INVESTIGATIONS INTO ART APPRECIATION

An Interdisciplinary Approach

Noah van Dongen

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Noah N'Djaye Nikolai van Dongen
Rotterdam

Erasmus University Rotterdam

Doctoral Committee:

Promotors:	Prof.dr. C.J.M. van Eijck Prof.dr. J.W. van Strien
Other members:	Prof.dr. P.P.M. Hekkert Prof.dr. J. Janz Prof.dr. F.F.R. Vermeylen
Copromotor:	Dr. K. Dijkstra

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PREFACE

Art appreciation and its mechanics will be understood and explained by science. Although this is not a fact, it is my deeply held belief and it is ever more supported by research. This view is contrary to the ancient intellectual giants of philosophy and their graying defenders. These aged monoliths object to the science of art with beautiful rhetoric, countless references to prominent philosophizers, and arguments with internal logical consistency; though not with any empirical support or arguments younger than a century. The lack of curiosity in these naysayers surprises me; they appear to have all the answers and give the impression that the final and definitive word has been said over two millennia ago. I wonder, how can one say with absolute certainty that something is subjective and therefore *indefinable objectively*? Or how someone can know that something is *unknowable*? Against the stream of objections and profanities of armchair theorizers, cultural sociology, experimental psychology, and neuroscience have produced a robust body of research that has advanced our understanding of art and aesthetics; with a promise of more to come and no insurmountable obstacles in sight, apart from funding problems of course.

It is my curiosity to understand the ‘subjective’ nature of art and aesthetics and inclination to defy antagonists, that got me going on this academic path. Ever since I started at the art academy, I wondered how a consensus about aesthetics and art institutes (e.g. museums, galleries, art academies, etc.) were possible if – as everybody kept telling me – art appreciation and quality could not be objectively defined or measured. I could not accept such a definitive statement. I wondered if we shared a make-up of perception and interpretation, which could vary in more or lesser extend and could be influenced by culture and personal experience. I expected that maybe, like the wine connoisseurs, art experts use the same faculties as a layperson, though experience might enable one to savor the details and nuances of an artwork. Thus I became interested in philosophy and science of art and followed my curiosity to Arts and Culture Studies at the Erasmus University Rotterdam.

Differentiation between people via cultural and societal factors was the primary focus of the program. Therefore, in my spare time I supplemented my studies with research and theory from (evolutionary) psychology and neuroscience. It was and is still my opinion that together these three fields cover art and aesthetics sufficiently to further our insight in the mechanics of art and art appreciation. Both my bachelor and master thesis were dedicated to the science of art and over several years I conducted several experiments in collaboration with the department of Art and Culture Studies and the Department of Psychology, Development, and Pedagogy of the Erasmus University Rotterdam.

This dissertation is the product of my academic work of the last four years. The introduction gives a general overview of relevant theory and research results and the general setup of my research. The main body consists of descriptions of four individual studies. Guided by theory and previous research of both cultural sociology and neuroscience, I conducted two behavioral experiments, an electroencephalogram (EEG) experiment, and an eye-tracking study. Both classical and Bayesians statistics were used in the latter, to ascertain the plausibility of the null hypothesis. In the discussion, results of all studies are compared, possible implications are given, and further research is proposed. The dissertation ends with the acknowledgement of all those who supported and assisted me during this ordeal.

My journey to PhD is now completed and I can look back on four years I will never get back or spend otherwise. I did not love every second of it, there was doubt and many obstacles and pitfalls. However, I enjoyed doing research, the practical side of it and its organization and management, even more so now than I did before. I had great fun with my collaborators and supervisors in solving the methodological puzzles that the research gave me. I expect that the research presented in this dissertation will only contribute to a small extend to the science of art. Though I have only just started on my academic path and others might find my research and results useful in ways I did not foresee. Be this as it may, I look back with pride and fondness and hope you will enjoy reading the fruits of my labor.

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INTRODUCTION

Art and aesthetics have enjoyed a long history as academic topics of enquiry and debate. This history ranges from pre-Socratic times until the present and investigation is ongoing in several academic fields, such as cultural sociology, cognitive psychology, and neuroscience. All fields aim to explain, understand, and/or describe how aesthetics, art, and its appreciation work and come into being. Each academic field (mostly) works in isolation from the others. Psychology and neuroscience focus on the mechanical process from perception of physical characteristics of the artwork to emotional and cognitive responses (e.g., Chatterjee, 2011; Ramachandran & Hirstein, 1999; Zeki, 2001, 2013). In general, these fields rely almost exclusively on experimental methods, disregarding social and cultural differences and the context in which artworks are presented (e.g., museum, gallery, restaurant, etc.). Cultural sociology, on the other hand, investigates the social and cultural processes involved in the waxing and waning of appreciation of particular art (e.g., art types, styles, artists, etc.), their non-physical characteristics (e.g., authenticity, monetary value, etc.), and social groups' structure and development of aesthetic tastes (e.g., Bourdieu, 1985; Bourdieu & Nice, 1980; Tampubolon, 2008). In this case, the physical characteristics of the individual artworks are mostly ignored, instead focusing on the overall categorization of style (e.g., classical paintings, abstract expressionism, etc.), the context in which they are presented, artists' reputations, and the social dynamics of appreciation and consumption. To this end, mostly observational and survey methods are employed.*

However, in isolation, none of these research areas can fully explain art appreciation. Aesthetics and the appreciation of art appear to involve components from each of these fields; from the specifics of our anatomy to the level of country-spanning culture. For instance, our perception is constrained by the anatomy and physiology of our eyes, how stimulation of the retina is translated into agitation of the optical nerve, and how this is processed by our visual cortex. This puts constraints on what is produced and appreciated. Butterflies are capable of perceiving colors in the ultraviolet range (e.g., Arikawa, 2017) and several frogs, snakes, insects, and fish can see infrared (e.g., Enright et al., 2015; Newman & Hartline, 1982). But, to put it crudely, no artist works with infrared or ultraviolet colors, because we are unable to see them with the naked eye. In addition, our emotions and emotional range shape our experiences. Patients with neural lesions that have disconnected the visual cortex from the limbic system (i.e., brain area responsible for emotional response) report being incapable of appreciating visual art due to a lack of emotional response (Ramachandran, 2012). At the other end of the spectrum, there is clear differentiation in artistic expression between cultures (e.g., African masks and totems, Buddhist mandalas, conceptual

*It needs to be noted that art is also investigated from historical, anthropological, and ethnographic perspectives. In these fields, the focus is on position, purpose, and meaning of art in particular settings (e.g., historical periods, pre-modernized tribes, sub-cultures, etc.) instead of an overarching perspective on aesthetics and art appreciation. These fields are therefore beyond the scope of this dissertation.

art in Western Europe and North America, etc.) and changes within cultures over time (e.g., from Roman statues and frescos through Christian iconic paintings to expressionist and abstract paintings). In between basic anatomy and broad cultural movements, one finds how cognitive evaluation and personal experience shape the momentary appreciation of an artwork (e.g., Tinio & Leder, 2009a) and change art appreciation over time (e.g., Thomas & Lin, 2002). As a rough summary, art and art appreciation appear to require our shared instruments for perceiving and feeling, the processes with which we learn and change, and the social and cultural movements that give rise to art forms and styles. Thus, none of the research fields of neurobiology, psychology, and cultural sociology can provide a complete picture and could benefit from input by the others.

Therefore, it seems that interaction and collaboration between these fields is required to move towards a more complete understanding of art and aesthetics. It requires combined effort to explain how the interplay of neurobiological, psychological, social, and cultural factors produce both similarities and differences in art appreciation between individuals, groups, and cultures. Such a shared goal can be captured in the following questions about art appreciation and aesthetics:

Which physical and non-physical characteristics of artworks are of relevance to their appreciation, why, and to what extent?

How, why, and to what extent are neural mechanisms of perception, memory, and emotion relevant?

How, why, and to what extent are cognition and experience involved?

How, why, and to what extent are social and demographic aspects of influence?

How, why, and to what extent does the socio-cultural context, from birth to the current moment, affect the appreciation of an artwork?

Although I sincerely wish to know the answers, these questions require more time and effort than the scope of this dissertation can offer. The research described in this dissertation is therefore restricted to the investigation of *a limited number of neurologically shared* (e.g., the level of contrast in a painting) *and socio-culturally differentiated* (e.g., level of education of the perceiver) *causes of art appreciation that resulted from clear predictions from theory or were derived from previous research*.

In this chapter, I provide a synopsis of the history and state-of-the-art of research and theorizing in this domain, the aims and outline of my research, and its general methodology. The theoretical foundation is outlined from a philosophical perspective, a cultural perspective focused on differences (i.e. cultural sociology), and biological/psychological perspective focused on similarities (i.e. psychological and neuroscientific). The combination of these perspectives provides the rationale for the aims and methods of my research. This chapter is neither an exhaustive theoretical review nor a critical discussion of the classical and current literature. This chapter is a broad and concise overview of theory and research in the relevant academic fields that allows room for more in-depth discussion of the literature relevant in next chapters. In other words, this chapter is intended as a narrative, supported by research and documented sources, that serves the purpose of providing insight in my thought process and making the multidisciplinary introductions of chapters 2 through 5 more accessible.

1.1. Philosophy of Aesthetics

Before Kant (2016[1790]), beauty was not considered a property of the object; the painting itself was not aesthetic. True to the original Greek definition, aesthetics concerned perception and beauty was thought to reside in the mind that perceives the object (Baumgarten, 1986[1750]; Hume, 1987[1757]; Tatarkiewicz, 2012). According to this subjective view, each person experiences a different beauty when perceiving the same object. This leads to relativism and makes consensus arbitrary and coincidental. Common sense, on the other hand, tells us that one artwork (e.g., a Rembrandt or Van Gogh) can be qualitatively superior to another (e.g., a doodle of an infant or elephant) and that widespread systematic consensus can be witnessed in museums and at art auctions. At face value, some degree of objectivity in aesthetics is apparent.

Kant (2016[1790]) attempted to overcome complete subjectivity by focusing on aesthetic judgment instead of experience. Kant demarcates two types of judgment. 1) An observer can be *interested* in the scrutinized object. The object is then liked or appreciated due to its purpose outside its mere existence. A small statue might function as a paperweight that goes well with the style of desk and the design of the bookcase behind it or a print by Dali or Picasso might remind you of a dream you remember fondly. These objects are not liked for their own sake and the real existence of the object is part of the pleasure. Also, other people can disagree about the adequacy of the paperweight or have different associations with the print. In this sense, everyone has his or her own taste. 2) For the second type of judgment, one needs to be *disinterested* to experience the object itself as beautiful. To this contemplative judgment, the artwork is gratifying without understanding, and the experience originates from feeling instead of reason. Under disinterested conditions, it does not matter if the thing perceived is a sunset or a photograph of a sunset, who created it, how much it is worth, or if you can hang it on your yellow wall above your blue couch. This type of judgment is not conditioned on a particular purpose of the object or a desire of the perceiver and, under the assumption of common sense; this subjective experience becomes inter-subjective and can be presented as objective.

This second type of judgment can be linked to the theory that aesthetic experience follows from perceiving the object at *psychical distance* Bullough (1912). The object needs to be considered for its own sake and with a disinterested attitude. Concretely, aesthetically experiencing a painting requires a mental state that is devoid of desires, practical needs, and idiosyncratic concerns (e.g., Osborne, 1970). In this case, you cannot aesthetically appreciate your favorite television show when you are involved to the point that you ask the main character why she does not turn on the light when she suspects that a cat-burglar has entered her home.

Apart from the difficulty of disentangling the interested and disinterested judgments, Kant's (2016[1790]) theory of aesthetic judgment reduces aesthetic instances to formal beauty. It is the formal features of the object, their combination, and interaction that cause delight in all disinterested viewers. This is described by Bell (2011[1914]) as *significant form*. Specifically, the expertise of the visual artist lies in the capacity to compose lines, planes, and colors in a tableau of significance. The expertise of the perceiver is the capacity to pierce the fog of interests and associations with the object and only see its pleasing form. It follows from Kant and Bell that a creator can be an objectively great artist and a perceiver an objectively great connoisseur.

Other theories gave a more prominent role to the perceiver's personal contribution to the appreciation of the artwork (e.g., Berleant, 1986; Dewey, 2005[1934]). In this case, an object only becomes an artwork through the engagement with the perceiver. The immediate and non-cognitive response to an artwork is (partly) the result of one's disposition and active contribution to the experience; the perceiver is interested instead of disinterested and there is participation instead of emotional distance (Berleant, 1986). In this case, it is your state of mind and willingness to participate that can make blobs of paint on a canvas enjoyable, just like a horror movie can be frightening through our involvement (empathy) with the victim(s).

In addition, content and context contribute to our experiences. To aesthetic judgment, Hegel (1998[1807]) added a conceptual and historical dimension. It is not only the form, but also the idea that can and must be grasped to fully appreciate a work of art. Understanding what is depicted and what is meant by the depiction contributes to the aesthetic experience. Understanding the historical situation in which the painting was created, the cultural and social context of the artists, the materials and techniques that were used, discloses the content of the artwork and adds to the experience. In opposition to formalism as proposed by the likes of Kant (2016[1790]), Hegel thus argues for the necessity of knowledge and expertise for understanding and appreciating the aesthetic. In brief, philosophical theories of aesthetics range from completely form dependent – where our shared perceptive system just has to be receptive of the artwork and its physical attributes – to completely dependent on conception and history – where it concerns the information we possess about the object – with various possibilities for the perceiver to influence personal appreciation.

If knowledge, experience and context are relevant, then the appreciation of art is at least to some degree differentiated. If these theories are taken at face value, the conclusion that follows from millennia of philosophy is that art and its appreciation contain both elements universal for each person and elements relative to personal experience, state of mind, knowledge, and socio-cultural setting. Whether these theories can coexist, which physical (e.g., composition) and non-physical (e.g., name/fame of the artist) characteristics are relevant, and to what degree these are shared/universal, can most likely be elucidated by empirical research.

1.2. Aesthetics and Art Appreciation in Cultural Sociology

The field of culture studies has its own perspective on aesthetics and art appreciation. On the one hand, art is said to be a reflection of time and culture (Berleant, 1986; Hegel, 1998[1807]; Marx & Engels, 2009[1932]). The style, materials, and content of a painting can tell the knowledgeable viewer when and where it was made. On the other hand, taste in art is a social tool and resource for identification. Having a particular preference for avant-garde art distinguishes one from those who prefer the traditional, popular, or mainstream and might get you on favorable footing with the upper crust of society that shares your predilection (Bourdieu, 1985; Bourdieu & Nice, 1980).

As social creatures, groups of people institute conventions and rules for living and interaction and develop these over time (Elias & Hammer, 2000[1939]). A society can be seen as a configuration of individuals with a distribution of power (e.g., an aristocracy) in which conventions and etiquette prescribe appropriate behavior. How a gentleman should speak and eat is inculcated in the little lord from birth and maintained throughout his life. Conventions and etiquette evolve and are refined through the unconscious attempt of the populace to emulate the elite's way to distinguish itself from the populace. It might be hard to show others you are the better person, if a peasant can dress, talk, and eat in the same manner as you. Concretely, the social configuration dictates people's behavior and tastes to a certain degree and is intrinsically dynamic (Elias & Hammer, 2000[1939]). In keeping with this view, aesthetic tastes stem from (differences in) this socialization process.

According to Bourdieu (1990), differences in socialization and the relations between people and groups are largely determined by social inequality. Specifically, it requires perpetual competition to accumulate and hold on to sparse resources (i.e., capital) for the purpose of attaining and keeping favorable social positions. Apart from economic capital (i.e., money; liquid and fixed assets), Bourdieu hypothesizes the social relevance of other types of capital (notably cultural, social, and symbolic capital). Combined, these types of capital determine people's social position. In addition, social struggle takes place in partly segregated social fields, which correspond to the particular resources that are at stake. Such fields consist of a hierarchical structure of social positions, how these are related, and how they are based on the unequal distribution of capital pertinent to that field. The norms, mobility, and relations within such a field are determined by those highest in the hierarchy (Bourdieu & Wacquant, 1992). The art world is such a field, where those in power (i.e., gatekeepers such as museums, curators, galleries) determine what (e.g., style, subject, content) or who is currently in vogue (Bourdieu, 1985, 2013[1984]).

One's position in this art field depends on cultural capital. This is defined as a combination of tastes, level of education, titles or degrees, and possession of cultural objects (Bourdieu, 2013[1984]; Bourdieu & Nice, 1980). Being in possession of capital allows one to show, consciously or unconsciously, membership of the cultural elite as distinguished from the other classes (Bourdieu, 1990). Next to the possession of economic capital, doors that are closed to most people can be opened by means of cultural capital, such as a doctoral degree, possession of honorary titles, or knowledge of Russian literature. Social groups vary in their levels of cultural capital, because members of different groups are born in different milieus, vary in upbringing, and enjoy different levels of education. People tend to develop shared tastes for art within social classes, while differentiating themselves from other social classes. Art that is familiar and speaks to the immediate desires of the senses (e.g., a melodramatic soap series) is accessible and associated with the tastes of the lower social classes, or those with less cultural capital. Art that is original and avant-garde requires time and effort to be appreciated, which typically limits this appreciation to those with higher levels of cultural capital, attained either through higher education or (family) socialization. In other words, a person's taste depends on the set of cognitive schemata, tastes, and values that differentiate between social classes from birth onward (i.e., *habitus*; Bourdieu, 1990).

In addition, one's art appreciation can be explicitly used as a social tool and resource. Flaunting your specialized taste that had to be cultivated over an extensive period of time, such as wine preference, shows others that you are a person of means and copious leisure time (i.e. *conspicuous consumption*; Veblen, 2005[1899]). It marks you as one of the higher social class and elevates you above the lower classes. Those who want to move up in the world will attempt to emulate you, while you attempt to stay ahead of them by continuously developing your taste.

Research only partly corroborates this theory. Specifically, social classes do not appear to be homogeneous in their art tastes (i.e., high social classes do not enjoy only high art; Peterson & Simkus, 1992; Tampubolon, 2008). A preference for high culture (i.e., the reigning art style supposedly liked by the higher class) is related to education, but also to age, which is not a determinant of social class. Specifically, level of education and age are found to be positively related to people's consumption of art (e.g., visiting theatres, concerts, and museums; Lizardo & Skiles, 2008; López-Sintas & Álvarez, 2004; López-Sintas & Katz-Gerro, 2005) and appreciation of art (e.g., avant-garde instead of traditional; Berghman & van Eijck, 2009; Bryson, 1996; Chan & Goldthorpe, 2007; Lizardo & Skiles, 2008; Silva, 2006; Tampubolon, 2008, 2010; van Eijck, 2001, 2012). On the other hand, social class determinants such as occupation do not appear to be consistently related to art tastes (van Eijck & Knulst, 2005). From this sociological perspective, it is socio-cultural structure that shapes people's aesthetic appreciation. The value of art is determined by competing prominent actors (e.g., renowned museums, galleries, and art critics) who promote or disassociate from artworks and artists. Simultaneously, the prominence of such an actor is dependent on their tastes for the appropriate art and artists according to other actors and consumers of art. For instance, the status of a gallery owner will increase with the discovery of a 'promising young artist' if others agree, or decrease when others disagree. The formal features of a painting have no relevance outside the socialization process; it is who represents it and how it is presented that is important. In other words, art does not have intrinsic value; it has symbolic values that are attributed to it.

These symbolic values can be collectively seen as the *aura* of the artwork, which gives it aesthetic value (Benjamin, 2008[1936]). The aura of a painting is the conventional interpretation of material elements (e.g., place of presentation, lighting, physical condition, formal features, etc.) and immaterial elements (e.g., authenticity, producer, owner, description, etc.). Perceiving a drawing as an original work of art or rather as a reprint, and the artist as a singular genius or an amateur hobbyist, influences our appreciation of the object (e.g., Berghman & van Eijck, 2012; Sgourev & Althuizen, 2017). Benjamin (2008[1936]) thought that technical reproducibility (i.e., printing of images of artworks in great volumes) and loss of consensus on aesthetic value (i.e., canon of art) through social diversification eroded the universal aura of artworks. Even if a painting might have a single aura, additional physical elements (e.g., properties of and distances between objects, words, and bodies) and a perceiver's subjective elements (e.g., internalized cognitive schemata and conventions) influence appreciation (Griswold, Mangione, & McDonnell, 2013). In other words; similarities within and differences between social classes in art appreciation can indeed be caused by their similarities and differences in habitus (Bourdieu, 1990).

Although appealing, the socio-cultural perspective leaves a few things unexplained. Most prominently, it does not explain why we create and appreciate aesthetic objects in the first place[†] and why it seems that the form of one painting elicits more appreciation than the other when confronted with them under similar circumstances (e.g., same artist, same, museum, same lighting, similar description, etc.). This perspective uses concepts such as 'cognition', 'emotion' and 'perception' as postulates and it does not

[†] For instance, conspicuous consumption does not explain why what is consumed needs to be (aesthetically) pleasing instead of ugly, painful, or devoid of emotional response.

go into the finer details of their machination, how they are related to each other, or how they bring about art appreciation (DiMaggio, 1997). A more thorough understanding of art requires a more in-depth investigation of the psychological mechanisms of perception, cognition, and emotional response to objects that might or might not be aesthetically pleasing.

1.3. Aesthetics and Art Appreciation in Psychology

The *interactive collative-motivation model* is the first psychological theory of aesthetics (Berlyne, 1960, 1966; Berlyne & Boudewijns, 1971). According to this view, the pleasure derived from the perception of an artwork depends on its potential to *arouse* the viewer. Artworks possess several *collative* properties – physical and semantic elements, such as incongruity, novelty, uncertainty, and complexity – that, in combination and as a whole, produce a certain level of emotional response (i.e., degree of arousal; Berlyne & Boudewijns, 1971). The relation between arousal and aesthetic experience is curvilinear, an inverted U-curve. The amount of arousal one can handle and the level one finds optimal depend on experience (Berlyne, 1966). Specifically, the pleasantness of the experience increases with the level of arousal (i.e., amount of emotional response) with a decreasing slope to a peak. When the optimal experience is reached and arousal is further increased, the experience becomes exponentially less pleasant. For instance, if a painting is too complex, novel, or one does not know what to make of it, perception is frustrating instead of rewarding.

A major deficit of arousal theory is the absence of cognitive elements and nuanced emotional responses. The relation between the level of arousal and appreciation does not always show an inverted U-curve; linear and other curvilinear relations have also been observed (Berlyne & Boudewijns, 1971). Furthermore, how we appraise such a somatic response, emotionally and cognitively, affects our response to an object or situation. According to this view, the aesthetic experience of an artwork is the outcome of an amalgamation of appraisals (Silvia, 2005). Specifically, a viewer can have a wide variety of possible emotional responses to elements of an artwork or their combination (e.g., a gruesome painting can leave you both disgusted and amazed) and how you appraise depends on your cognitive and emotional dispositions (e.g., expectations and memories of a painting contribute to the response). Such a perspective that allows for cognitive and emotional nuances, offers an explanation of why art appreciation changes with child development (e.g., Parsons, 1987; Thomas & Lin, 2002) and expertise (e.g., Hekkert & van Wieringen, 1996a, 1996b; Palmer & Griscom, 2013; Tinio & Leder, 2009a). A strength of the appraisal theory is its capacity to cope with contradictory responses to works of art (Turner & Silvia, 2006). For instance, although a painting of a turbulent seascape is pleasant to look at, it might also be uninteresting or make you envious of the painter's skill. This theory allows for more nuanced differences between individuals of different cultures and levels of expertise. However, the underlying mechanisms of appraisal remain unclear.

1.4. Neuroaesthetics: The Neuroscience Perspective on Art

Neuroscience could offer further insight into these machinations and explanations of why our perceptual, affective, and cognitive systems must work in such a manner with respect to art appreciation. Neuroaesthetics in particular provides further insight into the mechanisms of aesthetics. Art appreciation is suggested to have a universal neurobiological basis (Zeki, 2001, 2013), which can be explained by evolution (Ramachandran & Freeman, 2001; Ramachandran & Hirstein, 1999). Because adequate perception increases survival chances, evolution favoured perception processes that can have affective rewards.

A central function of the visual system is delineating and discovering objects in our field of vision (Marr, 1981; Pinker, 1998; Ramachandran, 1990). For this purpose, distinct cortical areas dedicated to visual perception rely on extracting correlations between elements (i.e., combining shapes of yellow and brown to see the lion in the grass). To increase our chances of survival, our vision is adapted to perceive edges of shapes (i.e., contrast between background and object) and to disregard redundant visual information (i.e., colour gradients and background luminance). As a result, objects and events can be quickly distinguished by cross-referencing relevant visual information. To enhance survival, the operation of combining shapes into objects must be reinforcing (Ramachandran & Blakeslee, 1998). Specifically, the perceiver should be enthralled to detect correlates (e.g., distinguish a predator or prey hiding in the bushes) and receive an emotional reward for having done so.

According to this perspective, our emotional responses to artworks depend on a combination of several possible features. Specifically, what grabs our attention in an artwork can be a combination of symmetry or harmony (e.g., lack of deformities and disease in a potential mate); intensity (e.g., colour saturation); contrast between adjacent shapes; grouping of non-adjacent shapes (e.g., yellow spots indicating a lion behind green leaves); focus (e.g., discernible hierarchy in relevant and redundant shapes); enigmatic composition (i.e. necessity of perceptual problem solving); and/or typicality (e.g., shapes are in accordance with knowledge and expectations) (Ramachandran & Freeman, 2001; Ramachandran & Hirstein, 1999).

Although these characteristics might tell us which artworks tend to be more appreciated than others and why this is so, they do not offer a complete explanation of the aesthetic experience (e.g., Hyman, 1996). Even if it can be argued that a number of relevant aesthetic properties are indeed purely formal (Zangwill, 2000), art is more than what can be immediately perceived. Extreme versions of formalism cannot account for differences in people's art appreciation, which could be related to culture, expertise, or previous experiences. This is why Ramachandran and Hirstein (1999) hypothesize a distinction between aesthetic *perception* and *evaluation*. Specifically, when a particular artwork is inconsistent with expectations (e.g., seeing an abstract painting that is not recognized as a work of art), an emotional response that is initiated (i.e., activation of the limbic system) might be inhibited (e.g., interference by systems related to episodic memory) before the perceiver becomes aware of it. In brief, there will be a neural and preconscious aesthetic response, but no conscious feeling of appreciation for the perceived artwork.

A second argument against the focus on physical features alone is the finding that activation of neural correlates of emotion is modulated by artworks' semantic contexts. fMRI results revealed modulation of the medial orbito-frontal cortex by memory processing areas (e.g., entorhinal cortex) when paintings were described as owned by an art gallery versus computer generated and an increased reported preference for the former over the latter (Kirk, Skov, Hulme, Christensen, & Zeki, 2009). Kirk et al. (2009) hypothesize that the artwork's hedonic value is primarily determined by conception instead of sensory properties, through involvement of reward expectation systems (i.e. midbrain dopaminergic systems), which could underpin the effect of expertise (e.g., Hekkert & van Wieringen, 1996a, 1996b; Palmer & Griscom, 2013). Specifically, aesthetic evaluation involves more than what can be directly perceived in works of art (Walton, 1970), as it seems impossible to understand aesthetics without including context and people's memory and habits.

To summarize, the perspectives on art and aesthetics of cultural sociology, psychology, and neuroscience overlap and tie into each other in an apparent hierarchical feedback structure. In other words, no perspective seems capable of providing a full explanation of the 'how' and 'why' of art appreciation and aesthetics in isolation. It requires an interdisciplinary approach that incorporates the evolutionary basis, the neural mechanics of perception processing, the (translation to) cognitive and emotional response, and modulation by experience and culture. In the next section, I outline how this is put into practice for this dissertation.

1.5. Aims, Outline, and Methods

The purpose of the research outlined in this dissertation can be summarized as steps to draw philosophy, cultural sociology, and psychology closer together in their quest for understanding art. Some inroads already exist for bringing these different fields together under a single theoretical framework (e.g., Bullot & Reber, 2013; Chatterjee & Vartanian, 2016; Leder, Belke, Oeberst, & Augustin, 2004). However, the socio-cultural dimension is still absent and these frameworks take the existence of art for granted. They do not explain why we, human beings, make art in the first place, and why we would choose to make this particular form of art in contrast to other forms of art. For that reason, we do not address the specifics of these frameworks. It would be premature to postulate an overarching theory before we know more about how the important factors, identified by the individual disciplines, are connected. This suggestion was explicitly made before (Leder et al., 2004) and was taken to heart in the design of the experiments for this dissertation. As a patchwork blanket, theories of each field are juxtaposed to- or superimposed on one another, providing hypotheses for each chapter. The studies reported in the next four chapters are methodologically diverse, though connected by particular combinations of interdisciplinary perspectives, which together hopefully offer a meaningful contribution to the theory and methodology of the field of aesthetics. In these chapters, we zoomed in on the interaction between a number of social and cultural characteristics of people, and physical features (Chapters 2 and 3) as well as non-physical features (Chapter 3) of artworks; investigated how people look at paintings (Chapter 4); and measured the physiological emotional reaction to objects presented as art (Chapter 5).

For the next chapter, we measured how luminosity contrast in paintings affected their appreciation (Chapter 2). We examined to what extent an increase in contrast in paintings leads to an increase in appreciation and if this varied between types of paintings and levels of luminosity contrast. Furthermore, we tested the possible moderation of the effect of contrast by people's background characteristics, such as education level, art expertise, and ethnicity. Theoretically, this study is a combination of the neuroaesthetic prediction of the relevance of contrast (Ramachandran & Hirstein, 1999) with the differentiating effects of art expertise (e.g., Hekkert & van Wieringen, 1996a, 1996b), social factors (e.g., Berghman & van Eijck, 2009), and cultural influence (Benton & DiYanni, 2012). The study served a dual purpose. The primary purpose was testing the universality of the effect of contrast in art appreciation. The secondary purpose was testing whether people's background characteristics that have a differentiating effect on appreciation at the level of individual artworks and art styles have also have a differentiating effect on the appreciation of artwork's physical characteristics. For this study, a forced choice paradigm was used. Participants were instructed to view stimuli on a screen and choose their preferred version from two manipulated copies of the same painting. Luminosity contrast of the copies was systematically decreased or increased. Data was analyzed with standard null-hypothesis significance testing using Repeated Measure ANOVA.

Chapter 3 is partly a replication of the study of the previous chapter with an added condition. Next to contrast, the effect of authenticity as a non-physical element is investigated. Specifically, we measured to what extent appreciation of paintings is affected by labeling them as original artworks, forgeries, or of unknown authenticity. As in Chapter 2, we tested the possible modulation of the effects of contrast and authenticity by pertinent background characteristics. The theoretical rationale was similar to that of Chapter 2 with the addition of a cultural sociological perspective on the impact of non-physical characteristic (e.g., Berghman & van Eijck, 2012). The addition in this chapter is the test of whether there is a differentiation effect of background characteristics in relation to authenticity at the level of properties of artworks (instead of the level of artworks or art types and styles). Similar to Chapter 2, a forced choice paradigm was used and participants had to choose between two manipulated copies of the same painting. In this case, luminosity contrast of the copies was systematically decreased or increased or the painting was labeled as an original work of art or a forgery. Again, data was analyzed with standard null-hypothesis significance testing using Repeated Measure ANOVA.

In Chapter 4, the focus is shifted to perception and the possible differences between art experts and laypersons. Ambulant eye-tracking instruments were used to measure eye-fixations on paintings in Museum Boijmans Van Beuningen in Rotterdam, the Netherlands. Specifically, we investigated the possible relation between the relative amount of time people spent gazing at visually salient areas of paintings and measures of art expertise. In this case, theories from perception research (e.g., Borji, Sihite, & Itti, 2012), neuroaesthetics (Zeki, 2001), and cultural sociology (e.g., Bourdieu, 1984) guided the formulation of a test whether experience with art affects primary perception (i.e., gaze time and place of focus) or evaluation of what is perceived (e.g., emotional and cognitive responses). For this study, the null hypothesis was relevant and supportive evidence could be meaningful. Thus, both frequentist and Bayesian statistics were used for data analyses.

Chapter 5 concerns a combination of behavioral and physiological measurements of the effect a non-physical characteristic. In this study, we measured people's emotional reaction to non-art pictures presented in the context of art (e.g., described as works of art) or photography (e.g., pictures of real events). Their emotional responses, measured as neural activity and self-reports, provide insight in how art and the context of art modulate people's reactions and situation assessments. Theoretically, this study combines the philosophical emotional distancing (Kant, 2016[1790]), the cultural-sociological creation of meaning and value via context (e.g., Berghman & van Eijck, 2012), and the neuroaesthetic expectation that emotional response to art can be captured with brain scans (e.g., Zeki, 2001; Skov, 2019). Concretely, participants viewed pleasant and unpleasant images of the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005) that were made to look more aesthetically pleasing. These pictures were either presented as works of art or photographs depicting real events. Participants' physiological responses were measured as event-related potentials (ERPs) in Electroencephalograms (EEG). In addition, participants' self-reported responses on appreciation and emotional reaction were taken into account. Data was analyzed with standard null-hypothesis significance testing using ANOVA and t-tests.

To conclude, in the next chapters, theories from all discussed research disciplines are combined and tested with a diverse range of research methods. Evidence is provided for the effects of physical and non-physical artwork characteristics on appreciation, which is robust across cultures, demographic characteristics, and level of art experience. In addition, results show that aspects of art appreciation predicted by philosophical and socio-cultural theories can be traced to the neurophysiological level. These findings are summarized and integrated in the final chapter.

2

THE LAW OF CONTRAST

Abstract:
Visual contrast appears to be an important factor in the appreciation of paintings. However, it has not been determined whether and how the effect of contrast differs between painting characteristics and whether and how it differs between people. We investigated whether the effect of contrast generalizes across cultures, variations in initial contrast levels (i.e., the amount of contrast in the digital reproductions of an original painting) between paintings, painting types (i.e., representational or abstract), and social and cognitive–aesthetic factors (e.g., age, education, art expertise). Our results indicated that people consistently favor high-contrast versions of paintings over their low-contrast counterparts; this effect is stronger for abstract paintings and paintings with a low or moderate initial contrast level; this effect is not influenced by culture, social factors, or cognitive–aesthetic factors; and surprisingly, the aesthetic value of digitized original paintings can be increased by increasing their contrast value. In short, we found empirical support against the universal importance of contrast in relation to painting characteristics but in favor of the universal importance of contrast in relation to people characteristics.

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Both authors contributed equally. *Note:* J. Zijlmans only has one PhD, but I still love him.

2.1. Introduction

Art and aesthetics have been the focus of investigation across various academic fields. Both psychological (e.g., Hekkert & van Wieringen, 1996a, 1996b) and sociological (e.g., Silva, 2006) studies provide empirical evidence for cultural, social, and cognitive differences in art appreciation. However, the existence of museums and art history books reveals the possibility of a consensus on artistic value of artworks. At face value, this offers an argument for shared mechanisms or laws of art appreciation. Neuroscientists have hypothesized (e.g., Zeki, 2001, 2013) and provided evidence for (e.g., Kawabata & Zeki, 2004; Vartanian & Goel, 2004) a universal basis of art appreciation, and previous research has shown several factors to be important in the appreciation of aesthetic stimuli (e.g., contrast; Tinio, Leder, & Strasser, 2011; harmony; Palmer & Griscom, 2013; fractality; Hagerhall, Purcell, & Taylor, 2004; and self-similarity; Amirshahi, Koch, Denzler & Redies, 2012).

Ramachandran and Hirstein (1999) have proposed a possible framework of mechanisms for such a universal basis, describing a set of laws of art appreciation. Although this framework was met with resistance (Hyman, 1996), in combination with sociological and psychological theory it may be an asset for the advancement of scientific understanding of art and aesthetics. The purpose of our study was to test the universality of one of these laws, namely the law of contrast. Experiments were conducted to examine the effect of contrast in paintings on appreciation of the paintings; how this effect differs between painting types; and how it relates to pertinent differentiating factors, deduced from sociological and psychological research.

Psychological research reveals relations between art appreciation and demographic (e.g.,age and sex; Furnham & Walker, 2001a, 2001b) and cognitive (e.g., expertise; Hekkert & van Wieringen, 1996a, 1996b; Thomas & Lin, 2002) factors. Although both the symmetry and complexity of works of art are positively related to their appreciation, the effect of complexity is not robust when people are familiarized with the artworks in question (Tinio & Leder, 2009a), and although symmetry cues in stimuli influence preference positively, the use of these cues varies considerably (Jacobsen & Höfel, 2003). Preference for color, shape, and composition varies with individual preference for overall harmony, which is negatively correlated with art expertise (Palmer & Griscom, 2013). In addition, art experts evaluate art differently from laymen. For example, art experts' appreciation appears to be more strongly related to the artworks' originality, whereas the appreciation of laymen is predominantly guided by familiarity (Hekkert & van Wieringen, 1996a). In sum, although every person perceives the same object, attention allocation to, interpretation of, and ultimately appreciation of artworks varies across people (Thomas & Lin, 2002).

Cultural sociology offers another explanation for this differentiation between people's art appreciation. According to the sociologist Bourdieu (Bourdieu, 1985; Bourdieu

& Nice, 1980), artworks are attributed a symbolic value through social interaction. He argues that an artwork does not have intrinsic artistic value, but that value is attributed through positive evaluation by art authorities (e.g., museums, art critics). Through promotion by galleries, museums, and art critics, the status of the artwork, and thereby its artistic value, increases. However, the status of these authorities is also linked to the art they promote. Their status increases or decreases when art is promoted with positive or negative results (e.g., recognition or acquisition by others). In short, artworks' status, appreciation, and consumption are linked to social class. Which artwork is appreciated does not only confirm a person or institute's social status, it can also increase their status in relation to others (Bourdieu, 1985; Bourdieu & Nice, 1980).

Empirical research does indeed provide evidence for the associations between art appreciation and factors of socialization. For instance, studies have shown a positive relation between educational level and frequency of art consumption (e.g., art museum visits and craft exhibitions; Chan & Goldthorpe, 2007) as well as between educational level and type of art appreciation (e.g., higher educated prefer more abstract and contemporary art; Silva, 2006). Similarly, Berghman and van Eijck (2009) showed that age and level of education are related to variation in painting style preferences. Specifically, appreciation for more contemporary painting styles is linked to the younger and higher educated, whereas the older and lower educated preferred classical painting styles (e.g., Renaissance and landscape paintings). In short, sociological research suggests a link between the status of the artwork and its perceiver, resulting in socio-cultural differences in art appreciation.

Although art appreciation appears highly differentiated, the fact of existing consensus in art appreciation remains a quandary. With the advent of neuroaesthetics, researchers have suggested a universal basis of art appreciation and its mechanisms (Ramachandran & Freeman, 2001; Ramachandran & Hirstein, 1999; Zeki, 2001). If art appreciation is grounded in neurophysiological perception processing, this may offer an explanation for various research results. For instance, naive subjects can discern original artworks from compositionally altered versions (Locher, 2003). This suggests that the original's material elements are arranged to elicit a positive affective reaction, and this reaction is disrupted when the composition is altered. Similarly, abstract paintings by professional artists are appreciated over counterparts selected on resemblance, made by children, primates, or elephants (Hawley-Dolan & Winner, 2011). These results are in line with neuroimaging research, which reveals different patterns of brain activity when people view beautiful, rather than ugly paintings (Kawabata & Zeki, 2004; Vartanian & Goel, 2004). In sum, research results point towards a universal neurobiological basis of art appreciation (Cela-Conde, Agnati, Huston, Mora, & Nadal, 2011; Chatterjee, 2011; Nadal, Munar, Capó, Rosselló, & Cela-Conde, 2008; Zeki, 2013).

Ramachandran and Hirstein (1999) contend that because perception is useful for survival, evolution has resulted in perception processing that can have affective rewards. One of the main functions of our visual system is discovering and delineating objects in our visual field (Marr, 1981; Pinker, 1998; Ramachandran, 1990). For this feat, distinct cortical areas dedicated to vision rely on extracting correlations between visual elements. In order to adequately allocate attention, our visual system is attuned to perceive edges of objects (i.e. contrast between the object and its background) and to discard redundant information (i.e. gradient coloring and luminance of the background). In this manner, visual information can be quickly cross-referenced to distinguish objects and events. To promote survival, the process of binding visual elements into unitary events or objects must be reinforcing (Ramachandran & Blakeslee, 1998). In other words, one should be enticed to discover correlates (i.e. being able to distinguish pray, mate, or meal from its background) and be emotionally rewarded for having done so.

From this evolutionary perspective and based on earlier research, Ramachandran and Hirstein (1999) postulated several neurophysiological laws of art appreciation. They argue that, because humans to a large extent share one neurophysiological makeup, we are likely to experience similar affective rewarding sensations that result from perception processing. In other words, artworks' distinct material elements and their compositions should trigger a universal reaction in people. The laws they coined include *peak shift* (exaggeration of shapes), *grouping* (combining non-adjacent objects to one shape), *perceptual problem solving* (effort-costing constructing of a coherent image), and *contrast* (distinguishing between adjacent objects). Contrast in particular has been previously studied and research results indeed show that contrast-rich artworks and other contrast-rich visual stimuli are preferred over their lower contrast counterparts (Krentz & Earl, 2013; Reber, Winkielman, & Schwarz, 1998; Tinio & Leder, 2009b; Tinio et al., 2011).

Although a neurological explanation of artistic preferences is appealing, current theories are far from exhaustive (Tyler, 1999). Moreover, other factors might be better at accounting for overlap in people's art appreciation. For instance, an artwork's symbolic context appears to play a role in its appreciation. Namely, appreciation for artworks increases or decreases when the artworks are respectively labeled as the product of a professional artist or a hobby painter (Berghman & van Eijck, 2012). Cognitive differences between experts and non-experts (e.g., differences in the perception and interpretation of artworks) are suggested as an explanation for the differences in what type of paintings they prefer (e.g., representational versus abstract; Hekkert & van Wieringen, 1996a) and what they appreciate about them (e.g., subject matter, medium, originality; Hekkert & van Wieringen, 1996a; Thomas

& Lin, 2002). In addition, cognitive differences between people of dissimilar cultures exist, which potentially influences art appreciation. For instance, Americans are better at copying the absolute measures of objects, whereas Japanese people are better at copying their relative measures in relation to their surroundings. This is suggestive of cultural attentional differences guiding perception (Kitayama, Duffy, Kawamura, & Larsen, 2003). And, as stated before, research indicates that there is a relation between people's art preference (i.e. which type of art is appreciated) and their familiarity with paintings, personality, education, and demographic factors Furnham and Walker (2001a, 2001b). This is in line with sociologists stressing the role of background characteristics such as culture, age, level of education, and social class as explanations for art appreciation (Berghman & van Eijck, 2009; McManus & Furnham, 2006; Silva, 2006; van Eijck, 2012).

In sum, there is evidence for both a neurobiological basis and differentiation due to social and cognitive differences when it comes to art appreciation. It is our expectation that combining neuroaesthetic, psychological, and sociological perspectives will result in a more comprehensive insight into art appreciation and aesthetics. Therefore, we studied suggested universal aesthetic aspects and investigated whether psychological and social participant characteristics influence them. We chose contrast for our experiments, because it is one of the universal aspects that has been demonstrated to be aesthetically pleasing. However, only unaltered and decreased contrast copies of paintings have been used in previous research and neither the initial levels of contrast or the type of painting (e.g., abstract versus representational) were taken into account (Krentz & Earl, 2013; Tinio & Leder, 2009b; Tinio et al., 2011).

Thus, the purpose of our first experiment was to investigate the effect of increasing and decreasing contrast of paintings of different types and initial contrast-levels and whether this effect is related to culture (American versus Indian) and other participant characteristics that have previously been shown to be of effect in both sociological (e.g., Berghman & van Eijck, 2009) and psychological (e.g., Hekkert & van Wieringen, 1996b) research. Because previous research has only compared original images with lower contrast versions of those images, in our second and third experiment we tested the effects of increased and decreased contrast separately.

2.2. Methods and Results

2.2.1. Experiment 1

In this experiment, participants judged which of two paintings they appreciated more. One painting was a heightened contrast version of the digital reproduction of an original painting, the other painting was a lowered contrast version of the same painting. After the experiment, a short questionnaire was administered. Data were analyzed using a repeated measure analysis of variance. Differences between preference for the high contrast version and the low contrast versions of paintings were used as main effect. Variations between painting types and initial levels of contrast were measured as interaction effects. Participant characteristics were added to the analysis as covariates and between-subjects factors.

Participants

Participants were 150 American (U.S) (52% male, mean age = 36.4, SD = 12.2) and 150 Indian people (53% male, mean age = 32.1, SD = 9.5), recruited via Mechanical Turk. Previous research has shown that experiments performed via Mechanical Turk yield similar outcomes as experiments performed in the lab (Paolacci, Chandler, & Ipeirotis, 2010). Nonetheless, it should be taken into account that we could not control the type of monitor on which our participants viewed the stimuli. Participants were not allowed to perform the experiment on a smartphone. Both American and Indian participants were included to ensure we could compare a group of participants culturally congruent to the stimuli (i.e. Western people in regards to paintings from European and American artists) to a group of participants culturally incongruent to the stimuli. Twelve participants (all Indian) were excluded from the analyses because they failed to complete the experiment.

Stimuli

The stimuli were 80 pairs of color reproductions of paintings from digital collections of five established European museums and we therefore assumed the digital reproduction to be reliable approximations of the actual paintings. We focused on Western art in order to have a somewhat homogeneous sample of stimuli. The period in which the paintings were created ranges from the years 1500 to 2010 and all were painted by either European or American artists, predominantly Dutch or Flemish artists. Half of the 80 original paintings were representational and half were abstract. All stimuli were presented at the same width (500 pixels) and resolution (72 dpi). An overview of all paintings can be found in Appendix A.

Initial contrast of the paintings was assessed in Adobe Photoshop CS5. Of the selected paintings, 20 were low in initial contrast, 40 were medium in initial contrast, and 20 were high in initial contrast. Luminosity contrast was measured by the lightness and the amount of pixels, and the range between the lightest and darkest pixels. The lightness of pixels was measured on a grey scale of 256 shades, ranging from black (0) to white (255). Dark shades of any color translate to values between 0 and 127 and light shades of any color to values between 128 and 255. Thus, the pixels of each painting were translated to gray scores resulting in a contrast histogram for each painting.

The low contrast-level was defined as having a contrast peak (greatest amount of pixels) in the middle six octiles of the contrast histogram and having a range smaller than 190 shades of grey (less than three quartiles). The high contrast-level was defined as having a contrast peak in the highest or lowest octile and having a range from 0 to 255 shades of grey. The middle contrast-level was defined as the rest of the paintings that had a range larger than 190 shades of grey. No paintings with a contrast peak in the outermost octiles and a range below 190 shades were used. To verify our categorization, we measured the standard deviation of grey values (i.e. root mean square contrast; RMS). The higher the standard deviation, the more pixels near black and white compared to the total amount of pixels. On average the painting categories low initial-contrast, moderate initial-contrast, and high initial-contrast had a standard deviation of grey values of 28.58, 40.57, and 44.99 respectively. These three levels of initial contrast were used to control for the possibility of a ceiling effect. Logically, there is a limitation of the amount of contrast that is considered beautiful. For instance, if contrast is indefinitely increased, all that remains are black and white shapes. By investigating several levels of contrast, we ensured the contrasts were not too high, nor too low.

In short, the 80 paintings were divided into six categories: 1) representational paintings with low initial contrast (10); 2) representational paintings with medium initial contrast (20); 3) representational paintings with high initial contrast (10); 4) abstract paintings with low initial contrast (10); 5) abstract paintings with medium initial contrast (20); and 6) abstract paintings with high initial contrast (10).

Each pair of artworks consisted of two versions of the same painting: one with lowered luminosity contrast and one with heightened luminosity contrast (see Figure 2.1 for an example). In order to create high contrast versions of the paintings, dark shades (i.e. shades of grey 0-127) were made darker and light shades (i.e. shades of grey 128-255) were made lighter. Shade of grey 64 (between the first and second quartile) and shade of grey 191 (between the third and fourth quartile) were respectively decreased and increased by 15 shades. The changes were progressively smaller towards the extreme values (0 and 255) and the neutral value (128). At the extreme and neutral values no changes were made. The decrease and increase were reversed for low contrast versions. To verify our manipulation, we measured and compared the average increase [4.07] and decrease [3.61] of the standard deviation of grey values after the manipulation, the sizes of the manipulations did not significantly differ [$t(79) = 1.58$, $p > 0.05$]. Additionally, we tested if our manipulations affected the paintings' global luminance by comparing the average grey value of the unmanipulated paintings (80.83) to the heightened-contrast copies [79.34; $t(79) = 0.85$, $p > 0.05$] and lowered-contrast copies [80.59; $t(79) = 0.44$, $p > 0.05$]. Global luminance in the manipulated paintings did not significantly differ from that of the unmanipulated paintings.

Figure 2.1: Stimulus example. The painting copy on the left is decreased in luminosity contrast; the contrast of the one on the right is increased.

Procedure

In each trial, the participants viewed a pair of paintings (one on the left side and one on the right side of the monitor) and judged which of the two paintings they liked better and whether or not they were familiar with the painting. In half of the trials the high contrast version was presented on the left and in the other half of the trials the high contrast version was presented on the right. The pairs of paintings were presented in random order. For analysis of the results, preference proportions per subject per painting-category were calculated for a) heightened-contrast paintings in relation to the total amount of paintings in the category and b) the lowered-contrast paintings in relation to the total amount of paintings in the category. For instance, a person would have a proportion score of 0.75 for a) and 0.25 for b) if this person preferred 15 heightened-contrast copies and 5 of the lowered-contrast copies of representational paintings with a medium initial contrast level of the 20 of representational paintings with a medium initial contrast level.

After the experiment, participants filled in the questionnaire. Education was inquired and divided into two groups. Separate groups were created for American and Indian participants because of central tendency differences in education between the groups. The American low education group consisted of educational levels of up to a two-year college degree. The American high education group consisted of educational levels of a four-year college degree and higher. The Indian low education group consisted of educational levels up to a four-year college degree. The Indian high education group consisted of educational levels of a Master's degree and higher.

Annual household income was inquired and divided into two groups. Separate groups were created for American and Indian participants because of the large differences in income between the groups. The American low income group consisted of incomes up to $39,999 per year, the American high income group consisted of incomes of $40,000 and higher per year. The Indian low income group consisted of

Table 2.1: Means and standard deviations of the proportions of preference for higher contrast versions of paintings per experiment and per condition

	Type of painting	**Initial contrast**	**Mean (sd) preference**
Experiment 1	Representational	Low	0.74 (0.23)
Section 2.2.1		Medium	0.68 (0.25)
		High	0.61 (0.29)
	Abstract	Low	0.77 (0.16)
		Medium	0.78 (0.21)
		High	0.69 (0.23)
	Total		0.72 (0.19)
Replication	Representational	Low	0.70 (0.19)
Section 2.2.2		Medium	0.60 (0.17)
		High	0.43 (0.21)
	Abstract	Low	0.78 (0.11)
		Medium	0.80 (0.10)
		High	0.60 (0.22)
	Total		0.65 (0.11)
Experiment 2	Representational	Low	0.75 (0.19)
Section 2.2.3		Medium	0.70 (0.18)
		High	0.70 (0.20)
	Abstract	Low	0.73 (0.17)
		Medium	0.74 (0.15)
		High	0.69 (0.19)
	Total		0.72 (0.14)
Experiment 3	Representational	Low	0.64 (0.20)
Section 2.2.4		Medium	0.65 (0.16)
		High	0.62 (0.21)
	Abstract	Low	0.65 (0.16)
		Medium	0.67 (0.17)
		High	0.59 (0.15)
	Total		0.64 (0.12)

incomes up to $19,999 per year, the Indian high income group consisted of incomes of $20,000 and higher.

Knowledge of art and interest in art were assessed on separate visual analogue scales ranging from 1 to 100 with a self-report question.

Because participants recognized very few paintings (50% of participants recognized 3 or less paintings), familiarity was not taken into account in analyses.

Results

A 2 (manipulated contrast: heightened versus lowered) x 2 (type: representational versus abstract) x 3 (initial contrast: low versus medium versus high) repeated measures ANOVA revealed a significant main effect of manipulated contrast [$F(1, 287) = 363.86$, $p < 0.0001$, $\eta_p^2 = 0.56$] (see Figure 2.2), a significant manipulated contrast * type interaction [$F(1, 287) = 57.16$, $p < 0.0001$, $\eta_p^2 = 0.17$], a significant manipulated contrast * initial contrast interaction [$F(2, 186) = 67.21$, $p < 0.0001$, $\eta_p^2 = 0.32$], and a significant manipulated contrast * type * initial contrast three-way interaction [$F(2, 286) = 18.14$, $p < 0.0001$, $\eta_p^2 = 0.11$].

Three post hoc t-tests for the three types of initial contrast and six post hoc t-tests for the three types of initial contrast separately for the two types of paintings revealed that all mean proportions of high contrast scores differed significantly from each other (all ps < 0.05, Bonferroni corrected), except for the mean proportions of the abstract paintings with low initial contrast and the abstract paintings with medium initial contrast (p > 0.05, Bonferroni corrected). See Table 2.1 for an overview of the proportions per condition.

When the cultural (i.e. Culture: Indian versus American), social (i.e. Age: high versus low; Education: high versus low; and Income: high versus low), and cognitive-aesthetic variables (i.e. Knowledge of art and Interest in art), were entered in a stepwise regression model predicting the effect of contrast, none were significant (all ps > 0.05).

2.2.2. Replication of Experiment 1

This experiment has the same design as experiment 1, except the experiment was performed in the laboratory under controlled circumstances. Stimuli were presented on 22” TFT widescreen displays (resolution 1920 x 1200, ratio 16:10) with color depth 32 bit and a refresh rate of 59Hz. The distance between the display and the participants was approximately 60cm.

Participants

Participants were 24 psychology students (46% male, mean age 26.7, SD = 3.4) recruited from the Erasmus University Rotterdam. They received credits for their participation.

Stimuli

The stimuli in this experiment were identical to those of experiment 1.

Procedure

The procedure of this experiment was identical to that of experiment 1, except that annual household income, education, and knowledge of and interest in art were not recorded.

Results

A 2 (manipulated contrast: heightened versus lowered) x 2 (type: representational versus abstract) x 3 (initial contrast: low versus medium versus high) repeated measures ANOVA revealed a significant main effect of manipulated contrast [$F(1, 23) = 44.89$, $p < 0.0001$, $\eta_p^2 = 0.66$] (see Figure 2.2), a significant manipulated contrast * type interaction [$F(1, 23) = 28.23$, $p < 0.0001$, $\eta_p^2 = 0.55$], a significant manipulated contrast * initial contrast interaction [$F(2, 22) = 32.13$, $p < 0.0001$, $\eta_p^2 = 0.58$], and a significant manipulated contrast * type * initial contrast three-way interaction [$F(2, 22) = 4.04$, $p < 0.05$, $\eta_p^2 = 0.15$].

Three post hoc t-tests for the three types of initial contrast and six post hoc t-tests for the three types of initial contrast separately for the two types of paintings revealed that all mean proportions of high contrast scores differed significantly from each other (all ps < .05, Bonferroni corrected), except for the mean proportions of the abstract paintings with low initial contrast and the abstract paintings with medium initial contrast (p > .05, Bonferroni corrected). The overall preference for high contrast paintings was slightly lower in this experiment (0.65) than in Experiment 1 (0.72). See Table 2.1 for an overview of the proportions per condition.

2.2.3. Experiment 2

This experiment has the same design as experiment 1, except participants judged between original contrast versus lowered contrast versions of the paintings.

Participants

Participants were 75 American people (28.8% male, mean age = 38.1, SD = 13.9), recruited via Mechanical Turk. Two participants were excluded from analysis because they failed to complete the experiment.

Stimuli

The stimuli in experiment 2 were identical to those in experiment 1, except instead of comparing heightened versus lowered contrast versions of the same painting, participants judged between original contrast versus lowered contrast versions. Since the same lowered contrast versions of the paintings as in experiment 1 were used, the difference in contrast between the pairs in experiment 2 was half as large as in experiment 1.

Procedure

The procedure of experiment 2 was identical to that of experiment 1, except the question of familiarity was not asked because of the very low familiarity of the paintings to participants of the first experiment. In addition, 40 filler items were included to divert the attention of participants away from the differences in contrast. Each filler consisted of two versions of an abstract or representational painting, the original and a mirrored copy (no differences in contrast were applied). Additionally, at the end of the experiment participants were asked what they thought the experiment was about. Two participants specifically mentioned the liking of higher contrast and eight participants mentioned contrast among other features (e.g., presentation to the left or right, orientation of the pictures). Excluding these participants did not significantly change the results.

Results

For experiment 2, a 2 (manipulated contrast: original versus lowered) x 2 (type: representational versus abstract) x 3 (initial contrast: low versus medium versus high) repeated measures ANOVA revealed a significant main effect of manipulated contrast [$F(1, 72) = 176.28$, $p < 0.0001$, $\eta_p^2 = 0.71$] (see Figure 2.2), a significant manipulated contrast * initial contrast interaction [$F(2, 71) = 3.54$, $p < 0.05$, $\eta_p^2 = 0.09$], and a significant manipulated contrast * type * initial contrast three-way interaction [$F(2, 71) = 3.13$, $p < 0.05$, $\eta_p^2 = 0.08$]. Note that, unlike in experiment 1, the manipulated contrast * type interaction was not significant [$p > 0.9$].

Three post hoc t-tests for the three types of initial contrast revealed that only the mean proportions of normal contrast scores for high initial contrast versus low initial contrast differ significantly from each other ($p < 0.05$, Bonferroni corrected, other ps > 0.05, Bonferroni corrected). See Table 2.1 for an overview of the proportions per condition.

When the social and cognitive-aesthetic variables were entered in a stepwise regression model predicting the effect of contrast, none were significant (all ps > 0.05).

2.2.4. Experiment 3

This experiment has the same design as experiments 1 and 2, except participants judged between original contrast versus heightened contrast versions of the paintings. Two participants specifically mentioned the liking of higher contrast and seven participants mentioned contrast among other features. Again, excluding these participants did not significantly change the results.

Participants

Participants were 75 American people (38.7% male, mean age = 38.3, SD = 12.6), recruited via Mechanical Turk. All participants completed the experiment.

Stimuli

The stimuli in experiment 3 were identical to those in experiment 2, except instead of comparing lowered contrast versus original contrast versions of the same painting, participants judged between heightened contrast versus original contrast versions.

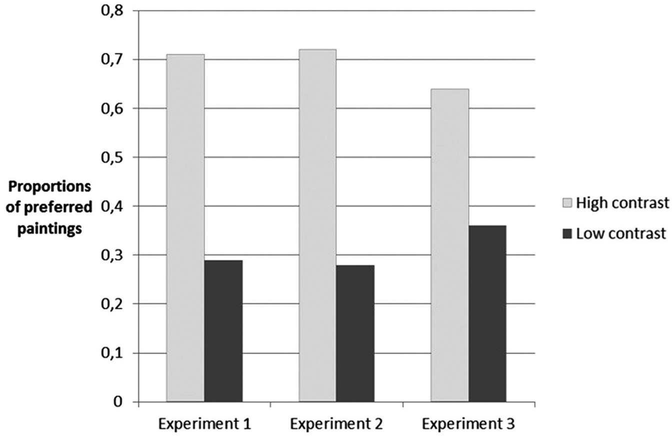

Figure 2.2: Proportions of preferred paintings per experiment. For experiment 1 the light gray bar represents heightened contrast versions of paintings and the dark gray bar lowered contrast versions of paintings. For experiment 2 the light gray bar represents original paintings and the dark gray bar lowered contrast versions of paintings. For experiment 3 the light gray bar represents heightened contrast versions of paintings and the dark gray bar original paintings.

Procedure

The procedure of experiment 3 was identical to that of experiment 2.

Results

For experiment 3, a 2 (manipulated contrast: heightened versus original) x 2 (type: representational versus abstract) x 3 (initial contrast: low versus medium versus high) repeated measures ANOVA revealed a significant main effect of manipulated contrast [$F(1, 74) = 91.72$, $p < 0.0001$, $\eta_p^2 = 0.55$] (see Figure 2.2) and a significant manipulated contrast * initial contrast interaction [$F(2, 73) = 6.29$, $p < 0.005$, $\eta_p^2 = 0.15$]. Again, the manipulated contrast * type interaction was not significant [$p > 0.8$], nor was the manipulated contrast * type * initial contrast three-way interaction significant [$p > 0.1$].

Three post hoc t-tests for the three types of initial contrast revealed that only the mean proportions of high contrast scores for high initial contrast versus medium initial contrast differ significantly from each other ($p < 0.05$, Bonferroni corrected, other ps > 0.05, Bonferroni corrected). See Table 2.1 for an overview of the proportions per condition.

When the social and cognitive-aesthetic variables were entered in a stepwise regression model predicting the effect of contrast, none were significant (all ps > 0.05).

2.3. Discussion

Our results indicate that people consistently favor high contrast versions of digitized paintings over their low contrast counterparts and that this effect partially depends on painting characteristics. On the other hand, participants' characteristics seem to be of minor importance since this preference for higher contrast is not influenced by social and cognitive-aesthetic factors. Most notably, neither age, nationality, income, nor education was predictive of the main effect of contrast.

In experiment 1, we found the effect of contrast to be larger for abstract paintings than for representational paintings, which may be explained following Ramachandran and Hirstein's (1999) theory that the aesthetic value of a discrete artwork is dependent on several laws of art. We suggest that the law of contrast is in general of greater relative importance in abstract paintings than in representational paintings, since in abstract paintings there is less emphasis on the realistic interpretation of the painting and thus fewer laws seem to readily apply. Additionally, contrast may be of more absolute importance in abstract paintings, because they purely consist of adjacent shapes that differ in color and luminosity contrast, and lack representation.

Alternatively, the difference may be a result of a layer of varnish or dirt covering the older representational paintings, lowering their initial level of contrast. Because this problem is less prevalent in abstract paintings, the effect of type we find may be confounded by the varnish or dirt on representational paintings. However, as discussed below, we found the effect of contrast to be smaller for paintings with high initial contrast, which is at odds with the effect being larger for abstract paintings. We therefore expect these effects to be caused by differences between representational and abstract art other than initial contrast. These findings were not replicated in the other experiments, which may be explained by the smaller contrast differences between the high contrast and low contrast stimuli in experiments 2 and 3.

In addition, in all experiments there was a significant interaction between manipulated contrast and initial contrast. The effects for paintings initially high in contrast were smaller, suggestive of a ceiling effect for these stimuli. In experiment 1, the effect of initial contrast was smaller in abstract paintings, again suggestive of a ceiling effect, since the main effect of contrast was already larger in abstract paintings.

Experiments 2 and 3 empirically support the claim of the existence and relevance of the law of contrast since they compare original paintings with manipulations of the paintings with both increased and decreased contrast. Previous studies have shown that decreasing contrast lowers appreciation. We show that it is also possible to increase the aesthetic value of artworks by increasing the amount of contrast, indicating that original art can be made more aesthetically appealing by simple manipulation. If other factors were greatly changing due to the alteration in contrast, it may have been expected that changing the contrast in any direction would worsen the composition of the entire painting. Because the effect works both ways (decreasing contrast decreases appreciation and increasing contrast increases appreciation), it seems contrast is indeed the relevant factor.

Our study has several limitations. First, as Hekkert and van Wieringen (1996b) have previously pointed out, it should be kept in mind that it cannot be expected that manipulating one element of a work of art really only changes that dimension and has no impact on other elements, nor that the entire aesthetic experience can be fully captured.

Second, the paintings are presented on a monitor rather than in their original form, thus for example the texture of the paintings is left out of the picture, limiting the ecological validity. However, previous research has shown that participants respond similarly to original paintings and (digital) reproductions (Locher, Smith, & Smith, 1999). Also, because participants performed the task on their personal computer, the monitors that have been used will not have been identical and thus the viewing conditions (e.g., gamma settings of the monitor) varied between participants beyond experimental control. Because of this, the absolute size of the manipulation may differ slightly between participants, but we show the direction of the manipulation is the same for all participants. Moreover, in the replication of experiment 1 under controlled conditions, we show that the main effect of contrast is similar to that of the original experiment, suggesting that the results are not meaningfully influenced by the different viewing conditions under which participants performed the experiment via Mechanical Turk. It should be noted that the interaction effects between contrast and painting type as well as contrast and initial level of contrast have larger effect sizes in the replication. This seems to be due to a decrease in appreciation of representational paintings high in initial contrast, suggesting that in this condition the expected ceiling effect of contrast is reached sooner on the calibrated monitors that were used in the laboratory.

Third, because we make use of digital reproductions, the initial levels of contrast are estimates. We deemed this an acceptable limitation, because our study pertains to the effect of luminosity contrast in general and we categorized our stimuli by initial level of contrast to investigate the possibility of a ceiling-effect. Also, as mentioned, we assumed the digital reproductions to be reliable approximations of the actual paintings, because all were retrieved from the digitized collection of renowned museums.

Fourth, knowledge of and interest in art were measured only by self-report, thus the reliability of these measures is unknown.

Fifth, participants' familiarity with the paintings was too low to take into account, so our results cannot be generalized to both familiar and unfamiliar paintings. Indeed, previous research has shown that the effect of painting characteristics on appreciation is less robust for familiar works of art (Tinio & Leder, 2009a).

Nonetheless, given the robustness of our results and effect sizes, we conclude that it is probable that contrast is of universal importance in the aesthetic value of paintings and that participants' own characteristics are of minor influence. Painting characteristics, on the other hand, do seem to partially determine how important contrast is in the appreciation of a painting.

We suggest further research to focus on replicating these experiments in samples from other cultures and extending the amount of investigated background characteristics of the participants. For instance, it would be informative to find out whether the effect remains as robust when considered in combination with contextual factors (e.g., labeling the copies of paintings as either 'original' or 'forgery'; Berghman & van Eijck, 2012) or when non-Western paintings are used as stimuli. Moreover, research should be directed at testing the other laws proposed by Ramachandran and Hirstein (1999), given that the framework they provide is both viable and testable. For instance, the law of peak shift can be tested, which poses that exaggerated versions of people or objects are more appealing than generic versions (e.g., the extreme musculature of Greek statues serves as a so-called 'supernormal stimulus' for the human male). This could experimentally be achieved by manipulating human bodies in paintings towards the extreme.

With this study we hope to inspire more interdisciplinary research into art and art appreciation, contributing to a more complete understanding of art and its mechanisms.

3

CONTRAST AND AUTHENTICITY

Abstract:
Visual contrast and authenticity are considered to be important factors in the appreciation of paintings. However, it is unknown if the effects of contrast and authenticity interact and how their effects are moderated by people's culture and art expertise. We investigated to what extent peoples' appreciation of paintings is affected by heightening or lowering the luminosity contrast of paintings and labeling them as a genuine artwork, a forgery, or of unknown origin. We presented these paintings to samples of Dutch, Indian, and American people, as well as to a group of art experts. Our results indicate that 1) people appreciate heightened contrast paintings over their lowered contrast counterparts, 2) people prefer paintings labelled 'original' over their 'forgery' labelled counterparts, 3) these effects are additive, 4) the effect of contrast is stronger than the effect of authenticity, and 5) the effects of contrast and authenticity are present across the investigated groups. In short, we found empirical evidence for the universality and additivity of the effects of contrast and authenticity on peoples' appreciation of paintings.

This chapter is adapted from van Dongen,* N. N. N., Zijlmans,* J., & Dijkstra, K. (under review). The effects of contrast and authenticity on art appreciation of paintings. *Empirical Studies of the Arts*. *These authors contributed equally. *Note:* J. Zijlmans only has one PhD, but I still love him.

3.1. Introduction

Although traditionally art appreciation has been viewed as something of a personal nature, more recently it has been suggested that universal and fundamental laws of art appreciation can be distinguished. Neurologists Ramachandran and Hirstein (1999) have proposed several universal principles of art and aesthetics that form a foundation that allows for personal and cultural similarities and differences. However, the principles they discuss only relate to our shared responses to physical properties (e.g., composition) of artworks and do not touch on attributed or symbolic properties (e.g., monetary value or authenticity) of artworks and how these may interact. In this paper, we present results of an experiment on how appreciation of paintings is affected by luminosity contrast (a relevant physical property; e.g., van Dongen & Zijlmans, 2017), authenticity (a relevant attributed property; e.g., Berghman & van Eijck, 2012), and their interaction. Additionally, we report on how cultural background and expertise of participants are relevant to these effects.

Ramachandran and Hirstein (1999) suggest that due to the usefulness of perception for survival, evolution has culminated in perception processing that can induce affective rewards (see also Nadal & Chatterjee, 2019). Discovering and delineating objects in our visual field is one of the primary functions of our visual system (Marr, 1981; Pinker, 1998; Ramachandran, 1990). To accomplish this feat, cortical areas dedicated to vision rely on extracting correlations between visual elements. For adequate attention allocation, the ocular system is accustomed to perceiving borders of objects (i.e. edges separating objects from their background) and disregards superfluous information (e.g., background luminance and gradient coloring). In this way, optic information can be quickly cross-referenced which allows to distinguish events and objects. As a mechanism that enhances survival because it allows to distinguish mate, meal, or pray from background, this process of binning optical elements into particular events or objects must be reinforcing (Ramachandran & Blakeslee, 1998). Put plainly, we should be motivated to discover these visual correlates and receive affective rewards for this discovery. From this evolutionary viewpoint, Ramachandran and Hirstein (1999) hypothesize a universal neurophysiological basis for art appreciation. They reason that because humans share a neurophysiology, it is probable that we also have similar affective rewarding sensations as a result of perception processing. Specifically, a universal reaction should be triggered by distinct material elements of artworks and their compositions. In addition, Zeki (2001) has argued that there must necessarily be a common neural organization underlying the creation and appreciation of art, and only starting from this common ground differentiation is possible.

Empirical evidence for a general universal basis of art appreciation is growing and a body of literature (for a review of the evidence, see Che, Sun, Gallardo, & Nadal,

2018) now provides evidence for universal effects of intrinsic properties of art (e.g., contrast, form, objects depicted) on art appreciation. Contrast is one of the properties that has been most intensively studied and for which much evidence is available. In line with expectations derived from the theory of neuroaesthetics (Ramachandran & Hirstein, 1999), studies have repeatedly shown that when contrast within artworks is lowered, appreciation decreases (Ewald & Krentz, 2012; Krentz & Earl, 2013; Tinio & Leder, 2009a; van Dongen & Zijlmans, 2017) and when heightened it increases (van Dongen & Zijlmans, 2017). People appreciate objects more when the color contrast or luminosity contrast of the object and its background is heightened (Reber, Schwarz, & Winkielman, 2004; Reber et al., 1998). Heightened contrast is appreciated across social-economic levels (van Dongen & Zijlmans, 2017) and both infants and adults prefer higher contrast to lower contrast versions of artworks (Krentz & Earl, 2013). Of course, contrast is only one factor in a complex process, but as it has consistently been found to be positively related to art appreciation it is an ideal factor to investigate further.

As for *symbolic* properties of artworks, according to (Benjamin, 2008[1936]), the value of art is derived from the aura of an artwork, which can be described as the interpretation of the material (e.g., place of exposition, lighting, physical condition) and immaterial (e.g., authenticity, producer, owner) aspects of a work of art. Following this reasoning, it can be expected that perceiving an artwork as authentic (i.e. as a genuine product of a professional artist) influences its appreciation. That the artwork is a product of artistic genius and expresses proper values, ideals and beliefs is the connotation of the conceptual label of authenticity (Dutton, 2003). The content and significance of this connotation is the product of the creation of meaning through social interaction (Benjamin, 2008[1936]; Fine, 2003; Handler, 1986; MacNeil & Mak, 2007). Therefore, labeling an artwork as the genuine product of an educated professional artist increases the observers' level of appreciation (Berghman & van Eijck, 2012; Hawley-Dolan & Winner, 2011), because in Western cultures the artist is valued separately from the artwork (Benton & DiYanni, 2012). However, the effects of labelling an artwork as authentic appear small. Reversing labels between paintings of professional artists and amateurs still leads to an overall preference for the professional paintings, only somewhat less pronounced than when the labeling of the paintings is correct or absent (Hawley-Dolan & Winner, 2011).

In addition to the effects of physical and symbolic properties, appreciation appears to vary with experience and art education. For instance, non-art students and senior art students differ in their appreciation of original paintings with color in comparison to copies made black-and-white (Hekkert & van Wieringen, 1996b). Cognitive differences between participants are expected to be the cause of these variations in art appreciation. In this case, the training of art experts was argued to result in the development of particular dispositions towards art. In another study, art appreciation of laymen was correlated with their familiarity with artworks and with what the works depict, whereas experts based their evaluation on how original the artworks were in comparison to their experience (Hekkert & van Wieringen, 1996a). Although these cognitive differences are linked to the quality and quantity of previous cultural experience, original representative paintings are still generally preferred by both experts and non-experts over their black-and-white and/or abstract counterparts (Hekkert & van Wieringen, 1996b). This raises questions about the relative strengths of the effects of formal features and contextual features of art, and the sizes of both the similarities and differences between groups

In sum, art appreciation is likely influenced by a range of factors, including physical (e.g., contrast; Krentz & Earl, 2013; Tinio & Leder, 2009a; van Dongen & Zijlmans, 2017) and symbolic (e.g., authenticity; Berghman & van Eijck, 2012; Hawley-Dolan & Winner, 2011) properties of the artworks themselves, and expertise and background of the perceiver (e.g., Benton & DiYanni, 2012; Hekkert & van Wieringen, 1996b). However, these effects have generally been investigated independently of one another and knowledge concerning their relative strengths and codependence is lacking. This is despite the acknowledgement that art appreciation is the result of interacting features of the artwork and the observer (e.g., Hekkert & van Wieringen, 1996b). Therefore, the purpose of this research was to investigate the independent effects of contrast and authenticity on art appreciation as well as their interactions with art expertise and cultural background. The rationale for choosing contrast and authenticity is that both their relations to art expertise are supported by theoretical foundation as well as empirical evidence. From the theoretical accounts and research findings, we formulated four hypotheses. We expected to find 1) a positive effect of contrast on art appreciation; 2) a positive effect of authenticity on art appreciation; 3) the effect of contrast on art appreciation to be constant across participants; and 4) the effect of authenticity on art appreciation to be associated with cultural background (i.e., stronger for Western participants than for non-Western participants). We investigated the effect of art expertise exploratively, as no theory or previous research allowed for the formulation of testable hypotheses.

3.2. Methods

3.2.1. Participants

Participants were 155 Americans (U.S; 44.5% male, mean age = 38.1 years, SD = 13.2), 150 Indians (66.7% male, mean age = 35.2 years, SD = 10.3), 74 Dutch individuals (31.7% male, mean age = 32.5 years, SD = 12.7), and 70 art experts (52.9% male, mean age = 44.9 years, SD = 17.8) recruited via Mechanical Turk and social media (i.e. Facebook and LinkedIn). Mechanical Turk is an international platform for people to participate in online studies for small monetary rewards. Previous research has found no significant differences between experiments performed in the lab and via Mechanical Turk (Zwaan et al., 2018). Moreover, previous research into the effect of luminosity contrast on art appreciation showed no meaningful difference between the same experiment performed in the lab and via Mechanical Turk (van Dongen & Zijlmans, 2017). Nonetheless, the lack of control of monitor type and settings of the participants should be considered. To minimize differences between devices used, participants were prohibited from performing the experiment on a smartphone.

Dutch, American, and Indian participants were included to assess culture related differences in the effects of authenticity on art appreciation. Art experts were included as a fourth participant group to assess possible differences between art experts and laypersons. This group consisted of gallery owners, curators, art critics, and artists either currently working in the field of art or retired with several years of experience in the field of art. They were contacted through social media and could only participate if they had a college degree in arts or were working in the art sector. 52 of 501 participants were excluded from the analyses because they failed to complete the experiment, resulting in a total of 449 participants.

This study was approved by the Ethics Review Committee, Department of Psychology, Education, and Child Studies, Erasmus University Rotterdam.

3.2.2. Stimuli

Eighty color reproductions of paintings were used as stimuli. Stimuli were selected from digital collections of five established European museums. As all museums described the care that was taken to digitize their collection, we assumed that our stimuli reliably approximated the real paintings. The paintings were created between 1500 and 2010 by Western European and North American artists. All stimuli were randomly assigned to one of the four experimental conditions and presented at the same width (500 pixels) and resolution (72 dpi). See Appendix A for an overview of the painting information.

Heightened and lowered contrast copies of 60 of the 80 paintings were created with Adobe Photoshop CS5. For all copies with heightened contrast, brightness of the pixels with a higher luminosity score than neutral gray was systematically increased and brightness of pixels with a lower luminosity score was systematically decreased. The manipulation was exactly the opposite for the lowered contrast copies. The manipulation was validated by comparing the standard deviation on the shade scale before and after manipulation and ensured that global luminance was not affected by the manipulation by comparing the means on the shade distribution before and after manipulation. The exact procedure has been described elsewhere (See Chapter 2 or van Dongen & Zijlmans, 2017).

Authenticity was manipulated by including a caption above the stimuli. One word was presented above each copy of the paintings when presented pairwise. Either both were labelled “unknown”, to indicate lack of knowledge of authenticity, or one was labelled “original” and the other “forgery”.

3.2.3. Procedure

In each trial, participants were presented with a pair of copies of a painting and had to select which of the two copies they liked best. The experiment consisted of 80 trials separated into four conditions, to which 20 paintings were randomly assigned (see Table 3.1 for the condition overview): 1) The contrast condition consisted of heightened and lowered contrast copies both captioned “unknown” (i.e., nothing is known about the paintings authenticity); 2) the authenticity condition consisted of unaltered copies of the paintings where one of each copy-pair was captioned “original” and the other as “forgery”; 3) the first mixed condition consisted of heightened contrast copies captioned “original” and lowered contrast copies captioned “forgery”; 4) the second mixed condition consisted of heightened contrast copies captioned “forgery” and lowered contrast copies captioned “original” (see Figure 3.1 for an example of condition 4). Presentation of the stimuli was randomized and left-right counterbalanced. Preference proportions per subject per experiment condition were calculated for analysis.

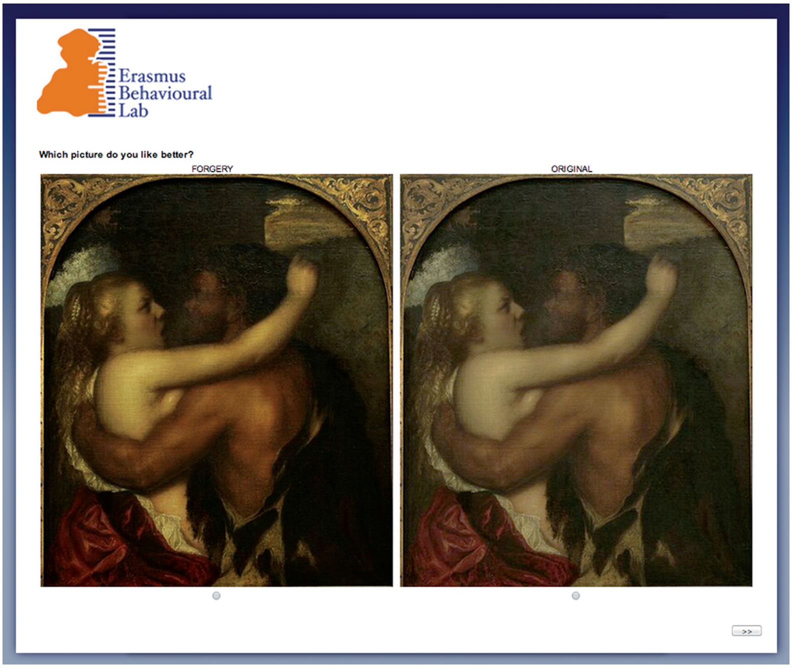

Figure 3.1: Example of a condition 4 experiment question using a representational painting.

Table 3.1: Scheme of the Contrast and Authenticity Manipulation per Condition.

Condition	Contrast	Authenticity
1	Heightened contrast	Unknown
	Lowered contrast	Unknown
2	Normal contrast	Original
	Normal contrast	Forgery
3	Heightened contrast	Original
	Lowered contrast	Forgery
4	Heightened contrast	Forgery
	Lowered contrast	Original

3.2.4. Data analysis

In order to test the main effects of contrast and authenticity on art appreciation and the interaction effects with background characteristics, we performed a 3 (contrast: heightened, original, lowered) x 3 (authenticity: original, unknown, forgery) x 4 (group: American, Indian, Dutch, art expert) mixed ANOVA. We added a dummy factor with a value of 0.5 for all participants to fit the 3 x 3 repeated-measures element of the model. We chose this solution, because adding a condition to the experiment where both copies were identical in contrast and were both labeled “unknown” could be confusing and make it easier for the participants to understand the purpose of the experiment. Such a dummy factor with a fixed value does not introduce additional variance for the model to explain, thus we consider this a benign operation where the main effects are concerned. However, it may have unintentional influences on interaction effects of the repeated measures. Therefore, to ensure the validity of our findings we also performed the analysis without the “original” condition. For the comparisons of the effects on art appreciation between conditions, we performed six Bonferroni corrected paired sample t-tests.

3.3. Results

The mixed ANOVA revealed a significant main effect of contrast [$F(1, 445) = 489.49$, $p < 0.0001$, $\eta_p^2 = 0.52$] with higher contrast begin appreciated more, a significant main effect of authenticity [$F(1, 445) = 295.49$, $p < 0.0001$, $\eta_p^2 = 0.40$] with authenticity being appreciated more, a positive significant interaction between contrast and authenticity [$F(2, 444) = 48.92$, $p < 0.0001$, $\eta_p^2 = 0.18$], and a significant interaction between contrast and participant group [$F(3, 445) = 8.52$, $p < 0.0001$, $\eta_p^2 = 0.05$]. We found no interaction between authenticity and participant group nor did we find a three-way interaction.

To check whether the interaction effect was spurious, we also performed the analysis without the dummy factor. This made the contrast*authenticity interaction disappear [$F(1, 448) = 0.57$, $p = 0.45$, $\eta_p^2 = 0.001$]. Because of its fixed value, it only

Table 3.2: Means and Standard Deviations of Preference Proportion per Condition.

Condition	Contrast	Authenticity	Mean	SD
1	Heightened contrast	Unknown	0.71	0.21
2	Normal contrast	Original	0.66	0.18
3	Heightened contrast	Original	0.80	0.20
4	Heightened contrast	Forgery	0.64	0.25

Table 3.3: Dependent T-Tests of Paired Sample of Experiment Conditions.

Pair	Conditions	t	df	p-value
1	Condition 1 — Condition 3	-7.21	135	< 0.001
2	Condition 1 — Condition 4	5.41	135	< 0.001
3	Condition 1 — Condition 2	20.67	135	< 0.001
4	Condition 3 — Condition 2	8.99	135	< 0.001
5	Condition 3 — Condition 4	8.21	135	< 0.001
6	Condition 4 — Condition 2	0.07	135	0.71

affected the contrast * authenticity interaction, as it created a difference between itself and values of condition 1. It is therefore likely that the interaction is an artifact of the analysis.

We compared the effects on art appreciation between conditions with six post-hoc paired sample t-tests. Mean proportion scores for each condition differed significantly from all other conditions ($ps < 0.05$, Bonferroni corrected) except for heightened contrast “forgery” paintings vs. normal contrast “original” paintings ($p > 0.05$). See Table 3.2. and for an overview of the means and standard deviations per conditions. See Table 3.3 for an overview of the statistics.

The interaction between contrast and participant group was further investigated with a one-way ANOVA. We used the average results of the three conditions that used the contrast manipulation (1, 3 and 4), because a reliability analysis indicated that they could be considered as measuring the same construct (Cronbach’s $\alpha = 0.82$). The ANOVA indicated a significant difference between groups [$F(3,445) = 8.52$, $p < 0.001$, $\eta_p^2 = 0.05$], where Americans preferred the heightened contrast paintings the most (mean = 0.77, SD = 0.16), followed by Indians (mean = 0.71, SD = 0.18) and Dutch people (mean = 0.69, SD = 0.20), and art experts the least (mean = 0.64, SD = 0.18). Post-hoc comparisons reveal that the effect is driven by the difference between Americans versus Dutch [$t = 2.93$, $p_{scheffe} < 0.05$] and Americans versus Art experts [$t = 4.82$, $p_{scheffe} < 0.001$]. None of the other post-hoc comparison showed differences after correction for multiple comparisons. Figure 3.2 presents the results for mean contrast preference scores and 95% confidence intervals per group.

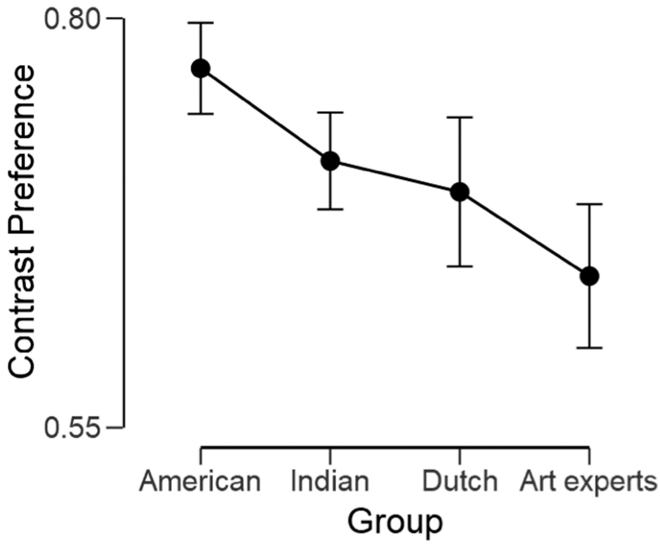

Figure 3.2: Mean contrast preference scores for heightened contrast paintings and 95% confidence intervals per group.

3.4. Discussion

In this study, we investigated the effects of contrast and authenticity on art appreciation and whether these effects are related to the culture and art expertise of participants. The results confirm our first two hypotheses as we found both contrast and authenticity to be strongly related to art appreciation with higher contrast and authenticity compared to forgery being appreciated more. Unexpectedly, we found a small interaction between participant group and contrast (evidence against hypothesis 3), but did not find an interaction between participant group and authenticity (evidence against hypothesis 4).

As hypothesized and in line with previous research (Ewald & Krentz, 2012; Krentz & Earl, 2013; Tinio & Leder, 2009a; van Dongen & Zijlmans, 2017), the level of contrast strongly affected appreciation. These results are in accordance with neuroaesthetic theory, based on a shared neurophysiology for perception-induced affective reward (Ramachandran & Hirstein, 1999; Zeki, 2001). Thus, our results corroborate the expectation that specific physical properties of artworks affect their appreciation across people.

As for the relevance of symbolic properties, our results indicate that authenticity also has a large impact on art appreciation, albeit not as large as contrast (η_p^2 = 0.40 and 0.52 respectively). These results corroborate previous findings where labelling the artworks as the work of professional artists versus amateur artists (Berghman &

van Eijck, 2012) or professional artists versus child, chimpanzee, or elephant (Hawley-Dolan & Winner, 2011) increased appreciation of the first over the latter. Thus, in addition to evidence for a universal basis of art appreciation, we also found evidence in favor of the relevance of symbolic properties of artworks as proposed by Benjamin (2008[1936]) and Dutton (2003).

One unexpected finding is the greater preference for contrast of American participants compared to the Dutch and art experts. Although the effect of contrast was not equal among the participant groups, paintings with heightened luminosity contrast were generally preferred and the effect size for contrast was largest in the Americans. It might be the case that Americans differ culturally from the Dutch, but as we found no differences between Americans and Indians and American culture has more resemblance to Dutch culture (i.e., shared cultural and artistic history) than to Indian culture, this seems unlikely. In addition, if art expertise moderates the effect of contrast, then the art experts should differ in appreciation from the Dutch and Indians as well. Finally, as the effect is fairly small and there is no strong theoretical reason to expect differences particular to American culture, the effect may simply be coincidental. This explanation makes sense in light of findings from a previous study (van Dongen & Zijlmans, 2017), in which Americans participants had preference scores of 0.72; very similar to the preference scores of Indian (0.71) and Dutch (0.69) people in the current study.

Another unexpected finding is the lack of interaction between authenticity and participant groups. We have no strong theoretical or empirical explanation for the absence of differences between cultural backgrounds or levels of art expertise on art appreciation. Speculatively, it might be the case that it is our innate preference for honesty and abhorrence for cheating or deceit (e.g., de Waal, 2009) that affects our appreciation for authentic art and reduces our appreciation for forgeries. It might therefore have nothing to do with what is culturally valued in art and artists or what is learned to be valued by gaining expertise with art. However, no clear conclusion can be drawn from this singular result.

Our study has several limitations. First, the paintings are digitized and presented on monitors rather than in their original shape and form. This results in leaving out elements of texture, smell, and three-dimensional structures that can result from using thick paint and does not allow for the possibility to walk around the paintings. One could argue that this reduces ecological validity. However, research indicates the people react similarly to digitized copies as to the original paintings (Locher et al., 1999). Second, viewing conditions might have varied between participants, because they used their personal computer. There may have been slight variations in monitor settings between participants that could have affected the contrast of the stimuli (e.g., gamma settings of the monitor). However, replication of the effect of contrast in a laboratory experiment indicates that monitor setting variations do not influence the effect of contrast (van Dongen & Zijlmans, 2017). Of course, it could be relevant in association to the other effects we discussed and should be taken into consideration when interpreting the findings. Finally, it is pertinent to realize that it is unlikely that manipulating one or two elements of an artwork changes only these singular dimensions without impacting other elements, nor is it the case that our manipulations capture the full machination of interacting effects that contrast and authenticity have on art appreciation.

Therefore, we offer several suggestions for further research into how art appreciation is affected by artworks' physical and symbolic properties and their interactions. First, we suggest a replication of our study to test if the effect of contrast is indeed stronger in Americans than in others to exclude the possibility that our findings are false positive. Second, the experiment could be extended to include people from more different cultures to further establish whether the effect in Americans is unique or shared by other cultures. Third, similar studies could be attempted with different operationalizations of 'authenticity' (e.g., 'computer rendering/copy' versus 'original', 'early career' versus 'late career'). Fourth, the experiment could be extended to include manipulations of other physical and symbolic properties to map which aspects are also relevant. For instance, the effect of appreciation by peers (e.g., tell participants that 80% of fellow students appreciated the artwork) or the effect of focal point positions (e.g., change the position of the brightest point of the painting, in color and luminosity; also see Ramachandran and Hirstein, 1999). Finally, performing these experiments (e.g., manipulating contrast, authenticity) during fMRI or EEG could be used to identify and investigate the neural correlates of these effects on art appreciation.

With this article, we provide evidence for the universal effects of contrast and authenticity on art appreciation. With work such as this, we hope to inspire more research that combines neuroscientific and cultural-sociological theory and research methods in order to progress to a more complete understanding of art and art appreciation.

4

GAZING AT ART

Abstract:

Differences in art perception between art experts and laymen have been investigated by examining the eye-fixations on salient areas. Previous studies, however, have provided incompatible results and interpretations. We argue that flaws in sampling and research methodology are likely to be responsible for these disagreements. We attempted to improve on the existing studies by investigating the relation between attention fixation on salient areas in paintings and participants' art expertise in a natural museum setting, measuring art expertise on several parameters, using data on 83 participants that were analyzed employing both classical and Bayesian statistics. Our results corroborate the hypothesis that there is no relation between art-expertise and gazing at salient areas of paintings.

This chapter is adapted from the manuscript van Dongen, N.N.N., van Engelen, M.S., Domhof, J.F.M., & Van Eijck, K. Gazing at art: An eye-tracking study on the relation between art-expertise and fixation on salient areas of paintings. The study is also featured in M.S. van Engelen (2015, June 8). 'Perception of Visual Art'. Master Arts, Culture & Society.

4.1. Introduction

Visual artworks such as paintings, sculptures, drawings, or prints are demonstrations of the human capacity to produce and appreciate aesthetic objects. On the one hand, studies have demonstrated that expertise and knowledge cause differences in art appreciation between people (Bourdieu, 1984; Hekkert & van Wieringen, 1996a, 1996b; Thomas & Lin, 2002). On the other hand, our shared physiology suggests a shared basis of aesthetics, implying a large degree of commonality (Ramachandran & Freeman, 2001; Ramachandran & Hirstein, 1999; Zeki, 1999, 2001, 2013).

It has been argued that appreciation results from how - and which - elements of artworks are perceived (Ramachandran & Freeman, 2001; Ramachandran & Hirstein, 1999; Zeki, 2013). People who are more familiar with art, such as art experts, are thought to perceive art differently (Bourdieu, 1984, 1985). We are supposed to take this quite literally, in the sense that people with more expertise peruse works of art in a different fashion, which should be detectible in the different ways in which they explore or scan art objects with their eyes. However, research is divided on how experts' 'gaze patterns' differ from those of laymen. When it comes to perceiving paintings, the eye movements of experts can be either 1) more stimulus-driven (Zeki, 2001); 2) more guided by experience (Zangemeister, Sherman, & Stark, 1995); or 3) not different from those of laymen at all. In the latter case, potential differences in appreciation should be wholly attributed to differences in interpretation (Bourdieu, 1984, 1985; Kirk et al., 2009). The aim of this study is to experimentally test which hypothesis is more plausible.

4.1.1. Similarities and differences in art appreciation between people

Recent advances in neurosciences have increased our understanding of the neurological underpinnings of art appreciation (Cela-Conde, Agnati, Huston, Mora, & Nadal, 2011; Chatterjee, 2011; Nadal, Munar, Capó, Rosselló, & Cela-Conde, 2008; Zeki, 2013). A universal basis for art appreciation, as neurophysiological perception processing (Ramachandran & Freeman, 2001; Ramachandran & Hirstein, 1999; Zeki, 1999, 2001, 2013), could explain various research results. For instance, people appreciate abstract paintings made by professional artists more than seemingly similar works made by children, primates, or elephants, even when the professional artworks are labeled as the product of children, primates, or elephants and vice versa (Hawley-Dolan & Winner, 2011). Similarly, people without prior knowledge of the artworks are often able to discern original paintings from compositionally altered versions. This is indicative of a specific arrangement of elements in the original painting that elicits appreciation, which is disrupted when the composition is changed (Locher, 2003). These results complement fMRI research showing distinct patterns of brain activity when people view paintings they find beautiful rather than ugly (Kawabata & Zeki, 2004; Vartanian & Goel, 2004). Combined, this type of research strongly suggests a common neurological basis for aesthetic appreciation (Cela-Conde et al., 2011; Chatterjee, 2011; Nadal et al., 2008).

Psychological research nevertheless reveals differences in art appreciation related to knowledge and expertise (Hekkert & van Wieringen, 1996a, 1996b; Thomas & Lin, 2002). Specifically, art experts have a higher appreciation for artworks they deem original, whereas laymen prefer the familiar (Hekkert & van Wieringen, 1996a). Art experts have a higher appreciation for novel and abstract artworks and laymen prefer works depicting things they can recognize (i.e. figurative paintings; Hekkert & van Wieringen, 1996b). Thus, while people perceive the same object, the way in which they interpret and weigh visual elements in their overall appreciation could be determined by knowledge and experience (Thomas & Lin, 2002).

Cultural sociological theory takes it a step further by suggesting that all aesthetic valuation is socially determined and in that sense arbitrary. Artworks do not have an intrinsic aesthetic value; their value is instead determined by people with authority in the relevant artistic field, also called gatekeepers, such as art experts, gallery owners, museum curators, etc. (Bourdieu, 1984, 1985). For instance, when an artwork is promoted by a curator of a famous museum, the artwork's reputation increases, which leads to an increase in aesthetic valuation. Aesthetic – and monetary - value increases or decreases when cultural gatekeepers evaluate a particular artist or artwork, thus assigning symbolic value to it (see also Sgourev & Althuizen, 2017). In other words, the attribution of aesthetic quality ultimately results from discussion – often ending in consensus - among gatekeepers, not from some objective or physiological basis determining the quality or impact of what is depicted or perceived (Bourdieu, 1984, 1985; van Rees, 1987).

4.1.2. Visual saliency

Because visual perception is fundamental for survival, evolution resulted in perception mechanisms with affective rewards (Ramachandran & Blakeslee, 1998; Ramachandran & Hirstein, 1999). The primary function of one's visual system is discovering and delineating objects in one's field of vision (Marr, 1981; Pinker, 1998; Ramachandran, 1990). To accomplish this, visual areas of the cortex rely on discerning relations between visual elements. For adequate attention allocation, the visual system is attuned to perceiving sharp variations in light and color, i.e., visual saliency (Borji et al., 2012; Nothdurft, 1993a, 1993b, 2002; Parkhurst, Law, & Niebur, 2002) while disregarding redundant information. This allows the quick cross-referencing of information to identify objects and events. To benefit survival, the binning procedure of visual elements into objects and events must be adaptable and reinforcing (Ramachandran & Blakeslee, 1998). Specifically, via emotional reward, we are enticed to discover visual patterns in varying environments (e.g., distinguishing a mate or predator from various backgrounds).

Visual saliency also guides our attention when it comes to perceiving paintings (Fuchs, Ansorge, Redies, & Leder, 2011). The concept may thus be helpful for our understanding of differences in art appreciation between experts and laymen. Such a difference may be attributed to differentiation in visual perception. We can conceive of different hypotheses in this respect. On the one hand, experts' extensive experience may guide their attention to areas where the laymen's eye does not venture. Indeed, research has shown that expert pathologists focus their eyes more on diagnostically relevant areas on a biopsy image, whereas laymen's eyes are more drawn to diagnostically irrelevant high saliency areas (Brunyé et al., 2014). Similarly, expert analysts of aerial photographs fixate less on high saliency areas in aerial photographs than laymen. Both use high saliency areas as location reference in change-detection and location memory tests, but an expert is able to use semantic information to prioritize where to look next (Lansdale, Underwood, & Davies, 2010). When it comes to professional artists and laymen, artists were found to spend less time gazing freely at empirically defined salient regions in a picture than laymen (Koide, Kubo, Nishida, Shibata, & Ikeda, 2015). During a memory task, such experts tend to be more fixated on these regions of interest, but still significantly less than laymen (Vogt & Magnussen, 2007). Also, art experts tend to let their eyes wander over the entire artwork, instead of fixing their gaze on areas that are close together (Zangemeister et al., 1995).

Alternatively, it is conceivable that experts are *more* attracted to the visually salient elements of a work of art. Through trial and error (i.e., practice and experience) artists produce artworks that they are more or less content with. The experience thus acquired provides them with implicit knowledge on how our visual system and related reward system work. Through the use of color, luminosity, and composition, the artist is able to guide the spectator's gaze over the painting, starting with the most visually salient parts (Zeki, 2001). In that case, visual saliency will overlap with the areas that are also aesthetically salient and experts will be more likely to recognize these parts of a work as artistically meaningful. Along this line of reasoning, it is possible that art experts pay more, rather than less, attention to visually salient elements than laymen.

Finally, instead of being directly related to perception, differences in art appreciation between experts and laymen may also, or instead, be attributable to interpretation. In an fMRI study, participants perceived digital representations of paintings that were presented as either owned by an art gallery or the product of a computer program. The pictures in the art gallery condition received greater appreciation, which was related to memory processing (e.g., entorhinal cortex) and reward expectation areas (e.g., midbrain dopaminergic system) in the brain. These results suggest that art appreciation is determined by conception instead of sensory perception (Kirk et al., 2009). This might explain why another study into visual saliency in art found no gaze difference between experts and laymen when it comes to viewing paintings (Pihko et al., 2011).

4.1.3. Methods of Research

Differences in research results as presented above might result from variations in the data and methods used. Therefore, in relation to previous research, we employed a method with higher ecological validity, extended measurement of art expertise, larger sample size, and less biased statistical analyses. We will elaborate on each of these topics below.

Our first set of choices relate to ecological validity. For free viewing without additional instruments, no significant behavioral differences between viewing original artworks and digital representations were found (Locher et al., 1999). However, variations in gaze patterns might occur between studies that transfix the head of participants with a chinrest and forehead strap (Fuchs et al., 2011; Koide et al., 2015; Vogt & Magnussen, 2007; Zangemeister et al., 1995) and studies where participants are seated on a sofa and use a portable eye-tracker (e.g., Pihko et al., 2011). Also, studies differ in stimuli presentation methods and their resolution; slide projector (Zangemeister et al., 1995), home theater projector (Pihko et al., 2011), or CRT monitor (Fuchs et al., 2011; Koide et al., 2015; Vogt & Magnussen, 2007). In order to minimize that the impact of an artificial test environment on our results, we chose to use real paintings, use a portable eye-tracker, and have our participants view the artworks freely.

Definitions of art expertise vary between studies and sample sizes are mostly small, possibly affecting the results. One study used 20 art history students as experts (Pihko et al., 2011), while others used six (Koide et al., 2015) or nine (Vogt & Magnussen, 2007) art students attending prestigious art academies. One sample consisted of two art collectors and two long-time art gallery and museum visitors as sophisticated group and four long-time practicing painters as professional group (Zangemeister et al., 1995). Apart from these differences in types of participants, the small sizes of these diverse samples are likely to have influenced results. The low statistical power inhibits the discovery of existing effects while significant effects that are reported are prone to be subject to chance and therefore overestimated, resulting in low reproducibility of results (Button et al., 2013). Therefore, we chose to measure art expertise with more than one parameter and use a larger sample.

In terms of the methods used, we argue that, in general, the classical statistical method is biased against the null-hypothesis (Gallistel, 2009) and the fulcrum-like p-value is unreliable as an indicator of significance for research results (Wagenmakers, 2007). Combined with the pervasive publication bias in our research culture, this plausibly leads to numerous false-positive results and a low reproducibility of published research (Collaboration et al., 2015). Thus, we chose to supplement our analyses with Bayesian statistics, which give a more equal comparison of the likelihood of both the null and the alternative hypotheses (Wagenmakers, 2007).

Thus, the aim of this study was to contribute to the understanding of art perception while avoiding these typical pitfalls. We chose to investigate the differences between art-experts and laymen in their perception of paintings as ecologically validly as possible (i.e., in a museum with a non-invasive eye-track instrument); to measure art expertise in a non-dichotomous manner using several parameters; and to analyze our results using methods that assess the likelihood of both the null-hypothesis and the alternative hypotheses (Gallistel, 2009). Based on previous research and theory, we formulated two alternative hypotheses:

H.1. *Experts allocate more attention to high saliency areas in paintings.*

H.2. *Experts allocate more attention to other areas than the salient regions in paintings.*

These hypotheses are compared to a hypothesis of no-difference: 0. There is no difference in perception between experts and laymen.

H.0. *There is no difference in perception between experts and laymen.*

4.2. Methods

An experimental design was used that ensured ecological validity. The experiment was conducted in 2015 in a museum using paintings of its collection exhibition. A non-invasive instrument was used that measured the gaze of participants on particular areas of the paintings and a questionnaire was used to measure art expertise and collect additional participant characteristics. Visitors of the exhibitions were invited to participate on their own volition and without reward. We gathered both experimental and survey data from 78 participants.

4.2.1. Stimuli and instruments

For this study, we used five paintings that are on permanent display in Museum Boijmans Van Beuningen, a Rotterdam based museum attracting some 300,000 visitors per year with a collection ranging from medieval to contemporary art (see Figure4.1). They are framed and exhibited in the same room of the museum, covering three white walls. Artificial light and a window on the east illuminate the paintings. They varied in size and level of abstraction (e.g., recognizable horse and rider or only geometrical shapes).

A pair of eye-tracking glasses were used to measure eye position and movement (i.e., gaze direction) of the participants. The S*MI Eye Tracking Glasses of SensoMo-*

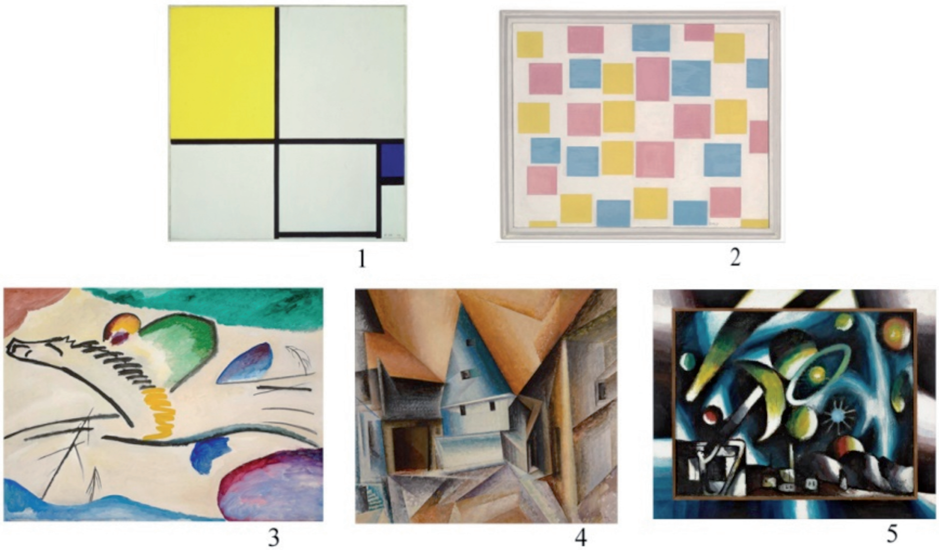

Figure 4.1: Paintings presented to participants. 1) Compositie Nummer II, Mondriaan, 1929; 2) Compositie Met Kleurvlakjes, Mondriaan, 1917; 3) Lyrisches, Kandinsky, 1911; 4) Ober-Weimar, Feininger, 1921; 5) Der Astronom, Segal, 1919.

toric Instruments (SMI-ETG) are worn like a normal pair of glasses and are compatible with contact lenses or glasses. The SMI-ETG contains two cameras (640 x 480 pixels) to track both eyes with a parallax compensation with a frame rate of 30Hz and one camera (1280 x 960 pixels) to record the egocentric view at a frame rate of 24Hz with a 60° (horizontal) by 46° (vertical) field of view. The output of the SMI-ETG is a 2D gaze point with an accuracy within 0.5° on the image plane of the egocentric video (Sensory Motor Instruments, 2015).

A questionnaire was used to assess participants' appreciation of the artworks and level of art expertise was assessed on several indicators (see Appendix B). Data were collected on their level of experience with art (i.e., the number of art museum and gallery visits, current and during their childhood Zangemeister et al., 1995); their art education during high school; art education after high school (Koide et al., 2015; Vogt & Magnussen, 2007); and art history education after high school (Pihko et al., 2011). Participants' appreciation per paintings was measured by asking if they found the painting, on a scale of 1 to 10, beautiful, complex, powerful, interesting, and if it touched them emotionally, as done in previous research (e.g., Berghman, 2013). The questionnaire was bilingual (English and Dutch) and conducted with Qualtrics, an online questionnaire software package (Qualtrics, 2015).

4.2.2. Procedure

During their visit to Museum Boijmans Van Beuningen, people were invited to participate in the experiment. To control for familiarity with the paintings, only first-time visitors to the museum were invited before entering the designated part of the exhibition. First, participants were asked to put on the SMI-ETG and stare at a dot on the wall. Meanwhile, the experimenter calibrated the SMI-ETG, superimposing the participants' gaze, visualized as a red dot, on the SMI-ETG life scene-camera recording of the dot on the wall. Then, participants were instructed to keep their gaze averted from the paintings and position themselves on a small red dot on the floor in front of the first painting. These floor markings were used to ensure the SMI-ETG scene-camera captured each painting entirely and each participant viewed the paintings from the same distance.

Participants were instructed to view the paintings freely. In previous eye movement studies focusing on art perception, viewing periods between 12 and 20 seconds were used (e.g., Koide et al., 2015; Smith & Smith, 2001; Zangemeister et al., 1995). In order to avoid premature truncation of the viewing experience, participants were instructed to view the painting for 20 seconds and then avert their gaze and move to the marking on the floor in front of the next painting. Paintings were viewed by all participants in the same fixed order, each at a distance at which for all participants the SMI-ETG scene-camera could capture the entire painting (see Table 4.1). Painting number one was the painting closest to the entrance of the room, the other paintings were placed going counter clockwise along the three walls of paintings, ending with the fifth painting next to the exit of the room. At face value, this is the natural route for visitors. Having viewed the five paintings, the participants filled out the questionnaire.

Table 4.1: Order of paintings and participants distance from painting.

Number	Painting	Distance to painting
1	Compositie Nummer II	130 cm
2	Compositie Met Kleurvlakjes	123 cm
3	Lyrisches	175 cm
4	Ober-Weimar	165 cm
5	Der Astronom	155 cm

4.2.3. Data

Raw data, the I-view videos, were processed in MATLAB using the algorithm of Itti, Koch, and Niebur (1998), an algorithm programmed for this study with the purpose to remove head movement and discard gaze points outside the boundaries of painting. Per participant, data were excluded if the eye-tracking device did not capture the entire painting. This resulted, in order of the paintings, in 8, 10, 2, 6, and 3 missing values over 78 participants. No participants produced unusable data across all five paintings and no meaningful pattern could be discerned in the missing data.

Per participant and per painting, data were condensed to a single image containing all gaze points (i.e. gaze-points image). Each I-view video consisted of the SMI-ETG egocentric camera frames with the participant's gaze coordinates, visualized as points. Per video, all gaze-points were plotted on the middle frame, while compensating for head movement and computing the transformation from each frame to the middle frame. First, key points were detected in all images by means of the Speeded Up Robust Features (SURF) detector of Bay, Tuytelaars, and Van Gool (2006). Then, key points were matched between every image and the middle image using the fast KNN method of Muja and Lowe (2009). Using the key points matching, the homography transformation was estimated using Torr and Zisserman (2000). Finally, with the homography transformation, the gaze-points for every frame were projected to the middle frame. Per participant, the result was five gaze-points images, one for each painting, on which all gaze-points were plotted with a maximum error of approximately 3.0 pixels.

Saliency in these gaze-points images was computed for each participant with the saliency detection algorithm of Itti et al. (1998). The algorithm computes saliency in terms of local feature contrasts (i.e., color, luminance, and orientation), resulting in a saliency map (see Figure 4.2). Thus, a saliency map was produced per participant per gaze-points image.

Figure 4.2: Saliency map of "Lyrisches", computed with the algorithm of Itti et al. (1998). *Note:* the lighter the area, the higher its saliency.

Thresholding was used to categorize pixels as either salient or non-salient in each gaze-point image. Via an iterative threshold process, 15% of the pixels were determined as salient. Visualized, this resulted in a few metaphorical islands of saliency, surrounded by a sea of low-saliency (see Figure 4.3). This is a deviation from previous studies (Fuchs et al., 2011; Pihko et al., 2011), where a 12.5% threshold was used and salient areas were determined by circles around each picture's five most salient points. We chose for an iterative threshold process, because the circles are prone to overlap and cover areas with low saliency. The threshold was increased to 15%, because this study was conducted on site and not in a laboratory. Specifically, a higher threshold results in a lower moment-to-moment difference in saliency of a perceived area, which could, for instance, be caused by increasing or decreasing luminosity of the room as a result of weather changes.

Figure 4.3: Saliency map of "Lyrisches", computed with a 15% saliency threshold. *Note:* white areas have high saliency, black areas have low saliency.

Based on these threshold maps, saliency proportion scores were calculated from the gaze-points images. For each image, we calculated the ratio of gaze-points within the high-saliency areas to the total number of gaze-points. The end-result was a variable for each painting with possible values between 0.0 and 1.0, representing the relative amount of time a participant gazed at high saliency areas.

Two types of analyses and two types of statistics were used. Factorial repeated measure ANOVA was used to measure perception differences between paintings and linear regression was used to measure the relation between participants' background characteristics and their perception of each individual painting and the overall average. Participants' appreciation of the paintings was also taken into account and used as a control variable. These analyses were conducted as classical statistics analyses and Bayesian statistics analyses. We used classical statistics because they are the default in our field. Even though we are used to testing hypotheses by drawing inferences from p-values, the p-value is based on data that were never observed (i.e., hypothetical data expected under the null-hypothesis). These assumed data are influenced by the intentions of the researcher (e.g., sampling plan) and do not quantify statistical evidence (Wagenmakers, 2007). Also, classical statistics are biased against the null-hypothesis (Gallistel, 2009).

Bayesian Statistical analyses were used because more types of inferences can be drawn from their results. Namely, it allowed us to test the probability of the data under both the null-hypothesis and the alternative hypothesis (Gallistel, 2009; Wagenmakers, 2007). Theory and previous research allowed us to postulate hypotheses predicting both the existence (e.g., Koide et al., 2015) and non-existence (Pihko et al., 2011) of differences in perception of art between paintings and between art experts and laymen. Using the statistical software package JASP (version 0.8.3.1; Love et al., 2015), ANOVA and regression analyses were conducted using Bayesian statistics. Instead of resulting in a p-value, they provide an odds ratio indicating if, and how much, the outcome is more likely under the null-hypothesis or the alternative hypothesis.

4.3. Results

4.3.1. Descriptive statistics

In total, 83 museum visitors participated in the experiment. Since five participants failed to fill out the questionnaire, the analyses are based on 78 participants (36 female, mean age = 34.27, SD = 14.52) who all had normal or corrected to normal vision and reported no color-blindness. Table 4.2 shows the distributions across the answers for our art expertise indicators. These were condensed into meaningful larger categories for reliable statistical analyses. The participants' average proportion of time spent on gazing at high saliency areas per painting is given in Table 4.3, which, as expected, was higher than the 15% surface areas that were identified as salient. Per painting, measures of appreciation were reliably indicative of a single factor of appreciation (in order of paintings, Cronbach's α = 0.79, 0.84, 0.88, 0.83, 0.84) and were aggregated into a single measure of average appreciation.

4.3.2. Repeated measure ANOVA

Variation in proportion of gaze time at high saliency areas between paintings was analyzed with a Repeated Measure ANOVA. Results show a significant variation between paintings [$F(3.17,1330,40) = 11.11$, $p < 0{,}001$, $\eta^2 = 0.16$]. However, there was no significant interaction with level of appreciation, art education of any type, or frequency of visiting art museums or galleries, now or in the past ($p > 0.05$). Analyses of variation in relative gaze time at high saliency areas between paintings were repeated with a Bayesian repeated Measure ANOVA (default prior, r scale fixed effects = 1.0). Results show that the data is more than 600,000 times more probable under the hypothesis that there is a difference in gaze time between paintings than the under the hypothesis that there are no such differences ($BF_{10} = 617701.61$). However, the odds were not in favor of a relation between this difference and indicators of art expertise (default prior, r scale covariates = 0.354). Specifically, the data did not clearly indicate the existence or absence of a relation between relative gaze time

Table 4.2: Art expertise questionnaire results and categories

Variable	Value	Frequency	Percent	Category
High school art education	None	9	11.5	Low
	1 hour or less per week	31	39.7	Low
	2-3 hours per week	27	34.6	High
	4-5 hours per week	5	6.4	High
	6-7 hours per week	1	1.3	High
	8 or more hours per week	5	6.4	High
Art education	None	60	76.9	No
	1-3 individual courses	3	3.8	Yes
	Bachelor degree	10	12.8	Yes
	Master degree	3	3.8	Yes
	Doctoral degree	2	2.6	Yes
Art history education	None	63	80.8	No
	1-3 individual courses	11	14.1	Yes
	Bachelor degree	2	2.6	Yes
	Master degree	2	2.6	Yes
Current average annual art visits	Not at all	1	1.3	Low
	1-2 visits	13	16.7	Low
	3-5 visits	39	50	Low
	6-11 visits	17	21.8	High
	At least once a month	6	7.7	High
	Each week	2	2.6	High
Average annual art visits before 18th birthday with parents, other family members, or friends	Not at all	16	20.5	Low
	1-2 visits	29	37.2	Low
	3-5 visits	18	23.1	High
	6-11 visits	12	15.4	High
	At least once a month	3	3.8	High

at high saliency areas and art history education (BF_{01} = 1.759) and current annual average art visits (BF_{01} = 2.89). The data supported the absence of a relation between relative gaze time at high saliency areas and art education during high school (BF_{01} = 5.67], art education (BF_{01} = 3.86), and annual average art visits during childhood (BF_{01} = 3.15).

4.3.3. Regression analyses

The effect of art expertise on eye-fixation was assessed via linear regression analyses. None of the regression models on variation in relative gaze time at high saliency regions in relation to indicators of art expertise were significant (see Appendix B). All analyses of variance for the regression models for the average across paintings and the individual paintings rendered non-significant outcomes ($p > 0,05$). For Mondriaan's Compositie Met Kleurvlakjes, level of art education had a near significant negative effect on the amount of time spent gazing at high saliency areas ($t = -2.139$, $\beta = -0.34$, $p = 0.05$). However, this is prior to multiple comparisons correction and level of art education made no significant contribution to other models. None of the other

Table 4.3: Average percentage of time spent on gazing at high saliency areas in paintings.

Painting	Mean gaze time (SD)	N (missing)
Compositie Nummer II	31.53 (16.11)	70 (8)
Compositie Met Kleurvlakjes	20.88 (9.28)	68 (10)
Lyrisches	23.54 (9.03)	76 (2)
Ober-Weimar	19.72 (8.16)	72 (6)
Der Astronom	24.21 (11.96)	75 (3)
Overall average	23.41 (7.37)	78 (0)

indicators made a significant contribution to the models.

Measurement of the effect of art expertise on eye-fixations was repeated via Bayesian linear regression analyses (default prior, r scale = 0.354). In all Bayesian regression models the odds are against a relation between variation in relative gaze time at high saliency regions and indicators of art expertise. The data are more than 83 times more probable under the null hypothesis than under the alternative hypothesis that indicators of art expertise predict a person's time spent on gazing at high saliency areas across all five paintings (BF_{01} = 83.38). The odds are also against a significant impact of the art expertise indicators for the individual paintings; *Compositie Nummer II* (BF_{01} = 26.48), *Compositie Met Kleurvlakjes* (BF_{01} = 15.74), *Lyrisches* (BF_{01} = 25.04), *Ober Weimar* (BF_{01} = 13.97), and *Der Astronom* (BF_{01} = 67.14).

Because we used six predictors, each analysis consisted of 69 possible models; 414 possible models in total (see Appendix B). In varying degrees, all but two models were in favor of the null hypothesis. The odds are in favor of an effect of participants' current level of annual art visits on the amount of time they spent gazing at high saliency areas in *Lyrisches* (BF_{10} = 1.42). The odds are also in favor of an effect of participants' high school art education and education in history of art on the amount of time they spent gazing at high saliency areas in *Der Astronom* (BF_{10} = 1.41). Because the odds are only slightly in favor of the alternative hypothesis, the evidence should be considered as anecdotal and lacking inferential value (Wetzels & Wagenmakers, 2012). This is supported by the fact that these effects disappear when more predictors are added to the model and they are absent in the analyses on the other paintings.

4.4. Discussion

The present study investigated whether people's observation of art is related to art expertise. The perception of five paintings was measured among visitors of Museum Boijmans Van Beuningen via a mobile eye-tracking device. Analyses showed that variations in perception time of areas classified as visually salient cannot be explained by the viewers' education or exposure to art through museum and art gallery visits. Through a shared perception system and affective reward system

(Ramachandran & Freeman, 2001; Ramachandran & Hirstein, 1999), art appreciation could be partly related to the sensory properties of the painting. However, lending support to theory (Bourdieu, 1984, 1985) and research (Kirk et al., 2009), differences between art experts and laymen might also be determined by how sensory information is processed and judged, instead of what is perceived.

Some limitations might restrict the generalizability of our results. 1) Although the SMI-ETG was deemed non-invasive, the instrument itself, the set distance from the art works and the fixed viewing order of the paintings may have influenced how people viewed each painting. People could not move their heads and view the paintings from the side or up-close. Even though the method is more natural than the use of a chinrest and computer screen, it may have prompted people to behave in a slightly unnatural manner. 2) The viewing order of the paintings was not randomized, which may have influenced perception. Although visitors of Museum Boijmans Van Beuningen usually view these paintings in the order in which we led them, we could not account for possible effects on perception paintings might have on each other. 3) Only five paintings were used for this study. A larger or different set might provide different results. Most studies use more than 15 paintings (e.g., 20 abstract paintings; Koide et al., 2015). 4) Based on previous research (e.g., Smith & Smith, 2001), we set the gaze time per painting at 20 seconds. Therefore, we cannot exclude the possibility of a difference in general gaze-time between experts and laymen or a difference in gaze-time at saliency regions if the period was extended beyond 20 seconds. In addition, our approach measures gaze-time over a time window and it does not exclude the possibility of differences between experts and laymen from moment to moment within this window. 5) For this study, we assumed the existence of differences between art experts and laymen based on previous research (e.g., Hekkert & van Wieringen, 1996b) instead of quantitative measurements apart from eye movements. We did find a correlation between the aggregate of art expertise indicators and the average painting appreciation ($r = 0.27$, $p = 0.02$). However, for further research we recommend the incorporation of additional instruments to measure differences (e.g., measures on knowledge, interpretation, or memory of the used artworks). 6) The Bayes factors for the Bayesian Repeated Measure ANOVA did not provide strong evidence. Although the data were in favor of the null hypothesis, Bayes factors for two of the art expertise indicators provided anecdotal evidence (BF_{01} = 1-3) and the other three provided substantial evidence (BF_{01} = 3-10) (Wetzels & Wagenmakers, 2012). More research is necessary for decisive outcomes. 7) Perfect correction for head movement was not attainable; this additional static in the data might have influenced results. Even though recordings of which head correction proved difficult were excluded, some noise in the data could not be avoided. At face value this error appears minimal, but a comparative study using mobile and stationary eye-tracking is needed to assess the effect of this error.

Despite these potential drawbacks, this study provides further insight into the perception of art. If our results are correct, the differences between art experts and laymen (Hekkert & van Wieringen, 1996a, 1996b; Thomas & Lin, 2002) are not a result of way their eyes explore artworks. This implies that the differences (e.g., preference for original or familiar) are a result of how people process, interpret, or think about art. This means that thinking about art and discussing art works is an important part of art education. The differences in participants' time spent gazing at salient areas between paintings, independent of their art expertise, suggest that visual properties of the paintings could explain these differences. Apart from saliency, also composition, luminance, color, and what is depicted might determine to which aspects of the paintings people pay attention. Some painters might be better at utilizing visual means in guiding people's gaze across their paintings (Zeki, 2001). For instance, one painter might draw people's attention with a single focus point (e.g., relatively light area) to what the artist considers the most important aspect of the painting, while another might try to drag people's attention from on area to the next via incremental decrease in saliency between the areas.

This study combined theory from different fields and used an ecologically valid setting and statistical methods that test both null and alternative hypothesis. This study has provided results that indicate the absence of an effect of art expertise on the way people's eye scans the artworks. It is our expectation that understanding of art, art appreciation, and aesthetics will advance and converge when more studies are undertaken in which theories from various fields are integrated and tested with methods that lend equal opportunity to the null and the alternative hypotheses.

We therefore suggest several avenues for further research. Investigation of the effect of experience on art perception and appreciation could be extended by studying starting art students, art history students, and non-art students during their education. During such a longitudinal study, art perception and appreciation could be measured using various visual art types (e.g., classical paintings and novel abstract and conceptual artworks) and a number of measurement instruments (e.g., skin response, EEG, eye-tracking, written assessment, and interviews) to assess which responses to art can actually be trained and which cannot. Furthermore, we suggest additional research into art perception. To test the reproducibility of our results, our experiment could be replicated in different museums and with different and additional paintings. Also, to test the reliability of mobile eye-tracking devices, one could compare a free viewing test in a museum with the same test with added chin rests and a laboratory study. For our study, we used several indicators of art expertise, while others use groups of artists, art students, or other art experts. Research comparing various measurements of art expertise should help us define a valid and reliable indicator of expertise and advance our understanding of the relation between (gradations in) art expertise and art appreciation.

To summarize, our study provided evidence against the existence of differences in eye movement across paintings between people differing in expertise. Although we recognize the existence of differences between experts and laymen, we suggest that the cause of these differences might not be found in visual perception, but in how the perceived in is interpreted.

5

EMOTION REGULATION AND ART

Abstract:
Presenting affective pictures as a work of art could change perceivers' judgment and strength in emotional reactions. Aesthetic theory states that perceivers of art emotionally distance themselves, allowing them to appreciate works of art depicting gruesome events. To examine whether implicit emotion regulation is induced by an art context, we assessed whether presenting pleasant and unpleasant IAPS pictures as either "works of art comprising paintings, digital renderings, and photographs of staged scenes" or "photographs depicting real events" modulated perceivers' Late Positive Potentials (LPP) and likability ratings. In line with previous research and aesthetic theory, participants evaluated the IAPS pictures as more likable when they were presented as works of art than when they were presented as photographs. Moreover, participants' late LPP amplitudes (600–900 ms post picture onset) in response to the pictures were attenuated in the art context condition. These results provide evidence for an implicit emotion regulation induced by the art context.

This chapter is adapted from van Dongen, N.N.N., van Strien, J.W., & Dijkstra, K. (2016). Implicit emotion regulation in the context of viewing artworks: ERP evidence in response to pleasant and unpleasant pictures. *Brain and Cognition*, 107, 48-54.

5.1. Introduction

Emotional content may be a prerequisite for creating art, but people will react differently to the emotional content of artworks than to the emotional content of photographs in newspapers or on websites. Scholars describe people's reaction to art as emotionally distanced (Beardsley, 1958; Bullough, 1912; Stolnitz, 1961). Visitors of a museum can appreciate the skill of an artist or the emotions expressed in a painting that depicts a war scene graphically, but can be revolted by a photograph of a war scene denoting similar content at the same time. Enjoying a painting or becoming immersed in a work of art are affective responses to art. These affective responses can be measured by self-reported pleasantness and arousal ratings, and by psychophysiological measures such as skin conductance or EEG. Do human behavioral and autonomic responses to affective pictures differ when the same pictures are presented as artworks compared to when they are presented as real-life photographs?

Usually, the strength of emotional reactions depends both on situational factors (e.g., real versus fictional danger) and appraisal strategies of the individual (e.g., voluntary reinterpretation of emotional stimuli in neutral terms). Situational factors may interact with appraisal strategies as has been demonstrated in empirical research. In their classic and seminal study, Speisman, Lazarus, Mordkoff, and Davison (1964) demonstrated that the content of the soundtrack that accompanied a highly unpleasant film on subincision rites modulated the psychophysiological stress responses among viewers of the film. When the comment of the soundtrack induced defensive interpretations of the film's content, such as intellectualization or denial, participants' skin conductance levels were lower than when it induced a traumatic mode of observation. The different soundtracks can be considered situational factors that induced different types of cognitive appraisal in the participants, resulting in a more detached attitude towards the otherwise arousing stimuli materials. It should be noted that in the Speisman et al. (1964) study, participants were not explicitly instructed to voluntarily reinterpret the film content. Hence their results also demonstrate that these changes in appraisal occur in an implicit manner.

In the present study, we examined whether an art context prompts implicit changes in the appraisal of pleasant and unpleasant pictures. These changes were investigated by measuring people's aesthetic evaluation of pictures presented as artworks and similar pictures presented as non-art pictures, and by measuring their brain electrical reactions to these pictures. We employed a counterbalanced design with two conditions, presenting pictures from the International Affective Picture System (IAPS; Lang et al., 2005) as either artworks or photographs of real events.

5.1.1. Art Experience, Distancing, and Emotion Regulation

Art experience is thought to be qualitatively different from everyday experience (Marković, 2012). For one, art experience takes place in a certain context (e.g., a museum) and it is assumed that such a context cues our cognitive system on how to handle and respond to objects within this context. Moreover, it might trigger the anticipation of a positive emotional pleasurable experience (Cupchik, 1995; Leder et al., 2004). The necessity of a quick reaction and goal-oriented actions to objects might be suppressed (Cupchik & Winston, 1996), because one usually views art in a rather safe environment and the artworks pose no threat to health or survival (Dissanayake, 2007; Tooby & Cosmides, 2001). Through the lack of practical and motivational consequences, people can adopt an emotionally distanced (Bullough, 1912; Cupchik, 2002) or disinterested (Kant, 2016[1790]; Stolnitz, 1961) perspective. In art perception, people go beyond mere object recognition (e.g., Cela-Conde et al., 2004; Kawabata & Zeki, 2004) and also tend to react to structural and stylistic properties of pictures presented as artworks (e.g., Cupchik, Vartanian, Crawley, & Mikulis, 2009; Kirk et al., 2009). The emotional distance to an artwork may thus be further enhanced because art viewing may have the observer focus on the techniques employed in the artwork rather than its emotional content (Marković, 2012).

People are capable of enjoying artworks that depict gruesome acts and situations (e.g., paintings by Francis Bacon). The art context induces a reappraisal that can be conceived as a form of implicit emotion regulation. Such implicit emotion regulation strategies may not be retained for art alone. People are capable of using the same strategies for everyday objects and situations (cf., Dewey, 2005[1934]). Emotional cues guide our attention in order to adequately react to our environment. However, not everything that emotionally grabs our attention on one occasion is something we should consider in another situation, which is why we employ emotion regulation strategies (Gross, 1998). For example, the sound of an explosion while watching a war movie on television will be responded to differently than the sound of an explosion when we walk on the street. In any case, the emotional appraisal of visual stimuli happens quickly, which is why this process can adequately be captured by EEG.

Several studies have demonstrated that the art context as such brings about changes in emotional and cognitive processing. In one study, participants' low positive feelings for disgusting images became more positive when these images were framed as art photographs instead of documentary photographs (Wagner, Menninghaus, Hanich, & Jacobsen, 2014). In another study, participants judged negative stimuli as aesthetically more positive when these pictures were presented as artworks than when the same stimuli were presented as non-art pictures (Gerger, Leder, & Kremer, 2014).

5.1.2. LPP and Emotion Regulation

In EEG research on emotion, the late positive potential (LPP) is a reliable event-related potential (ERP) that indexes sustained engagement of attentional resources by motivational systems (Moran, Jendrusina, & Moser, 2013). The LPP is a slow and positive deviation that develops approximately 300 ms after stimulus onset and lasts for hundreds of milliseconds to seconds, depending on the duration of the emotional stimuli (Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000). The amplitude of the LPP is larger for emotionally intense and arousing pictures than for neutral pictures (Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000; Schupp, Markus, Weike, & Hamm, 2003). Importantly, people are capable of actively attenuating their emotional responses. Specifically, when participants were asked to reinterpret negative images in neutral terms, their resulting LPP amplitudes decreased, reflecting the reductions in self-reported emotional intensity as a consequence of emotion regulation (Hajcak & Nieuwenhuis, 2006; Thiruchselvam, Blechert, Sheppes, Rydstrom, & Gross, 2011).

Aside from voluntary emotion regulation, the situational context can have an involuntary and automatic regulation effect. For instance, the LPP amplitudes, unpleasantness ratings, and arousal ratings were reduced when unpleasant IAPS pictures were described beforehand in neutral terms to the participants (Foti & Hajcak, 2008). Also, when unpleasant pictures were presented as fictitious (i.e., pictures from a movie scene), participants' LPP amplitudes were attenuated in comparison to pictures that were presented as real scenes (Mocaiber et al., 2010). Together, these results are indicative of context related and involuntary emotion regulation of which the perceiver might not be aware.

5.1.3. Research Aims

The current study involved an orthogonal design to investigate the effect of art context on LPP amplitudes in response to positively and negatively valenced pictures, and on the self-reported likeability, valence, and arousal ratings for these pictures. For that reason, we presented pleasant and unpleasant IAPS pictures, which were edited to increase their aesthetic quality (see Method), as either works of art or photographs of real events.

Because distancing can be conceived as a form of implicit emotion regulation, we hypothesized that, as a result of distancing, LPP amplitudes would be attenuated in the artwork compared to the photograph condition. Because the LPP is clearly enhanced for both pleasant and unpleasant stimuli, compared to neutral stimuli, the LPP is assumed to be less sensitive to valence than to arousal (Leite et al., 2012; Schupp et al., 2000). However, some LPP valence effects have been reported. As attention to, and processing of, aversive stimuli may have important survival value, it can be expected that unpleasant compared to pleasant stimuli elicit larger LPP amplitudes.

Larger LPP amplitudes in response to unpleasant versus pleasant pictures have been reported by a number of studies (e.g, Foti, Hajcak, & Dien, 2009; Schupp et al., 2000). In the present study, we might therefore expect larger LPP amplitudes in response to unpleasant compared to pleasant pictures.

LPP studies have demonstrated emotion down-regulation effects for both pleasant stimuli (e.g., Delgado, Gillis, & Phelps, 2008) and unpleasant stimuli (e.g., Foti & Hajcak, 2008; Hajcak & Nieuwenhuis, 2006). For the present research, we therefore expected no specific interaction of valence and context. That is, the implicit emotion regulation effect as a consequence of the art context and as reflected in the LPP will be comparable for pleasant and unpleasant pictures (i.e., a comparable reduction in arousal). Because reappraisal, as a form of emotion regulation, is thought to influence emotion processing in a relatively later stage (Thiruchselvam et al., 2011), we expected attenuated amplitudes in the art condition for the later part of the LPP in particular.

We further expected increased likeability ratings for images presented as artworks, because the aesthetic context would elicit an additional subjective satisfying reaction to the pictures' form and style (Cupchik et al., 2009; Jacobsen, Schubotz, Höfel, & von Cramon, 2006). As Gerger et al. (2014) and Wagner et al. (2014) found more positive judgments for unpleasant stimuli only, we expected that the increased likeability in the art context will be more evident for unpleasant than for pleasant stimuli. Further, we expected decreased arousal ratings and more positive valence ratings for pictures presented as artworks.

5.2. Methods

5.2.1. Participants

Participants were 24 students (10 men, 14 women) from the Erasmus University Rotterdam. Ages ranged from 19 to 26 years, with a mean age of 21.08 years. One of them was left-handed, the others were right-handed by self-report. As we did not expect any brain laterality effects for the ERP measures, the left-handed participant was not excluded from the present study. All students received course credits for participation. The departmental ethics committee approved the study and the participants provided written informed consent.

5.2.2. Stimuli and procedure

Stimuli consisted of 100 pictures of the International Affective Picture System (IAPS; Lang et al., 2005). IAPS is widely used in emotion research. It is a standardized set of about 1000 photographs that depict people, objects, and events representing all types of human emotional experience (for a detailed description, see Lang & Bradley, 2008). Each picture has been rated by a large group of men and women on the extent to which it elicits feelings of pleasure and arousal. On the basis of the published mean affective ratings, picture sets can be selected that are equated on the dimensions of valence and arousal. Half of the IAPS pictures selected for the present research had an unpleasant emotional valence (e.g., photographs of mutilated bodies, crime, disasters), the other half were pleasant (e.g., sport events, loving families, erotic couples). For unpleasant pictures, the mean IAPS norm scores (rated on a scale from 1 to 9) were 2.05 for valence and 6.19 for arousal. For pleasant pictures, the mean IAPS norm scores were 7.36 for valence and 5.95 for arousal. With Camera Raw 6.0 of Adobe Bridge CS5, the original digital IAPS images were edited to look more aesthetically pleasing. The images were uniformly adjusted in exposure, contrast, clarity, color-saturation, sharpness, and noise reduction (see Appendix C).

There were two conditions: the photograph condition and the artwork condition, each with a set of 25 pleasant and 25 unpleasant pictures. Picture sets were matched for valence and arousal ratings and were counterbalanced across conditions. In the photograph condition, participants were instructed: "*The following images are a collection of family photographs, newspaper photographs, and other forms of documentation photography. To ensure that you are not familiar with these images, the photographs were selected from local newspapers and personal collections. Permission for using these images was obtained where necessary. Keep in mind that the images you will see are photographs of real-life events" In the artwork condition, participants were instructed: "The following images are digital reproductions of artworks selected from reputable institutions, like the Guggenheim, National Gallery, Saatchi & Saatchi, and Christie's. To ensure that you are not familiar with these images, the artworks were selected from the institution's undisplayed collections. Keep in mind that the images you will see are reproductions of paintings, digital renderings, or photographs of staged scenes using actors and props.*"

To create the impression of research about art perception, all participants completed an art-experience questionnaire (Chatterjee, Widick, Sternschein, Smith, & Bromberger, 2010) prior to the EEG experiment. Participants were then seated in a dimly-lit room. Half of the participants started with the photo condition, the other half started with the artwork condition. In each condition, participants passively viewed the positive and negative pictures. After each picture, they rated the likability, valence, and arousal of it by pressing one of the numbers 1-9 on a keyboard in front of them for each rating scale. For the likability ratings, there was an on-screen instruction: "*how much did you like the artwork/photograph that you saw? (1 = not at all; 9 = very much).*" For the valence and arousal ratings, the appropriate diagrams of the self-assessment manikin (SAM, Bradley & Lang, 1994) were displayed on the screen. These diagrams are non-verbal visual analog scales with a row of schematic human faces or bodies indicating valence (very sad to very happy face) or arousal (calm to heavily pounding heart), respectively.

The sequence of each trial was (1) the variable 2250-2750 ms presentation of a fixation cross in the middle of the screen, (2) the 3000 ms presentation of the IAPS picture (3) the 1000 ms presentation of a fixation cross, after which the on-screen rating instructions were given until rating responses were made. Pictures fitted a 20" PC monitor screen with a resolution of 1024 * 768 pixels, and were viewed at a distance of 120 cm. Prior to the experimental run, there were 10 practice trials with unspecified pictures that were not used in the photograph or artwork condition.

5.2.3. EEG Recording

EEG activity was recorded using a BioSemi Active-Two system from 32 pin type active Ag/AgCl electrodes mounted in an elastic cap. Electrodes were Fz, Cz, Pz, Oz, FP1/2, AF3/4, F3/4, F7/8, FC1/2, FC5/6, C3/4, T7/8, CP1/2, CP5/6, P3/4, P7/8, PO3/4, and O1/2. Flat-type active electrodes were attached to the left and right mastoids. Electro-oculogram (EOG) activity was recorded from flat-type active electrodes placed above and beneath the left eye, and from electrodes at the outer canthus of each eye. An additional pin-type active electrode (common mode sense) and a pin-type passive electrode (driven right leg) were used to comprise a feedback loop for amplifier reference. The EEG and EOG data were digitized with a sampling rate of 512 Hz, a low-pass filter of 134 Hz, and 24-bit A/D conversion.

5.2.4. ERP Data Analysis

The EEG signals were referenced to the averaged mastoids, and phase-shift-free filtered with a band pass of 0.10–30 Hz (24 dB/Oct). Correction for ocular artifacts was done using the Gratton, Coles, and Donchin (1983) algorithm. ERP epochs were extracted lasting from 100 ms before stimulus onset to 1500 ms after stimulus onset. The ERP signals were defined relative to the mean amplitude of the pre-stimulus period. For each participant and each condition, average ERPs were computed for the pleasant and unpleasant pictures, respectively. Epochs with a baseline-to-peak amplitude difference larger than 100μV or smaller than -100µV on any channel were excluded from further analysis. The mean percentage of valid epochs at analysis-relevant electrodes was 98%. Visual inspection of the grand average waveforms revealed that the 350-600-ms time window after stimulus onset best represented the early LPP and the 600-900 ms time window best represented the later part of the LPP. These time windows are consistent with our previous LPP studies using IAPS pictures (e.g., Langeslag & van Strien, 2010). The LPP has a symmetrical scalp distribution with a maximum amplitude at midline electrodes. Over the course of affective processing, the LPP shifts from a posterior to a more central position (Hajcak, Weinberg, MacNamara, & Foti, 2012). For these reasons, and after visual inspection of the LPP topographies, the 350-600 ms LPP was scored at occipito-parietal and parietal electrodes (P3, Pz, P4, PO3, PO4), and the 600-900 ms LPP was scored at central and parietal electrodes (Cz, CP1, CP2, Pz).

5.2.5. Statistical Analysis

For the likability, SAM valence, and SAM arousal ratings, we conducted separate repeated measures analyses of variance (ANOVAs) with valence category (pleasant, unpleasant), and context (photos, artworks) as within-subject factors. For the early and late LPP we conducted separate repeated measures analyses of variance (ANOVAs) with valence category (pleasant, unpleasant), context (photos, artworks), and electrode (P3, Pz, P4, PO3, PO4 for the early LPP; Cz, CP1, CP2, Pz for the late LPP) as within-subject factors.

5.3. Results

5.3.1. Participants' Ratings

Rating data of one participant were missing due to technical failure. Pleasant pictures, when compared to unpleasant pictures, were rated higher on likability [6.29 versus 3.13; $F(1,22) = 78.28$, $p < 0.001$, $\eta_p^2 = 0.78$], SAM valence [6.26 versus 2.62; $F(1,22) = 124.65$, $p < 0.001$, $\eta_p^2 = 0.85$], and SAM arousal [4.76 versus 3.15; $F(1,22) = 36.59$, $p < 0.001$, $\eta_p^2 = 0.63$]. Across pleasant and unpleasant pictures, artworks were rated higher on likability than photos [4.85 versus 4.57; $F(1,22) = 1.76$, $p = 0.044$, $\eta_p^2 = 0.17$]. Although there was no significant interaction of valence and condition ($p = 0.129$), inspection of the data revealed that the increase in likability was larger for negative pictures than for positive pictures (negative pictures, photo: mean = 2.92, SD = 1.25, artwork: mean = 3.35, SD = 1.47; positive pictures, photo: mean = 6.23, SD = 1.09, artwork: mean = 6.35, SD = 1.07). Artworks and photos did not differ in SAM valence and SAM arousal ratings.

5.3.2. LPP

For the 350-600 ms mean LPP amplitude measure we found a significant main valence category effect with larger amplitudes for unpleasant than for pleasant pictures[$F(1,23) = 10.25$, $p = 0.004$, $\eta_p^2 = 0.31$]. The valence category effect is depicted in Figure 5.1 From this figure, it can be seen that across occipito-parietal and parietal electrodes the LPP was substantially larger for unpleasant compared to pleasant pictures.

For the 600-900 ms mean LPP amplitude measure we found a significant main context effect, with larger LPP amplitudes for photos than for artworks [$F(1,23) = 4.58$, $p = 0.043$, $\eta_p^2 = 0.17$]. The context effect is depicted in Figure 5.2. From Figure 5.2, it can be seen that the LPP context effect is evident across central and parietal

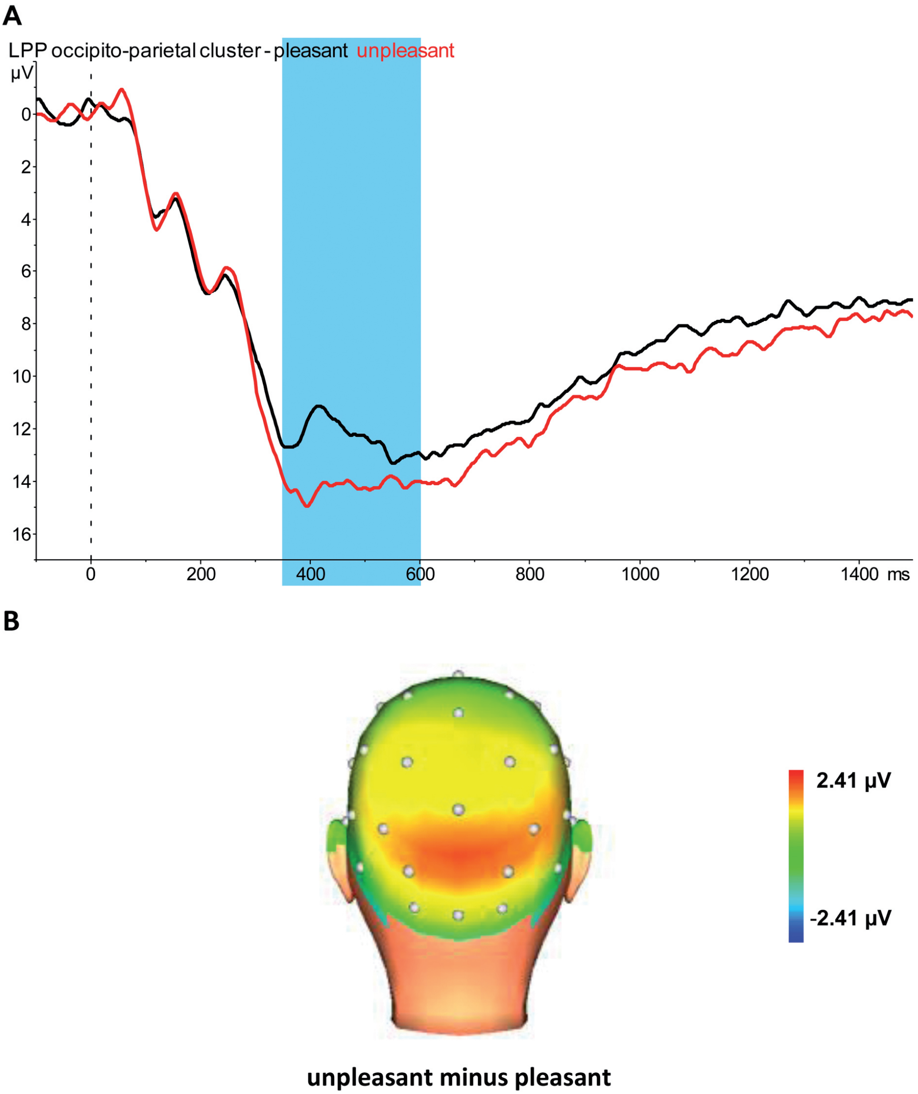

Figure 5.1: LPP potentials (350–600 ms) in response to unpleasant (red lines) and pleasant pictures (black lines) at the occipito-parietal cluster. Negativity is up. B: Topographic map of the difference between LPP amplitudes evoked by unpleasant versus pleasant pictures.

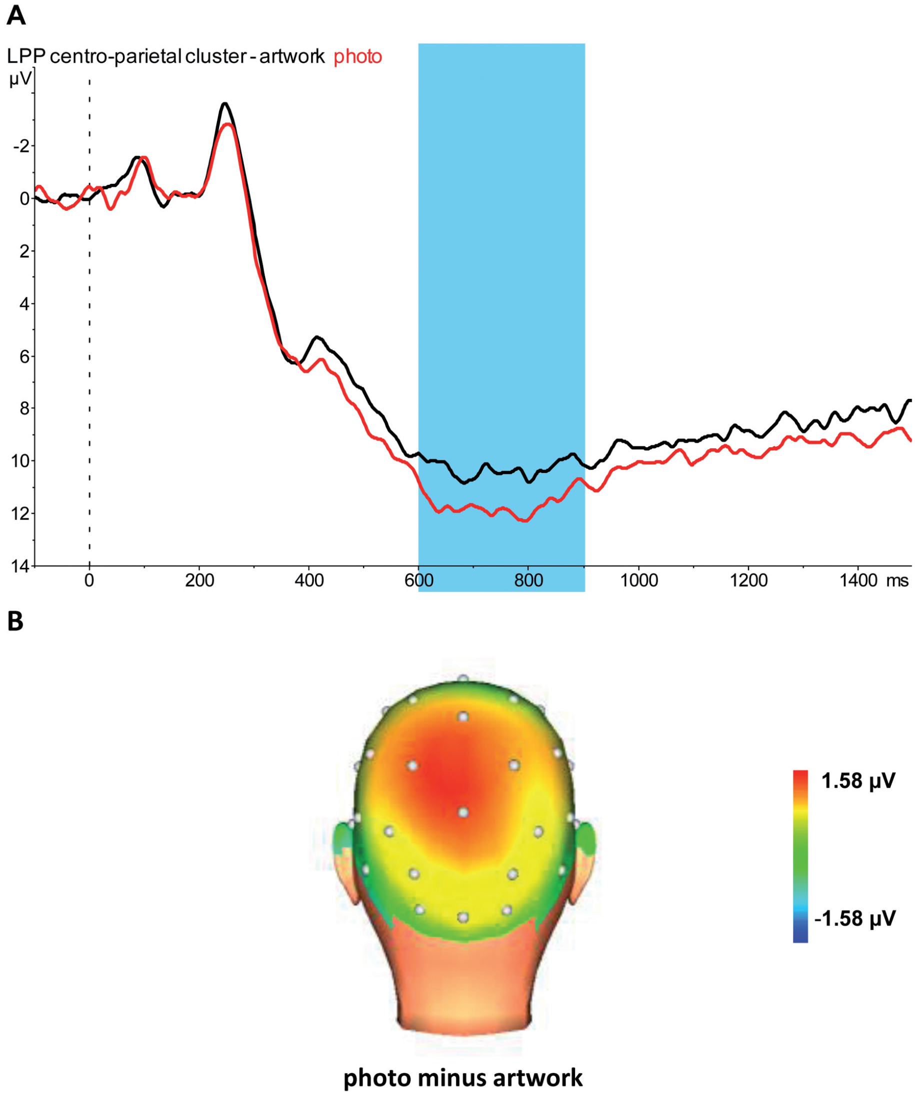

Figure 5.2: A: LPP potentials (600–900 ms) in response to photos (red lines) and artworks (black lines) at the centro-parietal cluster. Negativity is up. B: Topographic map of the difference between LPP amplitudes evoked by photos versus artworks.

electrodes. Notably, there was no interaction of valence category and context [$F(1,23) = 0.002$, $p = 0.966$, $\eta_p^2 < 0.01$].

5.4. Discussion

The present study investigated if and to what extent the appreciation of, and the brain's electrophysiological responses to, emotional stimuli are affected by presenting pleasant and unpleasant IAPS pictures as either a work of art or a photograph depicting a real event. To summarize, both negative and positive pictures in the artwork condition were appreciated differently from pictures in the photograph condition, with likability scores being higher in the artwork condition than in the photo condition. In addition, we found that the art context resulted in a distinct attenuation of the participants' LPP in the 600-900 ms time window in response to both positively and negatively valenced pictures. These results point to an implicit emotion regulation induced by the art context.

Likability ratings were higher for pictures framed as artworks than for pictures framed as photographs. This was found for both negative and positive stimuli, although this increase in appreciation tended to be somewhat larger for negative stimuli. From the assumption of a distanced aesthetic mode (Bullough, 1912; Cupchik, 2002) it would follow that aesthetic detachment yields a better appreciation of negative stimuli in particular. Consistent with this notion, Wagner et al. (2014) found that participants experienced disgusting images more positively in the art photograph compared to the documentary photograph condition. Notably, Gerger et al. (2014) found that unpleasant but not pleasant stimuli were judged more positively in an art context. Our participants' likability ratings suggest that their appreciation changes with context and that, in contrast to previous studies, describing both pleasant and unpleasant pictures as works of art increases these pictures' aesthetic value.

Not surprisingly, the participants' ratings on likability and SAM valence were higher for pleasant than for unpleasant pictures. Although we matched the pleasant and unpleasant picture categories on the IAPS norms for arousal, the present sample of participants exhibited higher SAM arousal ratings for pleasant compared to unpleasant pictures. From an evolutionary point of view, both pleasant (e.g., food, sex) and unpleasant stimuli may be important for survival, although prioritizing unpleasant (i.e., threatening) stimuli may have the highest acute survival value. The IAPS norm ratings show similar, high arousal ratings for pleasant and unpleasant pictures (Lang & Bradley, 2008). It is not exactly clear why our participants rated the unpleasant stimuli as relatively less arousing. It could be that in our sample, participants had a more defensive voluntary appraisal of the unpleasant stimuli, while their involuntary brain response, as reflected by a larger early LPP for unpleasant stimuli, may have been indicative of a negativity bias (i.e., prioritizing unpleasant over pleasant stimuli).

Regarding the ERP measures, we found a mean valence category effect for the early LPP (in the 350-600 ms time window) at the occipito-parietal cluster, with amplitudes being higher for unpleasant than for pleasant pictures. The larger early LPP in response to unpleasant pictures is consistent with previous research that found a larger LPP for unpleasant rather than pleasant stimuli (Foti et al., 2009; Schupp et al., 2000). The larger early LPP amplitude for unpleasant compared to pleasant pictures is not driven by the extent of self-reported arousal (Olofsson, Nordin, Sequeira, & Polich, 2008), as SAM arousal ratings were significantly lower for unpleasant than for pleasant pictures.

The centro-parietal late LPP amplitude attenuation that we found in the present study as a consequence of providing an art context, is consistent with previous research employing explicit emotion down-regulation. In their reappraisal study employing IAPS pictures, Hajcak and Nieuwenhuis (2006) demonstrated that in the reappraise condition the 600 - 1000 ms LPP amplitude at the centro-parietal electrode (CPz) was significantly smaller than the LPP amplitude in the attend condition. The similarities in the time course and location of the LPP modulation between their study and the present results suggest that in the late LPP time window the underlying neurophysiological process involved in implicit down-regulation is comparable to the process involved in deliberate reappraisal.

Valence category modulated early LPP but not late LPP amplitude, whereas art context modulated late LPP but not early LPP amplitude. This suggests that valence categorization (pleasant versus unpleasant) precedes the implicit emotion regulation. From an evolutionary viewpoint, prioritizing unpleasant above pleasant stimuli before subsequent emotion regulation makes sense. The present early LPP valence effect, which can be interpreted as a negativity bias (Ito, Larsen, Smith, & Cacioppo, 1998), challenges the notion that the quick goal-oriented response to art works will be reduced, because one typically views art in a rather safe environment and the artworks pose no threat to survival (Dissanayake, 2007; Tooby & Cosmides, 2001). It appears that the implicit emotion regulation does not take place immediately, but at a somewhat later processing stage after valence categorization. Note that the early LPP valence effect is localized at occipito-parietal sites, while the late LPP context effect is localized at centro-parietal sites. This is consistent with the known spatial shift of the LPP over the course of affective processing from posterior to more central sites (Hajcak et al., 2012).

The LPP attenuation might result from a difference in attention allocation between artworks and non-art pictures. Presenting a picture as a work of art might entice people to appreciate its form and style instead of what is depicted (e.g., Cupchik et al., 2009). While people are goal-oriented towards non-art pictures and therefore react to what is depicted, they react differently to art (Cupchik & Winston, 1996). Instead of studying a picture's content (e.g., a grotesque picture of a severed hand), attention is allocated to how it is depicted (e.g., composition, light, and color) and as a result people's emotional reaction is attenuated. It is our expectation that further insight into causes and mechanisms of context-related emotion regulation could be gained by continuing research with aesthetic stimuli.

The LPP context effect was not reflected in the participants' SAM valence and SAM arousal ratings as artworks and photos did not differ in these ratings. Asking participants to explicitly rate the IAPS pictures on these two emotional dimensions may be less susceptible to implicit emotion regulation.

It could be argued that the instruction that we used for the artwork condition suggested that at least some of the artworks were staged. This leaves the possibility that not only the art context but also the fictitious character of the stimuli contributed to the implicit emotion regulation that we found (e.g., Mocaiber et al., 2010). It should be noted, however, that throughout the art condition, the pictures were specifically presented as artworks. During the experiment, the context condition itself was stressed in each trial, because after each picture the participants were asked to rate the "artwork" or "photograph", respectively. Further research should disentangle the art and fiction aspect by framing pictures either as art or as staged.

A related limitation of the present research is that there was no manipulation check to find out if the participants actually believed that they were viewing artworks versus photographs. Research (Gerger et al., 2014; Wagner et al., 2014) has demonstrated the efficacy of the framing manipulation that we employed. However, it may be worthwhile to examine whether the magnitude of the LPP context effect is associated to the extent to which participants are convinced that they are looking at artworks.

We suggest several additional avenues for further research, to corroborate our results and continue the investigation into emotion and emotion regulation. Similar experiments using EMG or fMRI could provide more insight into context effects on both the valence and arousal dimension. A picture set of artworks with normative valence and arousal ratings comparable to IAPS could be used to further investigate emotion regulation through art. Using various fictitious contexts could provide further insight in emotion regulation in general, for instance, describing pictures as staged for a documentary; staged for a prank by individuals; a still from a movie; or a commercial advertisement.

To summarize, our results show that presenting a picture as a work of art changes people's appreciation of it, as well as brain electrical activity to it. The late LPP in particular is attenuated by the art context. The present results are indicative of an implicit emotion regulation mechanism, which is induced by an art context and in which psychological distancing and attention to aesthetic properties might play a role.

6

CONCLUSION

6.1. General Summary

For this project, the evaluation of several physical and non-physical characteristics of paintings was investigated to gain more understanding of the mechanisms underlying art appreciation. The individual studies were designed to incorporate elements from different fields of research. The purpose was to investigate how particular (elements of) theories from these disciplines coexisted. Specifically, we investigated the interplay of paintings' physical (contrast and saliency) and non-physical (authenticity and description) features and perceivers' characteristics (education, nationality, art expertise). In chapters 2 and 3, participants viewed a series of two versions of several paintings side by side that differed in their luminosity contrast and were asked to select the version they preferred. From the results of these studies, one can conclude that the positive effect of luminosity contrast in paintings on their appreciation is robust. Across five experiments, four mentioned in Chapter 2 and one in Chapter 3, participants clearly favored the paintings with increased contrast over their original or lowered contrast counterparts. The results also indicate that this effect was present across different types of people. All the groups researched in chapters 2 and 3 show the effect, even when controlled for theoretically pertinent participant characteristics such as education, age, and cultural background. However, culture might play a role as a modest moderator. In one experiment, the American sample was more affected by increased contrast than some of the other participant groups (Chapter 3).

The non-physical characteristic of authenticity has a positive effect on the appreciation of paintings as well. Labeling the digital copies of paintings as either "original" or "forgery" increased or decreased the appreciation of the painting respectively. This effect was stable across all four samples tested (total N= 449) in the experiment. Interestingly, the combination of contrast and authenticity appears to be additive, not interactive. Appreciation of higher contrast paintings increased with about the same intensity when labeled "original" as it decreased when labeled "forgery" (Chapter 3). Participant characteristics did not moderate this effect.

Results from Chapter 4 show that visual elements of a painting that stand out – have high visual saliency – grab people's attention. In this experiment, the eye movement of visitors of Museum Boijmans Van Beuningen (Rotterdam, the Netherlands) was measured with ambulant eye-tracking glasses while they looked at paintings displayed in the museum's permanent collection of abstract expressionistic art. In general, the participants spent more time gazing at the surface areas of paintings that were strong in luminosity and color saturation relative to the areas that were weak in these respects. This tendency was shared across participants. None of the theoretically suggested participant characteristics, such as art expertise and education, correlated with the proportion of time people spent gazing at high saliency areas (Chapter 4).

From Chapter 5, one can conclude that describing non-art photographs as works of art increases people's appreciation of these pictures and reduces their emotional response to them. When photographs were presented to participants as digitized works of art, in comparison to photographs from an archive, they showed an increased self-report of appreciation and an attenuated Late Positive Potential on their electroencephalogram. The latter is indicative of a lower emotional response to the pictures presented as artworks than to the pictures presented as photographs (Chapter 5).

6.2. Theoretical Implications

Based on the presented results, conception and interpretation of the viewed artworks appear to play an important role. The results corroborate earlier findings from cultural sociology (e.g., Sgourev & Althuizen, 2017) and neuroscience (e.g., Kirk et al., 2009). In addition, they conform to various aspects of theory from philosophy (e.g., Dewey, 2005[1934]; Kant, 2016[1790]), cultural sociology (e.g., Benjamin, 2008[1936]; Bourdieu & Nice, 1980), psychology and neuroscience (e.g., Zeki, 2001). As one would expect, the appreciation of the apparent artwork is not solely determined by its appearance. A person's appreciation of an object is modulated by whether it is conceived, for instance, as a work of art from a museum collection, as a family photo from a digitized archive (Chapter 5), or as an authentic work made by a creative genius or a forgery made by a skillful charlatan (Chapter 3). These results provide evidence for the hypothesis that one's expectations and memories matter when it comes to aesthetics. This could explain why, although there are clear differences in appreciation of the same objects (e.g., Hekkert & van Wieringen, 1996a, 1996b; Palmer & Griscom, 2013), people's level of art expertise and education did not affect what their eyes were focused on in the paintings (Chapter 4). In line with common sense, the difference between experts and laymen would not be due to paying more or less attention to peripheral details of the painting, but to the evaluation of the visual elements through their experiences and expectations (e.g., Bourdieu, 1990; Kirk et al., 2009).

However, experience and expectation might not play the leading role in art appreciation. It could be the case that physical components of an artwork are of more importance. Across studies, personal characteristics, cultural backgrounds, and expertise levels, the effect of contrast is robust and seems universal. These results (Chapters 2 and 3) can be considered as confirmatory evidence of the universal preferences for contrast as postulated by Ramachandran and Hirstein (1999). They argued that because of the evolutionary advantage of a reward-guided self-reinforcing perceptual system, physical characteristics of a painting, such as luminosity contrast, would universally trigger a rewarding emotive response. The results indicate that, all other things being equal, the effect of contrast on appreciation is not only strong (i.e., partial eta squared of about .6), it is also present across all studies and groups and the effect of authenticity only slightly increases or decreases appreciation of high contrast paintings (Chapter 3).

Curiously, close to none of the socio-cultural participant factors appeared to moderate the effects under investigation. From research in arts and culture studies, or cultural-sociological research, one would expect art appreciation to be highly dependent on cultural capital or social class (e.g., Bourdieu, 2013[1984]). Socio-cultural theory states that appreciation for art, especially highbrow art (i.e., modern, avant-garde, abstract, etc.), increases with education and experience with art. From such a perspective, one could expect that the difference in size of the effect of contrast on appreciation between abstract paintings and representational (classical) paintings might be related to these factors, such as people's level of (art) education. Or, that physical characteristics are irrelevant to appreciation due to its cultural construction. However, none of these factors appeared to explain the strength of preferences for copies of paintings with increased contrast (Chapter 2). In addition, art expertise, as art education and practice, did not increase or decrease preference for original copies over their alleged forged counterparts (Chapter 3). In stark contrast, many studies have found differentiation in art appreciation along socio-cultural factors (Berghman & van Eijck, 2009; Chan & Goldthorpe, 2007; Lizardo & Skiles, 2008; López-Sintas & Álvarez, 2004; Silva, 2006; Tampubolon, 2008, 2010; van Eijck, 2001, 2012; van Eijck & Knulst, 2005) and it could be the case that the absence of cultural differentiation in the results is a statistical fluke. However, this seems not a viable possibility, because the absence is consistent across six studies and over a thousand participants. As a more plausible explanation of the results, it could be that the socio-cultural factors operate on a more general level of art appreciation. Instead of on the level of elements of individual artworks, it might be the case that these factors influence which paintings are appreciated over others and whether or not a museum is visited. Thus, these results are not considered as evidence against the theory of cultural capital and social class, though they do provide evidence against the assumption that individual physical features of artworks are irrelevant or arbitrary.

In summary, the results of these experiments provide an interesting picture with respect to the theories from the fields that investigate art and aesthetics. On the one hand, we have robust evidence in favor of a physical characteristic like luminosity contrast (Chapters 2 and 3) that has a basis in biological evolution and neuroscience. On the other hand, there is evidence for a particular mindset towards art (Chapter 5, emotional distancing; Kant, 2016[1790]) and the effect of a contextual factor such as authenticity (Chapter 3) that can be considered more in line with philosophy and cultural theory. Additionally, there is indication that expected appreciation related to expertise and educational factors does not appear to be a result of differences in attention allocation to physical features of artworks (Chapter 4), which aligns with the involvement of cognition that is expected by cultural and psychological theory. From the perspective of a single field of research, these results are difficult to explain.

In other words, these results can be interpreted as a demonstration of the necessity to approach the research of art and aesthetics from several theoretical perspectives and that the combination of such perspectives in empirical research is possible and potentially fruitful. Such collaboration could add to or improve already existing attempts at partial unification (see Section 1.5 and Bullot & Reber, 2013; Chatterjee & Vartanian, 2016; Leder et al., 2004). There are highly speculative theories out there on the explanation and causes of art and culture through, for instance, memes (cultural equivalent of a gene; Blackmore, 1999) the effects of somatic responses to our environment to maintain homeostasis (somatic marker theory; Damasio, 2000, 2004, 2006, 2017), or sexual selection (Prum, 2017). However, even after this thesis, in my opinion, it is still too early to conjecture how the different academic perspectives on art and aesthetics will fit together and which overarching theory is more veracious. Such conclusions require more open-ended discovery-oriented research. Based on the results of this thesis, I can infer that relevant factors in one research field cannot be regarded as irrelevant random noise in another (e.g., cultural factors in neuroimaging research). Research methods can be borrowed and combined, and theory in each field could be amended to fit the others. Where one field does not take ecological validity and social and cultural diversity into account the other could benefit from certain experimental measurements and explication of cognitive and physiological processes. One could adopt a systematic review approach of comparing neuroaesthetic and cultural sociological theory, identifying overlap, gaps, and inconsistencies; followed by the derivation of predictions from specific neural response to behavior of social classes and cultures; and culminating in studies that combine measurement of physiological response and sophisticated observation and survey methods (see Section 6.4). The previous chapters have provided a glimpse of this possibility.

6.3. General Limitations

Apart from the particular limitations discussed in each chapter, the studies combined are marred by a few general limitations. 1) Apart from the effect of contrast, none of the other results are confirmed by replication. The effect of authenticity (Chapter 3) was found in all four of the tested groups, but additional experiments need to verify if this effect is real and robust. The same goes for the eye-tracking study where attention allocation was measured (Chapter 4) and the EEG study where ERP and self-report response was measured to contextualized photographs (Chapter 5). In addition, the last two studies also suffer from small sample size and samples unrepresentative of the general population (i.e., museum visitors in Chapter 4; psychology students in Chapter 5). Highly powered replication studies with representative samples need to be carried out before strong conclusions about the mentioned effects can be drawn with any confidence.

2) A relevant part of the theoretical background hinges on neurophysiology, though neural response is only measured in one case (Chapter 5). In line with the theory, the effect of contrast is shared across all investigated groups. However, this does not mean that the effect does indeed arise for the reasons specified by the theory (e.g., Ramachandran & Hirstein, 1999; Zeki, 2001, 2013). If we want clear confirmatory evidence of the theory of neuroaesthetics, then brain scanning with high spatial resolution (e.g., fMRI) needs to be part of further research into the effect of contrast.* A similar point can be made for the results from the EEG experiment (Chapter 5). Although ERP studies have a high temporal resolution (i.e., measurements in microseconds), it is very coarse spatially. It also only measures electrical activity of the cortex and does not penetrate to the subcortical brain structures (e.g., amygdala and hippocampus), which are relevant for inducing emotive responses and storing and activating memory (Kandel, Schwartz, & Jessell, 2000). In other words, experiments such as reported in chapters 2 and 3 should be repeated with fMRI to verify that contrast does indeed increase limbic-system response.

3) Finally, the theory of neuroaesthetics is based on evolutionary principles of natural selection. The issue is that the derivation of neuroaesthetic laws from evolution theory are not corroborated by empirical research. It is the case that the results from experiments on the effect of contrast (Chapters 2 and 3) support the neuroaesthetic hypothesis of the universal effect of contrast Ramachandran and Hirstein (1999). However, this is not direct confirmatory evidence of the survival value of positive affective feedback on contrast perception. It could be that there is another kind of biological adaptation that explains the results equally well or better. For instance, sexual selection has resulted in physical attributes (e.g., peacock plumage) and extended phenotypes (e.g., elaborate nest building) that we consider beautiful (Prum, 2017), which might also provide an explanatory theory of art appreciation (e.g., we appreciate certain things because the accompanying behavioral traits were favored by the opposite sex). Concretely, the lack of bio-evolutionary research, with for instance non-human primates, makes it impossible to draw strong conclusions from the results presented in this dissertation to the natural selection based theories of neuroaesthetics.

*Unfortunately, this was beyond the financial scope of this project.

6.4. General Implications and Suggestions for Further Research

Several general implications and suggestions for further research follow from the results and their limitations. Specifically, the results indicate that the effects of physical (contrast) and non-physical (authenticity) features on art appreciation could be universally shared and more than one feature can be investigated in one experiment. Generally, the academic implication is that philosophy, cultural theory, psychology, and neuroscience can be fruitfully integrated when testing aesthetics and art appreciation. Theories from these academic fields overlap and do not need to be mutually exclusive. Although they might contrast or contradict each other in some respects, they likely agree and supplement each other in other areas. Such agreement and contradiction can be tested to move towards a more complete understanding of art and aesthetics. As proof of principle – for instance the use of modern EEG methods to test Kant's theory of aesthetics (Chapter 5) – these results could persuade researchers and theorists across disciplines to collaborate (e.g., use each other's theories, learn from research methods, borrow instrument). Physical features such as contrast apparently have a strong influence on the appreciation of an artwork. Thus, these factors might still be of effect at the cultural level of tastes in art styles and contextual factors. Also, where and how an artwork is presented, might reverberate down to the neurophysiological level. If agreement is lacking, collaborations between researchers from different fields could resolve theoretical debates by providing empirical results from studies with methods agreed upon by all researchers. The specific academic implication is that the results indicate that artwork attributes can be successfully researched in combination (e.g., contrast and authenticity) to test if their effects on art appreciation are additive, interactive, or linked in a causal chain. This has the potential to culminate in an explanatory model of art appreciation that incorporates social, neuropsychological, and symbolic and physical artwork factors.

To bring these implications to fruition, I suggest the following avenues of further research. First and foremost, I suggest an interdisciplinary avenue of cooperative research between the humanities and the social sciences to make the investigation of aesthetics and art appreciation more theoretically refined (i.e., incorporate classical theories of aesthetics from the humanities) and methodologically adequate (i.e., employ rigorous and direct experimental methods from the social sciences). These collaborations do not have to agree on a particular theory, because the diverging predictions of multiple theories can in principle be tested by a single (set of) experiment(s). As long as the researchers can agree on the method,[†] inter-disciplinary

[†]This might appear difficult at first, because of large differences in research methods between the humanities and social sciences; stereotypically, qualitative and observational research in the field on the one hand and quantitative and experimental research in the lab on the other hand. However, these fields have used the other's methods on several occasions and technological advances make physiological measurements (e.g., heart rate, EEG, eye-movement, etc.) more mobile and less intrusive.

progress can be made that extends beyond the limits of each single discipline. Such interdisciplinary research will allow us to move towards an encompassing theory of aesthetics, from shared biological basis to personal differentiation. In this dissertation, Chapter 5, where Kant's (2016[1790]) theory of emotional distancing was tested with neuroscientific methods, is the clearest proof of principle. However, where theories disagree, proponents from each are required to specify what is predicted by these theories (e.g., the (ir)relevance of artworks' physical features in taste differences between social groups). As an illustration, imagine a set of studies with designs that are agreed upon by both philosophers and neuroscientists in an attempt to settle disagreements like the one between the theory guided by notions of natural selection that art appreciation results from the artworks' physical features (e.g., Ramachandran & Hirstein, 1999; Zeki, 2001, 2013) and the criticism on that theory from the philosophy of aesthetics (e.g., Hyman, 1996) that physical features explain only a small fraction of the entire art experience. Such an a-priori agreed-upon set of studies could then arbitrate between these perspectives due the difference in what they predict these studies will find.

Second, I suggest a cumulative research avenue. In general, we investigate a single property or mechanism, which we try to vary while keeping everything else constant in the experiment. However, such research tells us little about the machination of the subject of interest (e.g., the appreciation art) if it is a complex process of inter-related mechanisms that result from a diverse set of properties (e.g., social, neural, physical, symbolic, etc.). The effects of - and relation between two such properties were tested in an experiment reported in this dissertation (i.e., contrast and authenticity; Chapter 3), but more should be added step-by-step in and different combinations in further research. For instance, the contextual effect investigated in Chapter 5 (presenting the pictures as art or non-art) could be tested in combination with manipulation of luminosity contrast of the stimuli and the effect of composition and structure of high salience areas (Chapter 4) on appreciation could be tested in combination with manipulating the context (Chapter 5). A third manipulation can then be added after the effects of two such features in combination is robustly established (i.e., several positive replication studies). Such a step-wise approach allows testing combinations of features in clusters of increasing size without losing methodological rigor and will result in a more complete understanding of how the individual features of an artwork interact with, negate, add to, or subtract from one another with respect to its appreciation by the viewer.

Third, I suggest a more direct research avenue for testing the underlying theory. If aesthetics has a biological basis that resulted from natural selection, then, as a prerequisite, at least traces of this (e.g., particular responses to high-contrast stimuli) should be observable in our closest evolutionary relatives (e.g., chimpanzees and bonobos) and more distant evolutionary family members (e.g., all mammals). Concretely, we should share observable neural corollaries of aesthetic responses (e.g., limbic response to perceptual stimuli). When studying humans in particular, we should investigate the universality of neural corollaries of aesthetic responses moderation by particular properties. For instance, a neural response to (increased) contrast (in paintings) that is shared across people is necessary for the validity of a neuroaesthetic theory that hypothesizes the universality of the effect of contrast.

In conclusion, there is a long road ahead of us. The results presented in this dissertation are promising and generally in line with predictions deduced from the discussed theory, but their scope is limited and there are several auspicious avenues of research on which we have only just started. I therefore conclude with the request to both researchers from the humanities and social sciences to not necessarily set our differences aside, but to use these differences to develop ways in which we can test each other's theories as collaborators.

A

APPENDIX TO CHAPTERS 2 AND 3

Paintings used as stimuli in the studies of chapter two and three.

Table A.1: List of paintings used in the studies of chapter two and three.

	Title	Artist	Year
1	Discs	James Rosenquist	1965
2	Doorlopen naar buiten	René Daniëls	1987
3	Image IV	Fletcher Benton	1975
4	Ohne Titel (III.2)	Günter Förg	1986
5	Ratten und Melonen	Markus Lüpertz	1984
6	Septemberdag	Leo Gestel	1913
7	The landscape of silence	Azade Köker	2010
8	via sheen	Kenneth Noland	1968
9	Werkgruppe II- Das haben wir noch nie so gemacht!	Sigmar Polke	1982
10	Zonder titel	Klaas Kloosterboer	2007
11	Bloeiende appelboom	Piet Mondriaan	
12	Compositie no.11	Piet Mondriaan	1913
13	Counterpointed Grey	JCJ van der Heyden	2008
14	Das Schaf	Franz Marc	1913
15	Eyes in the heat	Jackson Pollock	1946
16	Flower	Yayoi Kusama	1954
17	Grijze boom	Piet Mondriaan	
18	Kleurencompositie nr. 6 (Bos)	Jacoba van Heemskerck van Beest	1913
19	Koffiepot	Daniël den Dikkenboer	1955
20	Lyrisches	Vasili Kandisky	1911
21	Mon Premier amour	Man Ray	1952
22	Montagnes aux écritures	Jaap Wagemaker	1960
23	Nus dans la forêt	Fernand léger	1909
24	Positano	Leo Gestel	
25	Recumbent form (groen en geel)	Barbara Hepworth	1947
26	Schilderij	Piet Ouborg	1931
27	Schneesturm auf dem meer	Joseph Mallord	1844
28	Stilleven met kan, pijp en wijnglas	Daniël den Dikkenboer	
29	Structuur III	Peter Struycken	1939
30	Verre et bouteilles	Juan Gris	1911
31	Accumulation Renault no 109 II	Arman	1969
32	Bord de l' Oise à Vadencourt	Auguste Herbin	1912
33	Compositie met kleurvlakjes	Piet Mondriaan	1917
34	Danger de la Force	Francis Picabia	1947
35	Egoïsme	Francis Picabia	1947
36	Gewonde duif	Constant	1951

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Table A.1: Continued from previous page

	Title	Artist	Year
37	Icebox	Peter Saul	1961
38	Kleurencompositie nr. 100	Jacoba van Heemskerck van Beest	1918
39	Launisch	Vasili Kandisky	1930
40	Ober-Weimar	Lyonel Feiniger	1921
41	De terugkomst van de ooievaar	Theo van Hoytema	1891
42	De Zomer	Arent Arentz	1620
43	De farao's dochter vindt mozes in biezenmandje	Ferdinand Bol	1655
44	Ijsgezicht voor Dordrecht	Jan Josefszoon van Goyen	1644
45	Ijsvermaak	Henderick Avercamp	1615
46	Interieur van de kunstenaar	James Ensor	1930
47	Italiaans landschap met twee herderinnen	Johannes van der Bent	1670
48	Military parade day during the empire	Adrien Dauzats	1810
49	Portrait of the artist	Ignacio Zuloaga	1931
50	Vanitas stilleven	Gerrit van Vucht	1658
51	De golf van Napels met op de achtergrond het eiland Ischia	Josephus Augustus Knip	1818
52	De oude beurs te Amsterdam	Job Adriaenszoon Berckheyde	1670
53	De pleisterplaats; een ruiter voor een hoeve	Barent Gael	1800
54	De windstoot	Willem van de Velde	1650
55	Faun en nimf	Titiaan	1540
56	Het oude stadshuis te Amsterdam bij winter	Abraham Beerstraten	1639
57	Interieur van een boerendeel met gezelschap aan tafel (driekoningenfeest)	Pieter de Bloot	1640
58	Le port de Rotterdam	Paul Signac	1907
59	Mona Lisa	Leonardo Da Vinci	1503
60	Portret van charles rappoport	Kees van Dongen	1920
61	Portret van een stel in een landschap	Frans Hals	1622
62	Rivierlandschap met Ruiters	Aelbert Cuyp	1653
63	Riviermond met schepen	Hans Goderis	1625
64	Rural landscape	Dirck	1650
65	Rust op de vlucht naar Egypte	Jan Brueghel	1600
66	Stilleven met koperen ketel	Francois Bonvin	1883
67	Stilleven met schelpen	Balthasar van der Ast	1640
68	Stilleven met vruchten, fluitglas en mandfles	Juriaan van Streek	1700
69	Storm op de Hollandse kust	Ludolf Bakhuizen	1682
70	Susanna en de beide grijsaards	Dirck van Delen	1640

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Table A.1: Continued from previous page

	Title	Artist	Year
71	Abraham en de engelen	Aert de Gelder	1680
72	De bleekzuchtige dame	Samuel van Hoogstraten	1660
73	De Pannekoeckebackerij	Pieter Aertsen	1560
74	Gezicht op Overschie bij maanlicht	Johan Jongkind	1872
75	Grot met herders en vee	Nicolaes Pieterszoon Berchem	1654
76	Interior of a collector's cabinet	Cornelis de Baellieur	1650
77	Late bezoekers van Pompeï	Carel Willink	1931
78	Nachtwacht	Rembrandt van Rijn	1642
79	Stilleven met asperges	Adriaen Coorte	1679
80	Stilleven met citroen, druiven, en glazen	Abraham van Beijeren	1640

B

APPENDIX TO CHAPTER 4

Bilingual questionnaire into art expertise.

Table B.1: Art expertise questionnaire.

Dutch	English
Hoeveel uur per week werd er gemiddeld besteed aan kunsteducatie op uw middelbare school? - Geen - tot minder - 2-3 - 4-5 - 6-7 - 8 en meer	On average, how many hours per week were spent on art during your high school education? - None - 1 or less - 2-3 - 4-5 - 6-7 - 8 or more
Heeft u een kunst opleiding gevolgd na het behalen van u middelbare school? Zo ja, op welk niveau? - Ik heb geen kunstopleiding gevolgd - Tussen 1 en 3 individuele cursussen - Bachelor diploma - Master diploma - Doctoraat / gepromoveerd	To what extent have you studied art after high school (i.e. in an official education institution)? - I have not - Between 1 and 3 individual courses - Bachelor Degree - Master Degree - Doctoral Degree
Heeft u een kunstgeschiedenis opleiding gevolgd na het behalen van u middelbare school? Zo ja, op welk niveau? - Ik heb geen kunstopleiding gevolgd - Tussen 1 en 3 individuele cursussen - Bachelor diploma - Master diploma - Doctoraat / gepromoveerd	To what extent have you studied art history after high school (i.e. in an official education institution)? - I have not - Between 1 and 3 individual courses - Bachelor - Master Degree - Doctoral Degree
Hoe vaak bezoekt u gemiddeld per jaar kunstgaleries of kunst musea? (geef een algeheel gemiddelde)	How often do you visit art galleries and museums per year? (give overall average)

Continued on next page

Table B.1: Continued from previous page

Dutch	English
- Nooit - 1-2 keer - 3-5 keer - 6-11 keer - Minstens een keer per maandag - Ongeveer eens per twee weken - Elke week	- Not at all - 1-2 times - 3-5 times - 6-11 times - At least once a month - About once every two weeks - Once a week
Hoe vaak heeft u gemiddeld per jaar kunstgaleries of kunstmusea bezocht met uw ouders, familie of vrienden tot uw 18e levensjaar? (geef een algeheel gemiddelde) - Nooit - 1-2 keer - 3-5 keer - 6-11 keer - Minstens een keer per maandag - Ongeveer eens per twee weken - Elke week	Until the age of 18, how many times per year did you annually visit art galleries or art museums with your parents, other family members or friends? (give overall average) - Not at all - 1-2 times - 3-5 times - 6-11 times - At least once a month - About once every two weeks - Once a week
Painting title, year, artist	
Op een schaal van 1 (volledig onees) tot 10 (helemaal eens) kunt u aangeven hoezeer u het eens bent met de volgende stellingen: - Ik vind dit schilderij mooi - Het schilderij raakt mij emotioneel - Ik vind dit schilderij interessant - Ik vind dit schilderij complex - Ik vind dit schilderij krachtig	On a scale from 1 (completely disagree) to 10 (completely agree) can you indicate how much you agree with the following statements: - I find this painting beautiful - This painting touches me emotionally - I find this painting interesting - I find this painting complex - I find this painting powerful

Regression analyses of eye-fixation on paintings onto art expertise.

For all regression analyses, the assumptions of normality, homoscedasticity, lack of multicollinearity independent residuals are tenable.

Table B.2: Regression model for average saliency gaze proportion

Model	Coefficient	SE	t-value	p-value
intercept	20.889	2.812	7.429	<.001
Level op Appreciation	0.033	0.059	0.568	0.572
Childhood art visits	0.854	1.897	0.450	0.654
Current art visits	0.964	1.994	0.483	0.630
High school art education	-0.342	1.760	-0.194	0.846
Art education	-0.169	2.723	-0.062	0.951
Art history education	2.594	2.900	0.894	0.374

Model Summary: $F(6,71) = 0.49$, $p = 0.81$, $R^2 = 0.04$

Table B.3: Regression model for saliency gaze proportion “Compositie Nummer II”

Model	Coefficient	SE	t-value	p-value
intercept	23.895	4.880	4.897	<.001
Level op Appreciation	0.163	0.097	1.670	0.100
Childhood art visits	0.763	4.339	0.176	0.861
Current art visits	3.689	4.542	0.812	0.420
High school art education	-1.604	4.021	-0.399	0.691
Art education	-5.015	5.904	-0.849	0.399
Art history education	5.973	6.355	0.940	0.351

Model Summary: $F(6,63) = 0.94$, $p = 0.47$, $R^2 = 0.08$

Table B.4: Regression model for saliency gaze proportion “Compositie Met Kleurvlakjes”

Model	Coefficient	SE	t-value	p-value
intercept	20.164	2.561	7.872	<.001
Level op Appreciation	-0.002	0.055	-0.040	0.968
Childhood art visits	3.412	2.551	1.338	0.186
Current art visits	-1.857	2.587	-0.718	0.476
High school art education	1.041	2.378	0.438	0.663
Art education	-7.144	3.597	-1.986	0.052
Art history education	5.878	3.661	1.606	0.114

Model Summary: $F(6,61) = 1.17$, $p = 0.33$, $R^2 = 0.10$

Table B.5: Regression model for saliency gaze proportion "Lyrisches"

Model	Coefficient	SE	t-value	p-value
intercept	23.574	2.648	8.901	<.001
Level op Appreciation	-0.034	0.048	-0.716	0.476
Childhood art visits	0.231	2.323	0.099	0.921
Current art visits	4.238	2.421	1.751	0.084
High school art education	-1.052	2.148	-0.490	0.626
Art education	2.155	3.283	0.656	0.514
Art history education	1.347	3.548	0.380	0.705

Model Summary: $F(6,69) = 1.03$, $p = 0.41$, $R^2 = 0.08$

Table B.6: Regression model for saliency gaze proportion "Ober Weimar"

Model	Coefficient	SE	t-value	p-value
intercept	17.600	2.998	5.870	<.001
Level op Appreciation	-0.008	0.052	-0.153	0.879
Childhood art visits	2.061	2.147	0.960	0.341
Current art visits	-2.445	2.210	-1.107	0.273
High school art education	3.085	2.001	1.542	0.128
Art education	0.663	3.097	0.214	0.831
Art history education	3.830	3.252	1.178	0.243

Model Summary: $F(6,65) = 1.27$, $p = 0.28$, $R^2 = 0.11$

Table B.7: Regression model for saliency gaze proportion "Der Astronom"

Model	Coefficient	SE	t-value	p-value
intercept	22.717	3.570	6.363	<.001
Level op Appreciation	0.061	0.070	0.864	0.391
Childhood art visits	0.753	3.191	0.236	0.814
Current art visits	-2.388	3.277	-0.729	0.469
High school art education	-3.213	2.919	-1.101	0.275
Art education	5.306	4.439	1.195	0.236
Art history education	-2.261	4.745	-0.476	0.635

Model Summary: $F(6,68) = 0.56$, $p = 0.76$, $R^2 = 0.05$

Bayesian regression analyses of eye-fixation on paintings onto art expertise.

Table B.8: Variable abbreviations

Variable name	Variable label
Level of Appreciation	La
High school art education	He
Art education	Ae
Art history education	Ha
Current average annual art visits	Cv
Average annual art visits before 18th birthday	18v

Table B.9: Bayesian regression model for average saliency gaze proportion

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
Null model	0.016	0.130	9.416	1.000	
18v + Cv + He + Ae + Ha	0.016	0.003	0.171	48.162	0.002
La + Cv + He + Ae + Ha	0.016	0.003	0.179	45.963	0.002
La + 18v + He + Ae + Ha	0.016	0.003	0.177	46.517	0.002
La + 18v + Cv + Ae + Ha	0.016	0.003	0.191	43.108	0.002
La + 18v + Cv + He + Ha	0.016	0.003	0.193	42.541	0.002
La + 18v + Cv + He + Ae	0.016	0.002	0.142	57.879	0.002
Cv + He + Ae + Ha	0.016	0.005	0.317	25.964	0.004
18v + He + Ae + Ha	0.016	0.005	0.322	25.578	0.004
18v + Cv + Ae + Ha	0.016	0.006	0.354	23.265	0.004
18v + Cv + He + Ha	0.016	0.006	0.356	23.169	0.004
18v + Cv + He + Ae	0.016	0.004	0.243	33.814	0.004
He + Ae + Ha	0.016	0.009	0.576	14.342	5.576e-4
Cv + Ae + Ha	0.016	0.011	0.719	11.518	4.596e-4
Cv + He + Ha	0.016	0.011	0.719	11.531	4.601e-4
Cv + He + Ae	0.016	0.008	0.488	16.917	6.416e-4
Ae + Ha	0.016	0.023	1.468	5.709	1.178e-5
He + Ha	0.016	0.023	1.468	5.711	1.178e-5
He + Ae	0.016	0.015	0.965	8.615	9.568e-6
Ha	0.016	0.069	4.684	1.879	6.703e-5
Ae	0.016	0.045	2.954	2.904	1.035e-4
He	0.016	0.031	1.994	4.238	1.475e-4
Cv + Ha	0.016	0.029	1.859	4.537	1.316e-5
Cv + Ae	0.016	0.019	1.230	6.790	1.081e-5
Cv	0.016	0.045	2.952	2.905	1.035e-4
Cv + He	0.016	0.015	0.965	8.622	9.564e-6
18v + Ae + Ha	0.016	0.011	0.727	11.395	4.552e-4
18v + He + Ha	0.016	0.011	0.731	11.336	4.531e-4
18v + He + Ae	0.016	0.008	0.485	17.021	6.449e-4

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Table B.9: Continued from previous page

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
18v + Ha	0.016	0.029	1.884	4.479	1.324e-5
18v + Ae	0.016	0.019	1.216	6.869	1.075e-5
18v	0.016	0.041	2.678	3.189	1.132e-4
18v + He	0.016	0.014	0.884	9.402	9.137e-6
18v + Cv + Ha	0.016	0.013	0.806	10.288	4.148e-4
18v + Cv + Ae	0.016	0.009	0.541	15.278	5.887e-4
18v + Cv	0.016	0.017	1.079	7.724	1.013e-5
18v + Cv + He	0.016	0.007	0.432	19.076	7.085e-4
La + He + Ae + Ha	0.016	0.005	0.312	26.404	0.004
La + Cv + Ae + Ha	0.016	0.006	0.372	22.169	0.004
La + Cv + He + Ha	0.016	0.006	0.374	22.055	0.004
La + Cv + He + Ae	0.016	0.004	0.274	29.978	0.004
La + Ae + Ha	0.016	0.011	0.705	11.748	4.678e-4
La + He + Ha	0.016	0.011	0.706	11.728	4.671e-4
La + He + Ae	0.016	0.008	0.510	16.202	6.187e-4
La + Ha	0.016	0.028	1.821	4.628	1.304e-5
La + Ae	0.016	0.020	1.283	6.514	1.104e-5
La	0.016	0.045	2.942	2.914	1.038e-4
La + He	0.016	0.015	0.963	8.638	9.555e-6
La + Cv + Ha	0.016	0.013	0.849	9.775	3.957e-4
La + Cv + Ae	0.016	0.010	0.612	13.507	5.293e-4
La + Cv	0.016	0.020	1.289	6.484	1.107e-5
La + Cv + He	0.016	0.008	0.513	16.099	6.154e-4
La + 18v + Ae + Ha	0.016	0.006	0.364	22.625	0.004
La + 18v + He + Ha	0.016	0.006	0.369	22.306	0.004
La + 18v + He + Ae	0.016	0.004	0.265	30.992	0.004
La + 18v + Ha	0.016	0.013	0.832	9.971	4.030e-4
La + 18v + Ae	0.016	0.009	0.586	14.102	5.495e-4
La + 18v	0.016	0.018	1.148	7.265	1.045e-5
La + 18v + He	0.016	0.007	0.463	17.834	6.703e-4
La + 18v + Cv + Ha	0.016	0.006	0.399	20.647	0.004
La + 18v + Cv + Ae	0.016	0.005	0.289	28.518	0.004
La + 18v + Cv	0.016	0.009	0.541	15.263	5.882e-4
La + 18v + Cv + He	0.016	0.004	0.245	33.530	0.004
La + 18v + Cv + He + Ae + Ha	0.016	0.002	0.098	83.380	0.011

Table B.10: Bayesian regression model for saliency gaze proportion “Compositie Nummer II”

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
Null model	0.016	0.082	5.593	1.000	

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Table B.10: Continued from previous page

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
18v + Cv + He + Ae + Ha	0.016	0.002	0.134	38.496	5.944e-4
La + Cv + He + Ae + Ha	0.016	0.006	0.383	13.509	5.802e-4
La + 18v + He + Ae + Ha	0.016	0.005	0.299	17.253	6.190e-4
La + 18v + Cv + Ae + Ha	0.016	0.006	0.364	14.203	5.892e-4
La + 18v + Cv + He + Ha	0.016	0.005	0.292	17.670	6.220e-4
La + 18v + Cv + He + Ae	0.016	0.004	0.274	18.806	6.291e-4
Cv + He + Ae + Ha	0.016	0.004	0.264	19.506	0.003
18v + He + Ae + Ha	0.016	0.003	0.182	28.262	0.003
18v + Cv + Ae + Ha	0.016	0.004	0.250	20.622	0.003
18v + Cv + He + Ha	0.016	0.003	0.215	23.931	0.003
18v + Cv + He + Ae	0.016	0.003	0.164	31.477	0.003
He + Ae + Ha	0.016	0.005	0.336	15.374	3.301e-4
Cv + Ae + Ha	0.016	0.009	0.545	9.507	3.080e-4
Cv + He + Ha	0.016	0.007	0.458	11.289	3.200e-4
Cv + He + Ae	0.016	0.005	0.348	14.860	3.299e-4
Ae + Ha	0.016	0.012	0.796	6.538	8.485e-6
He + Ha	0.016	0.011	0.694	7.485	7.890e-6
He + Ae	0.016	0.007	0.468	11.054	6.356e-6
Ha	0.016	0.030	1.962	2.699	9.548e-5
Ae	0.016	0.020	1.295	4.049	1.105e-4
He	0.016	0.020	1.317	3.980	1.100e-4
Cv + Ha	0.016	0.016	1.039	5.025	9.740e-6
Cv + Ae	0.016	0.012	0.784	6.637	8.418e-6
Cv	0.016	0.035	2.298	2.316	8.922e-5
Cv + He	0.016	0.013	0.839	6.201	8.727e-6
18v + Ae + Ha	0.016	0.006	0.372	13.879	3.287e-4
18v + He + Ha	0.016	0.005	0.334	15.442	3.301e-4
18v + He + Ae	0.016	0.004	0.227	22.730	3.119e-4
18v + Ha	0.016	0.012	0.752	6.912	8.237e-6
18v + Ae	0.016	0.008	0.507	10.218	6.644e-6
18v	0.016	0.022	1.440	3.649	1.070e-4
18v + He	0.016	0.008	0.534	9.708	6.837e-6
18v + Cv + Ha	0.016	0.007	0.427	12.112	3.238e-4
18v + Cv + Ae	0.016	0.005	0.325	15.864	3.301e-4
18v + Cv	0.016	0.012	0.781	6.656	8.405e-6
18v + Cv + He	0.016	0.006	0.351	14.710	3.297e-4
La + He + Ae + Ha	0.016	0.009	0.578	8.969	0.004
La + Cv + Ae + Ha	0.016	0.012	0.773	6.730	0.005
La + Cv + He + Ha	0.016	0.010	0.608	8.530	0.004
La + Cv + He + Ae	0.016	0.009	0.574	9.037	0.004

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Table B.10: Continued from previous page

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
La + Ae + Ha	0.016	0.020	1.308	4.010	2.163e-4
La + He + Ha	0.016	0.017	1.061	4.923	2.401e-4
La + He + Ae	0.016	0.014	0.926	5.629	2.554e-4
La + Ha	0.016	0.041	2.693	1.989	1.523e-5
La + Ae	0.016	0.036	2.352	2.266	1.436e-5
La	0.016	0.108	7.637	0.754	4.627e-5
La + He	0.016	0.036	2.353	2.264	1.436e-5
La + Cv + Ha	0.016	0.020	1.312	3.995	2.159e-4
La + Cv + Ae	0.016	0.019	1.250	4.192	2.215e-4
La + Cv	0.016	0.047	3.103	1.737	1.618e-5
La + Cv + He	0.016	0.019	1.250	4.190	2.214e-4
La + 18v + Ae + Ha	0.016	0.009	0.603	8.600	0.004
La + 18v + He + Ha	0.016	0.008	0.501	10.325	0.004
La + 18v + He + Ae	0.016	0.007	0.436	11.852	0.004
La + 18v + Ha	0.016	0.017	1.082	4.829	2.378e-4
La + 18v + Ae	0.016	0.015	0.950	5.488	2.525e-4
La + 18v	0.016	0.037	2.405	2.218	1.450e-5
La + 18v + He	0.016	0.015	0.971	5.370	2.500e-4
La + 18v + Cv + Ha	0.016	0.009	0.570	9.094	0.004
La + 18v + Cv + Ae	0.016	0.009	0.543	9.544	0.004
La + 18v + Cv	0.016	0.018	1.172	4.463	2.287e-4
La + 18v + Cv + He	0.016	0.009	0.547	9.477	0.004
La + 18v + Cv + He + Ae + Ha	0.016	0.003	0.195	26.480	0.012

Table B.11: Bayesian regression model for saliency gaze proportion ”Compositie Met Kleurvlakjes”

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
Null model	0.016	0.090	6.214	1.000	
18v + Cv + He + Ae + Ha	0.016	0.011	0.730	7.837	3.145e-4
La + Cv + He + Ae + Ha	0.016	0.006	0.364	15.638	2.999e-4
La + 18v + He + Ae + Ha	0.016	0.009	0.596	9.585	3.219e-4
La + 18v + Cv + Ae + Ha	0.016	0.011	0.677	8.446	3.181e-4
La + 18v + Cv + He + Ha	0.016	0.003	0.164	34.636	9.447e-5
La + 18v + Cv + He + Ae	0.016	0.004	0.270	21.011	2.492e-4
Cv + He + Ae + Ha	0.016	0.012	0.765	7.487	0.004
18v + He + Ae + Ha	0.016	0.020	1.286	4.487	0.005
18v + Cv + Ae + Ha	0.016	0.023	1.472	3.932	0.005
18v + Cv + He + Ha	0.016	0.005	0.325	17.471	0.003
18v + Cv + He + Ae	0.016	0.009	0.560	10.191	0.004
He + Ae + Ha	0.016	0.026	1.712	3.393	1.436e-4

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Table B.11: Continued from previous page

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
Cv + Ae + Ha	0.016	0.020	1.267	4.554	1.547e-4
Cv + He + Ha	0.016	0.005	0.313	18.130	3.348e-6
Cv + He + Ae	0.016	0.009	0.576	9.913	1.448e-4
Ae + Ha	0.016	0.049	3.262	1.824	1.495e-5
He + Ha	0.016	0.010	0.624	9.157	6.470e-6
He + Ae	0.016	0.021	1.365	4.234	9.909e-6
Ha	0.016	0.023	1.499	3.864	5.268e-5
Ae	0.016	0.047	3.106	1.911	5.322e-5
He	0.016	0.027	1.718	3.381	5.432e-5
Cv + Ha	0.016	0.010	0.613	9.321	6.403e-6
Cv + Ae	0.016	0.017	1.067	5.393	8.716e-6
Cv	0.016	0.025	1.631	3.557	5.380e-5
Cv + He	0.016	0.011	0.705	8.111	6.942e-6
18v + Ae + Ha	0.016	0.043	2.824	2.092	1.184e-4
18v + He + Ha	0.016	0.007	0.443	12.850	1.215e-4
18v + He + Ae	0.016	0.016	1.003	5.729	1.590e-4
18v + Ha	0.016	0.016	1.053	5.459	8.659e-6
18v + Ae	0.016	0.037	2.425	2.422	1.309e-5
18v	0.016	0.046	3.070	1.932	5.334e-5
18v + He	0.016	0.016	1.054	5.458	8.660e-6
18v + Cv + Ha	0.016	0.011	0.703	8.133	1.548e-4
18v + Cv + Ae	0.016	0.019	1.207	4.777	1.560e-4
18v + Cv	0.016	0.026	1.660	3.497	1.093e-5
18v + Cv + He	0.016	0.011	0.680	8.410	1.535e-4
La + He + Ae + Ha	0.016	0.012	0.740	7.730	0.004
La + Cv + Ae + Ha	0.016	0.009	0.558	10.219	0.004
La + Cv + He + Ha	0.016	0.002	0.150	37.908	0.002
La + Cv + He + Ae	0.016	0.004	0.265	21.430	0.003
La + Ae + Ha	0.016	0.019	1.247	4.625	1.551e-4
La + He + Ha	0.016	0.004	0.268	21.212	4.474e-5
La + He + Ae	0.016	0.009	0.556	10.268	1.423e-4
La + Ha	0.016	0.008	0.536	10.637	5.920e-6
La + Ae	0.016	0.016	1.047	5.489	8.633e-6
La	0.016	0.022	1.444	4.007	5.207e-5
La + He	0.016	0.010	0.608	9.386	6.377e-6
La + Cv + Ha	0.016	0.004	0.262	21.641	4.114e-5
La + Cv + Ae	0.016	0.007	0.442	12.884	1.212e-4
La + Cv	0.016	0.009	0.578	9.873	6.189e-6
La + Cv + He	0.016	0.005	0.299	18.980	0.003
La + 18v + Ae + Ha	0.016	0.018	1.181	4.879	0.005

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Table B.11: Continued from previous page

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
La + 18v + He + Ha	0.016	0.003	0.209	27.125	0.002
La + 18v + He + Ae	0.016	0.007	0.447	12.736	0.003
La + 18v + Ha	0.016	0.007	0.441	12.921	1.209e-4
La + 18v + Ae	0.016	0.015	0.947	6.062	1.593e-4
La + 18v	0.016	0.016	1.042	5.517	8.609e-6
La + 18v + He	0.016	0.007	0.440	12.950	1.207e-4
La + 18v + Cv + Ha	0.016	0.005	0.325	17.513	0.003
La + 18v + Cv + Ae	0.016	0.008	0.532	10.715	0.004
La + 18v + Cv	0.016	0.011	0.672	8.502	1.531e-4
La + 18v + Cv + He	0.016	0.005	0.313	18.170	0.003
La + 18v + Cv + He + Ae + Ha	0.016	0.006	0.361	15.741	8.462e-4

Table B.12: Bayesian regression model for saliency gaze proportion “Lyrisches”

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
Null model	0.016	0.069	4.705	1.000	
18v + Cv + He + Ae + Ha	0.016	0.005	0.293	15.032	8.274e-4
La + Cv + He + Ae + Ha	0.016	0.006	0.357	12.324	6.990e-4
La + 18v + He + Ae + Ha	0.016	0.002	0.110	39.892	0.002
La + 18v + Cv + Ae + Ha	0.016	0.005	0.326	13.499	7.559e-4
La + 18v + Cv + He + Ha	0.016	0.005	0.302	14.555	8.054e-4
La + 18v + Cv + He + Ae	0.016	0.005	0.339	12.997	7.318e-4
Cv + He + Ae + Ha	0.016	0.010	0.638	6.933	0.006
18v + He + Ae + Ha	0.016	0.003	0.203	21.613	0.004
18v + Cv + Ae + Ha	0.016	0.009	0.549	8.037	0.005
18v + Cv + He + Ha	0.016	0.008	0.512	8.624	0.005
18v + Cv + He + Ae	0.016	0.010	0.626	7.067	0.006
He + Ae + Ha	0.016	0.006	0.398	11.076	5.058e-4
Cv + Ae + Ha	0.016	0.020	1.302	3.431	1.799e-4
Cv + He + Ha	0.016	0.019	1.217	3.667	1.919e-4
Cv + He + Ae	0.016	0.023	1.505	2.979	1.564e-4
Ae + Ha	0.016	0.015	0.936	4.745	1.213e-5
He + Ha	0.016	0.011	0.671	6.598	1.031e-5
He + Ae	0.016	0.015	0.987	4.505	1.244e-5
Ha	0.016	0.030	1.927	2.341	1.026e-4
Ae	0.016	0.043	2.857	1.602	7.268e-5
He	0.016	0.017	1.097	4.060	1.636e-4
Cv + Ha	0.016	0.044	2.877	1.591	1.971e-5
Cv + Ae	0.016	0.053	3.535	1.308	2.134e-5
Cv	0.016	0.099	6.894	0.705	0.010

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Table B.12: Continued from previous page

Models	**P(M)**	**P(M|data)**	**BF_M**	**BF_{01}**	**% error**
Cv + He	0.016	0.035	2.299	1.974	1.802e-5
18v + Ae + Ha	0.016	0.006	0.408	10.787	4.954e-4
18v + He + Ha	0.016	0.005	0.321	13.726	5.966e-4
18v + He + Ae	0.016	0.007	0.447	9.855	4.609e-4
18v + Ha	0.016	0.011	0.729	6.076	1.074e-5
18v + Ae	0.016	0.016	1.013	4.390	1.259e-5
18v	0.016	0.020	1.255	3.559	1.469e-4
18v + He	0.016	0.007	0.460	9.590	8.478e-6
18v + Cv + Ha	0.016	0.017	1.060	4.199	2.184e-4
18v + Cv + Ae	0.016	0.020	1.286	3.475	1.822e-4
18v + Cv	0.016	0.031	2.029	2.227	1.712e-5
18v + Cv + He	0.016	0.013	0.857	5.179	2.653e-4
La + He + Ae + Ha	0.016	0.003	0.189	23.216	0.004
La + Cv + Ae + Ha	0.016	0.011	0.714	6.199	0.006
La + Cv + He + Ha	0.016	0.010	0.656	6.744	0.006
La + Cv + He + Ae	0.016	0.012	0.742	5.970	0.006
La + Ae + Ha	0.016	0.006	0.407	10.838	4.972e-4
La + He + Ha	0.016	0.005	0.296	14.863	6.330e-4
La + He + Ae	0.016	0.006	0.407	10.818	4.965e-4
La + Ha	0.016	0.011	0.719	6.159	1.067e-5
La + Ae	0.016	0.015	0.984	4.520	1.242e-5
La	0.016	0.017	1.085	4.105	1.651e-4
La + He	0.016	0.006	0.382	11.532	7.671e-6
La + Cv + Ha	0.016	0.023	1.457	3.075	1.615e-4
La + Cv + Ae	0.016	0.025	1.618	2.776	1.457e-4
La + Cv	0.016	0.037	2.436	1.866	1.845e-5
La + Cv + He	0.016	0.015	0.979	4.544	2.352e-4
La + 18v + Ae + Ha	0.016	0.003	0.212	20.741	0.004
La + 18v + He + Ha	0.016	0.003	0.168	26.056	0.004
La + 18v + He + Ae	0.016	0.003	0.216	20.293	0.004
La + 18v + Ha	0.016	0.006	0.355	12.399	5.522e-4
La + 18v + Ae	0.016	0.007	0.450	9.793	4.586e-4
La + 18v	0.016	0.007	0.457	9.657	8.447e-6
La + 18v + He	0.016	0.003	0.198	22.208	8.394e-4
La + 18v + Cv + Ha	0.016	0.010	0.607	7.278	0.006
La + 18v + Cv + Ae	0.016	0.011	0.669	6.609	0.006
La + 18v + Cv	0.016	0.014	0.904	4.912	2.528e-4
La + 18v + Cv + He	0.016	0.007	0.417	10.565	0.005
La + 18v + Cv + He + Ae + Ha	0.016	0.003	0.175	25.042	0.002

Table B.13: Bayesian regression model for saliency gaze proportion “Ober Weimar”

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
Null model	0.016	0.057	3.836	1.000	
18v + Cv + He + Ae + Ha	0.016	0.008	0.531	6.862	4.880e-4
La + Cv + He + Ae + Ha	0.016	0.006	0.372	9.775	6.190e-4
La + 18v + He + Ae + Ha	0.016	0.005	0.330	11.000	6.662e-4
La + 18v + Cv + Ae + Ha	0.016	0.003	0.212	17.106	8.512e-4
La + 18v + Cv + He + Ha	0.016	0.008	0.527	6.924	4.911e-4
La + 18v + Cv + He + Ae	0.016	0.005	0.310	11.713	6.918e-4
Cv + He + Ae + Ha	0.016	0.013	0.814	4.500	0.006
18v + He + Ae + Ha	0.016	0.011	0.717	5.102	0.006
18v + Cv + Ae + Ha	0.016	0.007	0.449	8.102	0.005
18v + Cv + He + Ha	0.016	0.018	1.159	3.177	0.007
18v + Cv + He + Ae	0.016	0.011	0.672	5.438	0.006
He + Ae + Ha	0.016	0.023	1.478	2.504	1.735e-4
Cv + Ae + Ha	0.016	0.008	0.526	6.931	3.513e-4
Cv + He + Ha	0.016	0.029	1.906	1.955	1.422e-4
Cv + He + Ae	0.016	0.018	1.169	3.150	2.067e-4
Ae + Ha	0.016	0.018	1.158	3.179	1.301e-5
He + Ha	0.016	0.060	4.021	0.957	2.192e-5
He + Ae	0.016	0.038	2.457	1.529	1.806e-5
Ha	0.016	0.051	3.395	1.123	6.513e-5
Ae	0.016	0.036	2.338	1.604	8.464e-5
He	0.016	0.056	3.765	1.018	6.041e-5
Cv + Ha	0.016	0.019	1.232	2.992	1.339e-5
Cv + Ae	0.016	0.014	0.869	4.217	1.136e-5
Cv	0.016	0.014	0.927	3.960	1.497e-4
Cv + He	0.016	0.021	1.352	2.733	1.397e-5
18v + Ae + Ha	0.016	0.011	0.672	5.437	3.021e-4
18v + He + Ha	0.016	0.026	1.702	2.181	1.555e-4
18v + He + Ae	0.016	0.016	1.040	3.535	2.249e-4
18v + Ha	0.016	0.026	1.687	2.201	1.541e-5
18v + Ae	0.016	0.017	1.095	3.360	1.268e-5
18v	0.016	0.022	1.443	2.563	1.159e-4
18v + He	0.016	0.022	1.405	2.631	1.421e-5
18v + Cv + Ha	0.016	0.016	0.997	3.685	2.318e-4
18v + Cv + Ae	0.016	0.010	0.624	5.850	3.166e-4
18v + Cv	0.016	0.010	0.619	5.898	9.601e-6
18v + Cv + He	0.016	0.011	0.726	5.041	2.876e-4
La + He + Ae + Ha	0.016	0.010	0.620	5.891	0.005
La + Cv + Ae + Ha	0.016	0.004	0.245	14.846	0.004

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Table B.13: Continued from previous page

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
La + Cv + He + Ha	0.016	0.012	0.787	4.651	0.006
La + Cv + He + Ae	0.016	0.008	0.502	7.259	0.005
La + Ae + Ha	0.016	0.008	0.478	7.630	3.716e-4
La + He + Ha	0.016	0.022	1.446	2.558	1.764e-4
La + He + Ae	0.016	0.015	0.929	3.950	2.435e-4
La + Ha	0.016	0.018	1.128	3.263	1.286e-5
La + Ae	0.016	0.013	0.841	4.358	1.118e-5
La	0.016	0.016	1.028	3.576	1.414e-4
La + He	0.016	0.019	1.211	3.044	1.328e-5
La + Cv + Ha	0.016	0.008	0.504	7.226	3.600e-4
La + Cv + Ae	0.016	0.006	0.381	9.547	4.203e-4
La + Cv	0.016	0.006	0.373	9.761	7.353e-6
La + Cv + He	0.016	0.008	0.538	6.783	3.468e-4
La + 18v + Ae + Ha	0.016	0.005	0.297	12.214	0.004
La + 18v + He + Ha	0.016	0.011	0.710	5.149	0.006
La + 18v + He + Ae	0.016	0.007	0.446	8.160	0.005
La + 18v + Ha	0.016	0.010	0.653	5.595	3.077e-4
La + 18v + Ae	0.016	0.007	0.449	8.106	3.846e-4
La + 18v	0.016	0.008	0.522	6.983	8.795e-6
La + 18v + He	0.016	0.009	0.550	6.631	3.421e-4
La + 18v + Cv + Ha	0.016	0.007	0.428	8.498	0.005
La + 18v + Cv + Ae	0.016	0.004	0.282	12.883	0.004
La + 18v + Cv	0.016	0.004	0.265	13.682	4.990e-4
La + 18v + Cv + He	0.016	0.005	0.318	11.442	0.004
La + 18v + Cv + He + Ae + Ha	0.016	0.004	0.260	13.966	0.001

Table B.14: Bayesian regression model for saliency gaze proportion “Der Astronom”

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
Null model	0.016	0.153		1.000	
18v + Cv + He + Ae + Ha	0.016	0.003	[illegible]	45.827	0.002
La + Cv + He + Ae + Ha	0.016	0.004	0.276	35.113	0.002
La + 18v + He + Ae + Ha	0.016	0.004	0.229	42.197	0.002
La + 18v + Cv + Ae + Ha	0.016	0.003	0.177	54.732	0.002
La + 18v + Cv + He + Ha	0.016	0.003	0.163	59.419	0.002
La + 18v + Cv + He + Ae	0.016	0.004	0.258	37.527	0.002
Cv + He + Ae + Ha	0.016	0.006	0.403	24.063	0.004
18v + He + Ae + Ha	0.016	0.006	0.350	27.718	0.004
18v + Cv + Ae + Ha	0.016	0.005	0.301	32.217	0.004
18v + Cv + He + Ha	0.016	0.004	0.256	37.854	0.004

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Table B.14: Continued from previous page

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
18v + Cv + He + Ae	0.016	0.006	0.403	24.101	0.004
He + Ae + Ha	0.016	0.012	0.767	12.718	5.717e-4
Cv + Ae + Ha	0.016	0.010	0.647	15.065	6.421e-4
Cv + He + Ha	0.016	0.008	0.513	18.948	7.451e-4
Cv + He + Ae	0.016	0.013	0.831	11.761	5.409e-4
Ae + Ha	0.016	0.021	1.325	7.433	9.392e-6
He + Ha	0.016	0.018	1.153	8.515	8.747e-6
He + Ae	0.016	0.027	1.767	5.612	1.083e-5
Ha	0.016	0.037	2.450	4.089	1.696e-4
Ae	0.016	0.055	3.671	2.780	1.256e-4
He	0.016	0.051	3.377	3.008	1.337e-4
Cv + Ha	0.016	0.015	0.934	10.472	7.829e-6
Cv + Ae	0.016	0.023	1.482	6.658	9.940e-6
Cv	0.016	0.041	2.660	3.778	1.597e-4
Cv + He	0.016	0.019	1.209	8.129	8.963e-6
18v + Ae + Ha	0.016	0.008	0.535	18.178	7.258e-4
18v + He + Ha	0.016	0.008	0.485	20.046	7.716e-4
18v + He + Ae	0.016	0.011	0.713	13.675	6.012e-4
18v + Ha	0.016	0.013	0.837	11.670	7.380e-6
18v + Ae	0.016	0.019	1.206	8.146	8.954e-6
18v	0.016	0.037	2.404	4.165	1.720e-4
18v + He	0.016	0.018	1.159	8.472	8.770e-6
18v + Cv + Ha	0.016	0.006	0.400	24.283	8.650e-4
18v + Cv + Ae	0.016	0.010	0.613	15.879	6.650e-4
18v + Cv	0.016	0.015	0.934	10.478	7.827e-6
18v + Cv + He	0.016	0.008	0.536	18.134	7.247e-4
La + He + Ae + Ha	0.016	0.007	0.476	20.427	0.004
La + Cv + Ae + Ha	0.016	0.006	0.361	26.857	0.004
La + Cv + He + Ha	0.016	0.005	0.322	30.058	0.004
La + Cv + He + Ae	0.016	0.008	0.525	18.537	0.004
La + Ae + Ha	0.016	0.010	0.646	15.080	6.425e-4
La + He + Ha	0.016	0.010	0.641	15.205	6.461e-4
La + He + Ae	0.016	0.015	0.972	10.069	4.831e-4
La + Ha	0.016	0.016	1.006	9.736	8.144e-6
La + Ae	0.016	0.023	1.462	6.750	9.870e-6
La	0.016	0.045	2.945	3.428	1.482e-4
La + He	0.016	0.024	1.562	6.327	1.020e-5
La + Cv + Ha	0.016	0.007	0.471	20.645	7.856e-4
La + Cv + Ae	0.016	0.012	0.735	13.264	5.887e-4
La + Cv	0.016	0.017	1.115	8.805	8.593e-6

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Table B.14: Continued from previous page

Models	P(M)	P(M|data)	BF_M	BF_{01}	% error
La + Cv + He	0.016	0.011	0.687	14.196	6.168e-4
La + 18v + Ae + Ha	0.016	0.005	0.296	32.762	0.004
La + 18v + He + Ha	0.016	0.005	0.291	33.318	0.004
La + 18v + He + Ae	0.016	0.007	0.431	22.534	0.004
La + 18v + Ha	0.016	0.007	0.414	23.431	8.473e-4
La + 18v + Ae	0.016	0.009	0.593	16.419	6.798e-4
La + 18v	0.016	0.015	0.989	9.904	8.069e-6
La + 18v + He	0.016	0.010	0.626	15.551	6.559e-4
La + 18v + Cv + Ha	0.016	0.003	0.218	44.462	0.004
La + 18v + Cv + Ae	0.016	0.005	0.332	29.215	0.004
La + 18v + Cv	0.016	0.007	0.458	21.223	7.989e-4
La + 18v + Cv + He	0.016	0.005	0.319	30.404	0.004
La + 18v + Cv + He + Ae + Ha	0.016	0.002	0.144	67.137	0.010

C

APPENDIX TO CHAPTER 5

Aesthetic IAPS pictures adjustment in Camera Raw 6.0 of Adobe CS5:

- Exposure: 0.45 points increase (starting on 0 on a scale of -4.00 to +4.00)
- Exposure: 0.45 points increase (starting on 0 on a scale of -4.00 to +4.00)
- Contrast: 49 points increase (on a scale of -100 to +100)
- Clarity: 29 points increase (on a scale of -100 to +100)
- Color-saturation: 36 points decrease (on a scale of -100 to +100)
- Sharpening:
  - Amount: 57 points increase (on a scale of 0 to 150)
  - Radius: 1.0 point increase (on a scale of 0 to 3.0)
  - Detail: 25 points increase (on a scale of 0 to 100)
  - Masking: 26 points increase (on a scale of 100)
- Noise Reduction:
  - Luminance: 26 points increase (on a scale of 0 to 100)
  - Luminance Detail: 50 points increase (on a scale of 0 to 100)
  - Luminance Contrast: 13 increase (on a scale of 0 100)
  - Color: 10 increase (on a scale of 0 to 100)
  - Color Detail: 50 increase (on a scale of 0 to 100)

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SUMMARIES

English Summary

Art and aesthetics have enjoyed a long history as academic topics of enquiry and debate. This history ranges from pre-Socratic times until the present. Investigation is ongoing in several academic fields, such as cultural sociology, cognitive psychology, and neuroscience. All fields aim to explain, understand, and/or describe how aesthetics, art, and its appreciation work and come into being. Each academic field (mostly) works in isolation from the others. Psychology and neuroscience focus on the mechanical process from perception of physical characteristics of the artwork to emotional and cognitive responses, disregarding social and cultural differences and the context in which artworks are presented (e.g., museum, gallery, restaurant, etc.). Cultural sociology, on the other hand, investigates the social and cultural processes involved in the waxing and waning of appreciation of particular art (e.g., art types, styles, artists, etc.), their non-physical characteristics (e.g., authenticity, monetary value, etc.), and social groups' structure and development of aesthetic tastes. In this case, the physical characteristics of the individual artworks are mostly ignored, instead focusing on the overall categorization of style (e.g., classical paintings, abstract expressionism, etc.), the context in which they are presented, artists' reputations, and the social dynamics of appreciation and consumption. However, in isolation, none of these research areas can fully explain art appreciation. In brief, aesthetics and the appreciation of art appear to involve components from each of these fields; from the specifics of our anatomy to the level of country-spanning culture.

The research outlined in this dissertation is an attempt to draw philosophy, cultural sociology, psychology, and neuroscience closer together in their quest for understanding art. As a patchwork blanket, theories of each field are juxtaposed to- or superimposed on one another. The studies are methodologically diverse, though connected by particular combinations of inter-disciplinary perspectives, which together hopefully offer a meaningful contribution to the theory and methodology of the

field of aesthetics. Specifically, the evaluation of several physical and non-physical characteristics of paintings was investigated to gain more understanding of the mechanisms underlying art appreciation. We investigated the interplay of paintings' physical (contrast and saliency) and non-physical (authenticity and description) features and perceivers' characteristics (education, nationality, art expertise). The main results are that 1) different types of people clearly favor paintings with increased contrast over their original or lowered contrast counterparts. 2) The non-physical characteristic of authenticity has a positive effect on the appreciation of paintings, also irrespective of the characteristics of the viewer. 3) The context of art is of effect on the physiological level. Concretely, describing non-art photographs as works of art increases people's appreciation of these pictures and reduces their emotional response to them. The results presented in this dissertation are promising and generally in line with predictions deduced from theories from the different disciplines, though their scope is limited and there are several auspicious avenues of research on which we have only just started. Finally, this dissertation underscores the potential for using the differences between theories and approaches of the humanities and social sciences as fertile soil for fruitful collaborations.

Nederlandse Samenvatting

Kunst en esthetiek kennen een lange geschiedenis als academische onderwerpen voor onderzoek en debat. Deze geschiedenis strekt zich van pre-socratische tijden tot nu. Onderzoek naar kunst wordt gedaan in verschillende academische disciplines, zoals cultuursociologie, cognitieve psychologie en neurowetenschappen. Het doel van deze disciplines is in dit geval het uitleggen, begrijpen en/of beschrijven hoe esthetiek, kunst en haar waardering werken en tot stand komen. Echter, deze academisch disciplines werken (meestal) geïsoleerd van elkaar. Psychologie en neurowetenschappen richten zich op het mechanische proces van waarneming van fysieke kenmerken van het kunstwerk tot emotionele en cognitieve reacties daarop, waarbij sociale en culturele verschillen en de context waarin kunstwerken worden gepresenteerd (zoals museum, galerie, restaurant, enz.) buiten beschouwing blijven. Cultuursociologie, aan de andere kant, onderzoekt de sociale en culturele processen die betrokken zijn bij het toe- en afnemen van waardering van bepaalde kunst (bijv., kunstsoorten, stijlen, kunstenaars, enz.), hun niet-fysieke/symbolische kenmerken (bijv., authenticiteit, monetair waarde, etc.), en de structuur en ontwikkeling van esthetische smaken van sociale groepen. In dit geval worden de fysieke kenmerken van de individuele kunstwerken meestal genegeerd, maar richten ze zich op de algemene categorisering van stijl (bijv. klassieke schilderijen, abstract expressionisme, enz.), De context waarin ze worden gepresenteerd, de reputatie van kunstenaars en de sociale dynamiek van waardering en consumptie. Afzonderlijk kan echter geen van deze onderzoeksgebieden kunstwaardering volledig verklaren. Kortom, esthetiek en waardering voor kunst lijken componenten uit elk van deze domeinen te omvatten; van de specifieke kenmerken van onze anatomie tot het niveau van cultuur die het hele land beslaat.

Het onderzoek dat in dit proefschrift wordt omschreven, is een poging om filosofie, cultuursociologie, psychologie, en neurowetenschappen dichter bij elkaar te brengen in hun zoektocht naar het begrijpen van kunst. Als een lappendeken worden theorieën van elk veld naast elkaar geplaatst of over elkaar gelegd. De studies zijn methodologisch divers, hoewel ze verbonden zijn door specifieke combinaties van interdisciplinaire perspectieven, die samen hopelijk een zinvolle bijdrage leveren aan de theorie en methodologie van het esthetische veld. Specifiek werd de evaluatie van verschillende fysieke en niet-fysieke kenmerken van schilderijen onderzocht om meer inzicht te krijgen in de mechanismen die ten grondslag liggen aan kunstwaardering. We onderzochten het samenspel van de fysieke (contrast en saillantie) en niet-fysieke (authenticiteit en beschrijving) kenmerken van schilderijen en kenmerken van de waarnemers (opleiding, nationaliteit, kunstexpertise). De belangrijkste resultaten zijn dat 1) verschillende type mensen duidelijk de voorkeur geven aan kopieën van schilderijen met een verhoogd contrast ten opzichte van hun originele of verlaagd contrast kopieën. 2) Het niet-fysieke kenmerk van authenticiteit heeft een positief effect op de waardering van schilderijen, ongeacht de kenmerken van de waarnemer. 3) De context van kunst is van invloed op het fysiologische niveau. Concreet betekent dit, het beschrijven van niet-kunstfoto's als kunstwerken verhoogt de waardering voor deze foto's en vermindert de emotionele reactie erop. De resultaten die in dit proefschrift worden gepresenteerd, zijn veelbelovend en in het algemeen in overeenstemming met de voorspellingen die zijn afgeleid uit theorieën van de verschillende disciplines. Wel is hun reikwijdte beperkt en zijn slechts de eerste stappen gezet in de verschillende vruchtbare onderzoeksrichtingen. Ten slotte onderstreept dit proefschrift het potentieel om de verschillen tussen theorieën en benaderingen van de geesteswetenschappen en sociale wetenschappen te gebruiken als vruchtbare grond voor lucratieve samenwerkingen.

PUBLICATIONS

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* Authors contributed equally. *Note:* J. Zijlmans only has one PhD, but I still love him.

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Short CV:

Noah N. N. van Dongen was born in Rotterdam on the 24th of August 1986. After completing secondary education, he studied Fine Arts at the Willem de Kooning Art Academy in Rotterdam, followed by a Masters in Arts and Culture Studies at the Erasmus University Rotterdam. He graduated cum laude in 2014. Subsequently, he worked as an academic teacher at the Department of Arts & Culture Studies at the Erasmus University Rotterdam and collaborated with Prof.dr van Eick, prof.dr. van Strien, and Dr. Dijkstra on several studies into art appreciation. In 2016 he started a PhD in philosophy of science under the supervision of Prof.dr. Sprenger, first at Tilburg University and later at the University of Turin in Italy. During this period, he continued his research into art appreciation in his spare time.

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