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"The influence of perceived complexity on understanding and appreciation of artworks"

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Index of contents

1.   INTRODUCTION

Artistic work exists almost as long as human kind (Chatterjee, 2014). Decorative artworks about 40.000 years old have been found in Europe – symbolic artefacts recovered in Africa are dated even older. A newer archeological discovery (a toolkit found near Cape Town), indicates, that *Homo sapiens* produced colors out of stones to paint on surfaces actually a 100.000 years ago (Henshilwood et al., 2011 cited in Nadal & Skov, 2013). Also, in today's state of knowledge, despite pictorial activities known from chimpanzees, humans seem to be the only creatures on this planet, who are able to appreciate arts (Cela-Conde et al., 2004). No wonder, that also questions about the underlying mechanisms, influences and values of aesthetic experiences have driven humans' interest for a very long time. Besides hundreds of years of philosophical approaches, the scientific approach to aesthetics is the second oldest branch of psychology (Jacobsen, 2006). The beginning of this field is marked with Fechner's (1876) work about aesthetic appreciation. He came up with the idea that specific properties of visual artworks such as complexity are responsible for the amount of pleasure they evoke and implemented research methods partly used until today (Nadal, 2007). As will be shown in this work, the discussion about the impact of complexity on the aesthetic appreciation of the perceiver is as old as the scientific branch of aesthetics itself. Although this field is still not a main stream one, it developed lots of subtopics and branches over the years and undergoes a new upswing since neuroscientific measurements have been involved into the discourse about 15 years ago.

The present work will give an historical and categorical overview on the intricate field of aesthetics that will lead the reader to specific properties and visual processing stages of artworks. Some of them, namely complexity and understanding are presented in detail, as well as the derived experiment in which the connection between those two features and their influence on liking-ratings has been investigated.

2.   THEORETICAL BACKGROUND

2.1. Definitions and related terms

Unfortunately there is no such thing as a common and comprehensive definition of the term "aesthetics". This first section tries to give an impression of what is usually meant in the context of a psychological approach to aesthetics.

The word "aesthetics" itself derives from the Greek verb "aisthanomai", translated: to perceive (Berlyne, 1974). In line with its word descent, aesthetic appreciation can occur due to all senses that allow humans to perceive input. Dance and music can evoke aesthetic appreciation, as well as literature, paintings or a landscape. In fact any object, phenomenon or individual can be aesthetically appreciated (Valentine, 1962). The present work is concerned with visual aesthetics (in comparison to e.g. gustatory or tactile aesthetics), in detail with the visual appreciation of artworks (in comparison to the visual appreciation of e.g. websites, architecture or human faces).

Depending on author and research interests, definitions of the term aesthetics vary (Nadal, 2007; Augustin & Wagemans, 2012). Brown and Dissanyake (2009, In Skov & Vartanian, pp. 43-57) for instance explain aesthetics psychologically as a "unique and even reverential mode of attention" toward artworks.

Anjan Chatterjee, a prominent researcher in the field of neuroaesthetics defines aesthetics in a more biological way as "the perception, production, and response to art, as well as interactions with objects and scenes that evoke an intense feeling, often pleasure" (Chatterjee, 2010).

Chatterjee (2014) also differentiates beauty, pleasure and arts because these terms are highly associated with aesthetics, sometimes even used equally, but do not entitle the same thing at all. Especially beauty seems to be central to most people's concept of aesthetics (Jacobsen, Buchta, Kohler, & Schroger, 2004), but beauty is neither a precondition nor the unalterable consequence of an aesthetic appreciation. Instead, "aesthetics relates to the continuum of beauty to ugly" (Chatterjee, 2014). One can find something or someone ugly, but also aesthetically appealing. Sometimes just the part that is not so beautiful catches our attention or gives us pleasure in watching or hearing it (e.g. Silvia, 2009). Also, what evokes an aesthetic response does not have to be art per se. A beautiful landscape can be aesthetically appreciated and evoke positive emotions, just as a painting of a famous artist (Chatterjee, 2014). Finally, what is defined as "Art" depends on cultural and social streams (for a review on defining arts see e.g. Noel Carroll's "Theories of Art Today" or Steven Davies "The Philosophy of Art"). A fitting definition for the purpose of this work would be: "Art is the turning of an object or activity into something special" (Zaidel, Nadal, Flexas & Munar, 2013), which

remains the question: what is special? Whatever it is, that is nowadays defined as an artwork, at least in earlier days often had the demand to be beautiful, but this fulfillment seems to lie in the eye of the beholder or the producer (Leder, Gerger, Dressler & Schabmann, 2012). The fact, that aesthetic appreciation is highly individual and subjective seems to be one reason, why there is no standard definition of it and also why the value of a scientific examination of aesthetics is being criticized by philosophers until today.

The following chapters give an historical overview about the development of both humanistic and scientific approaches to aesthetics including the main scientific branches.

2.2. Humanistic approaches to aesthetics: From philosophy to psychology

The philosophical interest for aesthetics is said to have its starting point in the ancient Greece with Plato and Aristotle. While agreeing in the importance of unity, harmony and integration in arts, they argued about the value of arts itself. While Aristotle found artworks to be a source of delight and knowledge, Plato understood art as nothing than a simple imitation of the real world, that couldn't be learned from and even would damage the soul (Palmer, Schloss & Sammartino, 2013).

Plato supposed that beauty has an existence of its own, independent of the subject recognizing it (Kawabata & Zeki, 2004) and divided the field of aesthetics in two affairs: The theory of beauty and the theory of arts. For nearly 2000 years, Plato's writings dominated the aesthetic discourse: Until the eighteenth century philosophical efforts around aesthetics focused on a theory of beauty (Dickie, 1997). But in 1750 the wind changed with Alexander Baumgarten's book "Aesthetica", which marks the beginning of modern aesthetics (Chatterjee, 2014). Baumgarten (1750) believed that human beings had a special sense that is responsive to beauty, harmony and proportionality. He called this "sensitive cognition" and provoked thereby a new focus on the issue of aesthetics: The role of cognition and emotions. Prominent philosophers like Burke and Tolstoy encouraged and developed the idea of the significance of emotions in dealing with artworks (Chatterjee, 2014). Burke (1757) for instance proposed, that aesthetic experiences were grounded on the same physiological structures than pleasant and unpleasant emotions (Nadal et al., 2012). Hume (1757, in Harris, J. A., 2015) took another step in the direction of a psychological contemplation of aesthetics: He involved the terms "taste" and "judgment" into the discourse. Hume claimed that the cognition of beauty devolves out of a subjective judgment, which itself develops out of taste, rather than out of logical or objective analysis.

He also recognized, that the judgment and in consequence taste for objects is influenced by education, which is a prominent scientific topic until today (e.g. Heinrichs & Cupchik, 1985).

Another philosopher who influenced and still influences the field of aesthetics is Immanuel Kant (see e.g. Osborne, 1979; Guyer, 2008). In addition to many other matters, he pointed to a characteristic of aesthetic appreciation that is scientifically relevant until today: The *disinterested interest* in artworks. According to Kant, what makes the aesthetic appreciation for artworks unique is the fact that the pleasure of viewing a painting or listening to a sonata lacks of the desideratum of having, owning or incorporate it (Kant, 1790).

With Kant's book "critique of aesthetic judgment" (1790) the focus shifted in the direction of fathoming the features of beauty in relation to the perceiver (Kawabata & Zeki, 2004), as he associated beauty explicitly with the mental processes of the viewer. Kant proposed that our judgments of beauty were grounded in the interaction of the object with our perception, intellect and imagination (Kant, 1790). This is a "decidedly psychological" idea (Palmer, Schloss & Sammartino, 2013) and in line with the modern scientific approach to arts, as it tries to figure out the dynamics of those interactions (Chatterjee, 2014).

But to set the humanistic approach apart from the scientific one, one last ingredient is missing to finally talk about a scientific approach to aesthetics: The statistical methods. It was Gustav Fechner in 1871, who made this link in implementing the very first empirical investigation on reactions to artworks in a museum in Dresden (Berlyne, 1971). Given the research interest of two versions of Holbein's *Madonna with Burgomaster Meyer*, which was controversial discussed in terms of authenticity, Fechner asked visitors of the exhibition to give a written judgment about both artworks. Even though the experiment did not carry out the answers that he hoped for, his idea led to a new methodological approach in the investigation of aesthetic preferences (Berlyne, 1971). In contrast to the type of aesthetics philosophers carried out until then, he proposed the *aesthetics from below*: Instead of analyzing a single artwork in depth, he proposed to study a large number of artworks, and instead of examining reflections of single individuals, averaged responses of a group. That way it became possible to determine attributes of classes of stimuli and therefore to begin an examination (from below) with particular facts towards to possible generalizations. This idea is considered to be the starting point of "the transition from traditional humanist perspectives towards a scientific and experimental approach" (Nadal, 2007).

Experimental aesthetics is the second oldest branch of psychology after Fechner's psychophysics and has extent widely to an intensively fathomed field of research with several sub branches (Nadal, 2007; Jacobsen, 2006; Tinio & Leder, 2009). The upcoming chapter shall give an overview.

2.3. The branches of empirical aesthetics

Empirical aesthetics cover everything regarding the behavior of aesthetic kinds, means the behavior of artists and of the appreciator and can be divided up among psychology, sociology, anthropology and linguistics (Berlyne, 1974). It confines itself from the philosophical acquisitions, in using methods of empirical science, meaning investigating not only humans and animals behavior, but also the observable conditions, that could influence the behavior. More precisely: Conclusions are derived by "controlled observations under circumstances that enable the effects of one factor to be distinguished from those of other factors that commonly accompany it" and include a research design and statistical analysis of the collected data (Berlyne, 1974). Corresponding to different admissions and due to progresses in technique and science, several sub-branches arose.

2.3.1. Experimental and new experimental aesthetics

As mentioned in chapter 2.2., Fechner (1876) imposed aesthetics to a scientific intercourse by introducing some methods, which are partly used until today. He presented besides others

a) The method of production: Subjects have to produce an object that accords best as possible to their own taste
b) The method of use: Artworks or other objects are examined regarding of their most appearing characteristics, assuming that those would be appreciated most in the society and most importantly
c) The method of choice: Subjects are presented a number of objects, which they have to rate regarding their pleasantness or other features

Especially the method of choice is used widely today, not only within experimental aesthetics, but also within the other branches of empirical aesthetics and psychology (Nadal, 2007). The experiment of the current work also exercises this option.

With this and other methods Fechner transacted his idea to investigate *aesthetics from below*, means to abridge an artwork into its properties such as size, shape or color and to register the reactions of a certain number of people on those single properties to derive conclusions and get an insight in the mystery of aesthetic appreciation. Research regarding aesthetic appreciation follows Fechner's ideas until today, beginning with Birkhoff (1932) and Eysenck (1942) trying to find a mathematical formula that can predict the amount of aesthetic pleasure an object evokes (see chapter 2.5.6.). Both used abstract polygons, varying in different features like complexity, order or symmetry to be rated by participants in terms of their aesthetic appeal. The choice of a simple stimulus like polygons is still popular, as it overcomes the problem of artworks being hardly comparable due to their uniqueness in allowing to manipulate a single dimension, which in turn allows to derive conclusions in connection with the specific dimension. On the other hand, which is why this method is also criticized, this kind of stimuli are far away from what is understood as arts and therefore could lack of the "essential components of the true aesthetic behavior" (Nadal, 2007).

Birkhoff's and Eysenck's efforts, revealing conflicting results (see chapter 2.5.6.), led to a theory that dominated the discourse almost completely for decades: The *arousal potential concept* of Daniel Berlyne (Martindale, Moore & West, 1988). Berlyne's admission was a motivational one, as he was mainly interested in the mechanisms that lead individuals to explore their environment, seek information or appreciate artworks or music. To answer this questions he developed the *Psychobiological aesthetics*, a research program from the 1960s and 70s and introduced besides other things the so called *collative variables* and the term of *hedonic value* into the discourse. *Collative variables* refer to the features of an artwork such as complexity, symmetry, novelty or ambiguity. *Hedonic value* means the intrinsic and extrinsic evaluation of an object in terms of its value. Berlyne (1974) stated, that the motivational condition of an individual is justified in the activity of three neural systems (primary and secondary reward systems and aversion system) and that people would seek to reach an optimal level of arousal, namely an intermediate one. If the arousal level would be too high or too low, the aversion system would be activated and influence the hedonic volume of a perceived stimulus negatively (see also chapter 2.5.1). With his theory, Berlyne developed the scientific focus from perception to attention and emotion (Chatterjee, 2014). His *Psychobiological Aesthetics* gave the framework for modern experimental approaches in aesthetics, also called "the new experimental aesthetics" (Nadal, 2007) and his work has been investigated widely ever since.

Maybe the most prominent challenger of Berlyne's work was Colin Martindale with his *cognitive theory of aesthetic processing*: He claimed that, if the arousal potential would be solely responsible for pleasure, another stimulus with the same intensity as measured while for instance watching the favorite artwork, should evoke the same amount of arousal and in consequence pleasure. But as one can image, so his example, a mild electric shock is hardly appreciated the same way as the view on the favorite painting. Furthermore, Martindale doubted the special importance of collative variables in explaining aesthetic preferences (Nardi & Martindale, 1981). Instead, he proposed in his theory meaning and prototypicality to be the most important predictor of preference (Martindale, 1984).

Over the years, Fechner's tradition of examining *from below* what people tend to find aesthetically pleasing went on and led to knowledge about visual perception and the impact of visual properties. In 2004, Leder and colleagues generated a comprehensive model that brings together this knowledge in an information-processing stage model of aesthetic appreciation. According to Leder and his colleagues an aesthetic episode consists of several stages of relative hierarchy, means that the stages do not expire in a strict serial succession, but fall back to each other or build loops. An object of aesthetic interest constitutes the input of the model, whereas the assumed outputs are aesthetic judgment and aesthetic emotion.
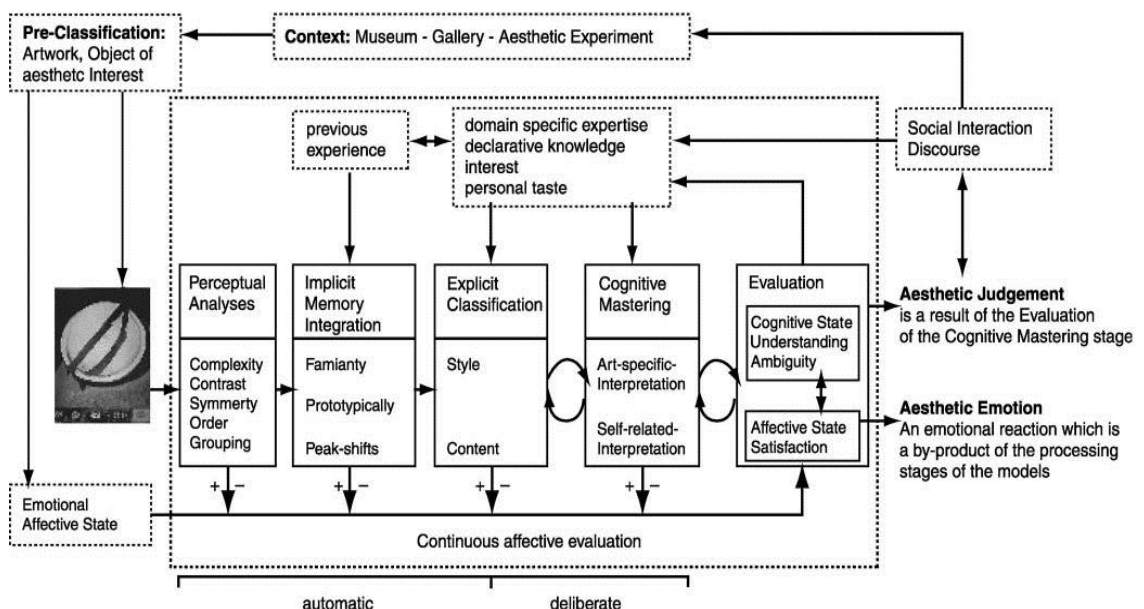

Figure 1: Processing model of aesthetic appreciation (Leder, Belke, Oeberst & Agustin, 2004).

The first step of an aesthetic episode according to Leder and colleagues (2004) is the *pre-classification* of an object as an artwork or something of aesthetic interest. *Context* influences this step.

For example: When an object is seen in a museum or gallery, it is likely that the viewer will value it as an artwork. On the other hand, when artworks are introduced as fakes, participants tend to give lower liking-ratings for them (Leder, 2001). Once the object in question is pre-classified, the stage of *perceptual analysis* comes into play, in which the specific features of the object, such as complexity, contrast, order or color are determined. Those features can have major effects on aesthetic appreciation and received most scientific attention within the psychological field of aesthetics, as displayed in the so far document. One of the most influencing features is complexity, the main variable of the current works experiment and is presented in chapter 2.5. The next step that occurs during an aesthetic episode is *implicit classification* or also called *implicit memory integration*. Some kinds of memory affect aesthetic appreciation unconsciously. One kind that is known to have a great impact on aesthetic appreciation is familiarity, which is presented in detail in chapter 2.6. *Explicit classification* on the other hand consists of the analysis of content and style. This stage might overlap with preceding processing stages, especially when the viewer possesses art expertise. The remaining two stages *cognitive mastering* and *evaluation* build a feedback loop with the other stages and with each other. The goal of cognitive mastering is to lead the viewer to an understanding of the object in question. Evaluation follows this process and hence guides the aesthetic processing back- or forwards to the other stages depending on how successful the cognitive mastering has been evaluated. If cognitive mastering didn't lead to experienced understanding of the object, the information processing falls back into the before described stages until a subjectively satisfying understanding is reached. An overview of the scientific examination of the role of understanding in the appreciation of artworks is given in chapter 2.7.

The model of Leder and colleagues (2004) is a good example of the progress that the scientific discourse about aesthetic appreciation underwent over the decades. With the beginning computerization in the 1980's and 1990's new methods and experimental designs became possible (for example the presentation of high quality stimuli on computer screens or the use of inventions like eye tracker), which vastly enhanced the scientific discourse (Leder & Nadal, 2014). Studies on the influence of composition and expertise on perception e.g. by the use of eye tracker (Locher & Nodine, 1987 in O'Regan & Levy-Schoen) or participants' evaluations (Martindale, Moore & West, 1988) followed, as well as analyses of the impact of familiarity (Leder, 2001) or prototypicality (Hekkert & van Wieringen, 1990) to name but a few. Also of course the role of complexity, introduced by Berlyne has been examined further from different standpoints (see chapter 2.5.).

By the end of the last century, another branch evolved, which meanwhile dominates the scientific discourse about aesthetics: The branch of neuroaesthetics.

2.3.2. Neuroaesthetics

Neuroaesthetics "merges empirical aesthetics with cognitive and affective neuroscience" (Chatterjee & Vartanian, 2014) and is concerned with the research of "neural and evolutionary foundations of our specie's capacity to appreciate beauty and art" (Cela-Conde, Agnati, Huston, Mora & Nadal, 2011).

Even though the employment with the biological underpinnings of aesthetic appreciation in a philosophical way reaches back hundreds of years (see chapter 2.2), the scientific exploration of those, especially under the use of neuroimaging techniques is a relatively new and upcoming field (Nadal et al., 2012).

The term "neuroaesthetics" was coined by Semir Zeki (1999), who had the strong persuasion, that aesthetics could never be fully understood without uncovering its neuronal underpinnings. Within neuroaesthetics, there are different approaches that consist of contrasting ways to categorize its aims and contents.

Besides others (e.g. Jacobsen, 2006) one catchy and easy way of categorizing the approaches within neuroaesthetics is presented by Chatterjee (2014). He explains that research questions of the field can be divided into questions asking for "how (does aesthetic experience work)?" and "why (do humans experience aesthetic appreciation at all)?" From a methodological standpoint, neuroaesthetics can be divided into descriptive and experimental neuroaesthetics (Chatterjee & Vartanian, 2014; see chapters 2.3.2.2. and 2.3.2.3.). While descriptive and experimental neuroaesthetics try to answer questions regarding the "how", evolutionary aesthetics, a theoretical approach to aesthetics, seeks for the "why?", in other words: The reasons and evolutionary benefits of aesthetic experiences (Chatterjee, 2014).

2.3.2.1. Theoretical neuroaesthetics: The evolutionary approach

Evolutionary aesthetics seeks to find answers regarding where, when and why humans evolved the ability to produce artifacts and experience aesthetically with all their senses. To do so, it makes use of archeological and neurobiological evidence (Zaidel, Nadal, Flexas & Munar, 2013).

An early approach points to the role of beauty in connection with evolutionary fitness, as proposed by Darwin (1911). Tying on Spencer's (1864) theory of the *survival of the fittest*, Darwin (1911) assumed, that beauty serves as a sign for good health or *fitness* within sexual selection.

An individual being able to afford the costs of beauty (e.g. a peacock having huge impractical feathers or a gaudy colored bird, being very obviously observable for carnivores), has to have properties on its disposal that make it fitter, than other individuals who cannot. These thoughts find support in studies that showed the same brain areas to be activated during both viewing faces and artworks, rated as beautiful (De Ridder & Vanneste, 2013). This might be a possible explanation for animals including humans to make some effort to appear beautiful, for instance to decorate themselves or on the other hand to detect and prefer beautiful objects, like potential mates or an appetizing fruit.

But at this point we are not yet talking about the creation and appreciation of arts. As Kant (1790) claimed in his critique of judgment (cf. chapter 2.2.), the specialty about pleasure for art is the fact, that it is self-sufficient and does not – in comparison to a potential sexual partner or meal - evoke the desire to incorporate or own it. Due to experimental neuroaesthetics (see chapter 2.3.2.3.), nowadays we know, that various brain areas are involved in aesthetic appreciation. But there is not one area under them that is exclusively activated during an aesthetic experience. All of them are participating in other mechanisms like decision-making, orientation or others. Hence, the evolutionary approach assumes, that aesthetic experiences are grounded on mechanisms that originally generated out of evolutionary benefits, but has led to this special ability as a side-effect of other adaptions occurring exclusively in humans (Zaidel, Nadal, Flexas & Munar, 2013).

2.3.2.2. Descriptive neuroaesthetics

Descriptive neuroaesthetics are typically qualitative and rely on observations. Such observations can be "informative anecdotes", as Chatterjee calls them. What he means are case studies about the changes in artistic expression or appreciation due to brain damages (Chatterjee, 2004).

To give a few examples: Lovis Corinth is known mainly for his works created after a right hemisphere stroke (Chatterjee, 2011). Oliver Sacks (1995) describes cases of people who drew paintings of one particular object or scene excessively after brain damages. One of the most popular example is Nadia, an autistic child who drew realistic images of horses by the age of three (Selfe, 1977 in Chatterjee, 2011).

Halpern and colleagues (2008) examined the consistency of aesthetic preferences in patients suffering from Alzheimer's disease and frontotemporal dementia by asking them on two testing dates (as well as a healthy control group) to rank three sets of artworks from most to least preference.

Even though the Alzheimer-patients couldn't remember the presented artworks at the second time, their preference did not change over time.

Those kind of studies led to the insight that the existence of one particular brain area specialized for aesthetic experiences is quite unlikely. Instead, brain damages can have an uncoupled impact on the perception, identification or the emotional occupation with an artwork, which speaks for several brain regions involved in the process (Nadal, 2013).

Descriptive neuroaesthetics thus has an important scope, as it leads researchers to new ideas and "offers a first draft of blueprint of how art relates to the brain" (Chatterjee, 2014). But to solidify observed relations, standardized conjunctures are needed, to make conclusions as accuracy as possible. In other words: Experiments are needed.

2.3.2.3. Experimental neuroaesthetics

With the entrance of neuroimaging techniques like fMRI (functional magnetic resonance imaging) or MEG (magnetoencephalography) by the end of the 20th century, the exploration of the underlying mechanisms of aesthetic experiences was able to take another step, as they allowed researchers to correlate appreciation for artworks (and other objects) with the activity in certain brain areas (Nadal & Skov, 2013).

While in earlier days, the demand was to explore one explicit "aesthetic center" (Brown, Gao, Tisdelle, Eickhoff & Liotti, 2011), nowadays we know, that several areas are concerned. The current state of affairs suggests, that at least three sets of brain areas are involved in the experience of art (Nadal, 2013).

a) The *reward circuit* as an interplay between cortical (anterior cingulate, orbitofrontal and ventromedial prefrontal cortices), subcortical (caudate nucleus, nucleus accumbens) and regulatory components (amygdala, thalamus and hippocampus).

b) Low,- mid, and high-level cortical sensory regions, reflecting the engagement of *attention*, and

c) Cortical regions involved in *evaluative judgment* (dorsolateral prefrontal cortex and anterior medial prefrontal cortex), *attentional processing* (ventrolateral prefrontal cortex) and *memory retrieval* (temporal lobe, posterior cingulate cortex and precuneus).
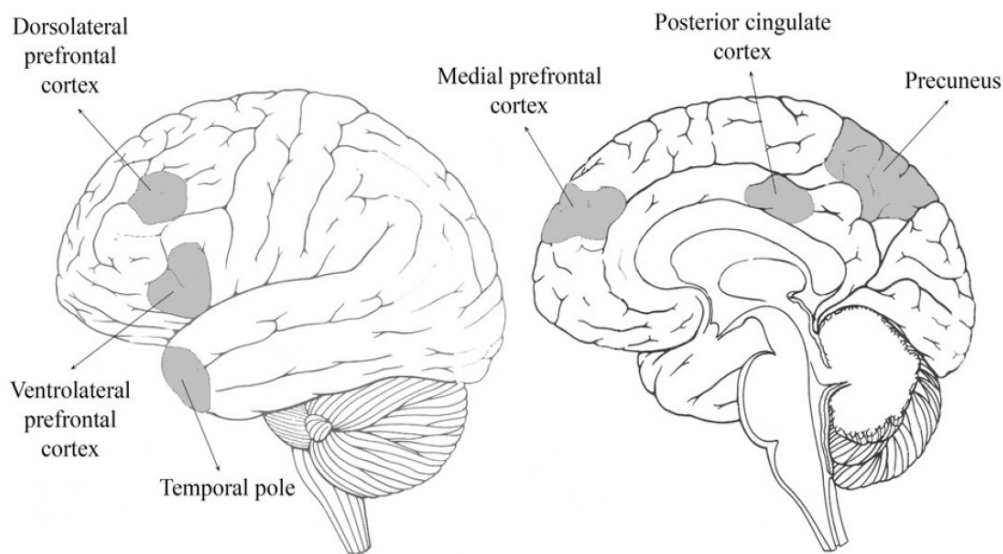
Figure 2: Brain areas involved in aesthetic experiences (Nadal, 2013).

But it was quite a way until such summaries were able to be made. The just presented knowledge is the integration of dozens of studies within neuroaesthetics revealed since the entrance of the 21st century. In order to clarify the enormously complex neuronal interplay underlying aesthetic appreciation and to get to an aggregation of knowledge so comprehensive, that a summary like the one of Nadal (2013) presented in the current chapter became possible, it seems traceable, that neuroimaging studies traditionally focus on isolated brain-areas under the use of different neuroimaging techniques, such as the orbitofrontal cortex (e.g. Tsukiura & Cabeza, 2011) or the lateral occipital cortex (e.g. Cattaneo et al., 2015). Another example is the dorsolateral prefrontal cortex, which recently reaches higher attention in relation to aesthetic experiences (Cattaneo et al., 2014; Cela-Conde et al., 2004; Jacobsen et al., 2006; Cupchick et al, 2009).

2.4. Recent findings within neuroaesthetics

Cattaneo and her colleagues (2014) went another step further within neuroaesthetics in overcoming the limitation of so far only correlational evidence: They used tDCS (transcranial direct current stimulation) in their study, a painless, noninvasive tool, that allows focal prolonged and fully reversible shifts of cortical excitability in the human brain (Batsikadze, Moliadze, Paulus, Kuo & Nitsche, 2013), to stimulate the dorsolateral prefrontal cortex of their participants. Cattaneo and colleagues (2014) carried out an experiment in two conditions: real or sham tDCS stimulation.

It was a single-blind experiment, so test persons were not able to detect whether they had been allocated in the real or the sham condition. Participants had to rate pictures for their subjective beauty and colorfulness in one of the two conditions. So in comparison to studies carried out before, it was not recorded, where and/or how the brain was activated while participants rated visual stimuli. Instead it was recorded how the ratings of participants changed *due to* an externally enhanced activation of one specific brain area, namely the dorsolateral prefrontal cortex. Researchers' analysis showed among other things, that the test persons who sustained anodal stimulation due to tDCS rated pictures significantly more beautiful and less complex, than test persons in the sham condition.

Gerger and colleagues (in prep.) did a follow-up, using the same independent variable of tDCS real vs. sham with the addition of having separated the stimuli-pictures regarding their valence and tested their effects on valence-, beauty-, understanding- and complexity- ratings. Their results showed again, that real tDCS stimulation leads to higher liking and less perceived complexity. Additionally it led to higher understanding-ratings. The fact that anodal tDCS leads to enhancement in cognitive performance (Batsikadze, Moliadze, Paulus, Kuo & Nitsche, 2013) might explain the significant differences in the groups real/sham tDCS in both Cattaneo and Gerger's work. However, Gerger and his colleagues' results also suggest that, regardless of tDCS stimulation and valence, as understanding-ratings increase, complexity-ratings decrease and vice versa, and that this interplay seems to have a significant impact on liking-ratings.

As the reader will learn in the next chapter 2.5., there already has been a lot of research in the past about the impact of complexity on aesthetic appreciation in arts as well as the impact of understanding on aesthetic appreciation in arts (see chapter 2.7.). Nevertheless, the connection between those two variables in reference to beauty-ratings has never been examined so far and is going to be the aim of this diploma thesis.

2.5. The role of complexity in the appreciation of artworks

The history of the search for the role of complexity in preference ratings goes again back to Fechner (1876, cf. Chapter 2.2 and 2.3). Besides his methodological acquisitions for scientific aesthetics and psychology, he proposed among other things the concept of *unitary connection*, which basically says, that pleasant stimuli are balanced regarding order and complexity, in other words, that people would prefer those images most, that constitute of intermediate order and complexity.

Birkhoff (1932) went one step further in proposing a mathematical formula (cf. Chapter 2.3) for that issue:

$$M \text{ (measure for aesthetic appreciation)} = O \text{ (order)} / C \text{ (complexity)}$$

Following that formula the aesthetic value of an object is predicted by the relation between complexity and order. In detail, Birkhoff (1932) proposed that the aesthetic appreciation for an object would decrease with the amount of complexity, as this would strengthen the effort to decompose it. And it would on the other hand rise with the amount of order a viewer finds in an object, as this would be the resulting reward for the effort of decomposing it. So Birkhoff's aesthetic measure is based on Fechner's (1876) two proposed variables, but predicts - in comparison to Fechner's model - that objects would be appreciated more, when they were ordered and simple, and less, when disordered and complex. Eysenck (1942) in turn, who tried to advance Birkhoff's formula, found a positive linear relation between aesthetic appreciation and both order and complexity.

2.5.1. Berlyne's arousal potential theory

Berlyne's popular arousal potential theory assembles on those findings and gives a framework for most of the questions addressed by Fechner (Nadal, 2007). As described in chapter 2.3.1 Berlyne proposed, that humans would seek to call on an optimal arousal level, namely an intermediate one. This intermediate arousal level he says, is in turn depending on the composition and nature of

a) *psychophysical variables* like brightness and saturation,
b) *ecological variables* like learned meaningfulness and
c) the already mentioned *collative variables*, being the most important variable in producing arousal according to Berlyne (1971).

In terms of aesthetic appreciation and arts, his arousal potential theory predicts, that an intermediate degree of complexity (which is in turn related to heterogeneity, symmetry and else) elicits the most preferred arousal level. Graphically illustrated, this effect shows itself as an inverted U-shape function with a first increasing, then decreasing line for complexity: The preference and interest for an artwork rises with the amount of complexity up to a certain peak, where the arousal becomes too high and therefore declines.

Summarizing spoken, following Berlyne's inverted U-shape hypotheses, people are expected to prefer intermediately complex artworks over such of high or low complexity (Nadal, 2007).
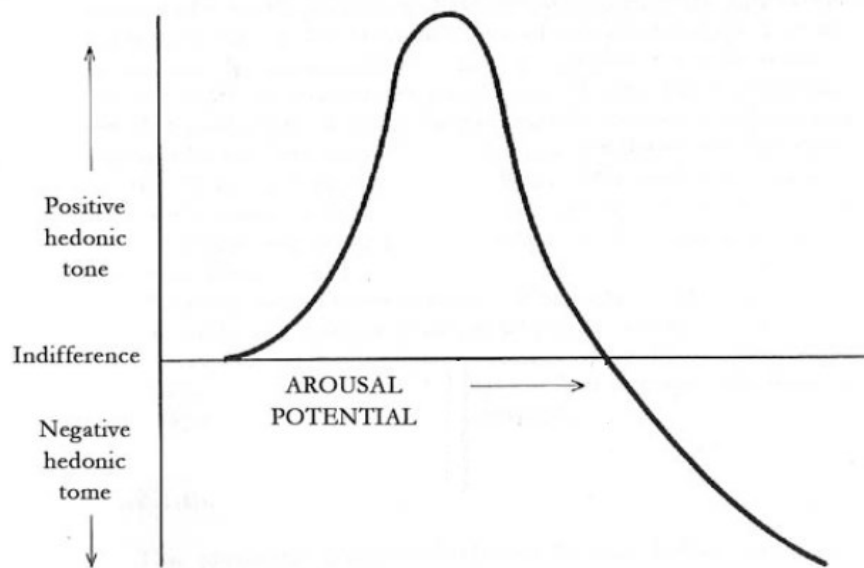
Figure 3: Inverted U shape function (Berlyne, 1971 in Nadal, 2007).

A great number of on tying studies followed, but served different results. While some could affirm Berlyne's prediction, some found other than the inverted U-shape curve and instead others, for instance a monotonic curve (Martindale, Moore & West, 1988). The following section gives a few examples of the perpetuation of Berlyne's work.

2.5.2. Approval for the arousal potential theory

One study that could flesh out Berlynes inverted U-shape hypothesis is that of Imamoglu (2000). He tested the relation between complexity and preference ratings in presenting drawings of traditional Turkish or modern facades of houses, varying in the degree of complexity. Simplest facades showed only very basic features of architecture like windows or chimneys - the degree of increasing complexity was established by successive adding more details. Thirty-four architecture students and 38 students with no explicit architectural expertise or training (both groups balanced regarding their sexes) were requested to rate those images on a seven - point scale in terms of preference, complexity and familiarity. The analysis of those revealed the highest preference ratings for intermediate complex facades in comparison to the very simple or very complex ones. This was true for both men and women, as well as for modern and traditional houses (Imamoglu, 2000).

Another author whose results confirm Berlyne's hypothesis is Nasar (2002). His aim was to investigate the impact of complexity, order, historical significance and prototypicality on preferences for libraries. Six photographs of buildings, some showing typical historical elements of libraries and some showing other architectural styles, but still a size that would commend them to be a library, served as stimuli. After checking the reliability of the scales by stimulus-ratings of graduate students of city planning regarding the features enumerated above, 130 participants, varying in political attitude, education and profession, and balanced in sexes had been asked to attend the study. Participants first had to choose which one of the images they liked most and least (half of them in reversed order), and then to give ratings on a seven - point scale, in answering how attractive, expensive, public, complex, ordered and impressive they guessed each of the six imaged buildings was. Two main factors emerged from the data-analysis: The first one consisted of the scales attractive, expensive, impressive and public, the second one solely of complexity. Additionally people rated intermediate complex buildings as the most attractive in comparison to buildings of high or low complexity. Surprisingly this relation was also true for order: While most and least ordered images had gained low attractiveness ratings, those of intermediate order received the highest attractiveness evaluation. So while Nasar's (2002) revealed results affirm Berlyne's (1971) hypothesis of intermediate complexity being most preferred, they contradict Eysenck's (1942) prognosis (see above) of preference being a linear function of order. The author explains this with participants' behavior, possibly confusing order with simplicity, while other researchers trace it back to the nature of stimuli, which were not manipulated independently in terms of complexity and order (Nadal, 2007).

2.5.3. Disapproval for the arousal potential theory

However, as already mentioned, Berlyne's hypothesis (1971) not always found approval. Heath, Smith and Lim (2000) for example, also employed with architectural aesthetics, found a linear relationship between complexity and preference, namely the complexity of skylines. To overcome the disadvantages of photographs of skylines such as possible familiarity with them (cf. upcoming chapter 2.6. Familiarity), they designed unicolor images of tall buildings above a common waterfront. The nine prepared stimuli varied in three complexity levels in each of two complexity dimensions (buildings silhouette and façade detail). After a pretest to make sure, that the complexity level they wanted to present accorded to subjective measures, Heath, Smith and Lim (2000) requested 32 female and 28 male psychology students to view the stimuli and complete an affect grid with the crossing dimensions of arousal and

appreciation due to respectively for the given stimuli. Afterwards, half of the participating students had been asked to rate complexity of silhouettes and facades, the other half to rate preferences for the stimuli. The results of that study showed a linear relationship between silhouette complexity and preference: The silhouettes with the highest complexity were preferred more than the intermediate or simple ones. This monotonic relation was also true for silhouettes in terms of arousal and pleasure, but none of these results occurred for facades. That is to say, Nadal (2007) notes, that with a more expanded range of complexity levels, the inverted U-shape distribution might have been revealed.

Another example for a monotonic increase of preference with complexity is given by Osborne and Farley (1970). They asked 20 participants to rate the complexity of 62 reproductions of well-known abstract artworks. The outcome served to create three complexity levels (high, intermediate and low), using five of each as stimulus-set for the following experiment. Thirty participants (15 psychology students and 15 art students, balanced by sexes) took part in this experiment, in which they had to allocate their preference for the stimuli on a three-point scale (high, intermediate or low preference). The analysis showed no differences regarding the sex or arts expertise, but a linear increasing for preference with increasing complexity of the stimuli. This result clearly stands against Berlyne's (1971) inverted U-shape hypothesis, but is in line with Eysenck's (1942) prediction. Nonetheless the fame of the used paintings might have influenced this outcome (cf. upcoming chapter 2.6.).

Finally, mixed results have been found as well in terms of the relation between complexity and preference ratings. To investigate this connection, Aitken (1974) created 50 geometric polygons, varying in ten levels of complexity. These levels emerged due to the number of sides (between four and 40) a polygon consisted of. Participants were asked to grade one set by another (10 stimuli per set) from least to most pleasing or from least to most interesting in a counterbalanced order. The relation between interest respectively pleasantness and complexity in Aitkens (1974) study turned out to be increased monotonically *or* inverted U-shaped.

2.5.4. Possible reasons for the divergence of results

The divergence of the presented results mirror the common problem of comparable results within scientific aesthetics and can be explained from different angles.

First, the composition of participants might account for a distortion of results, as some groups solely consisted of students, or even students of one specific profession (e.g. Imamoglu, 2000 and Heath, Smith & Lim, 2000).

The kind of rating - scales varied in their graduation, which influences the mathematical analysis (for example Imamoglu, 2000 in comparison to Osborne & Farley, 1970). Furthermore the kind of stimuli differed widely in between the presented studies. While some researchers presented non-artistic images to rate by their participants like geometric patterns (Aitken, 1974) or artificially generated images (Heath, Smith & Lim, 2000), others used artworks as stimuli, partly consisting of only one class, like abstract paintings (Osborne & Farley, 1970). Yet others stimuli – sets consisted of images (Imamoglu, 2000) or photographs of modern and traditional architecture (Nasar, 2002).

One might assume, that the use of different stimuli would be a main factor for the divergence of results, which is why Nadal and colleagues (2011) wanted to get to the bottom of this aspect in a series of experiments, using a well-thought-out and capillary composed set of stimuli. Out of over 1,500 digitalized images, they selected 200 of which were abstract artistic, 200 representational (varying in different styles like impressionism, cubism, dadaism, etc.), 200 abstract non-artistic, and 200 representational non-artistic images (including postcards, photographs, artifacts, urban scenes, etc.). To take account for the influence of familiarity (see upcoming chapter 2.6.), they chose only relatively unknown art pieces. To control the impact of ecological variables (cf. chapter 2.5.1) stimuli showing clear views of human faces or figures, as well as scenes of strong valence had been eliminated. The influence of psychological variables (cf. current chapter) had been avoided by adjusting all stimuli to the same resolution (150 ppi), size (9 by 12 cm) and luminance (between 370 and 390 lx). Additionally the color spectrum was standardized and all artists' signatures had been removed. This 800 chosen stimuli had then been divided into 8 sets of 100 images each, balanced regarding their kind of content, so that one set consisted of 25 abstract-artistic, 25 abstract-non artistic, 25 representational and 25 representational non-artistic images. The sets had been reviewed by 240 participants in total, 30 individuals rating one set of 100 randomized presented images on a scale from one to five in terms of their complexity. Deliberately the participants received no explicit definition for complexity. Instead they were instructed only, that they were asked "to focus on their general impression of the visual complexity of each stimulus, not on the complexity involved in producing it" (Nadal et al., 2010). To choose the fitting stimuli for the following experiment, two measures had been taken into account: The average ratings as complexity – score and the standard deviation as measure for participants' agreement on that score. To get a set with three complexity-dimensions low, intermediate and high, that would be silhouetted against each other as much as possible, the selection of high complex pictures was begun with the image that

18

received the highest averaged complexity-rating and was included, if the standard deviation was lower than .81. Then the image with the second highest average complexity-rating was tested for its standard deviation and included only, if this measure wasn't higher than .80 and so forth. The same procedure had been conducted for intermediate and simple stimuli. Out of each before rated set, ten images per type had been selected in this way, which left the authors with 120 stimuli, balanced in terms of complexity (low, intermediate and high), abstraction (abstract and representational) and artistry (artistic and non-artistic). Now with this cleverly devised material, Nadal and his colleagues executed two experiments. The first one served to examine the impact of complexity on beauty-ratings, this time with a series of well-balanced and standardized different image-types, overcoming the limitation of so far hardly comparable results because of the use of only one or two types of stimuli. Ninety-four participants had been requested to rate the 120 randomized presented stimuli on a scale from one to five regarding their subjective beauty. The so emerged average rating for each stimulus served as dependent variable in the analysis of the three independent variables of complexity (low, intermediate and high), abstraction (abstract and representational) and artistry (artistic and non-artistic). Surprisingly the results of this first experiment revealed that complexity had all in all no mentionable effect on preference. Only the beauty ratings of representational images showed a linear relation to complexity, in images being higher appreciated with increasing complexity. The authors interpret this as a possible confirmation of their initial hypothesis, that the relationship between complexity and preference is modulated by the type of stimuli.

2.5.5. Different types of complexity

But the group around Nadal (2010) proposes another possible explanation for the divergence of the before described studies results: Some of them used different definitions of complexity, others even none. To investigate this influence and furthermore, if different types of complexity are perceived, as it was already proposed by Berlyne (1986) but never elaborately examined, they conducted the third experiment of their study (2010). Based on a review of literature, Nadal and his colleagues chose seven features of complexity that seemed suitable to represent the different aspects of visual complexity, namely unintelligibility of elements, amount of elements, variety of elements, disorganization, asymmetry, variety of colors and three-dimensional appearance. After verbal and written instructions for each of these aspects, the same 94 participants of the first experiment were now asked to rate half of the stimuli of experiment one (this time only five from each of the four kinds in each complexity level

and in a different randomized order) regarding the seven different aspects on a scale from one to nine. The analysis was prepared to answer the following questions:

"a) do people consistently rely on the same features to perform complexity judgments of diverse visual stimuli?,
b) is visual complexity reducible to a single measure or is it multidimensional in nature?, and
c) do all forms of complexity influence beauty ratings the same way?" (Nadal et al., 2010).

In terms of the first question a), discriminant analyses were carried out, in order to determine the best combination of the seven aspects of complexity (see above) to predict the level of complexity (low, intermediate or high) of the different stimuli. It showed, that the aspect amount of elements was the best overall predictor of complexity ratings, while disorganization, variety of elements and variety of colors were almost irrelevant. The aspects unintelligibility additionally was of importance in the rating of abstract artistic stimuli as well as asymmetry and three-dimensional appearance for representational artistic stimuli.

The answer to author's research - question b) emerged out of factor analyses that revealed three main factors: The first one received loadings from the aspects amount of elements, variety of colors and three-dimensional appearance and explains nearly 48% of the variance. The second factor contained of loadings from unintelligibility of elements and disorganization and accounts for 31% of variance. The third factor representing 14.5% of the variance, only consisted of loadings from asymmetry. So in total the three extracted factors are able to explain over 93% of variance in participants' ratings.

Finally the investigation of question c), whether all forms of complexity influence beauty-ratings, was carried out by a curve fit test for the three complexity factors identified in the before executed factor analyses. The first factor (amount of elements, variety of colors and three-dimensional appearance) shows itself in relation to beauty ratings as a cubic function. The second one, consisting of unintelligibility of elements and disorganization, appeared to fit a quadratic function in proportion to beauty-ratings, as well as the third factor (asymmetry), albeit not significantly.

Thus, the study of Nadal and his colleagues (2010) could show that indeed different forms of complexity do exist and are differently perceived by the viewer. In line with other studies (Berlyne, 1968; Nicki & Moss, 1975; Chipman, 1977) there seem to be two or three factors that underlie subjective complexity, the most important being

amount and variety of elements. Additionally their results stand to reason, that the different forms of complexity influence beauty-ratings in different ways. This gives an important lead to the circumstance that the definition of complexity communicated to participants in experiments seem to play a crucial role in order to receive comparable results. The experiment of the current work follows that lead in having presented a curtailed and clear definition of complexity, including the factors amount and variety of elements.

2.5.6. Predicting complexity

Since the early works of Birkhoff and Eysenck (cf. chapter 2.5.1.), finding a mathematical measure for complexity has been of interest for researchers. As Hochberg (1968) claims, it remains impossible to be sure, whether a picture is simple or complex without an objective, reliable measure. The most popular way to determine the complexity of stimuli is to record and average the subjective ratings from a large number of people (Forsythe et al., 2011). But as already displayed in the preceding chapters, those kind of results are to take with a pinch of salt. Additional to the before mentioned circumstances that have to be accounted for like the existing different forms of complexity or also issues regarding the design of a study (see chapter 2.5.4.), which makes it difficult to compare studies, there are specific features of a stimulus like familiarity (chapter 2.6.) that influence the perception of complexity. Nevertheless, promising ways to predict complexity factoring out those influences, had been developed over the years. Lempel and Ziv (1976) were the first to develop an algorithm for complexity, which was based on a computer program for storage and production of images. Their work had been advanced over the years (e.g. Donderi, 2006; Forsythe et al., 2008) to result in an easy and reliable way to predict complexity:
Forsythe and colleagues (2011) propose Gif and jPEG compression to reveal a measure for complexity. To test the reliability of that measure, Forsythe and colleagues (2011) compared the results of the compression techniques (Gif and jPEG) with a subjective measure given by 240 participants on 800 images, including abstract artistic, abstract decorative, figurative representational and figurative decorative images, as well as environmental scene photographs. Participants were provided with a complexity definition as "the amount of detail or intricacy". The authors analysis revealed, that indeed both Gif and jPEG compression results correlated highly significant with participants subjective ratings. Additionally they found, that certain compression techniques work better or worse for certain types of images. Gif compression for instance, works better for highly colorful pictures like in lots of abstract artworks. The current work makes use of jPEG compression (see upcoming chapter 3.2.4.2.).

21

Besides the role of complexity on preference ratings per se, there is also strong evidence for aesthetic features that influence the perception of complexity. One of them is familiarity which is presented in detail in the following chapter.

2.6. Familiarity and familiarization

The feature of familiarity is known to play a crucial role in aesthetic appreciation almost since the beginning of a scientific approach to aesthetics. It was first examined by Zajonc in 1968 and revealed a theory, researchers on tie until today: The mere exposure paradigm.

2.6.1. The mere exposure paradigm

Using Chinese ideographs, photographs and nonsense-words as stimuli, Zajonc (1968) found, that the reported preference for stimuli increased by repeated exposure of them. He called this phenomenon *mere exposure effect*, which proposes, that familiarity due to repetition increases the appreciation of a stimulus (Zajonc, 1968; Kunst-Wilson & Zajonc, 1980). A possible explanation for this effect might be the reduced uncertainty resulting from familiarity (Leder et al., 2004). Mere exposure effects were replicated several times with different stimulus-types (e.g. Kruglanski, Freund & Bar, 1986; Bornstein & D'Agostino, 1992; Cutting, 2003). Leder (2001), to give an example, found an increasing relationship between aesthetic judgments and the familiarity with van Gogh paintings. Also, facilitating or hindering mechanisms of mere-exposure have been uncovered (e.g. Bornstein, 1989). For instance, mere exposure effects occur more intensive for complex, than for simple stimuli (Oskamp & Scalpone, 1975). A hindering mechanisms was also shown in Leder's study from 2001 (see above): The effect of familiarity leading to higher aesthetic appreciation was strongly reduced, when the van Gogh paintings were introduced as fakes (Leder, 2001).

2.6.2. Structural mere exposure

Mere exposure can also appear for novel but similar stimuli. Exposure to a stimulus has been shown to produce generalization effects to new, but analogical stimuli (Manza & Bornstein, 1995; Monahan, Murphy & Zajonc, 2000). This effect is called structural mere exposure and couples traditional mere exposure with implicit learning (Tinio & Leder, 2009). So in contrast to the traditional mere exposure, which "assumes positive affect towards familiar stimuli, structural mere exposure assumes positive affect towards familiar structures in stimuli" (Tinio, Gerger & Leder, 2013).

2.6.3. The processing fluency theory

Another common explanation for the phenomenon of aesthetic appreciation increasing by familiarity is the processing fluency theory. The theory basically says, that fluent processing – or in other words: the ability to visually perceive a stimulus easily and effectively - evokes pleasure (Cela-Conde et al., 2011). So if someone is familiar with a stimulus, it will be perceived more fluent and therefore be appreciated higher. This is even true, when stimuli just appear to be more fluent. Forster, Fabi & Leder (2015) asked 58 participants to rate basic line drawings of everyday life objects. While doing so, they were connected to a SCR (Skin conductance response), which should measure their skin rate while processing a given stimulus. It was explained to each subject what fluency means, that fluency has an positive impact on beauty ratings and that skin conductance response would be an indicator of how fluent a picture was processed. Directly after the appearance of a stimulus, a graphic of their even now measured skin conductance was shown, as an indicator of how fluently the stimulus in question was perceived. Participants were instructed in experiment one, that a decreasing curve would indicate a more fluent perception of the before seen picture, in another experiment two, they were instructed, that the opposite – an increasing curve – would suggest better fluency. What participants didn't know until the debriefing at the end of each experiment was, that the SCR was not powered. The graphically illustrated curves showing skin conductance were prepared in before and randomly presented to serve as a false feedback. Results of that study revealed, that participants indeed believed, that the presented feedback reflected their own fluency of processing. Furthermore, the false feedback influenced the beauty-ratings. Those stimuli that showed a (false) feedback of high fluency afterword had been rated highest in terms of beauty (Forster, Fabi & Leder, 2015).

Nevertheless, studies regarding the connection between familiarity and preference are inconsistent. While Zajonc's (1968) finding of a monotonic increasing relationship between those two variables (see above mere-exposure paradigm) was able to be replicated several times, others, for instance Cantor (1968) found the opposite. It was again Berlyne (1970), who wanted to examine this divergence and supposed the existence of a variable that might moderate the effects of familiarity on appreciation. He suggested the different types of complexity used in the prior studies to be responsible for the divergence of their results.

2.6.4. The relationship between complexity and familiarity

Familiarity counts to Berlyne's collative variables and indeed, Berlyne's studies regarding the before mentioned issue, revealed an interaction between complexity and novelty with higher pleasure ratings for complex and lower ratings for simple stimuli through increasing exposure (Berlyne, 1970). He explains this by the arousal potential concept, presented in chapter 2.5.1. According to his findings, novel and simple stimuli evoke an intermediate arousal which leads to higher preference. With repeated exposure, the stimulus in question loses arousal potential and preference ratings decrease due to boredom. On the other hand, complex stimuli when initially presented reveal lower preference ratings due to excessive demand or at least uncertainty, but with further exposure uncertainty disintegrates, while the excitement of complexity remains, which results again in an intermediate arousal and highest preference ratings (Berlyne, 1970). One problem that remains in dealing with Berlyne's model is the fact that it is not possible to predict the U-turn of his curve, before it has been reached (Forsythe et al., 2011).

Nevertheless, Berlyne's finding of familiarity influencing beauty-ratings by the mediator of complexity, has been developed ever since. Biedermann and Vessel (2006) for instance carried out an fMRI study, which revealed novel simple patterns to be preferred over complex scenes. The authors explain this by an exaggeration of the mere exposure phenomenon. They propose, that mere exposure effects are restricted to the early rising part of the inverted U-shape-curve of Berlyne. While arousal increases at the beginning due to familiarity, at a certain point the novel stimuli are needed to produce the sought amount of arousal.

On the other hand, Forsythe and her colleagues (2008) could show that unfamiliar stimuli are rated more complex, than they actually are. They propose that a complexity limit is fixed during the early visual processing, in which basic elements are being decomposed. On the contrary at a certain point, structural components of a stimulus like symmetry would reduce perceived complexity, as they help the viewer to organize the object, which in turn appears more familiar and (therefore) less complex.

Cox and Cox (2002) also studied the effects of repeated exposure in connection with simple and complex stimuli, using a between-subject-design for their experiment. This is of special interest as so far, as most studies to that issue carried out before (for a review see Bornstein, 1989) used a within-subject design, which allowed participants to compare stimuli regarding their complexity. Cox and Cox (2002) in contrary, using product designs of different complexity as stimuli (chosen by the results of a pretest), prepared 18 different booklets varying in their content (including simple or complex designs) and exposure (zero, one or three prior exposures of the complexity condition).

These booklets had been randomly distributed to 381 participants. After a distraction task in which the different exposure conditions had been executed, subjects had to rate the product design that was presented with zero, one or three exposures in before, regarding its aesthetic appeal. Their analysis of results revealed, that visually complex product designs show an increasing aesthetic appeal with repeated exposure, whereas preference for simple stimuli decrease with repeated exposure. Additionally their results suggest a mediating role of perceived complexity on the exposure-preference relationship.

On the other hand, Tinio and Leder (2009) illustrated the mediating role of familiarity on the complexity-preference relationship. They were able to show, that the impact of familiarity is indeed even strong enough to alter the seemingly stable effects of complexity (and that of symmetry too).

2.6.5. Familiarization - Availing the effects of familiarity

Tinio and Leder (2009) were able to show, that massive familiarization mediates the influence of complexity and symmetry on aesthetic judgments. In two experiments 160 basic patterns had been used as stimuli, varying in their properties to serve in four conditions: complex-symmetrical, simple-symmetrical, complex-nonsymmetrical and simple-nonsymmetrical patterns. The authors first reviewed in experiment one, in which 16 subjects had to rate the beauty of the presented patterns on a scale from one to seven, that complexity and symmetry are indeed strong determinants of aesthetic appreciation, as demonstrated in many studies before (e.g. Cardenas & Harris, 2006; Wagemans, 1993 for symmetry; see chapter 2.5. for complexity). In experiment two, 40 participants had first been familiarized to one of the four described stimuli – conditions in performing a matching task: 320 pairs of patterns of the correspondent condition were presented to participants one pair by another, in order to get a statement of them, whether each of the presented pairs were same or different. After this familiarization task, participants executed the same (beauty-) rating, as in experiment one. Analyses revealed, that the familiarization in two conditions, namely simple-symmetrical condition and complex-non-symmetrical condition, influenced the relation between complexity (and symmetry as well) and beauty-ratings significantly: Participants familiarized to simple-symmetrical patterns found complex-symmetrical patterns more beautiful, than those who had been familiarized to simple-non-symmetrical patterns. Furthermore they rated complex-non-symmetrical patterns more beautiful than participants in the other conditions. In other words, they preferred patterns that were - in terms of complexity - different to their familiarization. The same occurred for participants familiarized with complex-non-symmetrical patterns:

They rated simple-symmetrical and simple-non-symmetrical stimuli higher regarding their subjective beauty, than participants of the other conditions did. So the results of experiment two appeared to contradict both Berlyne's arousal potential concept (1970), as well as Zajonc's mere exposure paradigm (1968). According to the arousal potential theory, a contrast effect for complexity in participants familiarized with simple patterns would have been expected. In Tinio and Leder's study (2009) the opposite happened: Subjects familiarized with complex patterns judged simple patterns as more beautiful. In terms of the mere exposure paradigm, participants had been expected to prefer stimuli they had been familiarized to. Instead, subjects preferred subsequently the opposite of what they had been familiarized to. The authors interpret this as a sort of "craving for novelty", which is in line with Biedermann and Vessel's (2006) suggestion, that mere-exposure only works in the early phase of the arousal potential curve. Nevertheless, Tinio and Leder's study (2009) showed, that the seemingly stable effects of complexity can be altered by familiarization, resulting in a higher preference for the opposite type of stimulus.

2.7. The role of understanding in the appreciation of arts

As described in chapter 2.3.1., the process of aesthetic appreciation relies on several stages, as proposed in Leder and colleagues model (2004). After a stimulus has been analyzed regarding its features like complexity or symmetry (see chapter 2.5.), and underwent the stage of implicit memory effects, such as familiarity (chapter 2.6.) and explicit classification, a feedback loop between cognitive mastering and evaluation comes into play with the goal to reach a satisfying understanding of the artwork or aesthetic object in question. Thus it can be stated, that understanding plays a big role in the appreciation of arts and furthermore, that the pleasure of viewing an artwork is, besides other factors, also dependent on how good it is understood, or in other words: "on the feeling of having grasped the meaning and the understanding of it" (Leder, Carbon & Ripsas, 2006). This is in line with Martindale (1984, cf. chapter 2.3.1.), who argued that the meaning of an object would be the main factor of the resulting aesthetic appreciation of it. Nevertheless, not too much research work regarding the connection between understanding and appreciation of artworks has been done until now (Swami, 2013). As information processing helps to interpret an image and hence to improve the understanding of it (Leder, Carbon & Ripsas, 2006), research efforts to that topic usually involve the effects of context information, such as title and artist of a painting or content-specific information, on the appreciation and understanding of artworks.

Presenting representative and abstract artworks together with either elaborative titles or descriptive titles, Leder, Carbon & Ripsas (2006) found an increasing understanding of abstract paintings when presented together with elaborative titles. Interestingly this did not led to a higher appreciation of those artworks. Furthermore, Leder and his colleagues (2006) could show, that the presentation time of the context information had a significant influence on that effect: Presenting the context information only for one second led to an increased understanding, when the information was a descriptive title, but not when it was an elaborative title. On the other hand, with a medium presentation time of ten seconds, elaborative titles increased understanding, while descriptive titles did not. The author's assume, that a presentation time of about ten seconds might be needed to collate a meaning to the description.

Swami carried out a similar study in 2013, comparing the effects of three different types of information (titular information, broad genre information and content-specific information) on understanding and appreciation of representational and abstract paintings of Max Ernst and Pablo Picasso (Swami, 2013). In contrary to the before described study (Leder, Carbon & Rispas, 2006) he did not vary the presentation time. The author concludes for his findings, that understanding fully mediated the relation between information presentation and aesthetic appreciation (Swami, 2013). His results showed, that elaborate, content-specific information had the biggest impact on understanding and also the appreciation of abstract artworks by Max Ernst and Pablo Picasso, but not on the representational paintings of both artists. This is in line with Swami's suggestion that the contextual information might not provoke the same improvement of understanding for the two used types of art, as abstract paintings "typically include components that are independent of visual references in the world and that require some knowledge of the art-historical context to be fully appreciated", whereas representational artworks usually provide relatively clear objects, that can be understood without much elaboration (Swami, 2013).

Nevertheless, Gerger and colleagues tDCS study (in prep., cf. chapter 2.4.) revealed an increasing connection between understanding and appreciation also for representational artworks. Furthermore they could show an interaction with complexity: As the subjective complexity decreased, understanding and liking increased.

As reviewed, contextual information to a certain degree increases the understanding of laymen regarding representational artworks. On the other hand, understanding also seems to decrease by the rising of complexity in a stimulus. The worked out experiment of the current thesis tries to clarify the impact of perceived complexity on understanding- and liking- ratings.

2.8. Aims of this Diploma Thesis

The aim of the current work was to detect whether familiarization with a certain degree of complexity in representational artworks would influence the following complexity-, liking-, and understanding ratings and furthermore, how this three variables are influenced by each other.

Recent findings showed, that understanding - ratings of artworks increase by decreasing complexity (Gerger, in prep., cf. chapter 2.4.). Building on Tinio and Leder's work (2009, cf. chapter 2.6.5.), a familiarization task had been carried out, to

a) explore whether familiarization to the feature complexity also works for representational artworks (H1) and
b) whether the manipulation of perceived complexity has an influence on liking- (H2) and understanding- ratings (H3).

2.9. Hypotheses for the experiment

H1) Effects of familiarization on complexity-ratings
a) Participants familiarized with high complex artworks will give lower complexity - ratings than participants familiarized with low complex artworks.
b) Participants familiarized with simple artworks will give higher complexity - ratings than participants familiarized with high complex artworks.

H2) Effects of familiarization on liking-ratings according to mere exposure
a) Participants familiarized with high complex artworks will give higher liking - ratings for the more complex stimuli.
b) Participants familiarized with low complex artworks will give higher liking - ratings for the simpler stimuli.

H3) Effects of familiarization on understanding ratings
a) Participants familiarized with high complex artworks will give higher understanding - ratings than participants familiarized with low complex artworks.
b) Participants familiarized with low complex artworks will give lower understanding - ratings than participants familiarized with high complex artworks.

3. METHODS

3.1. Design of study

Pretest and experiment were carried out with different samples of participants. The pretest served to generate a fitting stimulus-set for the experiment. The experiment itself consisted of a familiarization task with a two alternative forced-choice design and a following evaluation task, including the variables complexity, liking and understanding.

Pretest and experiment had been programmed with the Software tool E-Prime® version 2.0.

Both tests were executed in the EVA Lab (Empirical Visual Aesthetics Laboratory), a test laboratory of the department of general psychology in Vienna in a quiet room. A maximum of two participants had been tested together.

3.2. Pretest

The pretest served to generate a fitting set of stimuli for the experiment: Pictures of different complexity - levels (low, intermediate and high) and different content (more rural or more urban).

3.2.1. Stimuli

First, a set of approximately 400 artworks (scans out of private books and files from http://www.prometheus-bildarchiv.de/) has been collected and saved. Regarding the needed task for the experiment, the pictures had been preselected by subjective measure regarding their complexity (low, intermediate and high complexity) and their content (rural or urban). Pictures showing scenes of more or less strong valence or good visible human faces have not been included at all, as those factors evoke a different kind of perception and appraisal (e.g. Aharon et al., 2001; O' Doherty et al., 2003; Ishai, 2007). All so far chosen pictures had been standardized in size with the longer side being 800 pixels and 300 dpi. The set had then been balanced in terms of the three complexity - levels due to its objective complexity (see chapter 3.2.4.2.) and unnecessary overlaps had been excluded. After cutting out those of deficient quality, 287 pictures showing representational artworks of different epochs remained for the pretest.

3.2.2. Participants

Twenty-two participants with an average age of 31.41 (*SD* = 9.64) took part on the pretest. Fifteen of these were females.

After being welcomed, every participant signed the informed consent (Appendix A).

As expertise influences the perception and appreciation of arts (e.g. Leder, Belke, Oeberst & Augustin, 2004; Leder, Carbon & Ripsas, 2006), a short questionnaire regarding arts expertise had been given to all participants before the pretest started (Appendix B). Criterion for exclusion was a current or completed university education in any kind of visual arts. None of the participants had to be excluded due to this criterion.

Additionally a visual acuity test and the Ishihara Shorttest for color deficiency (Ishihara, 1917) was conducted by all participants. None of the 22 participants had to be excluded due to visual impairment of any kind.

The pretest was performed in German exclusively.

3.2.3. Performance

All participants took place on a 24 Zoll (1920 x 1080) screen. Instructions (Appendix C) were given on the monitor. On a scale from one (not at all) to six (very much) participants had been asked to rate how complex they found the given pictures. For this study complexity was defined by amount of detail, elements and intricacy as suggested by Nadal and colleagues in 2010 (see chapter 2.5.4. and 2.5.5.). After a short exercise trial, participants started the pretest themselves by pressing the space button. Pictures appeared randomized (every participant got another order of artworks) and one by one: After starting the trial, the first picture appeared on the screen together with the question and the rating scale. After pressing a button between one and six, the next picture appeared and so on. The pretest took about 20 minutes in total.

3.2.4. Results of the pretest: Preparing a stimulus set for the experiment

As suggested by Nadal and colleagues (2010, cf. chapter 2.5.5.), a subjective measure due to the pretest, as well as an objective measure due to jPEG compression was used to prepare an adequate stimulus-set for the following experiment.

3.2.4.1. Subjective measure

Twenty-two participants gave ratings on a scale from one to six to the given 287 pictures. After checking normal distribution due to histograms, the mean-rating for each picture serves as subjective measure for complexity.

3.2.4.2. Objective measure

In addition all pictures had been analyzed regarding their objective complexity, as proposed by Forsythe and colleagues (2011). The difference between the original file size and the compressed file size indicates the amount of redundancy in an image and in consequence the amount of complexity.

3.2.4.3. Correlation of subjective and objective measures

Finally the correlation between subjective and objective measures had been calculated via Spearman's correlation coefficient due to given bivariate normal distribution (Field, A., 2005). This checks the validity of the subjective measure of complexity: The significant ($t(285) = 10.99$, $p < .0001$) correlation of $r = 0.546$ [95% *CI*: 0.46, 0.62] shows, that subjective judgments of complexity were related with objective complexity.

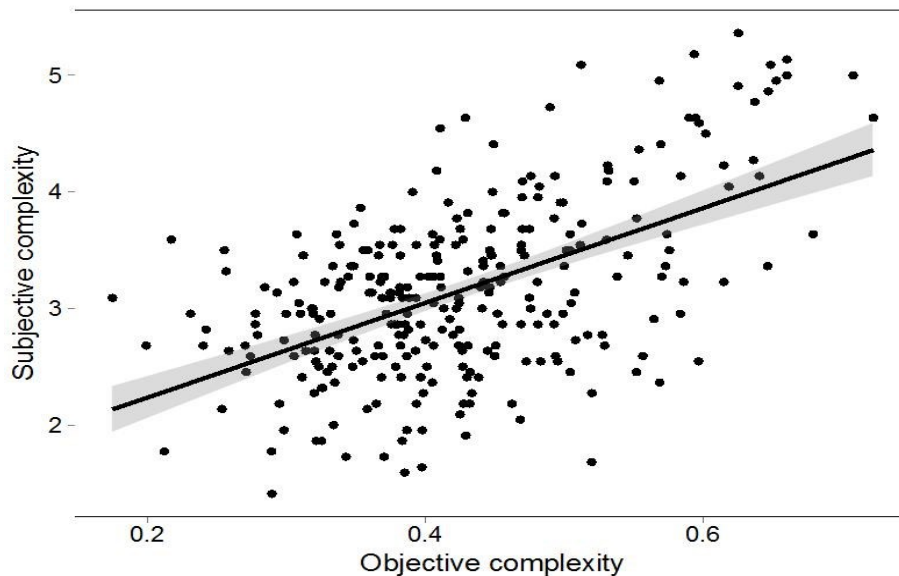*Figure 4: Correlation between subjective and objective complexity (n=287).*

A subset of pictures close to the regression line was chosen. This guarantees that the selected pictures have a high coincidence of subjective and objective complexity. As stimuli for the experiment, 96 pictures were chosen, in detail: 30 pictures of high complexity, 30 pictures of low complexity and 36 of intermediate complexity. Each of the three sets contained the same number of images depicting rural and urban scenes. Those of low and high complexity were used for the familiarization – phase and those of intermediate complexity for the test phase of the following experiment.

3.3. Experiment

The experiment consisted of two parts: The familiarization phase and the test phase. In the first part, participants had been familiarized with either very simple or very complex pictures. To do so, a two alternative-forced-choice task was used: Participants were asked to choose out of two presented pictures, which one is more rural in their opinion. This task allows letting participants deal intensively with the stimuli without revealing the intention of the study. To control the influence of the question for rurality, a part of the sample (randomized assignment) was asked to choose which one of the given two pictures is more urban. This means in total four conditions existed for the familiarization part of the experiment:

a) Familiarization with complex pictures in combination with the question which one of the two pictures is more rural
b) Familiarization with complex pictures in combination with the question which one of the two pictures is more urban
c) Familiarization with simple pictures in combination with the question which one of the two pictures is more rural
d) Familiarization with simple pictures in combination with the question which one of the two pictures is more urban

In the second phase of the experiment – the test phase - all participants, independent of familiarization condition, had to rate the same pictures of intermediate complexity in terms of complexity, subjective liking and understanding.

3.3.1. Stimuli

The 96 pictures chosen from the pretest (see chapter 3.2.4.) served as stimuli for the experiment. The two sets (low and high complexity, 30 pictures each) for the familiarization phase had been quadrupled to lengthen the timespan, participants would engage themselves with the stimulus material. The 120 pictures of each set then have been matched to pairs in consideration of their content (rural/urban) in order to keep the distraction task believable: Approximately one third of the pairs showed a rural picture with an urban picture, one third a rural next to a rural picture and one third an urban with an urban picture. The pairs were presented randomly, so every participant, independently of the assigned condition, had to rate 60 different picture pairs in the familiarization phase. In total the familiarization phase of the experiment took approximately 10 to 15 minutes.

The test phase consisted of 18 more rural and 18 more urban pictures, so in total 36 pictures of intermediate complexity that had been to rate regarding their complexity, subjective liking and how good they had been understood. This took about five additional minutes handling time.

3.3.2. Participants

Forty-five participants took part on the experiment. The average age of participants was 27.58 (*SD* = 8.46). Most of them quoted Abitur or Matura as their highest so far education (60%), followed by 22% who cited an university degree as highest education.

After signing the informed consent (Appendix A), again the visual acuity test and the Ishihara Short test for color deficiency (Ishihara, 1917) was conducted by all participants who took part in the experiment.

As in the pretest an art expertise questionnaire was edited by all participants, but this time after the experiment itself, to avoid the familiarization phase being influenced by the artworks rated in the expertise questionnaire. For the experiment a more detailed version of art expertise questionnaire was used than in the pretest – the Kunst Interessensfragenbogen (KIF), an open online questionnaire of the University of Vienna. It contains of three parts:

The first part explores individual behavior regarding arts, asking questions to be rated on a scale from one (not at all) to seven (absolutely) like "In everyday life I recognize artistic objects spontaneously that fascinate me" or "I come from a family that is interested in arts" as well as questions regarding the frequency of art-related behavior like "How often do you visit art-galleries?" to be answered with either "less than once a year", "once a year", "once in six month", "once in three month", "once in a month", "once in two weeks" or "once a week or more".

The second part tests art related knowledge like "who drew the Mona Lisa". Participants have to choose one out of four given answers.

In part three, eight printed images of more or less prominent artworks are given to the participants in order to answer the questions "Is the artwork familiar to you?", "What is the name of the artist?" and "What epoch does the artwork count to?" for each image.

None of the individuals had to be excluded due to arts expertise according to the result's analysis of the Kunst Interessensfragebogen or due to visual impairment of any kind.

Forty-four participants executed the experiment in German, one worked through the English version.

3.3.3. Performance

Again, all participants were seated on a 24 Zoll (1920x1080) screen. The instruction was given on the monitor (Appendix D). In order to engage individuals to look at the pictures for a preferable timespan, participants had been told, that it is essential for the study that they take their time and make very careful decisions. Additionally it was announced that after this first part of the experiment they would have to answer a question regarding the factors, which brought them to a decision. After the instruction and a short exercise trial, individuals started the test themselves by pressing space. Two paintings appeared side by side and participants were asked to press X in case they found the left one more rural/urban and M if they found the right one more rural/urban. After completion of the 60 trials, participants were asked to approach to the instructor for the announced question. In order to keep the hoped familiarization effect alive, this part was kept very quick, in asking which two aspects had the most influence on their decisions whether a picture was more rural/urban than the other. Usual answers for condition rural would be "the color green, few people" respectively for the urban condition "more people, more houses" or similar. Afterword participants were asked to turn back to the computer screen, where the instructions for the second part - the test phase - waited. Participants have been requested, to, in contrary to the first part, where they had been asked to take a long and careful look on the artworks and think very precisely about their answers, in the second part to rate quickly and intuitively three different dimensions (complexity, liking and understanding) on a scale from one (not at all) to six (very much). The three dimensions had been defined and explained carefully on the screen (Appendix E) and an additional card with the definitions of the dimensions (Appendix F) was placed next to the screen, in order an individual would want to reassure himself while the rating phase. Like in pretest and first phase of experiment, after the instructions and a short exercise trial, participants started the second part of the experiment by pressing space. The first picture appeared, together with the question, how complex the participant finds this picture and the rating scale from one to six. After pressing a number between one and six, the same picture appeared with the second question, which was "how much do you like the picture?" again presented with the scale from one to six. The third and last question, that appeared after the participant rated the dimension before was how good the painting was understood by the rater. After the three ratings for one picture the next picture was shown again together with the three questions, one by one and in the same order (always complexity first, followed by liking, followed by understanding). The artworks to be rated were presented randomly and in a different order for each participant.

4. RESULTS OF THE EXPERIMENT

The main aim of the study was to detect whether the familiarization with a certain degree of complexity would influence the complexity-, liking- and understanding-ratings.

To uncover results that could have got lost due to the analysis with means as usually carried out via ®IBM SPSS, a linear effects model was prepared using R, a free source available under https://www.r-project.org/.

4.1. Descriptive statistics

The Means of each rating scale, as well as the particular standard deviation are presented in the upcoming chapter 4.2.

The analysis revealed no outliers in the used variables and showed normal distribution due to histograms.

4.2. Interference statistics

After checking for normal distribution for the three scales (complexity-, liking- and understanding-ratings), a linear mixed effects model was carried out using R, as it allows to analyze data by multilevel modeling. As Silvia (2007) states:

"Multilevel modeling is a straightforward extension of conventional regression analyses. Because it is more general, multilevel modeling enables researchers to test hypotheses that cannot be tested with conventional regression or ANOVA models." (Silvia, 2007)

4.2.1. Group differences due to familiarization (condition)

a) Effects of familiarization on complexity ratings:

Participants familiarized with complex stimuli rated the intermediate ones in the test phase as more simple (M = 3.50, SD = .74), than participants familiarized with simple stimuli (M = 3.83, SD = .62). This group difference is significant ($t(43)$ = 2.56, p = 0.01).

Also, participants familiarized with complex stimuli were more sensitive to the complexity of the test stimuli than participants in the simple familiarization group (see figure 5).

Sensitive means, their ratings were significantly ($t(43) = 2.14$, $p = 0.04$) more in line with the objective measure for complexity, than ratings of participants familiarized with simple stimuli.
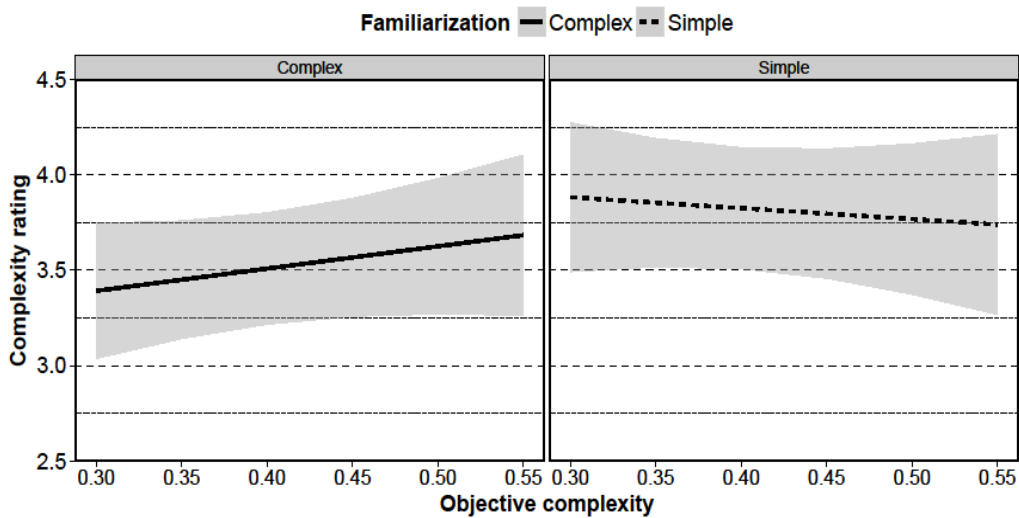

Figure 5: Effects of familiarization on complexity ratings.

b) Effects of familiarization on liking ratings:

Participants familiarized with complex stimuli liked the intermediate ones in the test phase more ($M = 3.53$, $SD = .54$), than participants familiarized with simple stimuli ($M = 3.49$, $SD = .65$). This group difference is also significant ($t(43) = 2.03$, $p = 0.04$).

Participants familiarized with simple stimuli disliked the more complex pictures in the test phase and preferred the simple ones. This is consistent with their familiarization and suggests a preference for simplicity, or apparent simplicity that comes from the complexity contrast effect above.
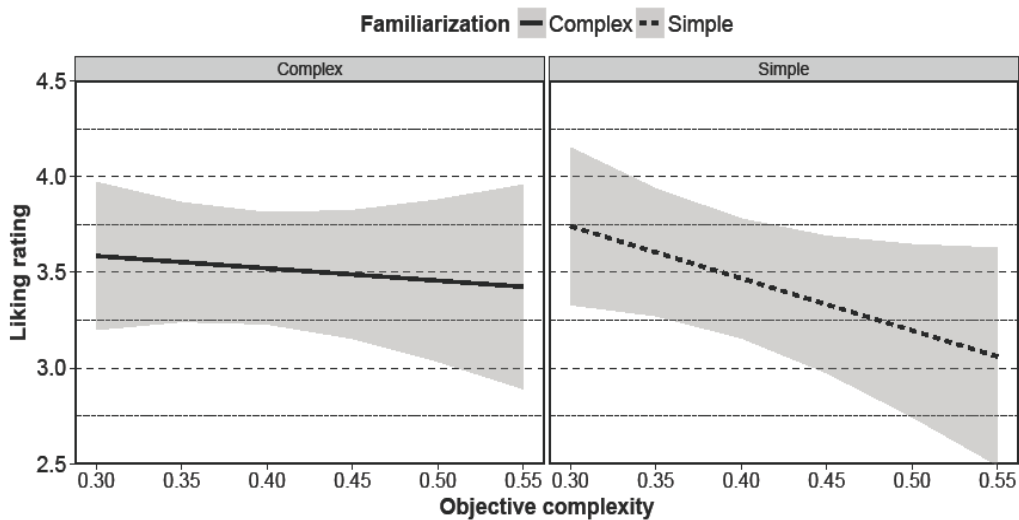

Figure 6: Effects of familiarization on liking ratings.

c) Effects of familiarization on understanding ratings:

The ratings regarding understanding turned out as followed: Participants familiarized with complex: $M = 4.10$ ($SD = .75$). Participants familiarized with simple: $M = 3.90$ ($SD = .92$). The analysis revealed no significant effects for understanding ratings ($p > 0.05$).
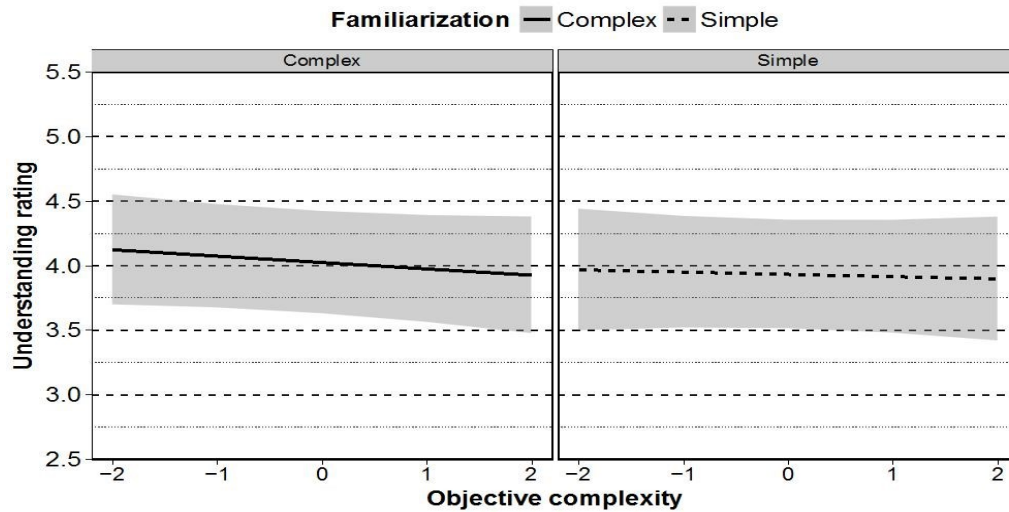

Figure 7: Effects of familiarization on understanding ratings.

5. DISCUSSION

The aims of the current Diploma Thesis were to detect whether familiarization with a certain degree of complexity as proposed by Tinio and Leder (2009; cf. chapter 2.6.5.) would lead to a changed perception of participants dealing with representational artworks (H1) and furthermore, to examine the impact of this perceived complexity on liking- and understanding- ratings (H2 and H3). In providing a two alternative- forced choice- task, participants had been familiarized with either simple (condition 1) or complex representational artworks (condition 2). Afterwards, they were asked to perform a rating regarding complexity, understanding and liking for representational artworks of intermediate complexity.

For hypothesis 1 (H1), it was expected that participants familiarized with high complex artworks would give lower complexity – ratings in the following test phase, than participants familiarized with low complex artworks and vice versa, as an indicator of the familiarization actually changing the perceived complexity of the participants in the given stimuli. According to the revealed analysis, hypothesis 1 can be assumed. Participants familiarized with complex stimuli perceived the intermediate pictures in the test phase as simpler. This suggests that when exposed to previous levels of complexity, participants change their complexity level of the test stimuli.

Hypothesis 2 (H2), asserted that - according to the mere exposure paradigm presented in chapters 2.6.1. and 2.6.2. - participants familiarized with high complex artworks would give higher liking - ratings for the more complex stimuli and on the contrary that participants familiarized with low complex artworks would give higher liking - ratings for the simpler stimuli. The analysis revealed that the familiarization indeed had significant effects on the appreciation of representational artworks: Subjects familiarized with simple stimuli preferred the simpler ones of the intermediate pictures in the test phase over the complex ones, which suggests a preference for simplicity or apparent simplicity due to their familiarization. Hence H2 seems to fit to be assumed, but an interesting limitation has to be accounted for: Participants familiarized with complex stimuli liked the stimulus set of intermediate complexity of the test phase (which proven occurred simpler to them due to their familiarization according to H1) more than the other group. In other words: Everybody, independent of familiarization-condition preferred simple. Therefore H2 has to be refused and discussed in terms of previous studies:

Tinio and Leder (2009, cf. chapter 2.6.5) could show, that familiarization seems to be able to alter the seemingly stable effects of complexity and symmetry. Their study revealed besides others, that massive familiarization led participants to prefer the opposite of what they had been familiarized to in the rating task afterwards.

The authors interpret this as a "craving for the novel", that seems to be stronger than the impact of complexity and symmetry. On the contrary the current work suggests an overall preference for simplicity.

Referring to this, it has to be considered that the massive familiarization carried out by Tinio and Leder (2009) might have washed out a general occurring preference for simplicity. Also that is to say, Tinio and Leder used for both familiarization- and test-phase extreme forms of complexity: simple or complex, while the experiment of the current Diploma Thesis made use of a set of intermediate complexity in the test-phase. So the craving for the novel, assumed by Tinio and Leder might only occur when participants don't have another choice but to decide between one extreme and the other, which strengthens the idea of a general preference for simplicity.

As in many other studies revealing divergences in results (cf. chapter 2.5.4.), a possible explanation for this inconsistent findings might also lie in the use of different stimuli. While Tinio and Leder (2009) used abstract geometric patterns, in other words: stimuli that were reduced on the two features symmetry and complexity, the experiment of the current work consisted of representational artworks. So maybe representational artworks consist of another confounding variable that the abstract, reduced stimuli don't have.

This thought is in line with the suggestion of Nadal and colleagues (2010, cf. chapter 2.5.4.) that the relationship between complexity and preference is modulated by the type of stimuli.

Another explanation that would be outstanding to explore in future studies is that the effects of familiarization might depend on the type or respectively amount of complexity, or in other words that familiarization with simple stimuli might work differently than familiarization with complex stimuli, independent of what type of stimulus (artworks, polygons, etc.) is being dealt with. So while Tinio and Leder (2009) talk about the "jaws of familiarization" altering the effects of complexity, the current work suggests contrary that complexity, or at least a certain type of it, has the thicker skin after all.

Also possible gender effects should be taken into account: It is known that abstract and representational artworks are being awarded different by men and women (Furnham & Walker, 2001) and that several studies found discrepancies in males and females brain activity regarding cognitive (Bell et al., 2006; Boghi et al., 2006) and affective (Azim et al., 2005; Piefke et al., 2005) processes regarding aesthetic experiences. This is especially interesting in comparison to Tinio and Leder's study (2009), who's experiment was executed by females exclusively and might depict another approach for further research efforts.

On the other hand, referring to Berlyne's (1971) concepts (cf. chapters 2.5.1. and 2.6.4.) the results of the current work support Berlyne's (1971) idea of complexity being a collative variable. So speaking in terms of Berlyne's collative variables, the results of the current experiment suggest that complexity indeed influences the appreciation of an artwork, but only in relation to other features of that artwork. This thought has to be taken into account in dealing with the numerous studies that tried to replicate Berlyne's arousal potential theory, but revealed highly different outcomes (cf. chapters 2.5.2., 2.5.3. and 2.5.4.)

Tying on the theoretical background of this work, namely the results of Cattaneo (2014) and Gerger's (in prep.) studies (cf. chapter 2.4.) the carried out familiarization was expected to also have an impact on understanding-ratings (H3). Hypothesis 3 has to be refused, as the analysis revealed no significant effects for understanding. Further studies could get an insight in this unexpected result in focusing on the relationship between complexity and understanding, and the impact of understanding on liking itself. The use of neuroimaging techniques might give an advance in that challenge.

Summarizing it can be stated that, although the analysis revealed no meaningful differences between participants of the two familiarization conditions regarding understanding (H3), it could be shown, that the aim to manipulate perceived complexity in using representational artworks was successful. When exposed to previous levels of complexity, participants change their complexity level. Furthermore the current study revealed, that this manipulated perception changed the appreciation of the artworks presented in the second phase of the experiment in a matter of an overall preference for simplicity. This outcome gives an important reference to Berlyne's suggestion of complexity being a collative variable and solves some of the questions regarding the divergence of results in studies that tied on Berlyne's arousal potential concept. Furthermore, the results of this Diploma Thesis uncover new angles for scientific efforts that might be constructive in the examination of the mystery of aesthetic appreciation.

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6.   APPENDICES

APPENDIX A - Informed consent

Fakultät für Psychologie
Institut für Psychologische Grundlagenforschung
und Forschungsmethoden
Liebiggasse 5
1010 Wien, Österreich

Studienteilnahmeinformation und Einverständniserklärung

Vielen Dank für Ihre Bereitschaft zur freiwilligen Teilnahme an der psychologischen Studie

AllgPsych_SS15_Kunst_ländlich/urban

StudienleiterInnen: Laura Siegel

Kontakt: a0747440@unet.univie.ac.at

Geschätzte Dauer der Teilnahme: 45Minuten

Ziel und Nutzen der Studie:

Erhalt einer Bewertung von Kunstwerken verschiedener Epochen bezüglich deren Inhalt (eher ländlich oder eher urban) und anderer Aspekte. Mit Ihrer Teilnahme tragen Sie wesentlich zur wissenschaftlichen Erforschung psychologischer Prozesse und Phänomene bei.

Risiken:
Das Risiko von körperlichen oder psychischen Unannehmlichkeiten ist äußerst gering.

Ihre Rechte:
Sie können die Studienteilnahme jederzeit, auch ohne Angabe von Gründen, von sich aus abbrechen. Für Sie entstehen dabei keinerlei negative Konsequenzen. Im Anschluss an die Studie erhalten Sie eine ausführliche Erklärung der Ziele der Studie. Falls Interesse besteht, können Sie gerne auch über die Ergebnisse der Studie informiert werden.

Anonymität und Datenschutz:
Sämtliche Ihre Person betreffenden Daten, insbesondere diese Einverständniserklärung, werden getrennt von den in der Studie erhobenen Daten aufbewahrt. Somit bleibt Ihre Anonymität gewahrt. Es ist geplant, die erhobenen Daten in einer wissenschaftlichen Zeitschrift zu veröffentlichen. Auch nach Ihrer Studienteilnahme können Sie bis zur Veröffentlichung die Verwendung Ihrer Daten untersagen.

Einverständniserklärung:
Durch Ihre Unterschrift bestätigen Sie, dass Sie die Studienteilnahmeinformation gelesen und verstanden haben. Sie bestätigen, dass Sie die gestellten Aufgaben konzentriert bearbeiten und Fragen wahrheitsgemäß und nach bestem Wissen und Gewissen beantworten. Sie erklären sich mit der Teilnahme an dieser Studie sowie der anschließenden Analyse Ihrer Daten durch befugte Personen einverstanden.

Name: _____

Geboren am: _____   in: _____

Datum: _____   Unterschrift: _____

APPENDIX B - Arts expertise questionnaire pretest

Wie viele Jahre hatten Sie Kunstunterricht in der Schule (seit Abschluss der Volksschule/Grundschule)?

0   1   2   3   4   5   6   7   mehr

Wie oft besuchen Sie durchschnittlich ein Museum?

Nie   1mal pro Jahr   alle 6 Monate   alle 2 Monate   jeden Monat   jede Woche

Wie oft besuchen Sie durchschnittlich eine Galerie?

Nie   1mal pro Jahr   alle 6 Monate   alle 2 Monate   jeden Monat   jede Woche

Wie viele Stunden pro Woche malen Sie selbst bzw. produzieren Sie Kunst?

0   1   2   3   4   5   6   7   mehr

Wie viele Stunden pro Woche lesen sie Artikel, die mit dem Thema Bildender Künste zusammenhängen?

0   1   2   3   4   5   6   7   mehr

Wie viele Stunden pro Woche betrachten Sie Kunst?

0   1   2   3   4   5   6   7   mehr

Geben sie hier bitte Ihr Geschlecht und Alter an:

Welches ist Ihre höchste abgeschlossene Ausbildung?

Haben sie eine Sehbeeinträchtigung?

Danke!

APPENDIX C - Instructions pretest

Herzlichen Dank für die Teilnahme an dieser Studie.

Im Folgenden werden Ihnen verschiedene Kunstwerke präsentiert, die Sie bewerten sollen.

Geben Sie bitte jeweils auf einer Skala von

1 (gar nicht) bis 6 (sehr)an,

wie komplex Sie das jeweilige Bild finden.

Achten Sie bei der Bewertung der Komplexität bitte auf die Anzahl der Elemente und der Details und darauf, ob das Bild verworren oder verschlungen wirkt, oder nicht.

Es gibt keine richtigen oder falschen Antworten, es geht uns um Ihre subjektive Meinung.

Zunächst folgt ein kurzer Übungsdurchlauf.

Zum Starten bitte die Leertaste drücken.

Nun folgt die eigentliche Testung. Sie wird in etwa 15 Minuten benötigen.

Sollten Sie noch Fragen haben, wenden Sie sich bitte jetzt an den/die VersuchsleiterIn.

Zum Starten bitte die Leertaste drücken.

APPENDIX D - Instructions experiment - Familiarization phase

ERSTER TEIL

Im ersten Teil der Studie werden Ihnen Kunstwerke verschiedener Epochen präsentiert.

Bewerten Sie bitte, welches der beiden dargebotenen Bilder Sie

als ländlicher empfinden.

Manchmal scheint die Antwort offensichtlich.

Nehmen Sie sich bitte trotzdem für jedes Bild Zeit und sehen es sich genau an.

Beachten Sie nicht nur den Inhalt des Bildes,

sondern auch die Stimmung, die es Ihrer Empfindung nach ausdrückt

und weitere Aspekte, die Ihnen wichtig erscheinen.

Versuchen Sie bitte während der Bearbeitung zu reflektieren,

welche weiteren Aspekte Sie für Ihre Entscheidung heranziehen,

also WARUM Sie ein Bild ländlicher finden, als das andere.

Nach dem ersten Teil wird Ihnen dazu eine Frage gestellt.

Das gleiche Bild kann zwei Mal oder auch öfter vorkommen - das ist so gewollt.

Es geht darum festzustellen, wie Sie ein Bild IM VERGLEICH zu einem anderen wahrnehmen.

Das bedeutet, dass es durchaus sein kann,

dass Sie ein bestimmtes Bild im Vergleich zu einem Bild A ländlicher finden,

im Vergleich zu einem anderen Bild B aber nicht.

Jedes Bilderpaar wird zunächst für 6 Sekunden angezeigt,

bevor Sie ihre Bewertung abgeben können. Lassen Sie sich bei Ihrer Entscheidung Zeit und überlegen Sie genau.

Empfinden Sie das linke Bild als eher ländlich, drücken Sie bitte die Taste X.

Empfinden Sie das rechte Bild als eher ländlich, drücken Sie bitte die Taste M.

Zunächst folgt ein kurzer Übungsdurchlauf.

Sollten Sie noch Fragen haben, wenden Sie sich bitte jetzt an den/die VersuchsleiterIn.

Die Bearbeitungszeit des ersten Teils beträgt in etwa 10 bis 15 Minuten.

APPENDIX E - Instructions experiment - Test phase

ZWEITER TEIL

Auch im zweiten Teil werden Ihnen Kunstwerke verschiedener Epochen präsentiert.

Geben Sie dieses Mal bitte RASCH und INTUITIV jeweils auf einer Skala von

1 (gar nicht) bis 6 (sehr) an,

a) Wie komplex Sie das jeweilige Bild finden.

Achten Sie bei der Bewertung der Komplexität bitte auf

die Anzahl der Elemente und der Details und darauf, ob das Bild verworren wirkt, oder nicht.

b) Wie Ihnen das jeweilige Bild gefällt.

Hierbei geht es einzig um ihr subjektives Gefühl.

c) Wie gut Sie das jeweilige Bild verstehen.

Hiermit ist gemeint, inwiefern Sie einen Eindruck davon haben, was der Künstler zeigen oder aussagen will.

Es gibt keine richtigen oder falschen Antworten, es geht uns um Ihre subjektive Meinung.

Zunächst folgt ein kurzer Übungsdurchlauf.

Zum Starten bitte die Leertaste drücken.

Sollten Sie noch Fragen haben, wenden Sie sich bitte jetzt an den/die VersuchsleiterIn.

Die Bearbeitungszeit des zweiten Teils beträgt in etwa 5 bis 10 Minuten.

Um den zweiten Teil der Studie zu starten, drücken Sie bitte die Leertaste.

APPENDIX F - Additional instructions experiment

Komplexität

1	**2**	**3**	**4**	**5**	**6**

• Gar nicht komplex • Wenige Elemente • Wenige Details • Gar nicht verworren • Sehr simpel zu erkennen	• Sehr komplex • Viele Elemente • Viele Details • Sehr verworren • Sehr kompliziert zu erkennen

Verständnis

1	**2**	**3**	**4**	**5**	**6**

• Das Bild ist schwer zu verstehen • Ich habe keine Idee, was der Künstler damit ausdrücken will • Das Bild sagt mir gar nichts	• Das Bild ist leicht zu verstehen • Ich begreife, was der Künstler damit ausdrücken will • Das Bild sagt mir etwas

APPENDIX G - Abstract (English)

The current work explores whether a familiarization to the feature complexity is possible for representational artworks as well as the impact of the so manipulated perception of representational artworks on understanding- and liking - ratings. For the experiment, a stimulus set balanced in terms of three complexity levels (high, intermediate and low complexity) was carried out by subjective and objective measures. The experiment itself consisted of a familiarization-, and an evaluation-task and was conducted by 45 participants. The analysis of the collected data showed that the aim to manipulate perceived complexity was successful. The mediating effect of familiarization revealed an overall preference for simplicity in the sample. However the subjective understanding of the given artworks was unaffected by the manipulation according to participant's ratings.

APPENDIX H - Abstract (deutsch)

Die vorliegende Arbeit untersucht, ob eine Familiarisierung mit dem Merkmal Komplexität für representative Kunstwerke möglich ist und den Einfluss der so manipulierten Wahrnehmung von representativen Kunstwerken auf die Bewertung ihrer Verständlichkeit und subjektivem Gefallen. Für das Experiment wurde mittels subjektiver und objektiver Maße ein Stimulus-Set zusammengestellt, das Bilder von drei Komplexitäts-Stufen (hohe, mittlere und niedrige Komplexität) zu gleichen Teilen enthielt. Das Experiment selbst bestand aus einer Familarisierungs- und einer Evaluations-Aufgabe. Fünfundvierzig Personen nahmen teil. Die Analyse der gesammelten Daten zeigte, dass die Absicht, die Wahrnehmung der präsentierten Bilder zu manipulieren, erfolgreich war. Der mediierende Effekt der Familiarisierung führte zu einer allgemeinen Präferenz für Einfachheit in der befragten Stichprobe. Das subjektive Verständnis für die präsentierten Kunstwerke blieb hingegen unberührt von der Manipulation.

APPENDIX I - List of figures

Curriculum Vitae

Laura Siegel

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Geboren am 20.05.1986 in Nürnberg, Deutschland

Ausbildung

Seit WS 07/08, Universität Wien	Diplomstudium der Psychologie
Seit 03/2013, Gesundheitsakademie Wien	Diplom-Ausbildung Tierpsychologie mit Schwerpunkt Hund
06/2006, Stiftung Louisenlund, Deutschland	Abitur, Leistungskurs Biologie und Deutsch

Private Weiterbildungen

10/2012   19. Internationaler Hypnose Kongress, Bremen, Deutschland

01/2011   Seminar "Trauma", Referentin Mag. Eva Münker-Kramer, Österreichische Akademie für Psychologie, Wien

12/2009   6th Evolution of Psychotherapy Conference, Anaheim, USA

08-09/2009   Summer School "Health Psychology", University of California, San Diego, USA

Am Milton Erickson Institut, Rottweil, Deutschland absolvierte Seminare

05/2009   Brian Alman Ph.D: "Self-Hypnosis"

05/2009   Liz Lorenz-Wallacher: "Geburtsvorbereitung"

02/2008   Dr. Burkhard Peter: "Hypnotherapie bei akutem Schmerz"

06/2007   Joyce Mills, Ph.D: "Story Play"

06/2007   Daniel Beaulieu, Ph.D: "Impact Techniques for Depression"

06/2007   Hans Riebensahm: "Suggestive Strategien"

06/2007   Dr. Charlotte Wirl: "Metaphern, Märchen und Mythen in der Therapie"

05/2007	Lic.phil. Susy Signer-Fischer: "Selbstvertrauen und Identitätsfindung"
05/2007	Daniel P. Kohen, M.D: "Child Hypnosis"
05/2007	Prof. Dr. Karl-Ludwig Holtz: "Entwicklungsgemäßes Arbeiten mit Kindern"
05/2007	Dr.med. Gunther Schmidt: "Systemische Konzepte"
04/2007	Bernhard Trenkle: "Hypnose und Selbsthypnose bei Ängsten"
03/2007	Jeffrey Zeig, Manfred Prior & Bernhard Trenkle: "Therapien & Interventionen"
03/2007	Dr.med. Gunther Schmidt: "Nutzung von Trancephänomenen"
03/2007	Birgit Steiner-Backhausen: "Individuelle Weltbilder des Kindes"

BERUFSERFAHRUNG

Seit 10/2013   Praktikum

Hundeschule „Hundefragen", Wien, Betreuer: Leo Dekrout

- o Mitarbeit bei Kursen auf dem Gelände der Hundeschule und außerhalb
- o Einzelbetreuung von Hund-Mensch-Teams

Seit 01/2013   Laufende Projektmitarbeit

differential Agentur für Marketing- und Salesservices, Wien

- o Lektorat, Eventmanagement etc.

Seit 01/2010   Laufendes Lektorat von Fachliteratur, Themenbereich Hypnosetherapie

Kinderärztin Dr. med. Charlotte Wirl, Wien

04-06/2014   Praktikum

Universität Wien, Fakultät für Allgemeine Psychologie,

Betreuer: Mag. Michael Forster

- o Vorbereitung und Durchführung wissenschaftlicher Experimente
- o Datenbereinigung und Datenanalyse
- o Literaturverwaltung

| 01-03/2007 | Praktikum |
| | |

Kurpfalz Internat Heidelberg, Deutschland, Betreuerin: Anke Schütrumpf

- o Betreuung von 12 bis 23-jährigen SchülerInnen im schulischen sowie Internatsinternen Bereich (u.a. Einzelnachhilfe, Hausaufgabenbetreuung, Organisation und Ausführung außerschulischer Aktivitäten, Abend-und Nachtdienst)

| 03-09/2007 | Praktikum |
| | |

Milton Erickson Institut Rottweil, Deutschland, Betreuer: Bernhard Trenkle

- o Seminar-Vorbereitung und -Betreuung, Telefondienst (Seminar- bzw. KongressteilnehmerInnen, KlientInnenenanfragen, Allgemeines), Teilnahme an Therapiesitzungen, Administration

Referentenbetreuung bei Kongressen

10/2010	Mentales Stärken, Heidelberg, Deutschland
10/2009	6.Kindertagung, Heidelberg, Deutschland
05/2009	20 Jahre MEGA, Wien, Österreich
05/2008	5th German-Nepali Medical Conference, Kathmandu/Pokhara, Nepal

SPRACHKENNTNISSE

| Deutsch | Muttersprache |
| Englisch | Letztes IELTS Ergebnis: 7.5 Punkte |

| 08-09/2006 | Advanced English, European School of English, Malta |
| 11/2006 | Advanced English, Wimbledon School of English, London |

Laura Siegel   Wien, im Oktober 2015

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