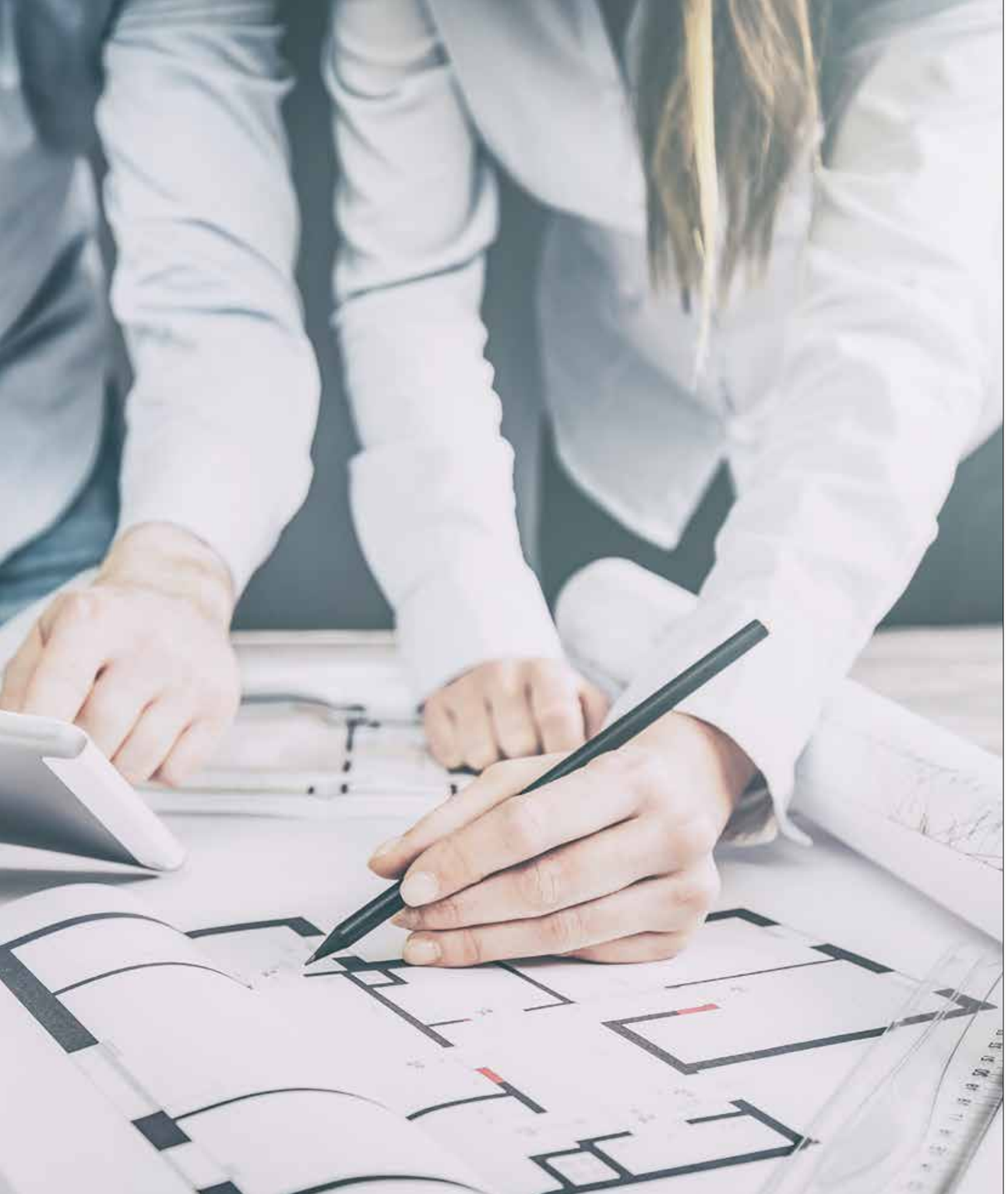
> ***A large window may be in order before a serene view to a field, the sea or a forest, but might be distracting in front of a busy urban street***

A further point here is that the strict scope of this research limits the generalizability of its results. The test images presented only theoretical spaces having the scale of apartment rooms, thus excluding the experience of an apartment as a series of spaces. Additionally, the spaces presented were general and for instance lacked any furniture. This excluded examination of features that are likely to influence overall preference for real apartments, such as kitchen or bathroom equipment. Test images were also highly simplified. While the impact of the environment around the spaces presented was deliberately excluded from this study, it is likely to limit the generalizability of the results too. For instance, even though the window surface area was demonstrated to increase the Interestingness - and thus the Pleasantness - value of the rooms in this research data, this is most probably a matter that depends on what kind of environment one sees through the window. For instance, a large window may be in order before a serene view to a field, the sea or a forest, but might be distracting in front of a busy urban street. Similarly, a large window facing a forest might feel pleasant during the day, but unpleasant when one is alone at home at night. These kinds of issues may also concern other variables in this study, and therefore their impact on different environments and occasions should still be studied separately as well. On the basis of this and other similar studies in the future, it would also be interesting to study whether experiments conducted with real environments or even with photographs

of real apartment interiors support the results of these theoretical studies. The use of virtual environments in similar studies might also increase the genuineness of the spatial experience and provide ways to examine the behavioural and affective responses of the subjects in the context of larger entities, such as in an entire apartment or house. Use of virtual reality would also enable use of new methods, such as recording the EEG, which often restrains subjects from moving or walking freely during an experiment.

It is not self-evident either that the results of this study would be generalized across time. The relationship between complexity, order and preference may perhaps be related to periodical trends, as also suggested by the architect Anne Tyng in her dissertation from 1975 (Lang 1987, p.196). It may be that, for instance, increased environmental complexity yields to positive affective responses in a period when simple architecture is dominant in the built environment, thus leading to an increased desire for complexity. During some other periods of time, it might be that a decrease in complexity and highly simple environmental scenes would yield to more positive affective responses. This idea would be discordant with theories suggesting that a preference for certain visual features, such as complexity and order, would be due to an evolutionary preference for features that are found in natural scenes (Appleton 1975, Kaplan, Kaplan 1989, Sussman, Hollander 2015).

Assuming that a preference for the visual appearance of an apartment associates with the apartment purchase decision, the results of the kind of studies that this study also represents might be partly applicable in the future to predict the apartment purchasing behaviour of customers. Nevertheless, preference has been said to lead to purchase only when the price is right (Knutson et al. 2007). In the future, it would thus be interesting to find out how preferred apartment features could be realized in housing production and what effect their implementation would have on apartment prices. Naturally only after such studies would it be possible to examine the effect of these matters on the actual apartment-purchasing behaviour of customers.



5.4
POSSIBLE **INTERPRETATIONS**

The nature of this research was experimental and its results should still be considered preliminary. Thus it can provide only a limited basis for any precise practical recommendations. Hopefully in the future, as research expands, the more it will also yield practical applications. However, I suppose some speculation of that kind is permissible even at this phase. Although this study focused only on apartment interiors, I here also allow myself the freedom to reflect the phenomenon in wider scope. In addition, even though the images used in the experimental part of this study were not intended to express any architectural styles in particular, I would like to reflect the results obtained from them in relation to some general discussion about stylistic matters.

The results of this study provide support for the general idea that an environment that is both complex and ordered at the same time would be the most highly preferred by people; an idea simplified already in the old phrase *"unity in variety"*. It seems that a scene must contain enough information in order to attract a viewer's attention and to provide motivation to keep on exploring it, thus preventing the arousal level from dropping. Scenes that are too ordered with low levels of complexity are most likely considered boring and thus unpleasant. In contrast, a complex scene with a low level of order may feel chaotic and senseless, perhaps because the individual does not succeed in interpreting it appropriately. Thus, it could be said that the role of order is to make the scene comprehensible and easily perceived, and the role of complexity to make it interesting.

As described in the introduction, previous studies (e.g. Cohen, Areni 1991, Bechara, Damasio 2005, Ambler, Ionnides & Rose 2000, Dijksterhuis, Nordgren 2006, Dijksterhuis et al. 2006, Dijksterhuis, van Olden 2006) suggest that the purchasing behaviour of customers may be more influenced by experiential aspects than had previously been believed. There is reason to believe that automatic information-processing, emotion and intuition in particular control complex decision-making processes such as the choice of an apartment. It is thus likely that the intuitive preference, "the gut feeling", and aesthetics would wield a great influence on the apartment decision as well: "it just felt right" is a commonly-heard phrase after a successful apartment purchase (Hasu 2010, p.80).(Bechara, Damasio 2005, Dagher 2007, Ambler, Ionnides & Rose 2000, Holbrook, Batra 1987, Kahneman 2011, Dijksterhuis, Nordgren 2006, Dijksterhuis 2004). Moreover, as the growth of wealth and welfare has driven Western societies to reach high levels of materialistic well-being, it has been argued that utility alone would no longer be capable of satisfying the various needs of customers (e.g. Lindström, Nyberg & Ylä-Anttila 2006). The basic functionality of apartments in Finland is today well-assured in general; they have the proper facilities for cooking and bathing, they keep warm and have sufficient amounts of space per resident and natural light. Most of these benefits are secured by legislation (G1 Suomen rakentamismääräyskokoelma 2004). As the basic functionality of

apartments has thus become self-evident, current housing demands are thought to redirect more to matters of comfort, style and expression of lifestyle or status (Juntto 2010 p. 35). Consequently, the intuitive preference for the visual appearance of apartments can be seen as a feature having increasing importance in the housing trade as well. However, there is evidence to suggest that the general public would not seem to enjoy the visual appearance of contemporary housing (e.g Scruton 2009, Stamps 1999b). A great number of people report preferring historical over contemporary styles (Gifford et al. 2000, Stamps, Nasar 1997, Mastandrea, Bartoli & Carrus 2011, Stamps 1994), a phenomenon that can also perhaps be reflected in the sale growth of rural or manor house-style houses or in the popularity of "new old"-look merchandise. Apartment block designs, on the other hand, can be regarded as still largely following the principles of modernism.

As indicated in the theoretical part of this thesis, traditional architectural styles typically seem to comprise a mode of expression where visual richness and order play important roles. Moreover, the visual richness of "old" buildings is typically multi-scaled; the building gradually offers ever more details on closer examination. On the other hand, order is provided by symmetry, repetitive elements and hierarchical visual principles such as systems of orders or proportions. In contrast, it could be said that the transition to the modern style of buildings has led to a radical decrease in both visual complexity (e.g. by the elimination of decoration) and order (e.g. by the adoption of asymmetry) at the same time. In light of the results obtained from this and many other studies, this change could provide one explanation for the inclination of general public preference in the direction of old and historical housing architecture. Besides, it could be speculated that contemporary architecture would be less preferred because of its large variation. Traditional architecture seems to have been governed by a set of rules and guidelines, considering for instance the system of orders or the appropriate proportions, which may have led to a typical appearance of buildings. In contrast, contemporary architecture seems to have fewer aesthetic rules of this kind: it is more free-form and involves large variance in the appearance of buildings. From the viewpoint of the exposure effect, which was examined in Chapter 2.2.4, it could thus be speculated that traditional architecture would in a way be more "predictable" than contemporary

architecture, which in contrast could be regarded as more uncertain. It may thus be that buildings in traditional architectural styles could provide some feelings of familiarity for the viewer, which perhaps would then lead to feelings of comfort.

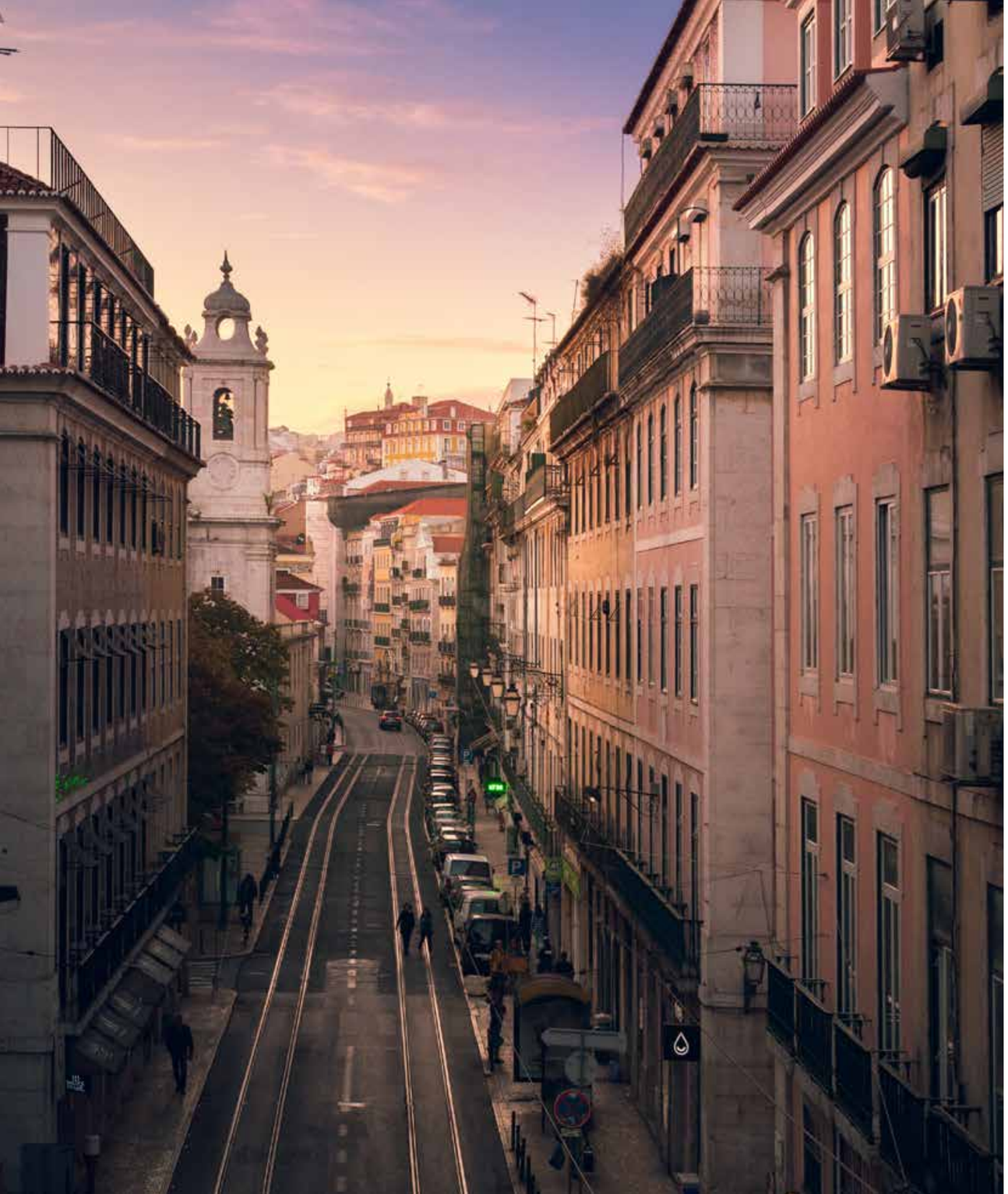
When examining the architecture that is built today, one can often notice intentions to increase visual complexity in the built environment. In my opinion, this currently manifests for example as vivid and sculpture-like volumes and the use of a variety of colours, patterns and materials in both new housing and public buildings. Yet they sometimes also comprise features that could, as a matter of fact, be described as factors of disorder rather than of complexity: the random arrangements of elements or the arbitrary use of element sizes, for instance. How the general public feels about these matters in the real built environment remains to be studied, but in this study they were found to decrease preference. Thus, even though the importance of visual complexity may be better perceived, it seems to me that the features of visual order are still more disregarded; for instance, symmetry is a feature that was found to increase preference in this study, but is rarely seen in today's architecture.

Main conclusions from the study

1) *Two concepts, complexity and order, were detected as repeating in earlier studies concerning visual preference. This was perceived in the literature from various fields, such as that of aesthetics, environmental psychology and architecture.*

2) *Several visual architectural characteristics based on the concepts of complexity and order, as well as on other features that were suggested in the literature to influence preference, were transformed into architectural variables, and embedded into synthetic images presenting apartment interiors.*

3) *Empirical evidence was found to support the assumption that visual complexity and order can explain the majority of variance in the subjective ratings of preference for apartment interior images. Besides, the results suggest that certain physical architectural characteristics can explain the majority of variance in subjective ratings of complexity, order and preference.*



Epilogue

I have a firm belief that architecture should be beautiful. Additionally, I am convinced that beautiful architecture is in most cases also durable and functional. Not because these features would automatically go together, but because people then make it so: they take care of things they like and use them because of that liking. Roger Scruton has put the same idea in the following way: “Beautiful objects change their uses, merely functional buildings get torn down. Sancta Sophia in Istanbul was built as a church, became a barracks, then a stable, then a mosque and then a museum. The lofts of Lower Manhattan changed from warehouses to apartments to shops and, in some cases, back to warehouses - retaining their charm meanwhile and surviving precisely because of that charm” (Scruton 2009). This charm that makes buildings survive and maintain their functionality over the decades is seemingly independent of their civil or monetary value; it may not be the presidential palace that survives but warehouses or barracks. Thus in the end, the function, the price or the ideology behind the design may be an irrelevant matter in how the building finally maintains its value, and beauty the only one that ensures it.

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Christmas 2017 at Jyväskylä, perhaps the most beautiful city in Finland

Noora Pihlajarinne

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APPENDICES

Appendix 1. All test images in the order of their image number

Image 1

Image 2

Image 3

Image 4

Image 5

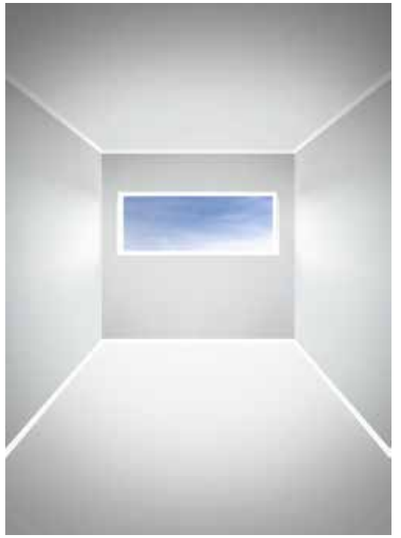


Image 6

Image 7

Image 8

Image 9

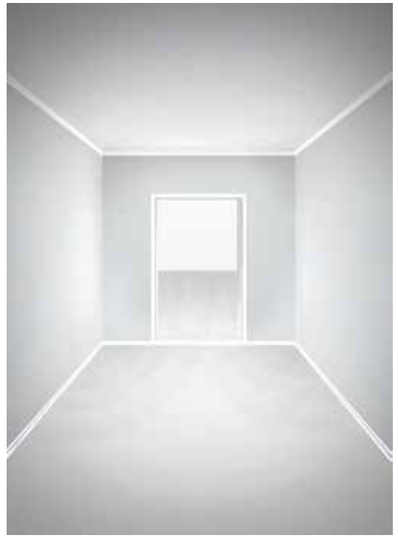


Image 10

Image 11

Image 12

Image 13

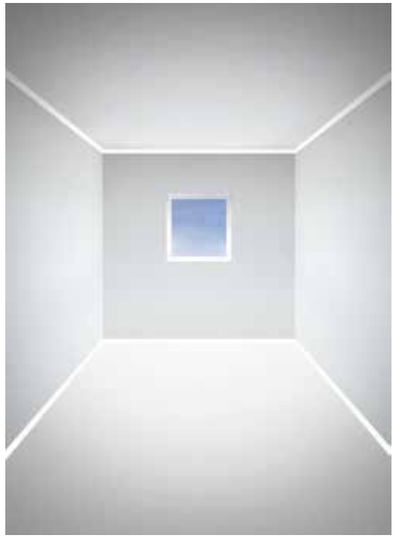


Image 14

Image 15

Image 16

Image 17

Image 18

Image 19

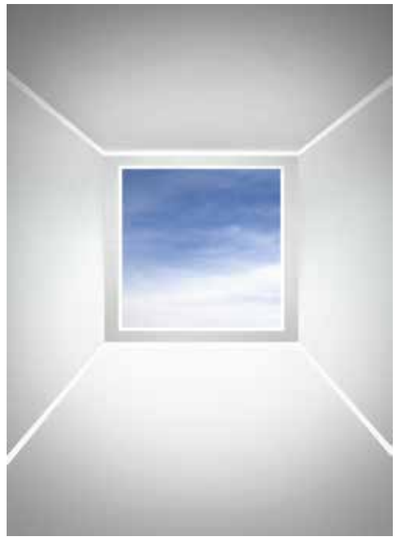


Image 20

Image 21

Image 22

Image 23

Image 24

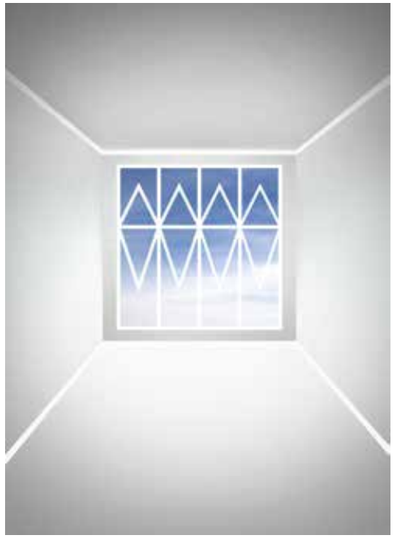


Image 25

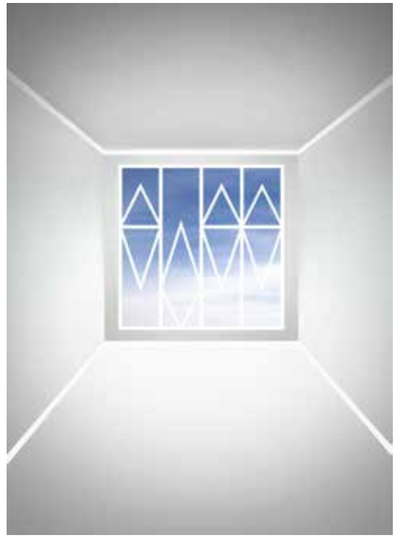


Image 26

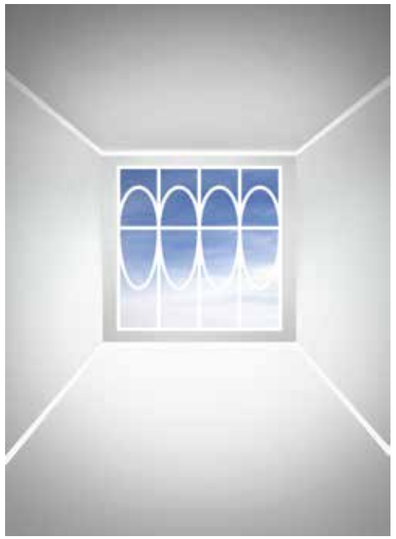


Image 27

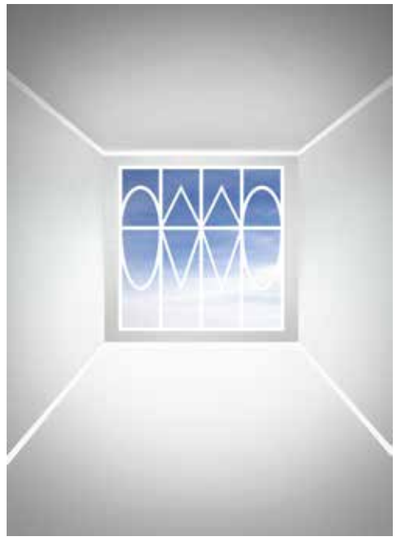


Image 28

Image 29

Image 30

Image 31

Image 32

Image 33

Image 34

Image 35

Image 36

Image 37

Image 38

Image 39

Image 40

Image 41

Image 42

Image 43

Appendix 2. The values of the architectural variables in the images

Image number	Number of black pixels	Number of building element types	Number of doors	Number of windows	Number of windowpanes	Number of windows + Number of windowpanes	Number of windowpanes / Number of windows	Amount of ornaments
1	57677	1	0	1	1	2	1	7
2	54383	1	0	1	1	2	1	7
3	55994	1	0	1	1	2	1	7
4	42758	1	0	1	1	2	1	7
5	50194	1	0	1	1	2	1	7
6	48465	1	0	1	1	2	1	7
7	41304	1	0	1	1	2	1	7
8	63112	1	1	0	0	0	-	7
9	79582	1	2	0	0	0	-	8
10	62603	1	1	0	0	0	-	7
11	78266	1	2	0	0	0	-	8
12	94194	1	3	0	0	0	-	9
13	37762	0	0	0	0	0	-	5
14	41691	1	0	1	1	2	1	7
15	120959	1	0	15	15	30	1	21
16	111078	1	0	3	15	18	5	9
17	122129	1	0	15	15	30	1	21
18	121707	1	0	3	15	18	5	9
19	116284	1	0	3	15	18	5	11
20	51285	1	0	1	1	2	1	7
21	64496	1	0	1	6	7	6	7
22	64215	1	0	1	6	7	6	7
23	73918	1	0	1	16	17	16	7
24	74104	1	0	1	16	17	16	7
25	88528	1	0	1	16	17	16	7
26	90410	1	0	1	16	17	16	7
27	81877	1	0	1	16	17	16	7
28	88704	1	0	1	16	17	16	7
29	89387	1	0	5	5	10	1	11
30	117184	2	2	3	3	6	1	11
31	132510	2	0	3	3	6	1	11
32	155758	3	2	1	1	2	1	11
33	93368	2	2	1	1	2	1	9
34	86585	2	2	1	1	2	1	7
35	76221	2	2	1	1	2	1	10
36	27887	1	0	1	1	2	1	0
37	60523	1	0	1	1	2	1	7
38	223701	2	0	1	1	2	1	7
39	613652	2	0	1	1	2	1	85
40	636040	2	0	1	1	2	1	87
41	808457	2	0	1	1	2	1	225
42	777205	2	0	1	1	2	1	81
43	884835	2	0	1	1	2	1	81

Image number	*Classical proportions*	*Curved forms*	*Diagonal forms*	*Number of forms*	*Element Alignments*	*Element levels*	*Grouping*	*Level of decoration*	*Room Height*
1	Yes	No	No	1	0	1	Yes	Normal	2700
2	Yes	No	No	1	0	1	Yes	Normal	3700
3	Yes	No	No	1	0	1	Yes	Normal	2500
4	Yes	No	No	1	0	1	Yes	Normal	2700
5	Yes	No	No	1	0	1	Yes	Normal	3700
6	No	No	No	1	0	1	Yes	Normal	2700
7	No	No	No	1	0	1	Yes	Normal	2700
8	Yes	No	No	1	0	1	Yes	Normal	2700
9	Yes	No	No	1	1	1	No	Normal	2700
10	Yes	No	No	1	0	1	Yes	Normal	2700
11	Yes	No	No	1	1	1	No	Normal	2700
12	Yes	No	No	1	1	1	No	Normal	2700
13	Yes	No	No	1	0	0	No	Normal	2700
14	Yes	No	No	1	0	1	Yes	Normal	2700
15	No	No	No	1	0	15	No	Normal	2700
16	No	No	No	1	1	1	Yes	Normal	2700
17	No	No	No	1	6	9	No	Normal	2700
18	No	No	No	1	1	1	Yes	Normal	2700
19	Yes	No	No	1	1	1	Yes	Normal	2700
20	Yes	No	No	1	0	1	Yes	Normal	2700
21	Yes	No	No	1	0	1	Yes	Normal	2700
22	Yes	No	No	1	0	1	Yes	Normal	2700
23	Yes	No	No	1	0	1	Yes	Normal	2700
24	No	No	No	1	0	1	Yes	Normal	2700
25	No	No	Yes	2	0	1	Yes	Normal	2700
26	No	No	Yes	2	0	1	Yes	Normal	2700
27	No	Yes	No	2	0	1	Yes	Normal	2700
28	No	Yes	Yes	3	0	1	Yes	Normal	2700
29	Yes	No	No	1	1	1	No	Normal	3000
30	Yes	No	No	1	2	2	No	Normal	3000
31	Yes	No	No	1	2	2	No	High1	3000
32	Yes	No	No	1	2	3	No	High1	3000
33	Yes	No	No	1	1	2	No	Normal	3000
34	Yes	Yes	No	2	1	2	No	Normal	3000
35	Yes	No	Yes	2	1	2	No	Normal	3000
36	Yes	No	No	1	0	1	Yes	None	2700
37	Yes	No	No	1	0	1	Yes	Normal	2700
38	Yes	No	No	1	0	1	Yes	Increased	2700
39	Yes	No	No	1	0	70	No	High1	2700
40	Yes	No	No	1	6	5	Yes	High1	2700
41	Yes	Yes	Yes	3	6	6	Yes	High2	2700
42	Yes	No	No	1	6	6	Yes	High2	2700
43	Yes	Yes	Yes	3	6	6	Yes	High3	2700

Image number	*Horizontality in room shape*	*Horizontality in windows*	*Horizontality*	*Verticality in room shape*	*Verticality in windows*	*Verticality*	*Neutral room shape*	*Neutral window shape*	*Miscallaneous window forms*
1	No	No	No	No	No	No	Yes	Yes	No
2	No	No	No	Yes	No	Yes	No	Yes	No
3	Yes	No	Yes	No	No	No	No	Yes	No
4	No	No	No	No	Yes	Yes	Yes	No	No
5	No	No	No	Yes	Yes	Yes	No	No	No
6	No	Yes	Yes	No	No	No	Yes	No	No
7	Yes	Yes	Yes	No	No	No	No	No	No
8	No	No	No	No	No	No	Yes	No	No
9	No	No	No	No	No	No	Yes	No	No
10	No	No	No	No	No	No	Yes	No	No
11	No	No	No	No	No	No	Yes	No	No
12	No	No	No	No	No	No	Yes	No	No
13	No	No	No	Yes	No	Yes	No	No	No
14	No	No	No	No	No	No	Yes	Yes	No
15	No	No	No	No	No	No	Yes	No	Yes
16	No	No	No	No	Yes	Yes	Yes	No	No
17	No	No	No	No	No	No	Yes	No	Yes
18	No	No	No	No	Yes	Yes	Yes	No	No
19	No	No	No	No	Yes	Yes	Yes	No	No
20	No	No	No	No	No	No	Yes	Yes	No
21	No	No	No	No	Yes	Yes	Yes	No	No
22	No	No	No	No	Yes	Yes	Yes	No	No
23	No	No	No	No	No	No	Yes	Yes	No
24	No	No	No	No	No	No	Yes	No	No
25	No	No	No	No	Yes	Yes	Yes	No	No
26	No	No	No	No	Yes	Yes	Yes	No	No
27	No	No	No	No	Yes	Yes	Yes	No	No
28	No	No	No	No	Yes	Yes	Yes	No	No
29	No	No	No	No	Yes	Yes	Yes	No	No
30	No	No	No	No	Yes	Yes	Yes	No	No
31	No	No	No	No	Yes	Yes	Yes	No	No
32	No	No	No	No	Yes	Yes	Yes	No	No
33	No	No	No	Yes	No	Yes	No	Yes	No
34	No	No	No	Yes	No	Yes	No	Yes	No
35	No	No	No	Yes	No	Yes	No	Yes	No
36	No	No	No	No	Yes	Yes	Yes	No	No
37	No	No	No	No	Yes	Yes	Yes	No	No
38	No	No	No	No	Yes	Yes	Yes	No	No
39	No	No	No	No	Yes	Yes	Yes	No	No
40	No	No	No	No	Yes	Yes	Yes	No	No
41	No	No	No	No	Yes	Yes	Yes	No	No
42	No	No	No	No	Yes	Yes	Yes	No	No
43	No	No	No	No	Yes	Yes	Yes	No	No

Image number	*Size differences between visual elements*	*Number of window directions*	*Passage direction to the front*	*Passage direction to the left*	*Passage direction to the right*	*Direction up*	*Total Number of directions*	*Window surface area*
1	No	1	No	No	No	No	1	Medium
2	No	1	No	No	No	No	1	Medium
3	No	1	No	No	No	No	1	Medium
4	No	1	No	No	No	No	1	Medium
5	No	1	No	No	No	No	1	Medium
6	No	1	No	No	No	No	1	Medium
7	No	1	No	No	No	No	1	Medium
8	No	0	No	No	Yes	No	1	No windows
9	No	0	No	Yes	Yes	No	2	No windows
10	No	0	Yes	No	No	No	1	No windows
11	No	0	Yes	No	Yes	No	2	No windows
12	No	0	Yes	Yes	Yes	No	3	No windows
13	No	0	No	No	No	Yes	1	No windows
14	No	1	No	No	No	No	1	Small
15	Yes	3	No	No	No	No	3	Large
16	Yes	3	No	No	No	No	3	Large
17	Yes	3	No	No	No	No	3	Large
18	Yes	3	No	No	No	No	3	Large
19	Yes	3	No	No	No	No	3	Large
20	No	1	No	No	No	No	1	Large
21	No	1	No	No	No	No	1	Large
22	Yes	1	No	No	No	No	1	Large
23	No	1	No	No	No	No	1	Large
24	Yes	1	No	No	No	No	1	Large
25	Yes	1	No	No	No	No	1	Large
26	Yes	1	No	No	No	No	1	Large
27	Yes	1	No	No	No	No	1	Large
28	Yes	1	No	No	No	No	1	Large
29	No	3	No	No	No	No	3	Large
30	Yes	1	No	Yes	Yes	No	3	Large
31	Yes	3	No	No	No	No	3	Large
32	Yes	1	No	Yes	Yes	No	3	Medium
33	Yes	1	No	Yes	Yes	No	3	Medium
34	Yes	1	No	Yes	Yes	No	3	Medium
35	Yes	1	No	Yes	Yes	No	3	Medium
36	No	1	No	No	No	No	1	Medium
37	No	1	No	No	No	No	1	Medium
38	Yes	1	No	No	No	No	1	Medium
39	Yes	1	No	No	No	No	1	Medium
40	Yes	1	No	No	No	No	1	Medium
41	Yes	1	No	No	No	No	1	Medium
42	Yes	1	No	No	No	No	1	Medium
43	Yes	1	No	No	No	No	1	Medium

Appendix 3. The questionnaire (with first pages from each section) for the experiment

Vastaajanumero (kokeen suorittaja täyttää): _____

Esitietolomake
Ympyröi tai kirjoita parhaiten tilannettasi kuvaava vaihtoehto

1) Ikä: _____

2) Sukupuoli 1 Mies 2 Nainen

3) Koulutustausta

Toinen aste:

1 Lukio

2 Ammattikoulutus

Korkea-aste

3 Ammattikorkeakoulu

4 Yliopisto, jos kyllä, tarkenna:

5 Alempi yliopistotutkinto (kandidaatti)

6 Ylempi yliopistotutkinto (maisteri)

7 Tohtorintutkinto

8 Muu, mikä? _____

4) Oletko saanut taiteellista koulutusta (esim. taideopinnot, kuvataidekoulu)?

Peruskoulun kuvataideopetusta ei huomioida.

1 Kyllä, _____ vuotta. Missä? _____

2 En

5) Kuinka kiinnostunut olet taiteesta / arkkitehtuurista / sisustuksesta?

En lainkaan 1 2 3 4 5 Hyvin paljon

Palauttamalla kyselylomakkeen kokeen suorittajalle annan suostumukseni minulta kerätyn aineiston käyttöön ko. väitöskirjatutkimuksessa.

Ympyröi jokaisen kuvan kohdalla kysytyn ominaisuuden voimakkuutta mielestäsi parhaiten kuvaavan vaihtoehdon numero. Kuvan vaihtuessa kuuluu äänimerkki.

1 Mielenkiintoisuus

Kuva 1	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 2	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 3	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 4	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 5	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 6	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 7	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 8	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 9	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 10	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 11	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 12	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 13	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 14	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 15	**Tylsä**	1	2	3	4	5	**Kiinnostava**
Kuva 16	**Tylsä**	1	2	3	4	5	**Kiinnostava**

Ympyröi jokaisen kuvan kohdalla kysytyn ominaisuuden voimakkuutta mielestäsi parhaiten kuvaavan vaihtoehdon numero. Kuvan vaihtuessa kuuluu äänimerkki.

2 Tilallinen selkeys

Kuva 1	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 2	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 3	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 4	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 5	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 6	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 7	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 8	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 9	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 10	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 11	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 12	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 13	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 14	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 15	**Sekava**	1	2	3	4	5	**Selkeä**
Kuva 16	**Sekava**	1	2	3	4	5	**Selkeä**

Ympyröi jokaisen kuvan kohdalla kysytyn ominaisuuden voimakkuutta mielestäsi parhaiten kuvaavan vaihtoehdon numero. Kuvan vaihtuessa kuuluu äänimerkki.

3 Visuaalinen miellyttävyys

Kuva 1	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 2	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 3	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 4	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 5	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 6	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 7	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 8	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 9	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 10	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 11	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 12	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 13	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 14	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 15	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**
Kuva 16	**Epämiellyttävä**	1	2	3	4	5	**Miellyttävä**

Appendix 4. Internal correlations for architectural variables with significant (p < .05) correlations to mean ratings of Interestingness. Correlation coefficient higher than .8 are marked with red text. The removed variables are marked with red text and filling.

	Size Differences Between Visual Elements	*Window Surface Area*	*Element Alignments*	*Number of Black Pixels*	*Number of Window Directions*	*Level of Decoration*	*Number of Building Element Types*	*Number of Windows + Number of Windowpanes*	*Verticality*	*Total Number of Directions*	*Number of Building Elements*	*Amount of Ornaments*	*Number of Sculptured Elements*	*Number of Windowpanes*	*Verticality in Windows*	*Number of Forms*	*Number of Windows*	*Curved Forms*	*Classical Proportions in Element / Room Layout*
Size Differences Between Visual Elements	-																		
Window Surface Area	.491**	-																	
Element Alignments	.430**	0.021	-																
Number of Black Pixels	.430**	-0.017	.781**	-															
Number of Window Directions	.394**	.669**	0.165	-0.024	-														
Level of Decoration	.434**	0.005	.698**	**.836****	0.045	-													
Number of Building Element Types	.556**	0.009	.513**	.565**	-0.039	.743**	-												
Number of Windows + Number of Windowpanes	.458**	.650**	0.014	-0.16	.668**	-0.222	-.314*	-											
Verticality	.536**	.426**	0.207	.318*	0.246	.323*	.459**	0.013	-										
Total Number of Directions	.359*	0.112	0.163	-0.17	.544**	-0.024	0.278	0.3	0.128	-									
Number of Building Elements	.329*	-0.025	.711**	**.877****	-0.022	.691**	.444**	-0.138	0.234	-0.168	-								
Amount of Ornaments	.324*	-0.026	.701**	**.867****	-0.026	.682**	.441**	-0.138	0.229	-0.17	**.999****	-							
Number of Sculptured Elements	.393**	-0.048	.717**	**.962****	-0.07	**.854****	.609**	-0.247	.325*	-0.237	**.835****	**.825****	-						
Number of Windowpanes	.454**	.649**	-0.098	-0.183	.523**	-0.248	-.351*	**.940****	0.087	0.159	-0.171	-0.172	-0.264	-					
Verticality in Windows	.439**	.441**	0.232	.379*	0.284	.392**	0.28	0.125	**.826****	-0.05	0.286	0.281	.393**	0.203	-				
Number of Forms	.415**	0.151	.306*	.415**	-0.11	.325*	0.213	0.106	.343*	-0.14	.466**	.462**	.369*	0.197	0.253	-			
Number of Windows	0.278	.384*	0.24	-0.047	.691**	-0.077	-0.108	.711**	-0.145	.467**	-0.013	-0.012	-0.109	.430**	-0.088	-0.125	-		
Curved Forms	.338*	0.102	0.294	.384*	-0.089	.306*	0.213	0.05	0.279	-0.1	.427**	.424**	.346*	0.114	0.193	**.849****	-0.102	-	
Classical Proportions in Element / Room Layout	-0.224	-.633**	0.206	0.177	-.345*	0.271	.320*	-.652**	0.029	-0.014	0.159	0.152	0.255	-.669**	-0.13	-0.032	-.347*	0.014	-
Diagonal Forms	.376*	0.156	0.234	.332*	-0.099	0.255	0.157	0.13	.310*	-0.14	.378*	.374*	0.292	0.222	0.241	**.872****	-0.113	.482**	-0.066

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Appendix 5. Internal correlations for architectural variables with significant (p < .05) correlations to mean ratings of Spatial Organization. Correlation coefficient higher than .8 are marked with red text. The removed variables are marked with red text and filling.

	Size Differences Between Visual Elements	*Number of Windows*	*Miscellaneous Window Forms*	*Element Alignments*	*Number of Windows + Number of Windowpanes*	*Total Number of Directions*	*Grouping*	*Classical Proportions*	*Number of Black Pixels*	*Bilateral Symmetry*	*Number of Window Directions*	*Number of Windowpanes*	*Element Levels*	*Number of Building Elements*	*Amount of Ornaments*	*Level of Decoration*	*Neutral Window Shape*	*Number of Sculptured Elements*
Size Differences Between Visual Elements	-																	
Number of Windows	0.278	-																
Miscellaneous Window Forms	0.206	**.950****	-															
Element Alignments	.430**	0.24	0.226	-														
Number of Windows + Number of Windowpanes	.458**	.711**	.630**	0.014	-													
Total Number of Directions	.359*	.467**	.327*	0.163	0.3	-												
Grouping	-0.208	-.362*	-.336*	-0.137	-0.016	-.751**	-											
Classical Proportions	-.365*	-.454**	-.429**	0.049	-.734**	-0.134	-0.09	-										
Number of Black Pixels	.430**	-0.047	-0.039	.781**	-0.16	-0.17	0.051	0.151	-									
Bilateral Symmetry	-0.106	-0.194	-0.23	0.157	-0.213	-0.08	0.173	0.288	-0.036	-								
Number of Window Directions	.394**	.691**	.465**	0.165	.668**	.544**	-0.136	-.411**	-0.024	-0.059	-							
Number of Windowpanes	.454**	.430**	.349*	-0.098	**.940****	0.159	0.155	-.723**	-0.183	-0.179	.523**	-						
Element Levels	0.24	0.152	0.173	0.056	0.014	-0.044	-0.3	0.013	.425**	-.423**	0.056	-0.055	-					
Number of Building Elements	.329*	-0.013	0.001	.711**	-0.138	-0.168	0.062	0.136	**.877****	-0.02	-0.022	-0.171	.355*	-				
Amount of Ornaments	.324*	-0.012	0.003	.701**	-0.138	-0.17	0.058	0.132	**.867****	-0.025	-0.026	-0.172	.359*	**.999****	-			
Level of Decoration	.434**	-0.077	-0.093	.698**	-0.222	-0.024	-0.089	0.216	**.836****	0.048	0.045	-0.248	0.299	.691**	.682**	-		
Neutral Window Shape	-0.259	-0.155	-0.122	-0.225	-0.23	-0.031	0.003	0.283	-0.241	0.222	-0.135	-0.22	-0.126	-0.187	-0.185	-0.231	-	
Number of Sculptured Elements	.393**	-0.109	-0.093	.717**	-0.247	-0.237	0.103	0.217	**.962****	0.023	-0.07	-0.264	.361*	**.835****	**.825****	**.854****	-0.232	-
Number of Building Element Types	.556**	-0.108	-0.132	.513**	-.314*	0.278	-.406**	.307*	.565**	0.108	-0.039	-.351*	0.267	.444**	.441**	.743**	-0.003	.609**

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Appendix 6. Internal correlations for architectural variables with significant (p < .05) correlations to mean ratings of Pleasantness. There were no correlation coefficient higher than .8.

	Miscellaneous Window Forms	*Bilateral Symmetry*	*Classical Proportions*	*Verticality*	*Verticality in Windows*
Miscellaneous Window Forms	-				
Bilateral Symmetry	-0.23	-			
Classical Proportions	-.429**	0.288	-		
Verticality	-0.287	0.107	-0.041	-	
Verticality in Windows	-0.237	0.028	-0.136	**.826****	-
Number of Windows	**.950****	-0.194	-.454**	-0.145	-0.088

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Correlations to Interestingness
Male subjects

Appendix 7. Final list of Pearson correlation coefficients for architectural variables and male subjects' evaluations for Interestingness. Architectural variables with possibility of intercollinearity have been removed. Architectural variables present in the corresponding list of the whole group's answers that are not present in this list are crossed out.

Architectural variables	*Pearson correlation to mean ratings for Interestingness*
	R
Size Differences Between Visual Elements	*.720***
Element Alignments	*.549***
Number of Black Pixels	*.548***
Window Surface Area	*.502***
Number of Building Element Types	*.492***
Number of Window Directions	*.465***
Verticality	*.434***
Total Number of Directions	*.427***
Number of Forms	*.388**
Number of Windows + Number of Windowpanes	*.385**
Number of Windows	*.325**
~~*Classical Proportions in Element / Room Layout*~~	

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

~~*Architectural variable*~~ Architectural variable excluded from whole group's answers

Correlations to Interestingness
Female subjects

Appendix 8. Final list of Pearson correlation coefficients for architectural variables and female subjects' evaluations for Interestingness. Architectural variables with possibility of intercollinearity have been removed. Architectural variables that were not present in the corresponding list of whole group's answers are encircled with dashed line.

Architectural variables	*Pearson correlation to mean ratings for Interestingness*
	R
Size Differences Between Visual Elements	*.757***
Window Surface Area	*.564***
Number of Window Directions	*.517***
Number of Windows + Number of Windowpanes	*.512***
Element Alignments	*.484***
Number of Black Pixels	*.451***
Total Number of Directions	*.444***
Verticality	*.436***
Number of Building Element Types	*.413***
Number of Forms	*.404***
Classical Proportions in Element / Room Layout	*-.392***
Number of Windows	*.385**
Classical Proportions	*-.307**

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Architectural variable additional to whole group's answers

Correlations to Interestingness

Subjects with artistic background:

Appendix 9. Final list of Pearson correlation coefficients for architectural variables and evaluations for Interestingness of subjects with visual artistic background. Architectural variables with possibility of intercollinearity have been removed. Architectural variables that were not present in the corresponding list of whole group's answers are encircled with dashed line.

Architectural variables	*Pearson correlation to mean ratings for Interestingness*
	R
Size Differences Between Visual Elements	*.754***
Window Surface Area	*.509***
Element Alignments	*.503***
Number of Window Directions	*.489***
Number of Black Pixels	*.474***
Number of Windows + Number of Windowpanes	*.471***
Number of Building Element Types	*.458***
Total Number of Directions	*.456***
Verticality	*.412***
Number of Forms	*.396***
Number of Windows	*.384**
Classical Proportions in Element / Room Layout	*-.323**
Element Levels	*.316**
Grouping	*-.306**

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Architectural variable additional to whole group's answers

Correlations to Interestingness

Subjects with no artistic background:

Appendix 10. Final list of Pearson correlation coefficients for architectural variables and evaluations for Interestingness of subjects with no artistic background. Architectural variables with possibility of intercollinearity have been removed.

Architectural variables	*Pearson correlation to mean ratings for Interestingness*
	R
Size Differences Between Visual Elements	*.714***
Window Surface Area	*.532***
Element Alignments	*.512***
Number of Window Directions	*.502***
Number of Black Pixels	*.484***
Total Number of Directions	*.459***
Number of Building Element Types	*.442***
Number of Windows + Number of Windowpanes	*.438***
Verticality	*.430***
Number of Forms	*.368**
Number of Windows	*.359**
Classical Proportions in Element / Room Layout	*-.336**

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Correlations to Spatial Organization

Male subjects

Appendix 11. Final list of Pearson correlation coefficients for architectural variables and male subjects' evaluations for Spatial Organization. Architectural variables with possibility of intercollinearity have been removed. Architectural variables present in the corresponding list of the whole group's answers that are not present in this list are crossed out.

Architectural variables	*Pearson correlation to mean ratings for Spatial Organization*
	R
Number of Windows	*-.651***
Size Differences Between Visual Elements	*-.636***
Number of Windows + Number of Windowpanes	*-.565***
Total Number of Directions	*-.539***
Element Alignments	*-.517***
Grouping	*.473***
Classical Proportions	*.470***
Number of Window Directions	*-.466***
Bilateral Symmetry	*.444***
Number of Black Pixels	*-.374**
Element levels	*-.362**
Neutral Window Shape	*.356**
~~*Number of Building Element Types*~~	

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

~~*Architectural variable*~~ Architectural variable excluded from whole group's answers

Correlations to Spatial Organization

Female subjects

Appendix 12. Final list of Pearson correlation coefficients for architectural variables and female subjects' evaluations for Spatial Organization. Architectural variables with possibility of intercollinearity have been removed. Architectural variables that were not present in the corresponding list of whole group's answers are encircled with dashed line.

Architectural variables	*Pearson correlation to mean ratings for Spatial Organization*
	R
Size Differences Between Visual Elements	*-.693***
Element Alignments	*-.571***
Number of Windows	*-.562***
Number of Windows + Number of Windowpanes	*-.509***
Number of Black Pixels	*-.490***
Total Number of Directions	*-.462***
Grouping	*.446***
Classical Proportions	*.429***
Element Levels	*-.419***
Bilateral Symmetry	*.408***
Number of Window Directions	*-.385**
Number of Building Element Types	*-.352**
Number of Forms	*-.346**
Neutral Window Shape	*.340**

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Architectural variable additional to whole group's answers

Correlations to Spatial Organization

Subjects with artistic background:

Appendix 13. Final list of Pearson correlation coefficients for architectural variables and evaluations for Spatial Organization of subjects with visual artistic background. Architectural variables with possibility of intercollinearity have been removed. Architectural variables present in the corresponding list of the whole group's answers that are not present in this list are crossed out.

Architectural variables	*Pearson correlation to mean ratings for Spatial Organization* **R**
Size Differences Between Visual Elements	*-.650***
Number of Windows	*-.619***
Element Alignments	*-.549***
Number of Windows + Number of Windowpanes	*-.528***
Total Number of Directions	*-.467***
Bilateral Symmetry	*.460***
Number of Black Pixels	*-.460***
Element Levels	*-.441***
Classical Proportions	*.438***
Grouping	*.437***
Number of Window Directions	*-.427***
Neutral Window Shape	*.324**
~~*Number of Building Element Types*~~	

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

~~*Architectural variable*~~ Architectural variable excluded from whole group's answers

Correlations to Spatial Organization

Subjects with no artistic background:

Appendix 14. Final list of Pearson correlation coefficients for architectural variables and evaluations for Spatial Organization of subjects with no artistic background. Architectural variables with possibility of intercollinearity have been removed. Architectural variables that were not present in the corresponding list of whole group's answers are encircled with dashed line.

Architectural variables	*Pearson correlation to mean ratings for Spatial Organization* **R**
Size Differences Between Visual Elements	*-.668***
Number of Windows	*-.610***
Number of Windows + Number of Windowpanes	*-.547***
Element Alignments	*-.533***
Total Number of Directions	*-.501***
Grouping	*.467***
Classical Proportions	*.461***
Number of Window Directions	*-.425***
Number of Black Pixels	*-.423***
Bilateral Symmetry	*.418***
Element Levels	*-.396***
Neutral Window Shape	*.348**
Number of Forms	*-.316**
Number of Building Element Types	*-.304**

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Architectural variable additional to whole group's answers

Correlations to Pleasantness

Male subjects

Appendix 15. Final list of Pearson correlation coefficients for architectural variables and male subjects' evaluations for Pleasantness. Architectural variables with possibility of intercollinearity have been removed. Architectural variables that were not present in the corresponding list of whole group's answers are encircled with dashed line.

Architectural variables	*Pearson correlation to mean ratings for Pleasantness*
	R
Classical Proportions	*.500***
Miscellaneous Window Forms	*-.473***
Verticality	*.468***
Bilateral Symmetry	*.445***
Number of Building Element Types	*.434***
Number of Sculptured Elements	*.432***
Number of Windows + Number of Windowpanes	*-.397***

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Architectural variable additional to whole group's answers

Correlations to Pleasantness

Female subjects

Appendix 16. Final list of Pearson correlation coefficients for architectural variables and female subjects' evaluations for Pleasantness. Architectural variables with possibility of intercollinearity have been removed. Architectural variables that were not present in the corresponding list of whole group's answers are encircled with dashed line. Architectural variables present in the corresponding list of the whole group's answers that are not present in this list are crossed out.

Architectural variables	*Pearson correlation to mean ratings for Pleasantness*
	R
Bilateral Symmetry	*.447***
Miscellaneous Window Forms	*-.423***
Verticality in Windows	*.377**
Window Surface Area	*.359**
Classical Proportions	*.357**

~~*Verticality*~~

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Architectural variable additional to whole group's answers

~~*Architectural variable*~~ Architectural variable excluded from whole group's answers

Correlations to Pleasantness

Subjects with artistic background:

Appendix 17. Final list of Pearson correlation coefficients for architectural variables and evaluations for Pleasantness of subjects with visual artistic background. Architectural variables with possibility of intercollinearity have been removed. Architectural variables that were not present in the corresponding list of whole group's answers are encircled with dashed line.

Architectural variables	*Pearson correlation to mean ratings for Pleasantness*
	R
Miscellaneous Window Forms	*-.483***
Classical Proportions	*.470***
Verticality	*.444***
Bilateral Symmetry	*.410***
Number of Windows + Number of Windowpanes	*-.350**
Diagonal Forms	*-.315**

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Architectural variable additional to whole group's answers

Correlations to Pleasantness

Subjects with no artistic background:

Appendix 18. Final list of Pearson correlation coefficients for architectural variables and evaluations for Pleasantness of subjects with no artistic background. Architectural variables with possibility of intercollinearity have been removed. Architectural variables that were not present in the corresponding list of whole group's answers are encircled with dashed line.

Architectural variables	*Pearson correlation to mean ratings for Pleasantness*
	R
Miscellaneous Window Forms	*-.463***
Verticality	*.451***
Bilateral Symmetry	*.450***
Classical Proportions	*.421***
Window Surface Area	*.321**
Number of Building Element Types	*.303**

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Architectural variable additional to whole group's answers

Appendix 19. Additional regression equations for Pleasantness

With only the architectural variables (table 17) as predictors:

Pleasantness =

-0.881

+ 0.404 × Classical Proportions
+ 0.391 × Bilateral symmetry
+ 0.383 × Verticality

R^2 = .502, $p < .001$

With only the mean ratings of Interestingness and Spatial Organization as predictors:

Pleasantness =

-0.001

+ 0.689 × Mean ratings for Spatial Organization
+ 0.609 × Mean ratings for Interestingness

R^2 = .675, $p < .001$

Appendix 20. Regression equations for the subgroup of male subjects

Interestingness =

-1.872
+ 0.477 × Total Number of Directions
+ 0.476 × Window Surface Area
- 0.228 × Number of Window Directions
+ 2.124 × 10^{-6} × Number of Black Pixels

R^2 = .812, $p < .001$

Spatial Organization =

- 0.037
+ 0.554 × Bilateral Symmetry
+ 0.353 × Classical Proportions
- 0.198 × Size Differences Between Visual Elements
- 0.196 × Total Number of Directions
- 0.139 × Element Alignments
- 0.041 × Number of Windows
- 0.010 × Element Levels

R^2 = .882, $p < .001$

Pleasantness =

- 0.419
+ 0.465 × Mean ratings for Interestingness
+ 0.441 × Mean ratings for Spatial Organization
+ 0.365 × Classical Proportions
+ 0.214 × Verticality

R^2 = .763, $p < .001$

Appendix 21. Regression equations for the subgroup of female subjects

Interestingness =

- 1.666
+ 0.436 × Total Number of Directions
- 0.419 × Classical Proportions in Element / Room Layout
+ 0.282 × Number of Forms
+ 0.255 × Window Surface Area
+ 1.780 × 10^{-7} × Number of Black Pixels

R^2 = .826, $p < .001$

Spatial Organization =

- 0.575
+ 0.645 × Grouping
+ 0.468 × Bilateral Symmetry
+ 0.369 × Classical Proportions
- 0.092 × Element Alignments
- 0.033 × (Number of Windows + Number of Windowpanes)
-1.350 × 10^{-7} × Number of Black Pixels

R^2 = .883, $p < .001$

Pleasantness =

- 0.322
+ 0.664 × Mean ratings for Spatial Organization
+ 0.546 × Mean ratings for Interestingness
+ 0.260 × Classical Proportions
+ 0.217 × Verticality in Windows

R^2 = .749, $p < .001$

Appendix 22. Regression equations for the subgroup of subjects with artistic background

Interestingness =

- 0.878
+ 0.562 × Size Differences Between visual Elements
- 0.530 × Classical Proportions in Element / Room Layout
+ 0.362 × Total Number of Directions
+ 1.690 × 10^{-6} × Number of Black Pixels

R^2 = .760, $p < .001$

Spatial Organization =

- 0.157
+ 0.942 × Bilateral Symmetry
- 0.542 × Size Differences Between visual Elements
- 0.159 × Element Alignments
- 0.090 × Number of Windows

R^2 = .842, $p < .001$

Pleasantness =

- 0.466
- 0. 678 × Diagonal forms
+ 0.503 × Mean ratings for Spatial Organization
+ 0.480 × Verticality
+ 0.423 × Mean ratings for Interestingness
+ 0.326 × Classical Proportions

R^2 = .784, $p < .001$

Appendix 23. Regression equations for the subgroup of subjects without artistic background

Interestingness =

- 1.53
+ 0.484 × Total Number of Directions
+ 0.373 × Window Surface Area
- 0.288 × Classical Proportions in Element / Room layout
- 0.187 × Number of Window Directions
+ 2.030 × 10^{-6} × Number of Black Pixels

R^2 = .813, $p < .001$

Spatial Organization =

- 0.174
+ 0.641 × Bilateral Symmetry
+ 0.469 × Grouping
- 0.186 × Size Differences Between Visual Elements
- 0.164 × Number of Forms
- 0.149 × Element Alignments
- 0.031 × (Number of Windows + Number of Windowpanes)

R^2 = .877, $p < .001$

Pleasantness =

- 0.312
+ 0.569 × Mean ratings for Spatial Organization
+ 0.542 × Mean ratings for Interestingness
+ 0.242 × Classical Proportions
+ 0.197 × Verticality

R^2 = .800, $p < .001$

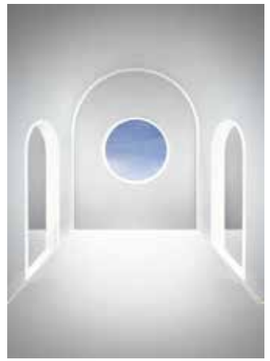
Appendix 24. Interestingness rankings

Ranking *1*
x̄ *Interestingness* *1.15*
Image Number *43*

Ranking *2*
x̄ *Interestingness* *1.03*
Image Number *41*

Ranking *3*
x̄ *Interestingness* *1.00*
Image Number *15*

Ranking *4*
x̄ *Interestingness* *.97*
Image Number *19*



Ranking *5*
x̄ *Interestingness* *.91*
Image Number *34*

Ranking *6*
x̄ *Interestingness* *.90*
Image Number *35*

Ranking *7*
x̄ *Interestingness* *.78*
Image Number *42*

Ranking *8*
x̄ *Interestingness* *.71*
Image Number *39*

Ranking *9*
x̄ *Interestingness* *.69*
Image Number *16*

Ranking *10*
x̄ *Interestingness* *.68*
Image Number *18*

Ranking *11*
x̄ *Interestingness* *.63*
Image Number *17*

Ranking *12*
x̄ *Interestingness* *.60*
Image Number *40*

Ranking *13*
x̄ *Interestingness* *.57*
Image Number *20*

Ranking *14*
x̄ *Interestingness* *.55*
Image Number *31*

Ranking *15*
x̄ *Interestingness* *.51*
Image Number *32*

Ranking *16*
x̄ *Interestingness* *.47*
Image Number *21*

Ranking *17*
x̄ *Interestingness* *.39*
Image Number *30*

Ranking *18*
x̄ *Interestingness* *.29*
Image Number *28*

Ranking *19*
x̄ *Interestingness* *.25*
Image Number *29*

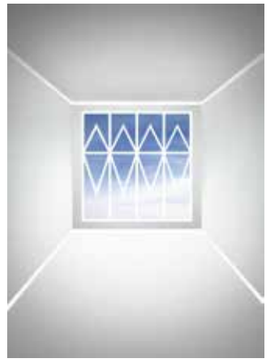
Ranking *20*
x̄ *Interestingness* *.22*
Image Number *26*

Ranking *21*
x̄ *Interestingness* *.22*
Image Number *23*

Ranking *22*
x̄ *Interestingness* *.11*
Image Number *22*

Ranking *23*
x̄ *Interestingness* *.11*
Image Number *27*

Ranking *24*
x̄ *Interestingness* *.09*
Image Number *24*



Ranking *25*
x̄ *Interestingness* *.03*
Image Number *25*

Ranking *26*
x̄ *Interestingness* *-.21*
Image Number *12*

Ranking *27*
x̄ *Interestingness* *-.42*
Image Number *38*

Ranking *28*
x̄ *Interestingness* *-.43*
Image Number *33*

Ranking *29*
x̄ *Interestingness* *-.45*
Image Number *4*

Ranking *30*
x̄ *Interestingness* *-.57*
Image Number *7*

Ranking *31*
x̄ *Interestingness* *-.60*
Image Number *9*

Ranking *33*
x̄ *Interestingness* *-.68*
Image Number *11*

Ranking *35*
x̄ *Interestingness* *-.85*
Image Number *37*

Ranking *32*
x̄ *Interestingness* *-.61*
Image Number *5*

Ranking *34*
x̄ *Interestingness* *-.72*
Image Number *6*

Ranking *36*
x̄ *Interestingness* *-.90*
Image Number *10*

Ranking *37*
x̄ *Interestingness* *-1.01*
Image Number *3*

Ranking *39*
x̄ *Interestingness* *-1.04*
Image Number *1*

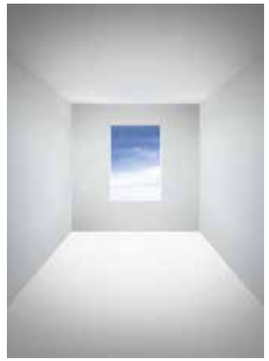
Ranking *41*
x̄ *Interestingness* *-1.15*
Image Number *8*

Ranking *38*
x̄ *Interestingness* *-1.02*
Image Number *36*

Ranking *40*
x̄ *Interestingness* *-1.04*
Image Number *2*

Ranking *42*
x̄ *Interestingness* *-1.19*
Image Number *14*

Appendix 25. Spatial Organization rankings



Ranking *1*
x̄ *SO* *1.01*
Image Number *36*

Ranking *2*
x̄ *SO* *.97*
Image Number *1*

Ranking *3*
x̄ *SO* *.90*
Image Number *37*

Ranking *4*
x̄ *SO* *.86*
Image Number *20*

Ranking *5*
x̄ *SO* *.84*
Image Number *6*

Ranking *6*
x̄ *SO* *.70*
Image Number *4*

Ranking *7*
x̄ *SO* *.69*
Image Number *7*

Ranking *8*
x̄ *SO* *.67*
Image Number *5*

Ranking *9*
x̄ *SO* *.64*
Image Number *14*

Ranking *10*
x̄ *SO* *.63*
Image Number *3*

Ranking *11*
x̄ *SO* *.59*
Image Number *38*

Ranking *12*
x̄ *SO* *.56*
Image Number *21*

Ranking *13*
x̄ *SO* *.54*
Image Number *2*

Ranking *14*
x̄ *SO* *.49*
Image Number *22*

Ranking *15*
x̄ *SO* *.47*
Image Number *23*

Ranking *16*
x̄ *SO* *.39*
Image Number *24*

Ranking *17*
x̄ *SO* *.31*
Image Number *8*

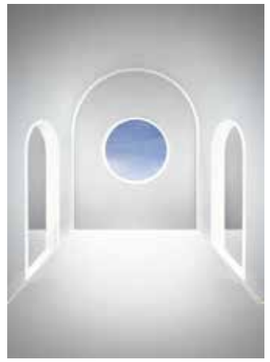
Ranking *18*
x̄ *SO* *.29*
Image Number *9*

Ranking *19*
x̄ *SO* *.17*
Image Number *29*

Ranking *20*
x̄ *SO* *.10*
Image Number *33*

Ranking *21*
x̄ *SO* *-.01*
Image Number *25*

Ranking *22*
x̄ *SO* *-.03*
Image Number *27*



Ranking *23*
x̄ *SO* *-.07*
Image Number *34*

Ranking *24*
x̄ *SO* *-.07*
Image Number *30*

Ranking *25*
x̄ *SO* *-.14*
Image Number *10*

Ranking *26*
x̄ *SO* *-.26*
Image Number *12*

Ranking *27*
x̄ *SO* *-.26*
Image Number *18*

Ranking *28*
x̄ *SO* *-.30*
Image Number *19*

Ranking *29*
x̄ *SO* *-.32*
Image Number *35*

Ranking *30*
x̄ *SO* *-.36*
Image Number *11*

Ranking *31*
x̄ *SO* *-.38*
Image Number *32*

Ranking *32*
x̄ *SO* *-.38*
Image Number *31*

Ranking *33*
x̄ *SO* *-.48*
Image Number *40*

Ranking *34*
x̄ *SO* *-.50*
Image Number *28*

Ranking *35*
x̄ *SO* *-.51*
Image Number *26*

Ranking *36*
x̄ *SO* *-.57*
Image Number *42*

Ranking *37*
x̄ *SO* *-.57*
Image Number *43*

Ranking *38*
x̄ *SO* *-.74*
Image Number *41*

Ranking *39*
x̄ *SO* *-.89*
Image Number *16*

Ranking *40*
x̄ *SO* *-.97*
Image Number *39*

Ranking *41*
x̄ *SO* *-1.75*
Image Number *15*

Ranking *42*
x̄ *SO* *-1.84*
Image Number *17*

Appendix 26. Pleasantness rankings

Ranking *1*
x̄ *Pleasantness* *.74*
Image Number *22*

Ranking *2*
x̄ *Pleasantness* *.68*
Image Number *29*

Ranking *3*
x̄ *Pleasantness* *.67*
Image Number *20*

Ranking *4*
x̄ *Pleasantness* *.62*
Image Number *30*

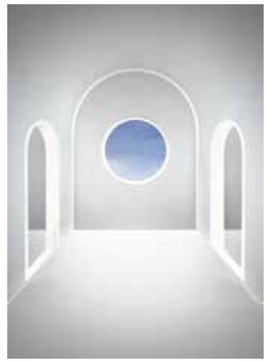
Ranking *5*
x̄ *Pleasantness* *.53*
Image Number *21*

Ranking *6*
x̄ *Pleasantness* *.48*
Image Number *43*

Ranking *7*
x̄ *Pleasantness* *.41*
Image Number *18*

Ranking *8*
x̄ *Pleasantness* *.40*
Image Number *40*

Ranking *9*
x̄ *Pleasantness* *.39*
Image Number *4*



Ranking *10*
x̄ *Pleasantness* *.39*
Image Number *34*

Ranking *11*
x̄ *Pleasantness* *.37*
Image Number *37*

Ranking *12*
x̄ *Pleasantness* *.35*
Image Number *42*

Ranking *13*
x̄ *Pleasantness* *.33*
Image Number *19*

Ranking *14*
x̄ *Pleasantness* *.32*
Image Number *24*

Ranking *15*
x̄ *Pleasantness* *.32*
Image Number *38*

Ranking *16*
x̄ *Pleasantness* *.27*
Image Number *41*

Ranking *17*
x̄ *Pleasantness* *.26*
Image Number *5*

Ranking *18*
x̄ *Pleasantness* *.17*
Image Number *33*

Ranking *19*
x̄ *Pleasantness* *.16*
Image Number *23*

Ranking *20*
x̄ *Pleasantness* *.14*
Image Number *31*

Ranking *21*
x̄ *Pleasantness* *.13*
Image Number *36*

Ranking *22*
x̄ *Pleasantness* *.06*
Image Number *16*

Ranking *23*
x̄ *Pleasantness* *.02*
Image Number *35*

Ranking *24*
x̄ *Pleasantness* *-.03*
Image Number *7*

Ranking *25*
x̄ *Pleasantness* *-.04*
Image Number *1*

Ranking *26*
x̄ *Pleasantness* *-.05*
Image Number *32*

Ranking *27*
x̄ *Pleasantness* *-.16*
Image Number *6*

Ranking *28*
x̄ *Pleasantness* *-.19*
Image Number *12*

Ranking *29*
x̄ *Pleasantness* *-.23*
Image Number *25*

Ranking *30*
x̄ *Pleasantness* *-.25*
Image Number *9*

Ranking *31*
x̄ *Pleasantness* *-.25*
Image Number *27*

Ranking *32*
x̄ *Pleasantness* *-.29*
Image Number *39*

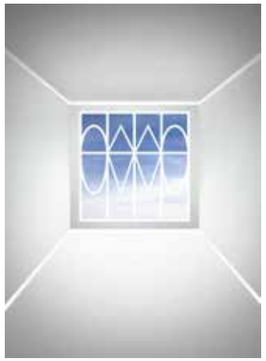
Ranking *33*
x̄ *Pleasantness* *-.33*
Image Number *3*

Ranking *34*
x̄ *Pleasantness* *-.39*
Image Number *2*

Ranking *35*
x̄ *Pleasantness* *-.40*
Image Number *10*

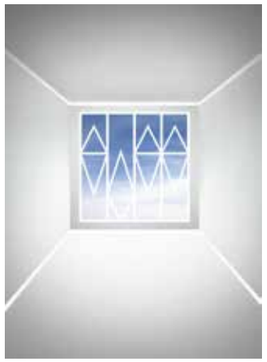
Ranking *36*
x̄ *Pleasantness* *-.46*
Image Number *8*

Ranking *37*
x̄ *Pleasantness* *-.50*
Image Number *11*



Ranking *38*
x̄ *Pleasantness* *-.61*
Image Number *28*

Ranking *39*
x̄ *Pleasantness* *-.69*
Image Number *14*



Ranking *40*
x̄ *Pleasantness* *-.81*
Image Number *26*

Ranking *41*
x̄ *Pleasantness* *-.90*
Image Number *17*

Ranking *42*
x̄ *Pleasantness* *-.92*
Image Number *15*

Appendix 27. Rankings orders of subgroups on Interestingness

Rank no	*Whole group*	*Males*	*Females*	*Artistic backgroud*	*No artistic background*
1	43	43	43	34	43
2	41	41	15	15	19
3	15	15	34	43	15
4	19	19	19	35	41
5	34	35	35	39	35
6	35	42	41	17	34
7	42	34	16	41	42
8	39	39	17	19	16
9	16	18	39	42	18
10	18	40	42	32	20
11	17	20	18	16	17
12	40	31	31	18	39
13	20	32	32	20	21
14	31	16	21	31	31
15	32	30	40	40	40
16	21	21	20	28	32
17	30	17	28	27	30
18	28	23	26	21	29
19	29	29	30	30	23
20	26	28	29	23	28
21	23	22	23	26	22
22	22	26	25	25	26
23	27	27	27	22	24
24	24	24	24	29	27
25	25	25	22	24	25
26	12	12	12	12	12
27	38	33	38	33	4
28	33	4	4	4	33
29	4	38	33	5	38
30	7	7	5	11	7
31	9	9	7	38	9
32	5	5	11	10	5
33	11	11	9	6	11
34	6	6	6	9	6
35	37	37	37	7	37
36	10	10	10	3	10
37	3	1	3	36	3
38	36	3	2	37	2
39	1	36	36	8	36
40	2	2	1	1	1
41	8	8	8	2	8
42	14	14	14	14	14

Appendix 28. Rankings orders of subgroups on Spatial Organization

Rank no	*Whole group*	*Males*	*Females*	*Artistic backgroud*	*No artistic background*
1	36	36	36	4	36
2	1	1	20	20	1
3	37	37	4	36	37
4	20	6	37	37	20
5	6	20	1	1	6
6	4	14	6	7	7
7	7	7	5	38	14
8	5	3	7	22	4
9	14	38	3	21	3
10	3	5	2	23	5
11	38	21	14	5	38
12	21	4	38	6	21
13	2	23	21	3	2
14	22	2	8	8	24
15	23	22	22	14	22
16	24	24	23	29	23
17	8	9	9	2	8
18	9	8	24	9	9
19	29	33	29	24	33
20	33	29	33	10	29
21	25	30	25	25	30
22	27	27	27	35	25
23	34	34	34	34	27
24	30	25	30	33	34
25	10	10	10	27	10
26	12	12	18	18	18
27	18	35	19	12	11
28	19	18	12	31	12
29	35	11	35	19	19
30	11	19	32	32	40
31	32	32	31	11	32
32	31	31	11	30	31
33	40	40	28	28	35
34	28	26	40	40	42
35	26	43	26	26	26
36	42	28	42	43	28
37	43	42	43	42	43
38	41	41	16	41	41
39	16	39	41	16	16
40	39	16	39	39	39
41	15	15	15	17	15
42	17	17	17	15	17

Appendix 29. Rankings orders of subgroups on Pleasantness. Major differences are marked by a colour.

Rank no	*Whole group*	*Males*	*Females*	*Artistic backgroud*	*No artistic background*
1	22	**43**	22	**5**	22
2	29	29	20	21	29
3	20	22	29	34	20
4	30	41	30	22	30
5	21	**42**	21	18	**43**
6	**43**	20	18	29	21
7	18	30	4	20	40
8	40	40	24	4	4
9	4	34	19	30	41
10	34	21	**5**	36	34
11	37	37	23	38	**42**
12	**42**	38	37	19	24
13	19	4	38	40	18
14	24	33	34	37	38
15	38	18	40	31	19
16	41	19	**43**	23	37
17	**5**	31	**42**	33	33
18	33	24	16	12	31
19	23	36	36	**43**	**5**
20	31	35	31	32	23
21	36	**5**	33	**42**	16
22	16	32	7	16	36
23	35	1	41	24	7
24	7	39	35	1	6
25	1	16	27	27	32
26	32	23	1	35	35
27	6	7	32	41	1
28	12	12	6	7	12
29	25	6	9	10	27
30	9	25	12	9	25
31	27	3	25	11	39
32	39	9	2	2	9
33	3	10	11	8	3
34	2	27	8	39	2
35	10	2	10	25	10
36	8	8	3	3	11
37	11	11	14	6	8
38	28	28	28	28	28
39	14	14	39	14	14
40	26	15	26	17	26
41	17	26	17	26	15
42	15	17	15	15	17

Appendix 30. Subgroup differences in highest three evaluations of Interestingness

Ranking *1*
x̄ *Interestingness* *1.15*
Image Number *43*

Ranking *2*
x̄ *Interestingness* *1.03*
Image Number *41*

Ranking *3*
x̄ *Interestingness* *1.00*
Image Number *15*

The most interesting images evaluated by the subjects on average

The most interesting images evaluated by the male subjects

Ranking *1*
x̄ *Interestingness* *1.23*
Room Number *43*

Ranking *2*
x̄ *Interestingness* *1.12*
Room Number *41*

Ranking *3*
x̄ *Interestingness* *.97*
Room Number *15*

The most interesting images evaluated by the female subjects

Ranking *1*
x̄ *Interestingness* *1.07*
Room Number *43*

Ranking *2*
x̄ *Interestingness* *1.03*
Room Number *15*

Ranking *3*
x̄ *Interestingness* *.98*
Room Number *34*

The most interesting images evaluated by the subjects with artistic background

Ranking *1*
x̄ *Interestingness* *1.15*
Image Number *34*

Ranking *2*
x̄ *Interestingness* *1.14*
Image Number *15*

Ranking *3*
x̄ *Interestingness* *1.13*
Image Number *43*

The most interesting images evaluated by the subjects with no artistic background

Ranking *1*
x̄ *Interestingness* *1.08*
Image Number *43*

Ranking *2*
x̄ *Interestingness* *1.01*
Image Number *19*

Ranking *3*
x̄ *Interestingness* *.98*
Image Number *15*

The images not appearing in the triad of the whole group are framed by color (same images by the same color)

Appendix 31. Subgroup differences in lowest three evaluations of Interestingness

Ranking *42*
x̄ *Interestingness* *-1.12*
Image Number *14*

Ranking *41*
x̄ *Interestingness* *-1.15*
Image Number *8*

Ranking *40*
x̄ *Interestingness* *-1.19*
Image Number *2*

The most boring images evaluated by the subjects on average

The most boring images evaluated by the male subjects

Ranking *42*
x̄ *Interestingness* *-1.12*
Image Number *14*

Ranking *41*
x̄ *Interestingness* *-1.10*
Image Number *8*

Ranking *40*
x̄ *Interestingness* *-1.05*
Image Number *2*

The most boring images evaluated by the female subjects

Ranking *42*
x̄ *Interestingness* *-1.27*
Image Number *14*

Ranking *41*
x̄ *Interestingness* *-1.22*
Image Number *1*

Ranking *40*
x̄ *Interestingness* *-1.20*
Image Number *8*

The most boring images evaluated by the subjects with artistic background

Ranking *42*
x̄ *Interestingness* *-1.37*
Image Number *14*

Ranking *41*
x̄ *Interestingness* *-1.29*
Image Number *2*

Ranking *40*
x̄ *Interestingness* *-1.21*
Image Number *1*

The most boring images evaluated by the subjects with no artistic background

Ranking *42*
x̄ *Interestingness* *-1.16*
Image Number *14*

Ranking *41*
x̄ *Interestingness* *-1.11*
Image Number *8*

Ranking *40*
x̄ *Interestingness* *-1.07*
Image Number *1*

The images not appearing in the triad of the whole group are framed by color (same images by the same color)

Appendix 32. Subgroup differences in highest three evaluations of Spatial Organization

Ranking *1*
x̄ *SO* *1.01*
Image Number *36*

Ranking *2*
x̄ *SO* *.97*
Image Number *1*

Ranking *3*
x̄ *SO* *.90*
Image Number *37*

The most organized images evaluated by the subjects on average

The most organized images evaluated by the male subjects

Ranking *1*
x̄ *SO* *1.04*
Image Number *36*

Ranking *2*
x̄ *SO* *1.04*
Image Number *1*

Ranking *3*
x̄ *SO* *.89*
Image Number *37*

The most organized images evaluated by the female subjects

Ranking *1*
x̄ *SO* *.99*
Image Number *36*

Ranking *2*
x̄ *SO* *.93*
Image Number *20*

Ranking *3*
x̄ *SO* *.92*
Image Number *4*

The most organized images evaluated by the subjects with artistic background

Ranking *1*
x̄ *SO* *1.03*
Image Number *4*

Ranking *2*
x̄ *SO* *1.03*
Image Number *20*

Ranking *3*
x̄ *SO* *1.02*
Image Number *36*

The most organized images evaluated by the subjects with no artistic background

Ranking *1*
x̄ *SO* *.98*
Image Number *36*

Ranking *2*
x̄ *SO* *.94*
Image Number *1*

Ranking *3*
x̄ *SO* *.89*
Image Number *37*

The images not appearing in the triad of the whole group are framed by color (same images by the same color)

Appendix 33. Subgroup differences in lowest three evaluations of Spatial Organization

Ranking 42
x̄ *SO* -1.84
Image Number 17

Ranking 41
x̄ *SO* -1.75
Image Number 15

Ranking 40
x̄ *SO* -.97
Image Number 39

The most disorganized images evaluated by the subjects on average

The most disorganized images evaluated by the male subjects

Ranking 42
x̄ *SO* -1.86
Image Number 17

Ranking 41
x̄ *SO* -1.75
Image Number 15

Ranking 40
x̄ *SO* -1.16
Image Number 16

The most disorganized images evaluated by the female subjects

Ranking 42
x̄ *SO* -1.82
Image Number 17

Ranking 41
x̄ *SO* -1.76
Image Number 15

Ranking 40
x̄ *SO* -1.16
Image Number 39

The most disorganized images evaluated by the subjects with artistic background

Ranking 42
x̄ *SO* -2.17
Image Number 15

Ranking 41
x̄ *SO* -2.08
Image Number 17

Ranking 40
x̄ *SO* -1.33
Image Number 39

The most disorganized images evaluated by the subjects with no artistic background

Ranking 42
x̄ *SO* -1.80
Image Number 17

Ranking 41
x̄ *SO* -1.66
Image Number 15

Ranking 40
x̄ *SO* -.94
Image Number 39

The images not appearing in the triad of the whole group are framed by color (same images by the same color)

Appendix 34. Subgroup differences in highest three evaluations of Pleasantness

Ranking 1
x̄ *Pleasantness* .74
Image Number 22

Ranking 2
x̄ *Pleasantness* .68
Image Number 29

Ranking 3
x̄ *Pleasantness* .67
Image Number 20

The most pleasing images evaluated by the subjects on average

The most pleasing images evaluated by the male subjects

Ranking 1
x̄ *Pleasantness* .77
Image Number 43

Ranking 2
x̄ *Pleasantness* .58
Image Number 29

Ranking 3
x̄ *Pleasantness* .56
Image Number 22

The most pleasing images evaluated by the female subjects

Ranking 1
x̄ *Pleasantness* .95
Image Number 22

Ranking 2
x̄ *Pleasantness* .83
Image Number 20

Ranking 3
x̄ *Pleasantness* .78
Image Number 29

The most pleasing images evaluated by the subjects with artistic background

Ranking 1
x̄ *Pleasantness* .97
Image Number 5

Ranking 2
x̄ *Pleasantness* .89
Image Number 21

Ranking 3
x̄ *Pleasantness* .86
Image Number 34

The most pleasing images evaluated by the subjects with no artistic background

Ranking 1
x̄ *Pleasantness* .71
Image Number 22

Ranking 2
x̄ *Pleasantness* .69
Image Number 29

Ranking 3
x̄ *Pleasantness* .66
Image Number 20

The images not appearing in the triad of the whole group are framed by color (same images by the same color)

Appendix 35. Subgroup differences in lowest three evaluations of Pleasantness

Ranking *42*
x̄ *Pleasantness* *-.92*
Image Number *15*

Ranking *41*
x̄ *Pleasantness* *-.90*
Image Number *17*

Ranking *40*
x̄ *Pleasantness* *-.81*
Image Number *26*

The most unpleasant images evaluated by the male subjects

Ranking *42*
x̄ *Pleasantness* *-.95*
Image Number *17*

Ranking *41*
x̄ *Pleasantness* *-.91*
Image Number *26*

Ranking *40*
x̄ *Pleasantness* *-.89*
Image Number *15*

The most unpleasant images evaluated by the female subjects

Ranking *42*
x̄ *Pleasantness* *-.96*
Image Number *15*

Ranking *41*
x̄ *Pleasantness* *-.84*
Image Number *17*

Ranking *40*
x̄ *Pleasantness* *-.69*
Image Number *26*

The most unpleasant images evaluated by the subjects with artistic background

Ranking *42*
x̄ *Pleasantness* *-1.29*
Image Number *15*

Ranking *41*
x̄ *Pleasantness* *-1.27*
Image Number *26*

Ranking *40*
x̄ *Pleasantness* *-1.19*
Image Number *17*

The most unpleasant images evaluated by the subjects with no artistic background

Ranking *42*
x̄ *Pleasantness* *-.89*
Image Number *17*

Ranking *41*
x̄ *Pleasantness* *-.88*
Image Number *15*

Ranking *40*
x̄ *Pleasantness* *-.72*
Image Number *26*

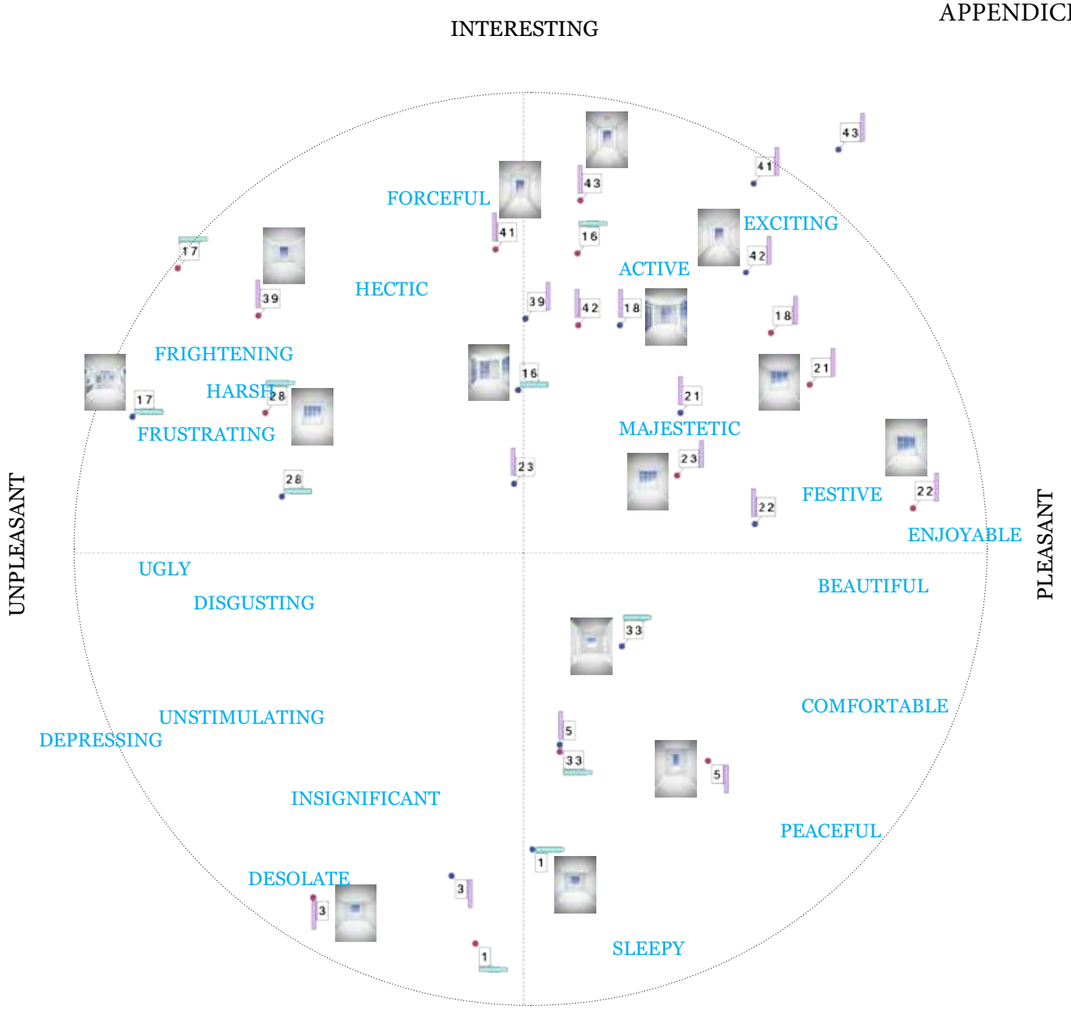
The images not appearing in the triad of the whole group are framed by color (same images by the same color)

Appendix 36. T-test results for the images whose mean scoring differated significantly (p<.05) between the judgments of males and females.

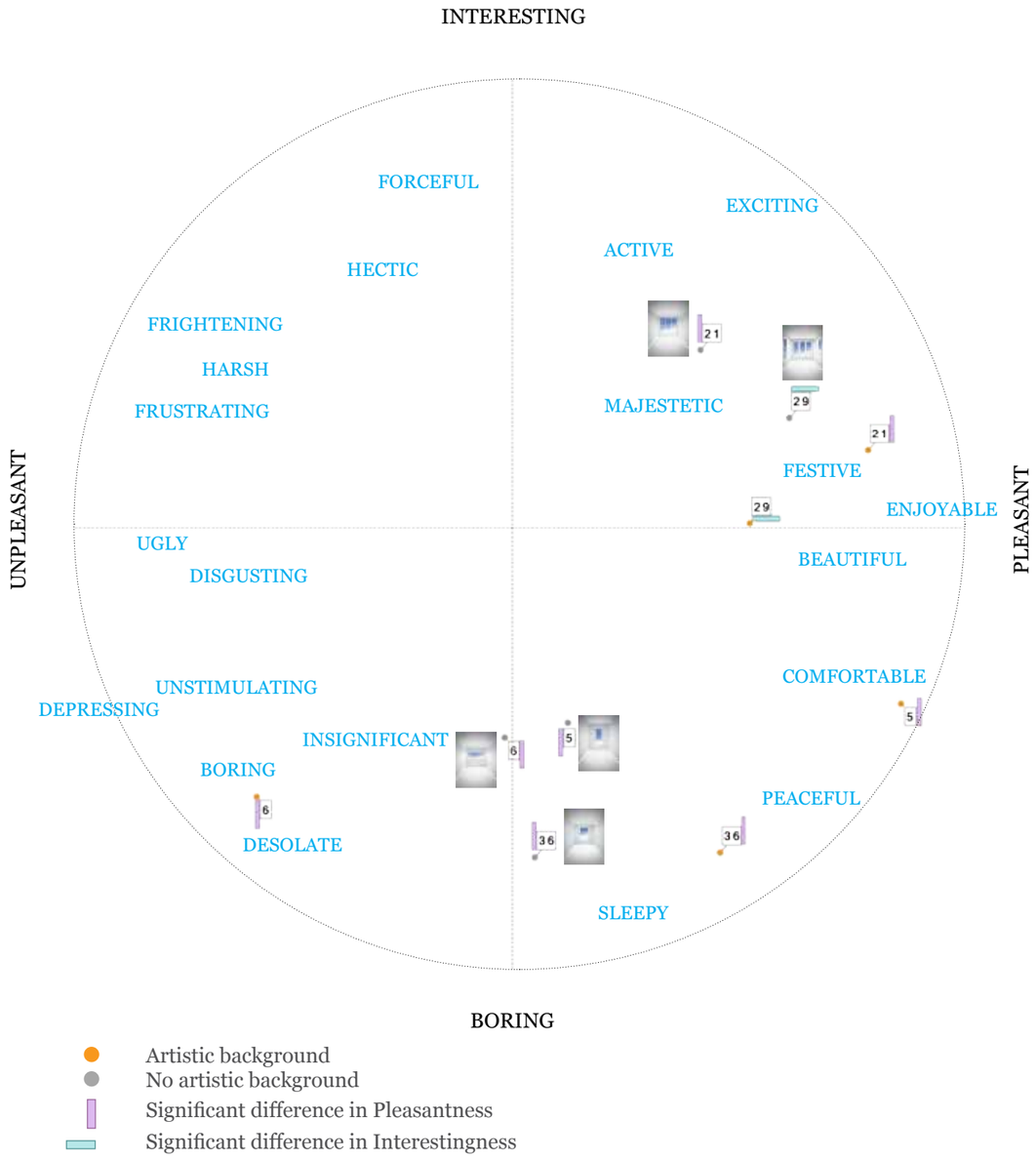
Image number	Mean score for Interestingness		t-test for Equality of Means				
	Males	Females	P-value (2-tailed)	Mean Difference	Std, Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
1	-0.9347	-1.1865	0.029	0.25182	0.11356	0.02648	0.47716
16	0.4949	0.9106	0.002	-0.41566	0.12901	-0.67165	-0.15966
17	0.413	0.866	0.001	-0.45305	0.13665	-0.72408	-0.18203
28	0.1696	0.4258	0.049	-0.25617	0.12867	-0.51129	-0.00105
33	-0.2845	-0.6043	0.004	0.31974	0.10742	0.10675	0.53273
	Mean score for Spatial Organization						
4	0.5136	0.9227	< 0,001	-0.40911	0.1089	-0.62504	-0.19318
5	0.5481	0.8126	0.024	-0.26444	0.11496	-0.49265	-0.03623
8	0.0951	0.5604	0.002	-0.46532	0.14897	-0.76075	-0.1699
29	0.0478	0.3193	0.049	-0.27144	0.13619	-0.54148	-0.00141
39	-0.764	-1.1989	0.014	0.43488	0.17441	0.08905	0.7807
41	-0.5227	-0.9972	0.002	0.47453	0.15214	0.17287	0.77618
43	-0.4157	-0.7409	0.033	0.32518	0.15013	0.02751	0.62285
	Mean score for Pleasantness						
3	-0.17	-0.51	0.02	0.34	0.14	0.06	0.61
5	0.09	0.45	0.02	-0.36	0.15	-0.65	-0.06
18	0.24	0.61	0.03	-0.37	0.17	-0.71	-0.03
21	0.38	0.70	0.03	-0.31	0.14	-0.59	-0.04
22	0.56	0.95	0.00	-0.39	0.13	-0.64	-0.13
23	-0.02	0.37	0.02	-0.40	0.16	-0.71	-0.08
39	0.01	-0.68	0.00	0.69	0.20	0.29	1.09
41	0.56	-0.07	0.00	0.63	0.21	0.21	1.05
42	0.54	0.14	0.05	0.41	0.20	0.01	0.80
43	0.77	0.14	0.01	0.63	0.22	0.18	1.07

Appendix 37. T-test results for the images whose mean scoring differated significantly (p<.05) between the judgments of subject with and without background for visual arts.

Image number	Mean score for Interestingness		t-test for Equality of Means				
	Background for visual arts	No artistic background	P-value (2-tailed)	Mean Difference	Std, Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
29	0.014	0.343	0.031	0.329	0.141	0.034	0.624
	Mean score for Spatial Organization						
4	0.240	0.606	0.040	-0.423	0.202	-0.826	-0.020
15	-2.168	-1.655	0.029	0.513	0.230	0.055	0.971
22	0.759	0.452	0.004	-0.307	0.098	-0.508	-0.105
	Mean score for Pleasantness						
5	0.972	0.140	0.001	-0.831	0.242	-1.314	-0.349
6	-0.639	-0.019	0.035	0.620	0.289	0.045	1.195
21	0.890	0.471	0.024	-0.419	0.170	-0.776	-0.062
36	0.519	0.058	0.033	-0.461	0.212	-0.884	-0.038



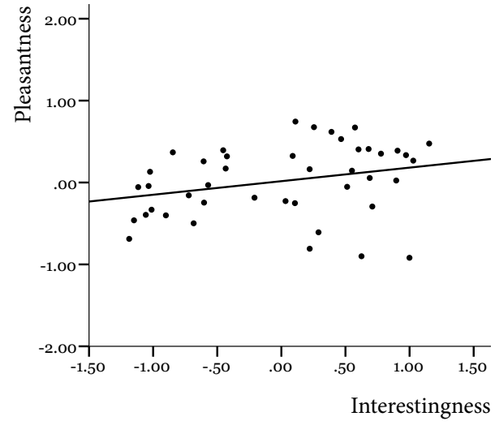
Appendix 38. The significant differences in responds between different genders presented in the circumplex model for affective quality attributed to environments (Russell, Ward and Pratt, 1981). Adjectives are equal with the original model presented in chapter 2.1.2.



Appendix 39. The significant differences in responds between subjects with and without artistic background presented in the circumplex model for affective quality attributed to environments (Russell, Ward and Pratt, 1981). Adjectives are equal with the original model presented in chapter 2.1.2.

Appendix 40. Pleasantness-Interestingness curve estimation for the average judgments of the whole group

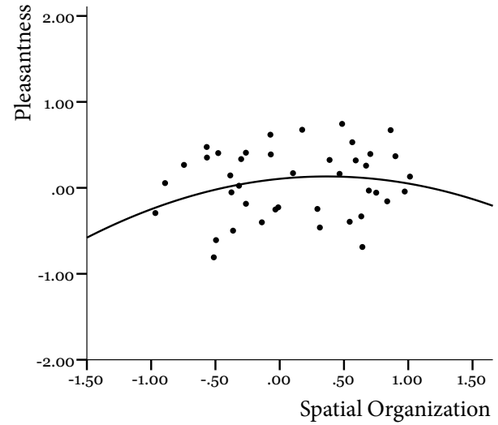
	R Square	***Sig.***
Linear	*.076*	*.073*
Quadratic	.102	.117

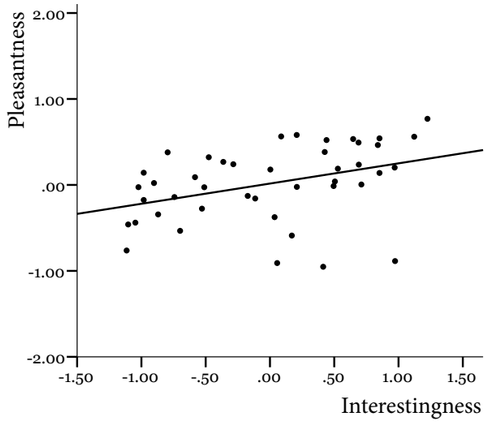


Appendix 41. Pleasantness-Spatial Organization curve estimation for the average judgments of the whole group

	R Square	***Sig.***
Linear*	.136	.015
*Quadratic***	*.217*	*.007*

*** Significant at the 0.01 level (2-tailed).*
** Significant at the 0.05 level (2-tailed).*

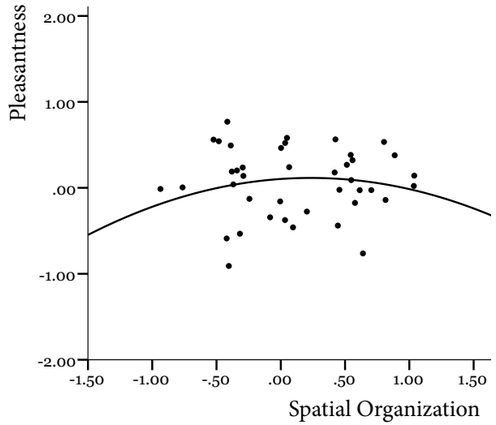




Appendix 42. Pleasantness-Interestingness curve estimation for the average judgments of males

	R Square	***Sig.***
*Linear**	*.144*	*.012*
Quadratic*	.146	.043

** Significant at the 0.05 level (2-tailed).*



Appendix 43. Pleasantness-Spatial Organization curve estimation for the average judgments of males

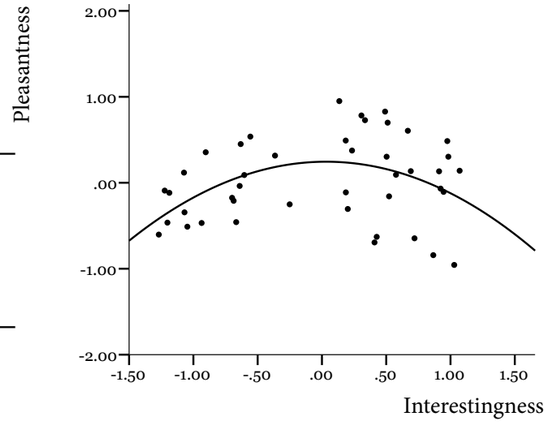
	R Square	***Sig.***
Linear*	.092	.048
*Quadratic**	*.190*	*.015*

** Significant at the 0.05 level (2-tailed).*

Appendix 44. Pleasantness-Interestingness curve estimation for the average judgments of females

	R Square	***Sig.***
Linear	.028	.285
*Quadratic**	*.152*	*.037*

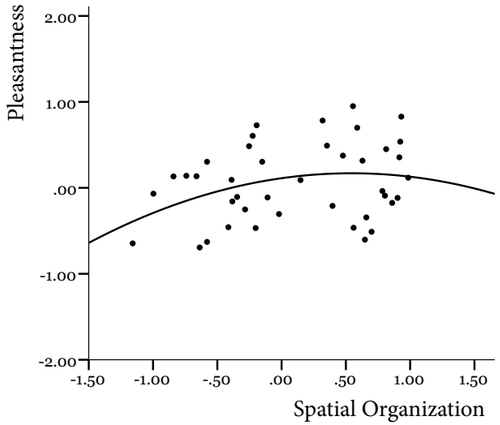
** Significant at the 0.05 level (2-tailed).*

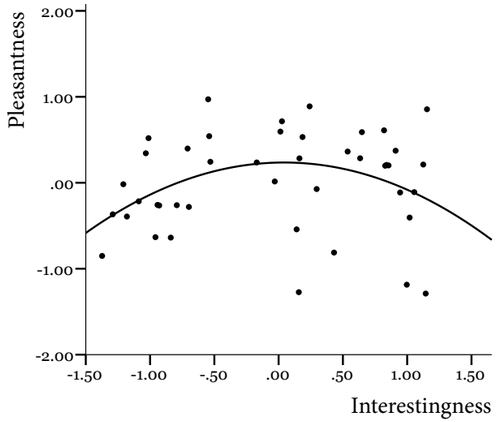


Appendix 45. Pleasantness-Spatial Organization curve estimation for the average judgments of females

	R Square	***Sig.***
Linear**	.188	.004
*Quadratic***	*.250*	*.003*

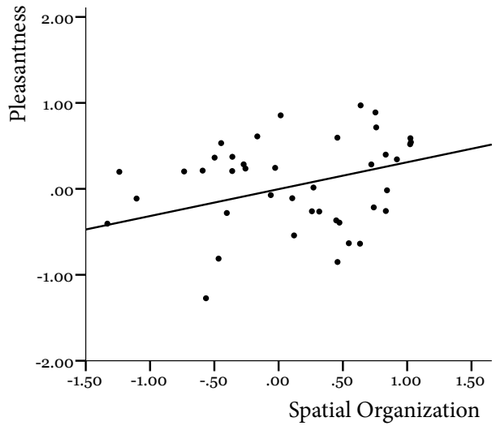
*** Significant at the 0.01 level (2-tailed).*





Appendix 46. Pleasantness-Interestingness curve estimation for the average judgments of subjects with artistic background

	R Square	***Sig.***
Linear	.010	.518
Quadratic	*.102*	*.115*



Appendix 47. Pleasantness-Spatial Organization curve estimation for the average judgments of subjects with artistic background

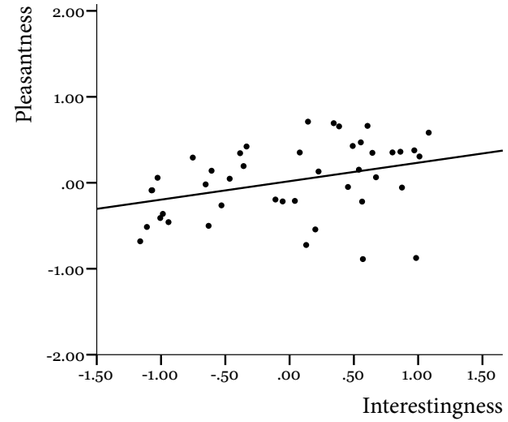
	R Square	***Sig.***
*Linear***	*.187*	*.004*
Quadratic**	.221	.007

*** Significant at the 0.01 level (2-tailed).*

Appendix 48. Pleasantness-Interestingness curve estimation for the average judgments of subjects without artistic background

	R Square	***Sig.***
*Linear**	*.122*	*.022*
Quadratic*	.143	.046

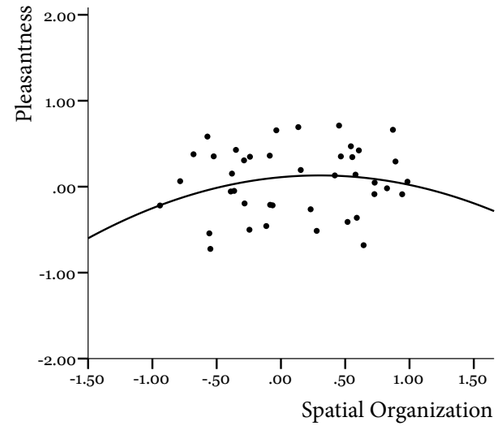
** Significant at the 0.05 level (2-tailed).*



Appendix 49. Pleasantness-Spatial Organization curve estimation for the average judgments of subjects without artistic background

	R Square	***Sig.***
Linear*	.117	.025
*Quadratic***	*.207*	*.010*

*** Significant at the 0.01 level (2-tailed).*
** Significant at the 0.05 level (2-tailed).*



Both everyday experience and scientific knowledge demonstrate the great power of the environment to influence human behaviour and well-being. Environmental preferences have been studied widely in both natural and urban contexts as well as in the context of external building styles. However, even though people seem to spend a great deal of time in architectural interiors and homes, systematic research on the influence of these spaces to well-being, preference and behaviour seems to be negligible.

In this study the preference for apartment interior appearance was studied in a theoretical framework obtained from earlier studies in the fields of aesthetics, perception, environmental psychology and architecture. The study examined a conjecture repeating in this earlier literature: could visual preference be defined as a construct of visual complexity and order also in the context of apartment interiors?

107 subjects were recruited and their evaluations of 43 images presenting apartment spaces were analysed. The results of this study give support to the idea that preference could to a great extent be predicted from levels of visual complexity and order also in the context of apartment scenes. Drawing more attention to this in today's design could help us to design the kind of built environment that people enjoy.