“Perception of Visual Art”

The impact of familiarity with art on eye-fixations during the pictorial perception of paintings

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ABSTRACT

In modernity, art experts are considered as a separate group of art viewers that experience art in a distinctive manner (Savazzi et al., 2014). It is assumed that one must learn how to interpret a work of art. In art schools and art history classes , future artists and experts on art are trained to pay attention, beyond the figurative elements of a painting, to other aspects of the paintings (e.g. the historical context, different painting styles and the composition of objects, forms and colour; Pihko et al., 2011, p. 1). Consequently, it is a common belief that art experts can perceive more in paintings than non-experts. They are thought to guide their gaze through their internal cognitive schemes or strategies which enable them to look beyond such figurative elements. However, this belief lacks experimental evidence. Therefore, this study aimed at investigating, by means of an eye-tracking device, the visual explorative behaviour of people with differing level of expertise of art, in "bottom-up saliency regions" and "top-down saliency regions", while looking at paintings. I have created and conducted, an experiment to measure to what extent someone's familiarity with art influences his or her eye fixations during the perception of paintings.

The experiment consisted of gathering physical data (recoding participants' eye-movements) and survey data (e.g., registration of background variables and cultural capital of the participants) regarding the observation of paintings. Because I particularly focused on the difference in top-down and bottom-up perception during art-viewing instead of natural scene-viewing, the use of actual original paintings was required. Therefore, the experiment took place in an exhibition context (i.e. Museum Boijmans van Beuning) which meant that the data-collection tools (SMI-ETG device) had to be flexible and work in an indoor environment. It also meant that I had to reconverted the raw data in many different ways in order to make the data usable for interpretation.

Results revealed that there was no strong evidence of differences between the eye-movements of people with differing level of expertise in art, viewing works of art. Hence, results did show there was a difference in appreciation of art among people with differing level of expertise in art, however this also didn't correlate with differences in eye-movements.

CONTENTS

1. PREFACE

1.1 INTRODUCTION

In modernity, art experts are considered as a separate group of art viewers that experience art in a distinctive manner (Savazzi et al., 2014). It is assumed that one must learn how to interpret a work of art. In art schools and art history classes, future artists and experts on art are trained to pay attention, beyond the figurative elements of a painting, to other aspects of the paintings (e.g. the historical context, different painting styles and the composition of objects, forms and colour; Pihko et al., 2011, p. 1). Consequently, it is a common belief that art experts can perceive more in paintings than non-experts. They are thought to guide their gaze through their internal cognitive schemes or strategies which enable them to look beyond such figurative elements. However, experimental evidence for this belief is lacking. Therefore, this study aimed at investigating, by means of eye-tracking, the visual explorative behaviour of art-experts and layman in bottom-up saliency and top-down saliency regions while looking at paintings. The phenomenon of bottom-up - and top-down saliency will be explained elaborately in the theoretical framework. For now, suffice to assume that bottom-up saliency regions correspond with conspicuous (figurative) elements in paintings, and top-down-saliency regions correspond with all the regions that are not visually conspicuous.

Thus, this research investigates whether it is reasonable to accept the assumption that art-experts perceive more in paintings (e.g. with their eyes) than layman. Do people with greater expertise focus more, less, or equally at conspicuous regions of paintings than those who are less experienced in this regard? I have created and conducted, an experiment to measure to what extent someone's familiarity with art influences his or her eye fixations during the perception of paintings.

1.2 RESEARCH QUESTION

From the assumption that art-experts perceive paintings differently than non-experts, the following research question has been examined:

> *To what extent does familiarity with art influence the eye-fixations in the top-down saliency regions during the perception of paintings?*

1.3 RELEVANCE

In order to further develop understanding of art appreciation, studies which are supported by technical devices to measure physical aspects of art perception could provide new insights in addition to existing studies. Technical devices, such as eye-trackers, make it possible to test whether there is a relationship between art-expertise and the physical way of perceiving art. Do people literally look differently at art when they have obtained more knowledge about art? Hopefully, we can learn something from insights like these. A possible application could be in the field of education; it might be relevant to direct people's gaze, which may influence the way people perceive and appreciate art. Another relevance could be for artist themselves; they could apply the insights of bottom-up and top-down perception on their own practice.

1.4 ORGANISATION

The thesis is organized in six chapters, including this one, plus a bibliography and appendix. I will shortly explain the content of each chapter:

(2) Chapter two formulates the theoretical framework and consist of five sections which will explain what visual art is in general and how visual art is perceived (both top-down and bottom-up). Furthermore, it discusses existing experiments and states the purpose of the research.

(3) Chapter three describes the methodology that has been used to conduct the experiment. This chapter consist out of six sections; (3.1) the research method of the experiment; (3.2) the concept operationalization, describing the concepts that are being used in the previous and coming chapters; (3.3) the hypotheses; (3.4) the general setup, explaining the experiment setup, hardware specifications, data collection and raw data; (3.5) the data reconfiguration, explaining how all the data has been reconverted and (3.6) the method of analyses describing how I analysed the data.

(4) Chapter four contains the results of the experiment. The results are separated in descriptive statistics of the data; participants' characteristics; participants' art-appreciation; participants' bottom-up correlations; within-subject analyses, and analyses of the relation between familiarity with art and appreciation.

(5) Chapter five evaluates the hypotheses in the conclusion.

(6) Chapter six closes the thesis with a discussion. This chapter has separate sections on the limitations of the study; the implications of the study and a proposal for further research

(7) The bibliography contains all resources that I have used in this thesis

(8) The Appendices consist of four parts; A participants questionnaire; B matlab software © Ir. J.F.M. Domhof ; C saliency frames of all participants conducted in matlab; D elaborate table results.

2 THEORETICAL FRAMEWORK

This theoretical framework presents existing theories that will be used as a rationale behind the experiment. Furthermore, definitions will be formulated in this theoretical framework which will provide a clarification of the concepts that are being used.

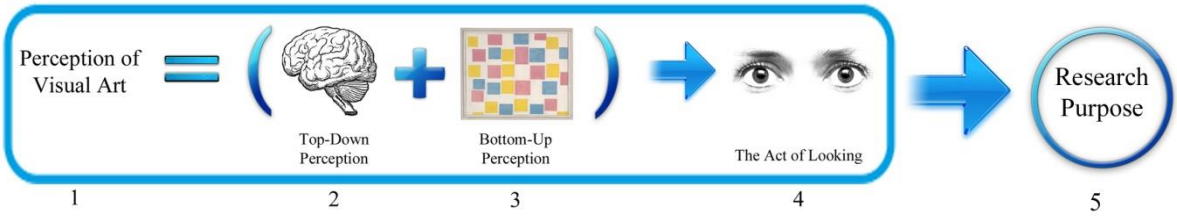


Figure 2.1. Sections Theoretical Framework

The theoretical framework consist of five sections that are shown in figure 2.1. The first section will give an introduction of the perception of visual art in general. The second section will explain “top-down perception”, the third section “bottom-up perception”, the fourth section will discuss some existing related experiments on the act of looking at art, and the last chapter will explain the purpose of the research.

2.1 PERCEPTION OF VISUAL ART

2.1.1. WHAT IS PERCEPTION?

Perception is man's primary form of cognitive contact with the world around him (Efron, 1969, p. 1). As perception consists of cognitive information processing, a person needs to have "knowledge" in order to do so. From the moment we are born, the process of perception starts. When we are a child, everything we perceive is new,. As we grow older, we can relate things to each other because we recognize and remember what we have perceived before. For this study, it is important to understand the difference between "bottom-up perception" and "top-down perception", as I am going to apply this to the concept of "art-perception". Moreover, the terms "bottom-up" and "top-down" will be applied in relation to several other concepts such as "saliency" and "knowledge", which might be confusing when one does not clearly understand the differences between "bottom-up" and "top-down".

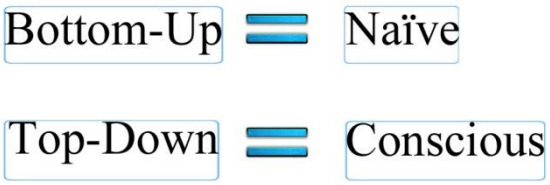


Figure 2.1.1. Meaning of "Bottom-up" and "Top-down"

The term "bottom-up" refers to the naïve perception process and the term "top-down" refers to the conscious perception process (see figure 2.1.1.). For example, when we show a baby a "red apple" for the first time in its life, the baby sees a red and round object without knowing it is a "red apple"; it perceives the apple in a "bottom-up" manner. When we show an adult a "red apple", s/he immediately connects it to related knowledge what s/he has obtained before during his or her lifetime about a "red apple"; for example that it is a sort of fruit, it can be eaten and you can make apple-pie or apple-compote out of it, and so on. Thus, "bottom-up perception" refers to naïve/instinctive information processing and "top-down perception" refers to conscious information processing.

2.1.2. WHAT IS VISUAL ART?

> 'Every art work creates a world in some respect unique, a combination of vast amounts of conventional materials with some that are innovative. Without the first, it becomes unintelligible; without the second, it become boring and featureless (Becker, 1982, p. 63).

What is (visual) art? This question has been debated by scholars of aesthetics for many centuries. No-one has yet found a way to settle every dispute over this question. Art is by its very nature, as an essentially aesthetic construct, difficult to define (Baumann, 2007, p. 5). Many of us say "I know it when I see it", but this is clearly inadequate because we all see differently. So who decides what is and what is not art? I will briefly go over some core concerns of art by reviewing the debate. Hence, this research concerns the perception of visual art, more specifically: paintings. Therefore I will not go too deeply into the general debate, and quickly move over to the visual arts.

An early definition of art was put forth by the Russian writer and philosopher Leo Tolstoy (1995 [1898], p. 40) in his text *What is Art?:* "Art is that human activity which consists in one man's consciously conveying to others, by certain external signs, the feeling he has experienced, and in others being infected by those feelings and also experiencing them". Tolstoy underlines the importance of the communicative and emotional elements, hence he excludes those works that would inspire audience members' emotions unintended by the artist (Baumann, 2007, p. 5). For art can communicate feelings and emotions as well as thoughts and ideas, both dependently and independently from its creator (Freeland, 2002). A little later, the American philosopher John Dewey (1935) claimed that art was the best way to understand a culture (Freeland, 2002, p. 148). More recently, the sociologist Howard Becker (1982) explained that a work of art is art when people say it is; the contents of the category of arts are defined socially (Alexander, 2003, p. 2). Howard Becker (1982:138) argues:

> Like other complex concepts, [the concept of art] disguises a generalization about the nature of reality. When we try to define it, we find many anomalous cases, cases which meet some, but not all, of the criteria implied or expressed by the concept. When we say "art", we usually mean something like this: a work which has aesthetic value, however that is defined; a work justified by a coherent and defensible aesthetic; a work displayed in the appropriate places (hung in museums, played at concerts). In many instances, however, works have some, but not all of these attributes.

Thus, according to Becker (1982), defining art is a sociological process, and therefore likely to change. Sociology is, among other things, the study of society, the study of human systems, of the way people create meaning and the study of social inequality that constantly changes (Alexander, 2003, p.1). Therefore, art and artists can be, and have been, constructed differently in other times and places. This research adapts the theory of Howard Becker, and assumes that the concept of art is socially created. This has the consequence that the research has to be conducted with paintings that have a high artistic value and are being recognized as "fine art" within the socially created aesthetic system of today.

Thus, the paintings that will be selected for the experiment have to meet the requirements of an aesthetic form. According to Marković (2012), an aesthetic form is a specific composition consisting of various features such as colours, lines, shapes, sounds and gestures (Marković, 2012, p.9). Paintings consist of a uni-model composition; they are visual artworks (Marković, 2012, p.9). The single features such as colour, line and shape can provide some elementary meanings themselves, such as dynamics, warmth, health, time, destruction, and so on (Marković, 2012, p.9). But from an aesthetic point of view, the composition of these features together is more important than the single features themselves because together the global structure can induce an impression which can stimulate the understanding of a narrative (Marković, 2012, p.9). Note that both depictive and abstract paintings can show narratives.

2.1.3. THE ACT OF ART-PERCEPTION

> There is no such thing as an immaculate perception.
>
> (Marshall Sahlin, 1985, p. 149)

Now that we have briefly sketched what the characteristics of visual art are, we can study how visual art is perceived. Visual art perception always starts with the act of looking. "Seeing comes, according to Scott (1991:776), before words" (Berger, 1972). Seeing is the origin of knowing whereas verbal and written communication are transmission methods to reproduce the visible world (Delany, 1988, p. 174-176). Moreover, Scott (1991) argues that knowledge is gained through vision; vision is a direct apprehension of a world of transparent objects, such as art (Scott, 1991, p. 775). In this conceptualization, the visible is privileged; and writing or speaking is then put at its service. Thus the visible is the pure "knowing" (Scott, 1991, p. 776).

While looking, the work of art influences the viewer through its physical features (shape, composition, colours, contrasts, edges). Some features are more noticeable than others (for example, a blue dot on a big red surface). As a result, the eye will be attracted to the conspicuous features (as a reflex); this is called bottom-up perception. Thus, bottom-up perception is the directing of the gaze immediately caused by the visual context where the eye is looking at (e.g. because the visual context attracts attention). On the other hand, top-down perception, takes place when the viewer is able to process the obtained visual information and add this to his or her (previously) obtained knowledge about the work of art or art world (for example; relate the work of art to the correct time period, style and context in which it was created). With this knowledge of the work of art, a person can consciously focus his or her gaze on certain parts of the surface of the painting. Thus, in top-down perception, the viewer influences the act of looking with his or her background knowledge of the work of art, and directs his or her eyes to certain parts of the work of art. So, by looking at a work of art, an observer enters into a dialogue between bottom-up influences (looking naïvely, gaze freely) and top-down influences (looking aware, direct the gaze) (see figure 2.1.2).

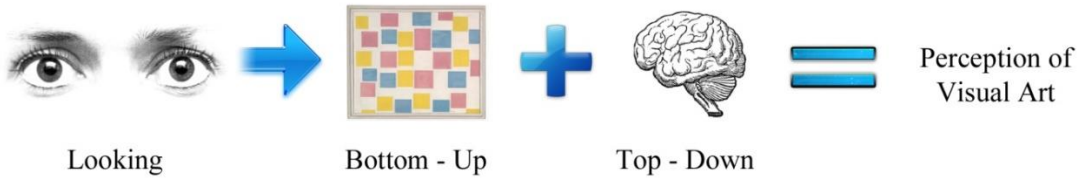


Figure 2.1.2. Perception of Visual Art

This process of perception of visual art will be explained more elaborately in the next sections. Figure 2.1.2 will be explained backwards in the next sections because, although the eye-movements include the information they see, it is more logical to explain it the other way around in order to understand the whole process of visual art perception clearly. As one first has to know how we think of art in general (even when one is completely untrained in the arts, one has certain ideas about art, therefore completely blank bottom-up information processing is almost impossible) it is more logical to explain perception of visual art in the order shown in figure 2.1.3.

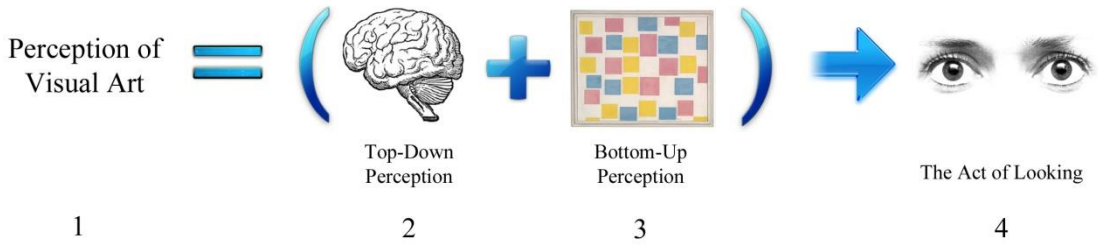


Figure 2.1.3. Perception of Visual Art, (backwards)

2.2 TOP-DOWN PERCEPTION OF ART

2.2.1. CONSUMPTION OF ART AND SOCIAL BOUNDARIES

Before one can state anything about the effect of "familiarity with art" on art perception, one has to know how "familiarity with art" originates and what it contains. This section discusses how audiences find meaning in artworks and how social systems create boundaries among different social groups on the basis of taste and aesthetic choice.

Many people argue that art makes up an important part of their lives (Augustin et al. 2011, p. 2071). Nevertheless, there are also many non-art consumers who, although they might acknowledge the importance of art, never spend time to visit art- galleries or museums themselves. How does someone become interested and familiar with art? The reason for the unequal distribution of cultural preferences across the social hierarchy is much debated (Berghman, 2013). A common-sense view implies that highbrow culture is more difficult to understand than lowbrow culture (Berghman, 2013, p. 7). The language of art (which can consist of graphic patterns, sound, movement or language) is not literal and therefore one must learn how a work of art can be interpreted. The American philosopher John Dewey wrote in his book "*Art as experience*":

> In common conception, the work of art is often identified with the building, book, painting, or statue in its existence apart from human experiences. Since the actual work of art is what the product does with and in experience, the result is not favourable to understanding. (Dewey 1934, p. 1)

Therefore, artworks only become relevant through appropriation and since they are characterized by a level of complexity, they require some form of specialized intellectual processing which entails the application of particular codes (Berghman, 2013, p. 7). Gombrich (1960) studied the psychology of pictorial representation, especially in illusionistic paintings (Alexander, 2003). He suggested that artists, such as primitive artists and medieval artists, whose goal it is to represent reality in a convincing way, often dismiss their goal because they base their representation on the knowledge of an object rather than what it actually looks like in space (Alexander, 2003). Therefore, the beholder of a painting needs to be able to interpret the artist's schema. It becomes even more difficult for the beholder to interpret the artist's schema when the picture does not depict reality but an abstract scene; now the beholder needs to know the underlying ideas of the artist. Without training, the skill of seeing and of interpreting what is seen remains latent (Csikszentmihalyi et al., 1990). Hence, the ability to appreciate and interpret art depends, according to Ganzeboom (1989, p. 46-47), on a person's capacity for information processing. The ability of information processing is closely related to educational achievement, as the capacity for dealing with abstract and complex information is also required for school success. Higher education can provide people with the cognitive means to cope with artistic products and strengthen the capacity of information processing, which is needed for appropriate artistic experience (Berghman, 2013).

Sociological research has amply demonstrated that social background is decisive for one's educational achievement as well as one's cultural taste (Bourdieu 1977; Kraaykamp & Van Eijck 2010; DiMaggio & Mohr 1985). This can explain the importance of the influence of someone's social background; parents who place great value on the arts may stimulate their children's interest in the arts. Moreover, parents determine in which social class their child is born and social systems create social boundaries between classes (Lamont, 1992). Boundaries

can exist in both physical and symbolic form (Alexander, 2003). "Symbolic boundaries are conceptual distinctions made by social actors to categorize objects, people, practices and time and space" (Lamont & Molnar, 2002, p. 168). For example, when elites state that fine arts are "high" and popular arts are "low", they create an invisible boundary for people from lower social classes to attending high arts; because these invisible boundaries actually function as visible barriers such as fences and walls, or explicit exclusion of certain social groups (historically; woman, foreigners, immigrants and ethnic minorities) from memberships in clubs, attendance of universities or participation in elections (Lamont & Fournier, 1992). The use of "high" and "low" culture coherent with social hierarchy therefore also influences one's amount of cultural capital. When one does not feel invited to attend the "high arts", it is unlikely one will generate a lot of cultural capital during his life time. Thus, from a sociological perspective it is the socio-cultural context that determines what is, and what is not, art; which subsequently determines who does and does not attendance "high" art.

Thus, it is the interaction between prominent actors that promote the value of artworks (e.g. the elites: renowned institutions, art critics, artists, museums) who determine what is and what is not art. Because elites are able to recognize other members of their upper class by their taste, they are also able to perpetuate class distinction intergenerationally by using their positions of power to structure other institutions –such as school systems- that favour themselves (Alexander, 2003). Individuals with economically or culturally poorer backgrounds may believe society is a fair open system for each citizen, offering the chance to climb higher up the social hierarchy ladder, but they typically do not realize that children with higher levels of cultural capital are favoured in the educational system (DiMaggio, 1982; Bourdieu, 1984). For example, DiMaggio (1982) found significant effects of cultural capital on high school grades (DiMaggio, 1982). Although Van Eijck and Knulst, (2005) found that education and age, as indicators, have shown to have a positive influence on the frequency with which people participate in the arts, Van Eijck (1999) also found that people who attained higher levels of education than their parents did not necessarily develop a taste for highbrow culture. This can be explained by the fact that participation in art worlds requires knowledge and expertise (e.g. visiting the theatre, music concerts or museums) which is instilled from childhood on (Van Eijck, 1999; Van Eijck & Knulst, 2005). This implies that the factor "family background" has a larger impact on familiarity with art and the preference of art than the factor "education" (DiMagio & Mohr, 1985).

2.2.2. DISTINCTION: ART AND THE TASTE FOR IT

> To see something as art requires something they eye cannot descry – an atmosphere of artistic theory, a knowledge of the history of art: an art world. (Danto 1964, p. 580)

As cultural participation requires knowledge, which is instilled from childhood on (Van Eijck, 1999; Van Eijck & Knulst, 2005), it is likely that the taste for art is also instilled from childhood on. Bourdieu (1984) formulated his theory of *distinction* (Alexander, 2003). Bourdieu suggests that social groups do not only vary in the amount of economic capital they possess and control; they also vary in the amount of cultural capital they possess. *Cultural capital* is a currency based on taste (Alexander, 2003, p. 229). Cultural capital involves knowledge about high art and culture, knowledge how to appreciate art in a sophistication manner (Alexander, 2003). This sophistication is difficult to acquire. Dewey (1934) argues that understanding art is like understanding another

person; one can only interpret someone's face when one is familiar with the culture of the person one is looking at. Similarly, the interpretation of art also requires knowledge about the context and culture in which it is produced and displayed (Freeland, 2002). Bourdieu (1984) connects cultural capital with the concept of habitus. *Habitus* is produced as categories of perception and appreciation that are themselves produced by an observable social condition (Bourdieu, 1984, p. 101). Thus, in other words, the habitus is an embodied mental structure (the way people think, evaluate and perceive) that is acquired through various instances of socialization. The habitus is thus shaped by experience, for a person can only take on board what s/he has effectively undergone (Berghman, 2013, p.30). Bourdieu suggest that children develop a way of thinking, a worldview or habitus, due to their socialization based on their class position (Alexander, 2003). Of course, over time, they internalize this habitus, and as a consequence they carry a mode of thought with them throughout their lives that betrays their social origins regardless of where they end up (Alexander, 2003, p. 231). Thus, the upper social classes use art as a way to distinguish themselves from other social classes. Furthermore, the value and meaning of art is produced through socialization, and art itself functions as a method for socialization. As a consequence, social differences cause differentiation in the perception and appreciation of art.

Thus, someone's knowledge about art is determined by someone's cultural. A recap; someone's cultural capital is established by someone's family (e.g. upbringing), someone's education (e.g. school diploma's), someone's experience with art (e.g. the amount of visits to museums and galleries with friends and family and alone), and someone's social background (e.g. the society in which someone grows op). Figure 2.1.1. shows a schematic overview of the content of "cultural capital".

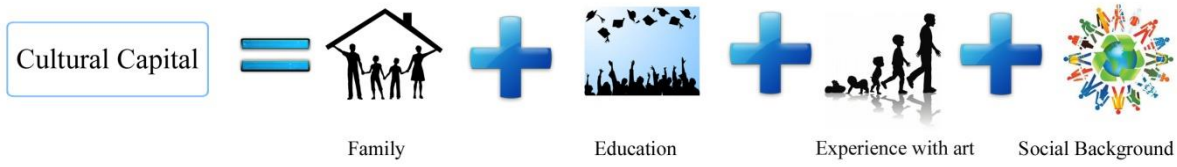


Figure 2.2.1. Schematic overview of the elements of Cultural Capital.

Now that we now what *cultural capital* encompasses, it is important to understand that, in this experiment, cultural capital is positively related to the "top-down perception of art"; because when someone possesses a certain amount of cultural capital, s/he does not look naïvely at the work of art anymore, but relates it to all his or her existing knowledge of the work of art. But, I have chosen to not use the word cultural capital in this paper anymore, instead I will use the term "familiarity with art", as this is a more all-embracing term. Because when someone only possesses one of the four influences (see figure 2.2.1) of cultural capital, someone is still familiar with art (only s/he does not possess all the four aspects of cultural capital). Therefore, the term "familiarity with art" will be used from now on. Figure 2.2.2. shows the correlation between familiarity with art and top-down perception schematically.

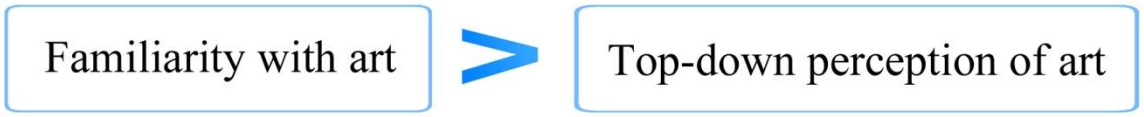


Figure 2.2.2. Familiarity with art is strongly positively correlated with "top-down perception" in this research.

This context and culture that are salient for the arts, are commonly determined by aesthetics. Aestheticians study the arguments that people use to justify classifying things and activities as "beautiful", "artistic", "good art", "bad art", and so on (Becker, 1982, p. 130). If one possesses knowledge of the history of art and the art world, and knowledge about aestheticians' judgement of art works, one can distinguish between his or her personal aesthetic perception and his or her aesthetic judgement (Schellekens 2006). One's judgement depends on one's perceptual processes. Thus, if one possesses more knowledge on the nature and complexity of a specific work (e.g. top-down information) and therefore uses the appropriate criteria, one can make distinctions between works of art without only judging a work of art on the basis of one's individual preferences. This means that, when someone is an experienced art-viewer, this person is able to deduce the presence or absence of aesthetic qualities from his or her cognitive-emotional response to a work of art. This means that perception and justification are not necessarily in agreement. For example, a work of art can evoke disgust by its beholder as an emotion, without the beholder considering the artwork disgusting. Thus, the emotional response and the aesthetic judgement can be based on entirely different criteria. Just as you need physical perception ability to perceive secondary qualities such as colour, you also need an aesthetic sensibility to perceive aesthetic features such as harmony, beauty and intensity (Schellekens 2006, p. 167).

One can only justify his or her aesthetic judgment by sharing (the why of) his or her experience with others. And the justification can only be based on agreement between subjects' experiences and is therefore no more than an explanation, relying on rational reflection on the work of art. Therefore, it is likely that the opinion of someone who does not possess (top-down) knowledge about the art world, shall not be taken seriously by people who do possess (top-down) knowledge about the art world. Thus, although personal taste of experienced viewers can differ, they still can agree on what art is about, because they all possess a certain amount of top-down knowledge (e.g. art expertise) about the arts, whereas this is more difficult for untrained viewers because they do not possess this amount of top-down knowledge which makes it difficult for them to relate the work of art to 'the bigger picture'.

To conclude from the previous sub-chapters, the four factors "family", "education", "experience with art" and "social background" together form one's "Familiarity with art". Figure 2.2.3. shows the influences of the four factors on "Familiarity with art".

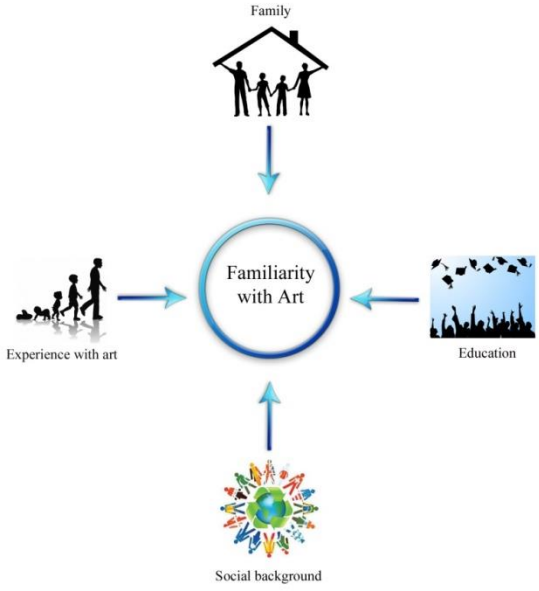


Figure 2.2.3. Factors that influence people's familiarity with art.

2.2.3. ART APPRECIATION

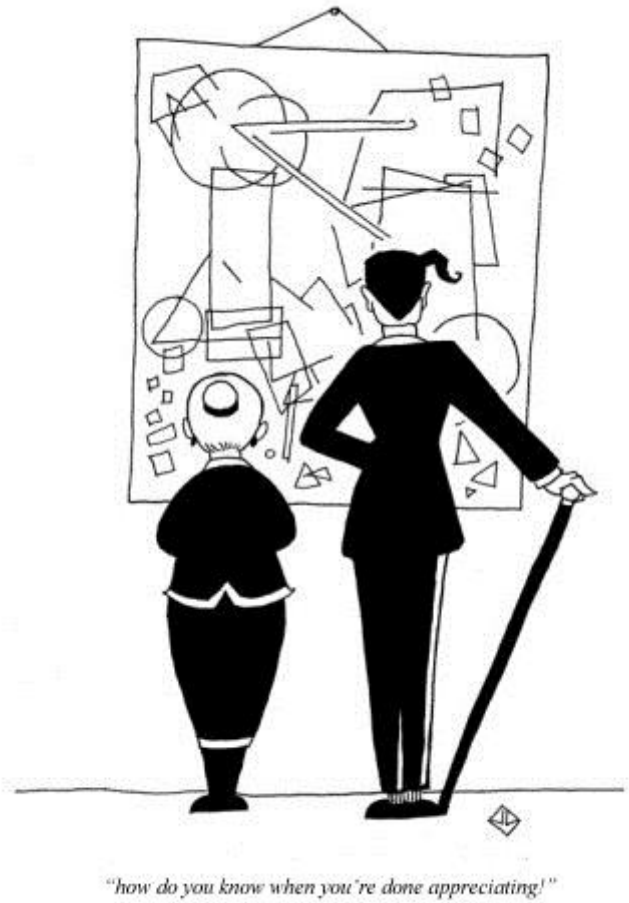


Plate 1. Couple look at a painting, a *New Yorker* Cartoon by J. Leavitt. © 2005 J. Leavitt from allposters.com

As we have seen in previous sections, sociology theorizes that social differences are the cause of variation in how people appreciate art (Boudieu & Nice, 1980; Bourdieu, 1985; Schellekens, 2006). What people appreciate, and why they appreciate certain works of art is therefore the result of social and cultural influences stemming from the family of origin, education, and boundaries prevalent in a certain society. Research indicates why experts and laymen appreciate art differently. Many non-experts see artworks not as exceptional objects with deeper aesthetic meanings, but rather as ornamental objects of everyday life (Winston and Cupchik, 1992, p.12). Therefore, untrained art viewers with little or no knowledge of art find technicalities, styles and periods unimportant; they just interpret a work of art from their own everyday personal experience. As a consequence, their appreciation is less affected by criticism from (unfamiliar) professionals (Bourdieu, 1990). This means that during the perception of paintings, the eyes of people with little knowledge of art are primarily caught by things that are easily recognisable (bottom-up information) such as human figures, especially faces (Pihko et al., 2011, p. 1). Therefore, laymen tend to appreciate depictive paintings more than abstract paintings. Experienced viewers, on the other hand, are more likely to view the holistic scene of an artwork and place it in a broader context, focussing more on the relation between the artistic artefact and the art world. Therefore, experienced viewers are more likely to appreciate more complex works of art such as abstract paintings.

The idea that experienced viewers tend to appreciate complex (e.g. abstract) art works more than laymen was already shown by Daniel Berlyne. Berlyne (1971, 1974) reinvigorated the study in of aesthetic preferences in his studies on 'new experimental aesthetics'. He argued that the gratification people derive from an aesthetic experience is dependent on the complexity of a work of art. Artworks have a number of properties such as complexity, uncertainty, novelty and conflict that are characterized by their capacity of arousal. He calls these features together *collative variables* because one must both combine and compare information from various sources in order to analyse the work of art (Berlyne 1971). The more arousing a work of art appears, based on these features, the more pleasing the experience is likely to be. However, at a certain point the stimulation turns into overstimulation. When the arousal level becomes too high, the appreciation level starts to decline. Thus, when a work of art becomes too complex, it is no longer satisfying but rather frustrating the viewer. On the other hand, when a work of art is too simplistic it bores the viewer. The optimum curve differs for each viewer, depending on their ability to decode and thus appreciate complex aesthetic stimuli. Figure 2.2.2. shows the Berlyne curve; the relation between complexity and liking.

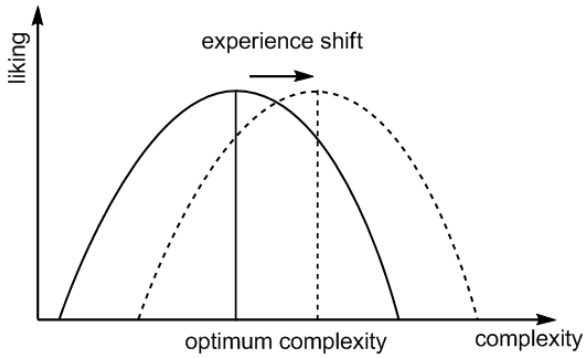


Figure 2.2.2 Berlyne curve showing expected correlation between complexity and liking

From the theory, it can be concluded that Top-down perception of art influences the amount of appreciation for a work of art (see figure 2.2.3). Top-down processing indicates a better understanding of the works of art due to the implication of cognitive schema's which direct the gaze of the viewer while perceiving a work of art. I therefore suspect that viewers who process more in a top-down manner appreciate (complex) paintings more than people who process paintings in a bottom-up manner. I will also shortly examine this hypothesis during my research, however it should be taken into account that the focus of this research lays on the influence of "familiarity with art" on top-down eye-movements while viewing works of art, and not on appreciation of artworks. However, since top-down perception is argued to cause the relation between expertise and appreciation, I also want to test if this relation in itself exists, apart from the process through which it is arguably caused.

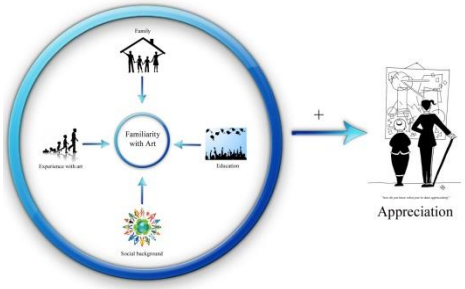


Figure 2.2.3 Schematic overview of the influence of "familiarity with art" on art appreciation.

2.3 BOTTOM-UP PERCEPTION OF ART

2.3.1.BOTTOM-UP SALIENCY

Unlike a machine, which uniformly analyses the whole image, the human brain is capable to detect the most dominant part in a certain scene, for example a person in a painting or a road sign on the road. For instance, if you look at figure 2.3.1, the road sign is the most dominant region in this image.

Figure 2.3.1.: The road sign is the most dominant region in this image.

The road sign in figure 2.3.1. is called 'salient'. Visual saliency refers mainly to bottom-up processes that reveal certain image regions as more dominant. The road sign in figure 2.3.1 can be considered as bottom-up information. However, to know what the road sign means, one must possess top-down information in order to recognise the black pixels in the yellow road sign as a cow, and to have the knowledge that the road sign means "watch out for cows". However, as top-down knowledge has been explained before, this section will only focus on the bottom-up process.

Bottom-up information can be considered as "dominant regions" (e.g. regions with different features from their surroundings, for a yellow road sign on an empty road) that are called "salient regions" because they discriminate against their surroundings. Like the picture of the road sign, paintings also contain salient regions that attract the eyes. Features such as colour, local contrast and position reveal the salient regions of a painting (Condorovici et al., 2011). This process is well-known to artists, and a wide range of techniques are used to guide the viewers' attention to some specific areas of the painting (Condorovici et al., 2011). For example, in the painting "Battle Mountain, 2014" made by M. van Engelen (see figure, 2.3.2), the road directs the eyes towards the mountains; therefore the mountains are the most dominant region (the most salient, and thus the most "bottom-up") in this scene.

Figure 2.3.2: Painting: Battle Mountain, 2015, M. van Engelen: The mountains are the most dominant region in this scene.

As I am going to determine the “bottom-up” and “top-down” saliency regions of every paintings that I use in the experiment, it is important to fully understand what is “bottom-up saliency”. In this study, I consider “dominant regions” bottom-up saliency and everything that falls outside these dominant regions top-down saliency; because one has to ignore the dominant parts of a picture and actively direct one’s gaze to the less-dominant parts of a picture. Figure 2.3.3 underlines what is, in the case of road-sign picture, the bottom-up and top-down saliency region. Note that pictures can have more than one bottom-up saliency region; for example see figure 2.3.4, shows that the painting “Battle Mountain” contains different saliency regions.

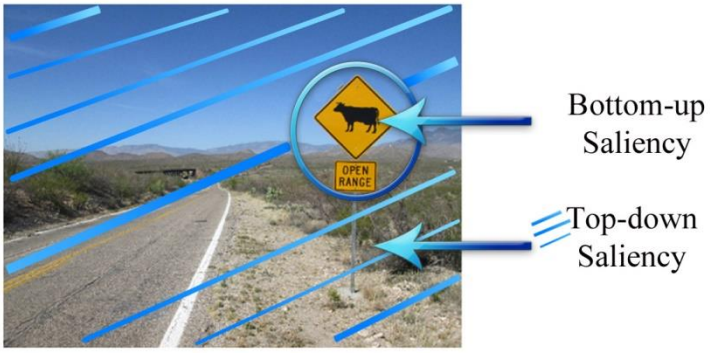


Figure 2.3.3: “Bottom-up” versus “top-down” saliency regions in picture of road sign.

Figure 2.3.4: “Bottom-up” versus “top-down” saliency regions in painting “Battle Mountain”

2.3.2. BOTTOM-UP SALIENCY MODELS

A machine uniformly analyses the whole image instead of detecting the most dominant part in a scene. However, several automatic methods (e.g. algorithms) exist for detecting regions of interest in digital representations of paintings. The main challenge is to use an algorithm that has been modelled in the way compatible with how a human eye and mind see and understand visual art.

Modelling bottom-up visual saliency has been the subject of numerous research efforts during the past 20 years, with many successful applications in computer vision and robotics (Borji et al., 2013, p. 1057). Saliency models consider an object salient if it has distinctive local features that discriminate against their surroundings. A saliency map can be estimated using features that are present in images, such as colour, intensity and orientations of edges (Domhof, 2015, p.3). As the saliency models are very technical and extensive to explain, I will not discuss all the different saliency-models that exist. Instead, I will only discuss the saliency model that I have chosen to use for conducting the experiment.

I have chosen to use the saliency detection algorithm of Itti et al. (1998) to compute the saliency map of the digital representations of the paintings used in this study, because it is widely used and biologically inspired. Moreover, the saliency algorithm of Itti et al. (1998) is also used in similar studies on eye-movement predictions during free-viewing tasks while perceiving paintings. For example, Fuch et al., (2011) used this model in order to explore the influence of bottom-up saliency on eye fixations and found that the salience model of Itti et al. (1998) predicted fixations far better than chance in all images (Funch et al., 2010, p. 34).

Figure 2.3.5 shows the saliency map of the picture with the road sign computed with the model of Itti et al. (1998). In the saliency map (see, figure 2.3.5 b) the bright pixels correspond to salient regions and the dark pixels correspondent to inconspicuous regions.

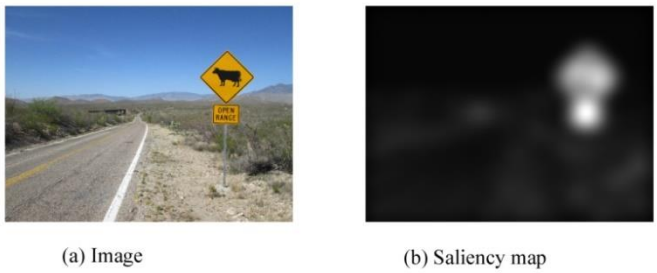


Figure 2.3.5: Image and saliency map as computed with model of Itti et al. (1998).

Such a saliency map is applicable on any kind of digital representation. Figure 2.3.6 shows the saliency map of the digital representation of the painting “Battle Mountain, 2014” by M. van Engelen

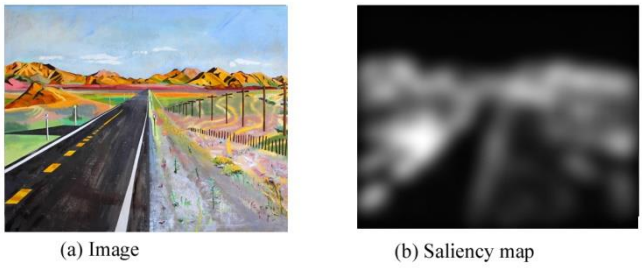


Figure 2.3.6: Painting “Battle Mountain, 2014, M. van Engelen” and saliency map as computed with model of Itti et al. (1998).

Because someone has to actively direct his or her eyes to less-dominant regions of paintings when exploring the scene, I suspect that one's amount of "familiarity with art" influences the conscious eye-movements (e.g. top-down perception) while looking at a painting. Figure 2.3.7. gives a schematic overview of the influence of "familiarity with art" on the top-down perception while looking at a painting. How this influences the eye-movements exactly will be explained in the next sub-chapter by discussing existing theory about the influence of "familiarity with art" of art on eye-movements.

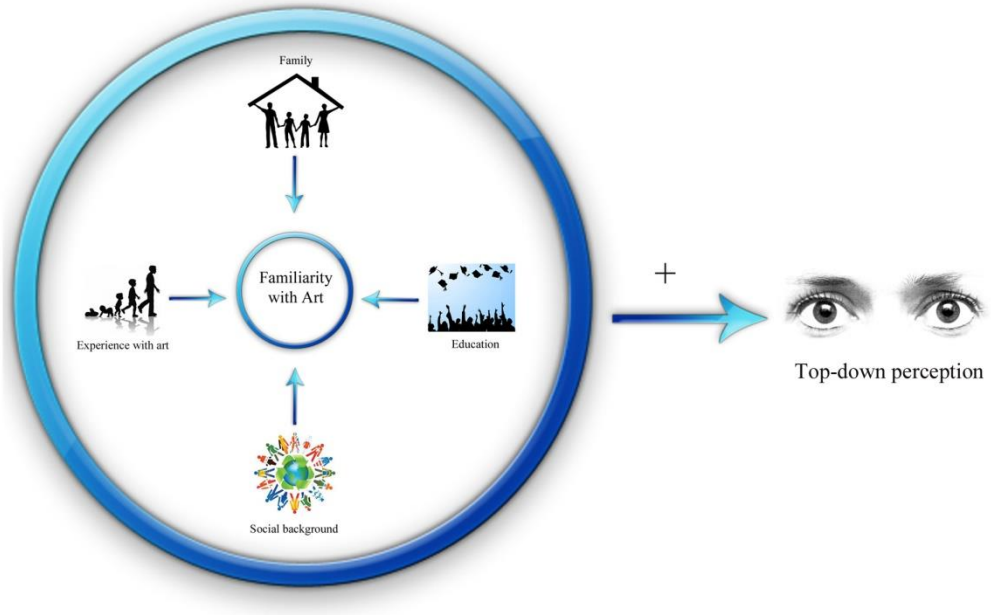


Figure 2.3.7 Schematic overview of the influence of "familiarity with art" on the eye movements while looking at a painting.

2.4 LOOKING AT ART: PREVIOUS EYE TRACKING RESEARCH

> 'whether it is an articulation of one's experience in the light of the object or an actualization of the object in the light of one's experience, the main point of the aesthetic consciousness is that it is one's passage to the external world through experience in the sense of actively realizing both oneself and the object correspondingly at the same time (Dewey,1934, p 19).

Picture perception by art experts and laymen has been compared in several studies on the assumption that art-experts perceive art differently from laymen (Vogt and Magnussen, 2007, p. 91). Studying eye movements can be a useful tool to understand the perception of artworks, the aesthetic experience and cognitive interaction with the work (Kapoula et al., 2009). I will provide a short summary of the most important studies conducted on eye movements and the perception of artworks in order to understand the fundaments on which my experiment is built.

Bushwell (1935) and Yarbus (1967) conducted pioneering studies in the field of art perception and eye-movements in the USA and the Soviet Union. Yarbus was the first to demonstrate that the eye movement pattern depends on the observer's objectives (Kapoula et al., 2009, p. 1). Thus, although the gaze behaviour during picture viewing is strongly affected by bottom-up salient regions, cognitive factors such as given tasks or the viewer's internal cognitive plans and strategies may differently guide the gaze. Difference in gaze behaviour can be studied by analysing fixations and saccades (Pihko et al., 2001, p.1). Fixations are the periods when the eye is relatively stable (e.g. you can see with the naked eye that the fixation is focused) and gathers visual information. Saccades are fast ballistic eye-movements which bring the pupil from one fixation point to another.

Locher (1996; Locher et al. 2007; Locher, 2012) conducted eye movement studies in relation to the perception of pictorial balance. They proposed a conceptual model in which there is a pre-attentive stage of visual processing of the painting that results in a representation of its global structural organization, which occurs within 100 ms, i.e. before the eyes will move to fixations (Kapoula et al., 2011, p. 2). They also stated that cognitive factors such as prior art knowledge may influence the eye movements. According to Locher (1996; Locher et al. 2007; Locher, 2012) the measurement of eye movements in selected areas could allow to extract local features and detailed information about the content and structural composition of the painting (Kapoula et al., 2011, p. 2)

Vogt (1999) investigated the effect of visual training on art perception by showing the participants photo collages in two sessions. During the first session participants could look freely and during the second session participants were asked to look extra carefully and remember what they saw. Afterwards, participants had to fill in a questionnaire about the pictures (Vogt, 1999, p. 325). Vogt (1999) found that the eye-movement patterns of artistically trained respondents differed from those of laymen; the artistically trained looked at graphic composition and colour contrast while the artistically naïve looked at figurative elements (Vogt, 1999, p. 325). There was no difference in the frequency of fixations between the two groups, but the duration of fixations did differ when they got the task to remember what they had seen. Laymen would look longer and at less different regions than experts. During the free-viewing experiment, the experts looked more to regions outside the salience regions than the laymen. During the second, carefully-looking experiment, laymen would look more

at the salience regions compared to experts. (Vogt, 1999). This would imply that expertise does affect top-down processing.

Fuchs et al. (2010) investigated whether visual salience attracts attention in a bottom-up manner (Fuch et al., 2010, p. 25). They presented images of both abstract and representational paintings and photographs to participants in two sessions; free-viewing- and task-driven (Fuchs et al., 2010, p. 25). They showed that for all images, orientation and colour were significant predictors of overall salience. Furthermore, the salience effects were short-lived (e.g. as time goes by, saliency effects become weaker), as only during the first seconds of looking were people driven by the saliences. The more complicated the images were (e.g., more abstract) the weaker the salience effects became. This implies that complicated pictures provide a less appropriate measure of stimulus-driven salience effects on fixations.

Pihko et al. (2011) studied differences in the subjective aesthetic judgments and emotional evaluations, gaze patterns and electrodermal reactivity (i.e. reactivity of skin) between art historians and laymen. They found that the laymen preferred realistic paintings and that art historians' appreciation did not depend on the realism of the paintings. Furthermore, they found that in both groups the frequency of the fixations increased when the paintings became more difficult to interpret (i.e. the paintings became more abstract). Moreover, the increasing amount of eye fixations when looking at more complex paintings resulted in a decrease of the durations of the fixations (Pihko et al., 2011).

To conclude, the studies of Vogt (1999), Vogt and Magnussen (2007), Fuch et al. (2010) and Pihko et al. (2011) show that experts' viewing strategies and aesthetic appreciations differ from those of laymen. How people look at paintings is influenced by a range of factors; the amount and strength of bottom-up regions in a scene, people's habitus, their cultural capital and their objectives. Therefore I assume that people's expertise in art influences his or her eye-movements in such a way that they fixate not only on the bottom-up saliency regions but also at the top-down saliency regions while viewing a work of art. This also means that I suspect that a viewer with less art expertise will show a top-down perception of art and therefore mainly look at the bottom-up saliency regions of a painting.

Figures 2.4.2 and 2.4.3, on the next page illustrate my hypothesis; the blue dots represent the eye-fixations of a viewer. Figure 2.4.1 shows what the bottom-up and top-down saliency regions are of the painting "Battle Mountain". Figure 2.4.2 shows how I expect someone with a lower level of cultural capital (e.g. less top down perception of art) looks at the painting "Battle Mountain" and 2.4.3 shows how I expect someone with a large amount expertise, and thus the ability of top-down perception of art, to fixate his/her eyes.

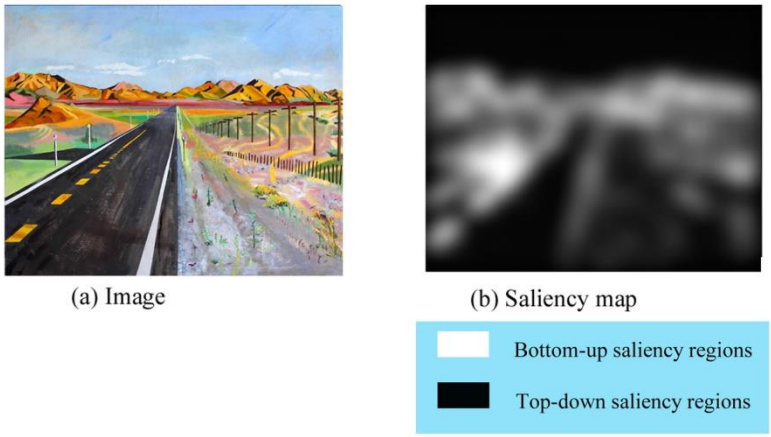


Figure 2.4.1. Illustration of the bottom-up and top-down saliency regions of the painting “Battle Mountain”

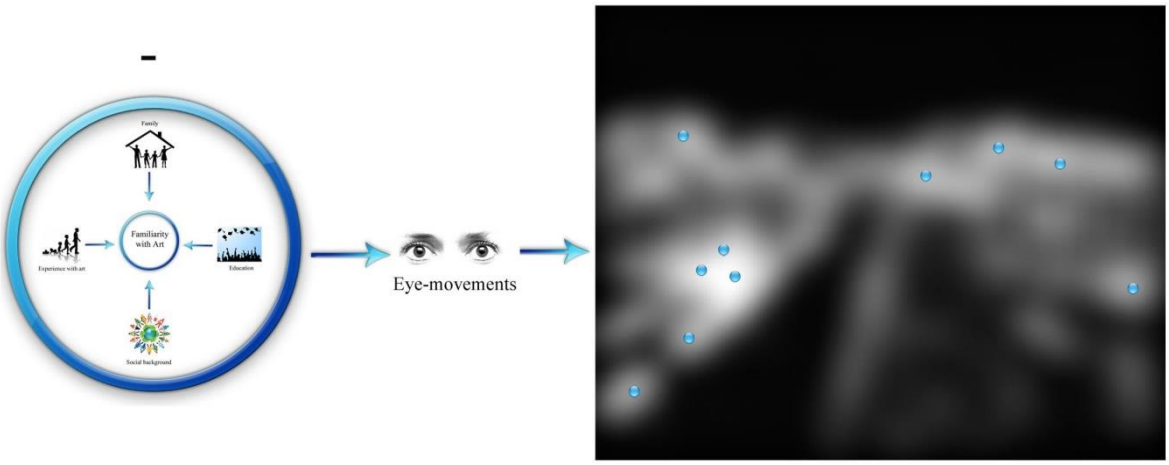


Figure 2.4.2. Expected eye fixations of person with little art experience: emphasis on bottom-up saliency regions of the painting “Battle mountain” mainly to the “bottom-up saliency regions”.

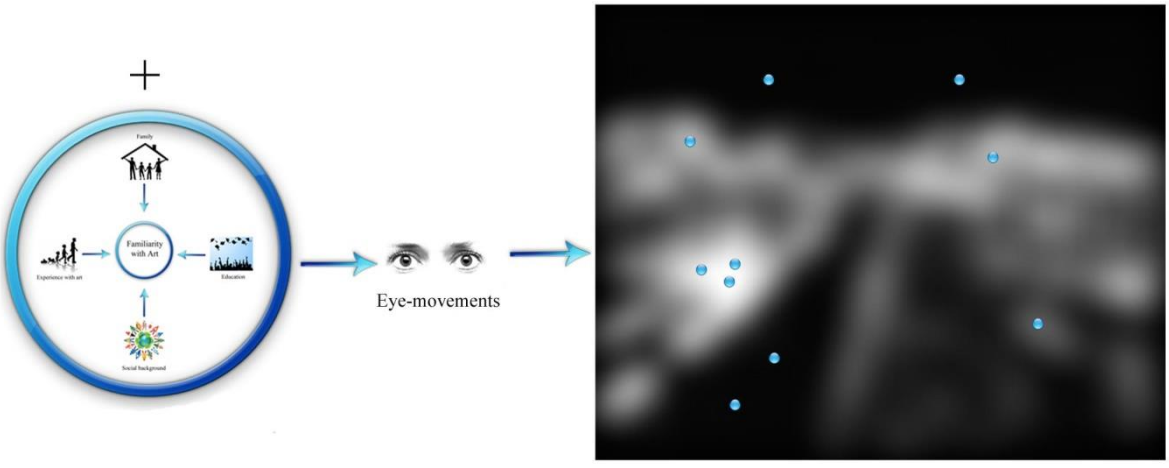


Figure 2.4.3. Illustration of how I suspect someone with a large amount of “top-down perception of art” fixates his/her eye movements while looking at the painting “Battle mountain”: not only to the “bottom-up saliency regions” but also to the “top-down saliency regions”.

2.5 RESEARCH PURPOSE

The purpose of this research was to investigate whether art-experts perceive more in paintings than laymen. Thus, I aim to investigate the relationship between the level of experience with art, or cultural capital, and top-down perception of art by studying the eye-movements of people while looking at paintings. I expect that someone's level of expertise influences the eye-movements and the appreciation of artworks, and that top-down perception influences the appreciation of artworks (see figure 2.5.1). Thus, as theory emphasize that familiarity with art is correlated with appreciation of art, I am going to research if this correlation also is visible through a detour; the way we look at paintings with our eyes.

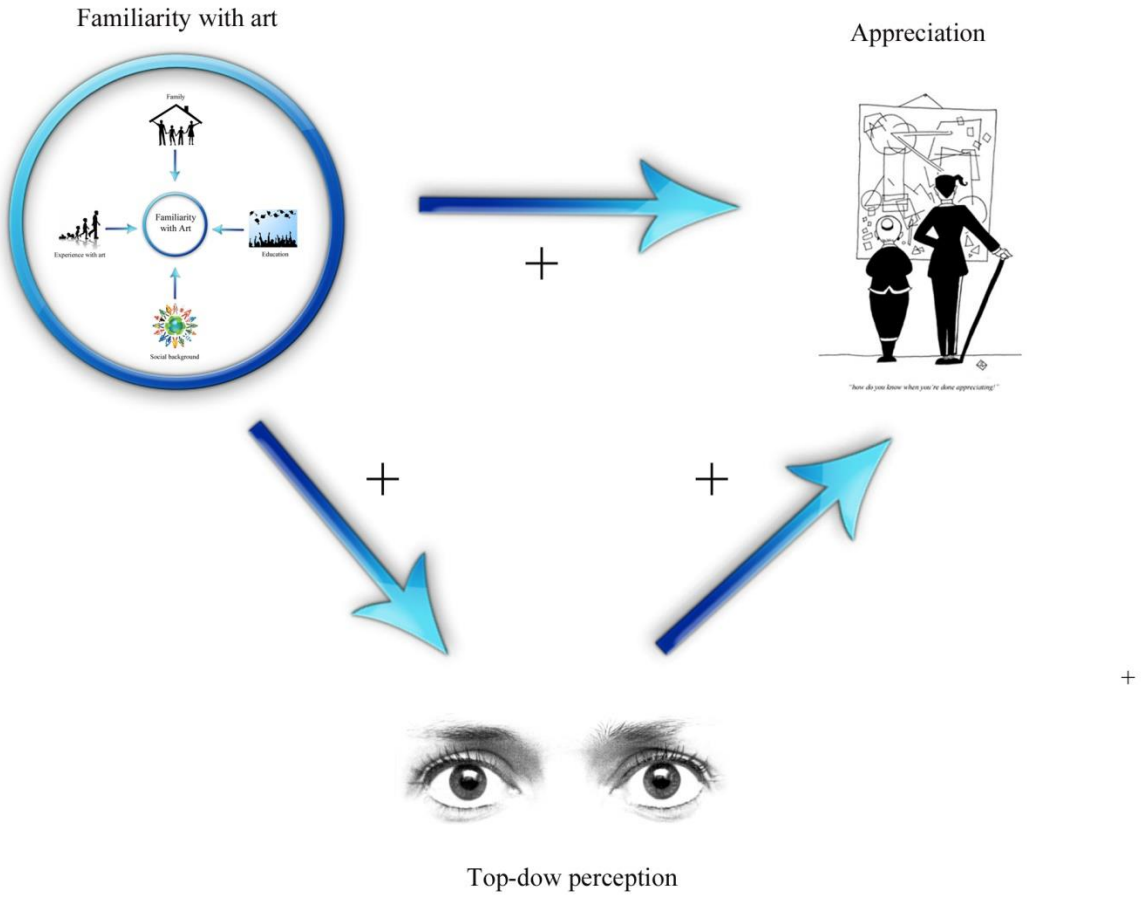


Figure 2.4.1 Triangle: schematic overview of the expected influence of "familiarity with art" on the eye movements (e.g. top-down perception) and appreciation of someone who is viewing a work of art.

3 METHODOLOGY

3.1 RESEARCH METHOD

The introduction of saliency-reception into the theory of cultural capital offers a promising avenue for empirical application. To test *to what extent familiarity with art influences the eye-fixations in the top-down saliency regions during the perception of paintings*, an empirical, quantitative method is the logical choice because we can only measure this through the device of an eye-tracker which generates quantitative output. In the subsequent sections, I will elaborate on a research design that includes both the impact of the participants cultural capital and the artefact (e.g. painting as stimulus) itself, on the ratio of top-down versus bottom-up processing of visual information of the paintings. The subsequent sections consist of the concept operationalization, general setup, and the method of analysis, respectively.

3.2 CONCEPT OPERATIONALIZATION

Appreciation, art, paintings, familiarity with art, social background, saliency, salient regions, bottom-up saliency, top-down saliency, local feature contrast, top-down saliency and bottom-up saliency were the main concepts of this research. *Appreciation* can be defined as *that which the participants prefers or likes*. It was the intention to measure the level of appreciation per art work. Per artwork, five criteria were offered in the form of statements, Berghman (2013) was a source of inspiration for these items. The respondent could express the extent to which they agreed by rating each painting with a number ranging from 0 to 100 (0 meaning "fully disagree", 100 meaning "fully agree"). The items are summed up below. The actual statements are between brackets.

- Beauty (I find this painting beautiful)
- Emotional strength (This painting touches me emotionally)
- Complexity (I find this painting complex)
- Interestingness (I find this painting interesting)
- Powerfulness of the image (I find this painting powerful)

Paintings, were used as representatives of visual *art.* I have chosen to use paintings which were displayed in a real museum, because this is a judicious choice from the institutional art theory. *Art* can be defined as the "application of skill and taste to production according to aesthetic principles: the conscious use of skill, taste and creative imagination in the practical definition or production of beauty: works of art'' (Webster 1976, p. 122). However, whether an object is received as art is determined by credible individuals and prestigious institution in the field of art (Bourdieu 1985; Bourdieu & Nice 1980) such as art history books, critics, or museums.

Familiarity with art is defined as the level of one's affiliation with art, which can range from art expertise to art consumption. Familiarity will be measured in 4 ways: 1. *Art Knowledge;* the participants' self-reported knowledge of art (see Appendix A: Q17). 2. *Art interest;* the participant's self-reported interest in art (see Appendix A: Q16). 3. *Art education,* the self-reported estimate of average hours spent weekly on art education during high school, level of art education; and level of art history education after high school (see Appendix A: Q11, Q12 and Q13). 4. *Art consumption,* a particular kind of cultural participation, measured as

how often the participant annually visited art galleries or art museums and the estimation of average annual art gallery or museum visits with parents or other family until the age of 18 (see Appendix A: Q 14 and Q15).

Social Background was defined as a set of indicators identified by theory (Bourdieu, 2013) and previous research (Berghman & Van Eijck, 2009). Its indicators were 1) the participant's age; 2) the participant's ethnicity; 3) the participant's place of birth; 4) the participant's current place of residency; 5) the participant's highest level of completed education; 6) highest level of completed education of participant's father; 7) highest level of completed education of participant's mother. Because of possible gender differences, participants' gender was also categorized under social background; we gave the option to choose between male, female and transgender.

Saliency is a factor assumed to drive the eyes and attention (Fuch et al. 2011, p. 25). *Salient regions* are dominant regions that discriminate against their surroundings. In this experiment, the model of Itti, Koch and Niebur (1998), is used to detect salient regions of the paintings. Image salience is computed in terms of *local feature contrast* in colour, luminance, and orientation (Fuchs et al., 2011, p. 25). *Local feature contrast* in paintings is defined as the amount of difference in dark (i.e. dark coloured to black) and light (i.e. light coloured to white). The level of luminance is defined as the reflecting light and the orientation are the appearance of edges in a painting. *Bottom-up saliency* (stimulus driven) thus has distinctive local features which make classify it as salience (Itti et al. 1998). In this research, bottom-up saliency is the same as 'salient regions'. *Top-down saliency*, in this experiment, refers to all the regions in the painting that are not caused by bottom-up saliency. Thus, salient regions that have certain features related to a goal at a certain moment (Itti et al., 1998)

3.3. HYPOTHESES

From previous research and theory, the following hypotheses are formulated.

The research of Vogt and Magnussen (2007) and Fuch et al. (2010) showed that the more art expertise someone has, the more top-down processing his viewing strategy will be while looking at a work of art. Therefore, a positive correlation between participants' familiarity with art and eye fixations in top-down saliency regions was expected:

1.0 *Familiarity with art is positively correlated with the percentage of eye fixations in the top-down saliency regions of a painting*

As theory emphasizes that social differences are the cause of variation in how people appreciate art (Boudieu & Nice, 1980; Bourdieu, 1985; Schellekens, 2006), and the assumption that art experts look more at top-down saliency regions, the following hypothesis can be conducted:

2.0 *Appreciation of the work of art is positively correlated with the percentage of eye-fixations in the top-down saliency regions of a painting*

The research of Fuch et al (2010) confirmed the finding that saliency effects were weaker in abstract scenes than realistic scenes. Thus, the more complex (e.g. more abstract) a work of art is, the less effect saliency regions have on perception, and therefore the smaller the effect of familiarity with art has on the eye-fixations:

3.0 *The more complex a work of art, the smaller the effect of familiarity on eye-fixations.*

From the theory of Winston and Cupchik, we can conclude that many non-experts see artworks not as exceptional objects with deeper aesthetic meanings but rather as ornamental objects of everyday life, indicates that untrained art- viewers with little to no knowledge of art appreciate works of art less than people with

expertise of art. As I have explained before that experts process art works in a top-down manner the following hypothesis can be conducted:

4.0 *Familiarity with art is positively related with the appreciation of art works.*

The research of Pihko et al. (2011) showed that expertise affects not only the viewing strategies, but also art preference. Art education and frequency of visits to art museums and galleries have a positive influence on the preference for abstract art (Furnham and Walker, 2001; Pinhko et al., 2011):

5.0 *The preference for realistic paintings is negatively correlated with familiarity with art.*

3.4 GENERAL SETUP

In the experiment, I focused on gathering physical data (e.g. recording participants' eye-movements) and survey data (e.g. registration of background and cultural capital of the participants) regarding the observation of paintings. Because I particularly focused on the difference in top-down and bottom-up perception during art-viewing instead of natural scene-viewing, the use of actual original paintings was required. Therefore, the experiment took place in an exhibition context (i.e., Museum Boijmans van Beuning) which meant that the data-collection tools (SMI-ETG device) had to be flexible and work in an indoor environment. In this section, general information is given about the system and setups. In the first sub-section, the experimental setup is explained and in the second section the specification of the hardware are stated.

3.4.1. EXPERIMENTAL SETUP

The experiment consisted of five free-viewing tasks and a digital questionnaire. At the beginning of the experiment, the participants were informed about the experiment through verbal instructions. During these instructions, participants were put on a pair of SensoMotoric Instruments Eye Tracker Glasses (SMI-ETG) and told not to look at the paintings in the room yet. Accordingly, a 1-point calibration procedure was conducted with the SMI-LAPTOP (note that before starting the calibration process, at least 30 seconds of time had elapsed since the participant has set up the SMI-ETG to ensure the internal eye model was completely adapted). Participants had to face a wall from a distance of 1.5 meters and were asked to look at a noticeable orange dot (with a diameter of 4 millimetre) while keeping their head as still as possible. On the ETG-laptop, the mouse was moved over to the orange dot and clicked in order to calibrate the system. The system had to calibrate each participant one time only as preparation for the five free-viewing tasks. After having conducted the calibration, the participants were instructed to walk over to a first pair of orange dots (also with a diameter of 4 millimetre) on the ground with their head down and place the points of their shoes on each dot. This ensured that all participants stood at the same distance from the paintings. The distance from each painting was determined such that a person of average length (e.g. 170 centimetres for female, and 180 cm for male; CBS, 2015) could oversee the whole painting and the camera of the SMI-ETG could record the whole scene. The distance from the paintings to the orange dots on the ground can be found in table 3.1. The distance differences because of the different sizes of the paintings.

When participants were positioned correctly with their head faced to the floor, they were asked to close their eyes for five seconds to minimise eye strain. After five seconds they were instructed to open their eyes and look up at the painting while holding their body and face as still as possible; they were free to look wherever they wanted on the painting for 20 seconds. This procedure was repeated for each painting.

In consultation with the Museum Boijmans van Beuningen, five original paintings ranging from semi-realistic (you recognize what the scene depicts, but the scene is not represented realistic) to abstract (you don't recognize what the scene depicts), from the collection of Boijmans van Beuningen were chosen as stimuli. The selected paintings were (see Fig. 3.1, starting top left): "Compositie no II", Piet Mondriaan, 1929; "Compositie met kleurvlakjes", Piet Mondriaan, 1917; "The Lyrical", Vasili Vasileevich Kandinsky, 1911; "Ober-Weimar", Lyonel Feininger, 1921; "Der Astronom (Zyklus Arbeit)", Arthur Segal, 1919. The first two works were considered "abstract", the other three works "semi-realistic".

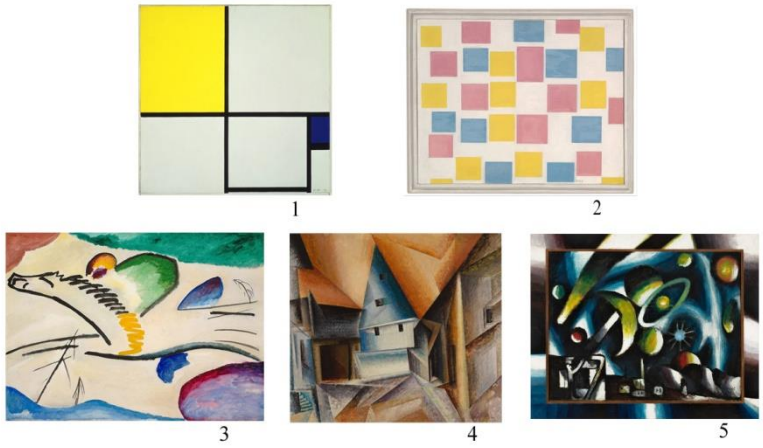


Fig. 3.1. Paintings presented to participants (beginning top left): (1) "Compositie no II", Piet Mondriaan, 1929; (2) "Compositie met kleurvlakjes", Piet Mondriaan, 1917; (3) "The Lyrical", Vasili Vasileevich Kandinsky, 1911; (4) "Ober-Weimar", Lyonel Feininger, 1921; (5) "Der Astronom (Zyklus Arbeit)", Arthur Segal, 1919. The first two works were considered "abstract", the other three works "semi-realistic".

Painting	Distance from wall
1	130 cm
2	123 cm
3	175 cm
4	165 cm
5	155 cm

Table 3.1 Distance of participant to painting

These paintings were shown in a fixed order (beginning with painting number 1, consecutively to painting number 5) to the participants. This was necessary to be able to record the data correctly and efficiently.

Right after the viewing task, participants had to fill in a pre-structured questionnaire (Appendix B), displayed on a Lenovo-PC, which was created in Qualtrics (www.qualtrics .com). The questionnaire was created to obtain information about the participants' background, cultural capital and their evaluation of the paintings, making sure it was comprehensible for all participants (Berghman, 2013). As aesthetic theory uses specific terminology, applying particular terms in a particular senses, only a small amount of participants would be able to apply the criteria. Nevertheless, all participants should know the words used. Therefore, no abstract terminology was used in the questionnaire.

Figure 3.2.a. Calibration of participant

Figure 3.2.b.Participant viewing painting “Ober-Weimar”, Lyonel Feininger, 1921

3.4.2. HARDWARE SPECIFICATIONS

Below, the specification of the SMI eye-tracker glasses (ETG) and ETG-laptop are listed.

SPECIFICATIONS SMI EYE-TRACKING GLASSES

A pair of eye-tracking glasses, which is a device for measuring eye positions and eye movements, is used to measure the gaze direction of the participants. The experiment required a mobile eye-tracker, therefor a pair of SMI Eye Tracking Glasses, a mobile gaze tracking device by SensoMotoric Instruments, and the accompanying iViewETG software for experimental design and recording have been used. The SMI-ETG is a non-invasive video based glasses-type eye tracker. The device is worn like a normal pair of glasses and includes a high definition scene camera. The eye-camera has a resolution of 640 x 480 pixels and the scene-camera has a resolution of 1280 x 960 pixels. Both have a frame rate of 30 frames per second. The viewing angle of the scene-camera is 60°. The camera also works when the participants wear contact lenses or glasses.

Figure 3.3: The SMI Eye Tracking Glasses

The working principle of an eye-tracker is explained in Guestrin and Eizenman (2006). An eye-tracker are glasses which one can put on, upon which a camera and two LEDs are installed and a connection to a hard disc to store the data. Thus, the system of an eye-tracker consists of one infrared camera and two LEDs to estimate the gaze. The two LEDs shine two different kinds of lights into the eye; 1. a ray of light that falls perpendicularly onto the corneal surface; 2. a ray of light that is the reflection from the LED to the camera. Consider a ray of light that falls perpendicularly onto the corneal surface. This ray of light is passing through the corneal surface and reaches the lens. The second ray of light is the reflection of the light from the LED to the camera. Now, the incidence angle and the reflection angle are equal; together the lights form one corneal reflection point, which is

used as a reference point to measure the position of the pupil. The corneal surface can be seen as a mirror. The mirror is used as a reference point to measure the position of the pupil. Please note that it is important to keep the distance of the light source and camera stable, otherwise the glint point shifts. In the figure below the model of Guestrin and Elizenman (2006) shows the schematic representation of the gaze estimation of an eye-tracker:

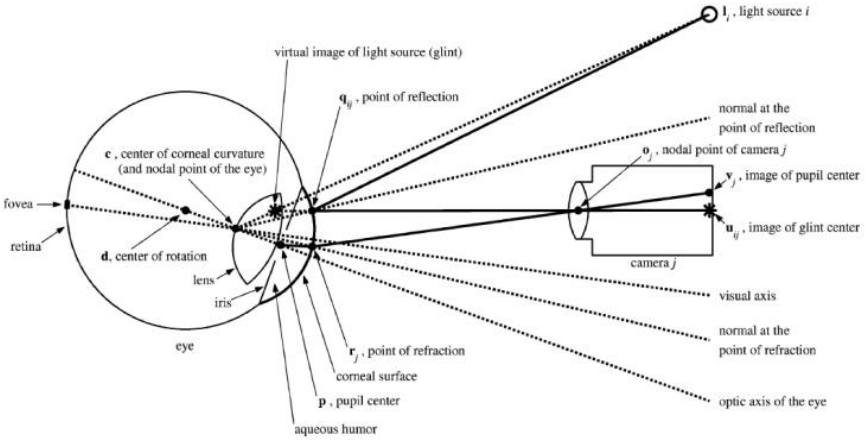


Figure 3.4: Shows schematic representation of the eye, a camera and a light source (Guestrin and Eizenman (2006)).

SPECIFICATIONS ETG-LAPTOP

The SMI Eye Tracking Glasses (ETG) is delivered with an ETG-Laptop for data recording and live view options. The ETG-laptop has an Intel Core i7-2640M CPU @ 2.80GHz x 8 processor and 4 GB RAM memory. The ETG-laptop allows real-time streaming and access via the SMI SDK. Data recorded with the ETG-Laptop can be loaded directly into BeGaze software which also runs on the ETG-Laptop.

3.4.3. DATA COLLECTION

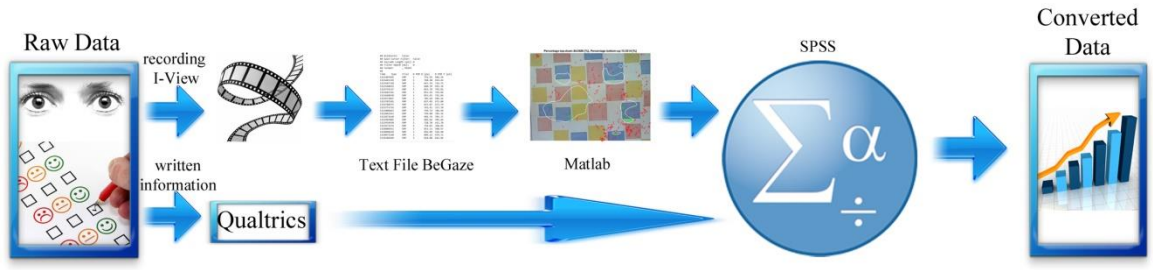
Power analyses reveal a requirement of 60 participants. To compensate for the possibility of missing values and necessary exclusion of participants, the aim of the experiment was to include around 80 participants. Data were collected over three days (Friday 20, Saturday 21 and Sunday 22 March 2015) in the Museum Boijmans van Beuningen.

3.4.4. RAW DATA

The raw data consisted of visual attention through eye movement (data collected with the I-ViewETG) and the visual attention through writing (data collected with Qualtrics). The raw data had to be converted in such a way that they could be linked and analysed in SPSS.

3.5 DATA RECONFIGURATION

The raw data consist of the recordings from the eye tracker and the written questionnaire conducted in Qualtrics. The data had to be computed into variables that could be compared to each other. Figure 3.5.1 gives a schematic overview of the software used during the analysis. Clearly visible is the contrast of the amount of steps that are needed to convert the raw data between the eye movements (five steps) and the written questionnaire (two steps).



Figuur 3.5.1 Schematic of Software

The raw data of the written questionnaire was directly transferred to SPSS. The raw data of the recordings in I-View had to be converted by the software of BeGaze and Matlab before they could be transferred to SPSS. The whole procedure of converting the raw data is explained following sections.

3.5.1. I-VIEW ETG

I-View is the controller software, running on the ETG-Laptop, for experimental design and recoding of eye tracking data using the SMI Eye Tracking Glasses. For managing the recordings, I used an experimental run. This uses customized settings and data are stored in one experiment folder for all participants. The recordings per participant resulted in a xml-document of the 0-calibration, which displayed the coordinates of the mouse clickings during the 1-point calibration, an xml-document of the 0-gazecorrection, which displayed the coordinates of the eye-s during the 1-point callibiration, an xml-document of the 0-participant, which displayed the calibration values, an avi-video of the left-eye, an avi-video of the right-eye and an avi-video of the world view. In figure 3.5.2, an example of a participant's eye-recordings and the world-view recording is shown. The recordings can only be analysed with the BeGaze Mobile Video Viewer software, otherwise you only see the videos separately and not combined.

Figure 3.5.2. Example recordings I-View.

3.5.2. SMI BEGAZE

SMI BeGaze is a behaviour- and gaze analysis software package for eye tracking data. The SMI BeGaze eye tracking software allows analysing and structuring information from experiments and subjects, as well as displaying eye tracking data as meaningful graphs (SMI Vision, 2015). Figure 3.5.3 shows a video analysed in SMI BeGaze software; you can see the gaze point of the participant on the world view video as the orange dot.

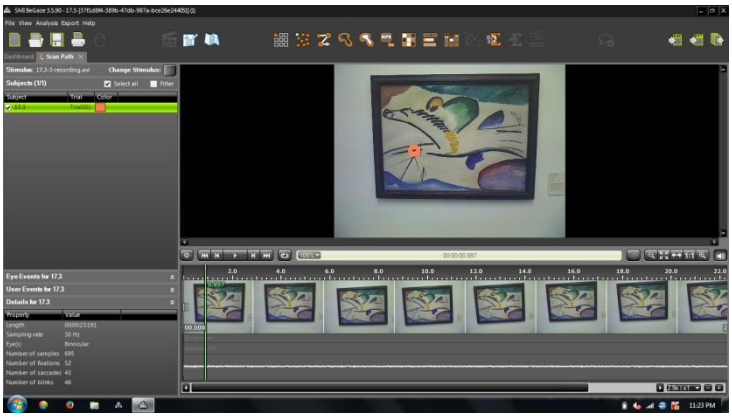


Figure 3.5.3. Video analysed in SMI BeGaze

I wanted to remove the movements of the participants (in figure 3.5.3 you can see the movement during the recording), but this was not possible in BeGaze. Therefore, I have checked if every video was recorded correctly and if the calibration of each participant was correct in the SMI BeGaze software and accordingly exported the raw data. Exported raw data consisted of a text file in which all the coordinates of the gaze vector of the left eye and the right eye were displayed. The text file of the raw data was converted further in Matlab.

3.5.3. MATLAB

MATLAB is the high-level language and interactive environment used by millions of engineers and scientists worldwide which enables one to explore and visualize ideas and collaborate across disciplines including signal and image processing, communications control systems and computational finance (MathWorks, 2015). For this experiment, Matlab was used to develop an algorithm which analyses and visualizes the movies and text files from the BeGaze software. The algorithm was created by Ir. J.F.M. Domhof with full copyright, and may only be used for this study.

The algorithm (see appendix D) can be divided into four main steps; specify region of interest, compute saliency map, create bottom-up mask and determine point of gaze, see also figure 3.5.4. This procedure runs for each individual combination of movie and text file, thus for each of the five paintings of each individual participant. The whole procedure takes about 5 minutes. In total, 415 combinations of movie and text file have been analysed.

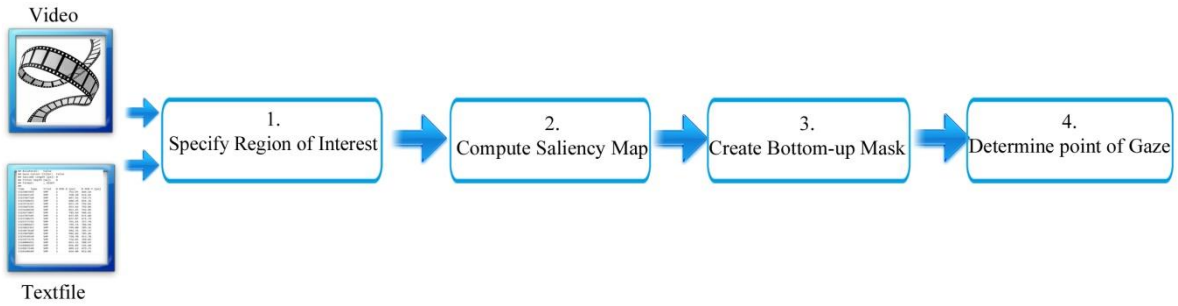


Figure 3.5.4. Schematic view of Analyse Matlab algortihm

First, the region of interest had to be specified because I wanted to create a bottom-up saliency map only for the painting itself, seeking to prevent that the picture frame or objects on the wall were registered as salient when making a bottom-up mask. Thus, we had to remove the picture frame and other possible objects in view of the participant, such as the information sign. In order to specify this region, the frame in the middle of the video was chosen because the first few frames are sometimes corrupt and it might be possible that in the last few frames the person is already looking in another direction. I clicked at the upper left- and the lower right corner of the painting, accordingly a square form sub-image was created. For each painting of each participant, the region of interest was selected anew because all participants had a different angle view from which they were looking at the painting. Figure 3.5.5. shows the selection of the corners of the painting "The Lyrical" by Kandinsky inside the picture frame. In this way, the region of interest was created.

Figure 3.5.5. Specify Regions of Interest

The second step was to compute a saliency map. For this experiment, the saliency detection algorithm of Itti et al. (1998) was used to compute a saliency map, because it is a widely used and biologically inspired saliency model. Furthermore, this model is suitable for real time applications because it is fast (Borji et al., 2013). For each participants' recorded video, a new saliency map was conducted because each participant had a slightly different angle-view. This differences in angle-views causes different saliency maps, therefore it was necessary to create a saliency map for each participant and each painting; Appendix B shows all the different saliency maps of the paintings of all the participants who participated in the experiment. Figure 3.5.6. shows a saliency map of the middle frame from one of the participants recorded video's; looking at the painting "The Lyrical".

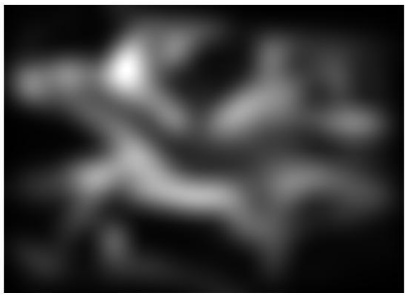


Figure 3.5.6. Saliency Map of painting "The Lyrical" by Kandinsky, computed with the algorithm of Itti et al., (1998)

The bright pixels on the saliency map correspond with the most salient regions of the painting; the darker the pixels become, the less salient they are. This saliency map was used to create the bottom-up mask in the next step.

Subsequently, the third step, creating a bottom-up mask, was conducted. The bottom-up region was determined by thresholding, such that 15% of the pixels were denoted as salient. This was done iteratively by starting with a maximum threshold and lowering it until the bottom-up percentage equalled 15%. The algorithm measures the 15% brightest pixels, which results in an organic and realistic bottom-up mask. Figure 3.5.7 shows a bottom-up mask for the painting "The Lyrical". Previous studies such as Fuchs et al., (2011) and Pihko et al. (2011) worked with 12,5% bottom-up regions but they differ in experimental setup; everything is measured in strict laboratorial contexts (e.g. participants get a chinrest). Moreover, they determined the salient regions with a completely different method; they depicted the 5 most salient points and drew a circle around these. I have tried this method at first, but it was too inaccurate because the circles can overlap, so that the amount of bottom-up pixels is not constant for each participant; they could differ up to 10%. Figure 3.4.7.a shows this circle-method. Because of the difference in working method, me having worked in a natural environment instead of a laboratory, I chose to increase the bottom-up region to 15% instead of 12,5% because this gives a little more balance between the distribution of bottom-up and top-down pixels. Figure 3.5.7.b shows a bottom-up mask of the middle frame from one of the participants recorded video's; looking at the painting "The Lyrical". The white pixels correspondent with the bottom-up regions, the dark pixels with the top-down regions.

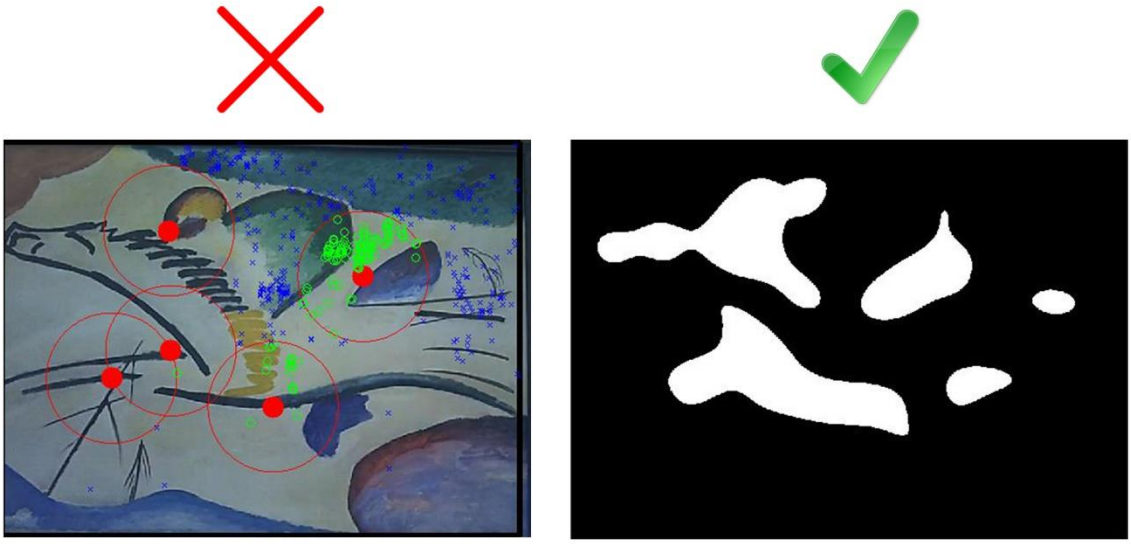


Figure 3.5.7.a Bottom-up Mask with circle-method -of painting "The Lyrical", computed with the algorithm of Itti et al., (1998)-

Figure 3.4.7.b Bottom-up Mask with pixel-method

You can see that in Figure 3.4.7.a the circles overlap; the bottom-up percentage here is 25,35% (this is 10% more than 15%) while in figure 3.5.7b the amount of bottom-up pixels is exactly 15%.

The last, fourth step, was to determine the point of gaze. In order to do so, we had to compute the ratio of bottom-up and top-down gaze positions of the participant. But before we could do so, we first had to remove the movement of the of the participants head during the recordings. Removing the movement of the participant was achieved by computing a transformation matrix between frame x and the middle frame. This was done by detecting features in the image of the middle frame and in frame x; comparing them with each other. After that, for every feature the descriptors were computed. Using these descriptors, the matches were found in the middle frame and frame x. A transformation matrix between frame x and the middle frame could be determined by using the feature matches. Then, the gaze direction could be transformed from frame x to the middle frame such that all gaze location were correct. The middle frame contains all gaze locations of the video corrected for movement. Figure 3.5.8 shows the correction of the gaze position of a participant looking at the painting "The Lyrical". The tiny black crosses represent the old gaze positions in the video that does not take into account the movement of the subject and the green crosses represent the corrected gaze positions of this particular participant.

Figure 3.5.8. Remove movement of gaze positions, painting "The Lyrical, Vasili Vasileevich Kandinsky, 1911", computed with the algorithm of Itti et al., (1998)

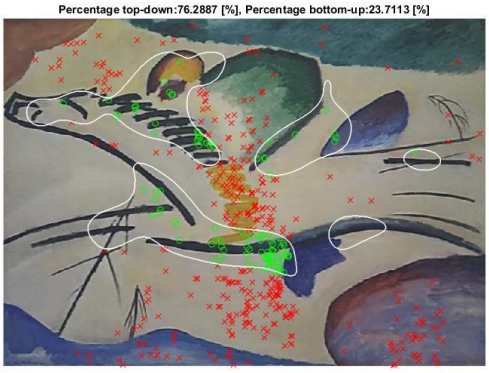


Figure 3.5.9. Ratio Bottom-up and Top-down gaze positions, painting "The Lyrical", computed with the algorithm of Itti et al., (1998)

Now that the movement of the participant had been removed, the bottom-up / top-down ratio could be computed. Figure 3.5.9 shows the ratio of bottom-up and top-down gaze positions of a participant looking at the Kandinsky painting.

Inside the white lines the bottom-up region is indicated and outside the white lines the top-down region is indicated. Therefore, the green circles are the gaze positions of the participant that fall inside the bottom-up region and the red crosses are the gaze positions of the participant that fall inside the top-down region. Figure 3.5.10 shows an overview of steps conducted in Matlab.

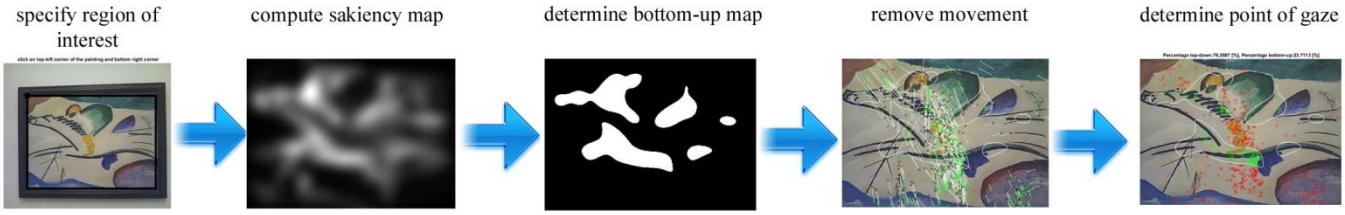


Figure 3.4.10. Steps conducted in Matlab, painting "The Lyrical", computed with the algorithm of Itti et al., (1998)

3.5.4. SPSS

In order to prepare the data collected from the questionnaire, variables were treated in several ways. First, the variables had to be recoded in such a way that the answering categories made sense. Secondly, the variables had to be transformed so that the distribution of participants across categories was more even, which was also necessary because of the limited number of participants. In most cases, the variables were recoded into three categories of about equal size, i.e., each containing around 33% of the participants. The reconfiguration of each variable will be discussed in the next section during the results.

3.6 METHOD OF ANALYSIS

Bivariate correlations and *Regression analyses using the General Linear Model* were used to analyse the acquired data. The bivariate correlations were used to search for correlations between all the variables. And the Regression analyses were used to estimate effects of the independent variables (background and cultural capital) on the dependent variables (top-down / bottom-up ratio and appreciation).

4 RESULTS

4.1 THE PARTICIPANTS

In total, 83 participants participated in the experiment, though only 78 participants completely finished the questionnaire. Therefore, information of 5 participants was lost. All participants had normal or corrected to normal vision, and reported no colour blindness. Of all the participants who completed the entire experiment, 36 were female (45.6%) and their average age was 35.1 with a minimum of 12 and a maximum of 71; 41 were male (51.9%) and their average age was 33.5 with a minimum of 10 and a maximum of 59; one was a transgender aged 24. Furthermore, 62 (78.5%) participants lived in the Netherlands, although 10 of these (16.1%) were born in a foreign country. 23.1 percent (N=18) of the participants lived in a village and 76.6 percent (N=60) lived in a city. The median of the participants' highest level of completed education was *2-year College Degree* (N=15) (see table 4.1.1).

In order to make both meaningful and statistically usable groups, I have recoded as much variables as possible into smaller groups (existing out of 2 or 3 categories). Because of my limited number of cases I had to be careful that my answers-categories were big enough for conducting a reliable analysis. I will shortly discuss the reconfiguration of each variable. The variables are indicated with the question number of the participant questionnaire (for example question 1 is indicated as Q1).

The variable "year of birth" was obtained by asking the participants in "which year they were born''. The year of birth was labelled as 1 = 1900, 2 = 1901 and so on till 2015. Therefore I created a new variable "age" by adding 1899 to the label of "birth year" (for example, when someone was born in 1900 it became 1899+1), and then subtract this number from 2015. Subsequently, I recoded the variable "age" into a variable consisting of three categories. The new value 1 (young participants) contained the ages 1 thru 24 and had a valid percentage of 32.5, the value 2 (middle age participants) contained the ages 25 thru 40 and had a valid percentage of 35.1, the value 3 (older participants) contained the ages 41 thru 65 and had a valid percentage of 32.5.

The variable "education" had different categories in the English and Dutch versions of the questionnaire.[1] This also applies for the participants' "father's education level" and "mother's education level". English participants could state that they fulfilled a "professional degree (JD MD)", but this is not an option in the Dutch education system, so for the English questionnaires I merged the "doctoral degree" and the "professional degree" into one category. Next, I recoded the variable "education" into two categories. The variable had the values *low education level* (Less than High School – 2-year College Degree; N=39), and *high education level* (4-year College Degree – Doctoral Degree; N=39).

[1] This also applies for the participants' "father's education level" and "mother's education level".

Table 4.1.1.

Highest completed level of education of participants

Education Level	**Frequency**	**Percent**
Less than High School	6	7.7
High School / GED	12	15.4
Some College	6	7.7
2-year College Degree	15	19.2
4-year College Degree	15	19.2
Master Degree	20	25.6
Doctoral Degree	1	1.3
Professional Degree (JD MD)	3	3.8
Missing	0	0
Total	78	100

2-year College Degree (N=18) was also the median of the highest level of completed education completed by the participants' father (see table 4.1.2). The variable, *father's education level* was recoded into a binary variable with the values *low education level* (Less than High School – 2-year College Degree; N=54), and *high education level* (4-year College Degree – Doctoral Degree; N=24).

Table 4.1.2.

Highest completed level of education of participant's father.

Education Level	**Frequency**	**Percent**
Less than High School	8	10.3
High School / GED	13	16.7
Some College	15	19.2
2-year College Degree	18	23.1
4-year College Degree	7	9.0
Master Degree	14	17.9
Doctoral Degree	2	2.6
Professional Degree (JD MD)	1	1.3
Missing	0	0
Total	78	100

Some College (N=15) was the median of the highest level of completed education completed by the participants' mother (see table 4.1.3). Similarly, the variable, *mother's education level* was recoded into binary variable with the values *low education level* (Less than High School – 2-year College Degree; N=59), and *high education level* (4-year College Degree – Doctoral Degree; N=19).

Table 4.1.3.

Highest completed level of education of participant's mother.

Education Level	**Frequency**	**Percent**
Less than High School	8	10.3
High School / GED	22	28.2
Some College	15	19.2
2-year College Degree	14	17.9
4-year College Degree	7	9.0
Master Degree	11	14.1
Doctoral Degree	1	1.3
Professional Degree (JD MD)	0	0
Missing	0	0
Total	78	100

Table 4.1.4 shows the highest completed schooling level of the participant's parents.

Table 4.1.4.

Highest completed schooling level of participant's parents.

Education Level	**Frequency**	**Percent**
Lower educated	50	64.1
Higher educated	28	35.9
Missing	0	0
Total	78	100

The median of hours spent per week were on art during the participant's high school education was "1 hour or less" (N=31) (see table 4.1.5). The variable, *hours spent per week were on art during the participant's high school* was recoded into a binary variable with the values *few hours* (none – 1 hour or less; N=40) and *many hours* (2 -3 hours – 8-more hours; N=38).

Table 4.1.5.

Hours spent per week were on art during the participant's high school.

Education Level	**Frequency**	**Percent**
None	9	11.5
1 or less	31	39.7
2-3	27	34.6
4-5	5	6.4
6-7	1	1.3
8 or more	5	6.4
Missing	0	0
Total	78	100

The median level of art-education completed by the participants was "I have not"; N=60; see table 4.1.6). The variable *highest level of completed art-education after highschool* was recoded into a binary variable with the values *none* (N=60) and *some* (between 1 and 3 individual courses – doctoral degree; N=16).

Table 4.1.6.

Highest level of completed art-education after high-school of participant.

Education Level	**Frequency**	**Percent**
I have not	60	76.9
Between 1 and 3 individual courses	3	3.8
2 year College Degree	0	0.0
4 year College Degree	10	12.8
Master Degree	2	3.8
Other	2	2.6
Missing	0	0
Total	78	100

The variable, *highest level of completed art-education after highschool* was recoded into a binary variable with the values *none* (N=63) and *some* (between 1 and 3 individual courses – doctoral degree; N=15) (see table 4.1.7).

Table 4.1.7.

Highest level of completed art history-education after high-school of participant.

Education Level	**Frequency**	**Percent**
I have not	63	80.8
Between 1 and 3 individual courses	11	14.1
2 year College Degree	0	0
4 year College Degree	2	2.6
Master Degree	2	2.6
Other	0	0
Missing	0	0
Total	78	100

Subsequently, I computed a new variable, *general art education,* which exists of the recoded variable "highest level of art education after high-school of participant" and "highest level of art history education after high-school of participant". This variable assumes that the highest education of one of the educational fields counts. Thus, if the participant has followed an art-education but not an art-history education, the value still states that the participant has followed a general art education. 26.9% percent of participant's are thus educated in art (see table 4.1.8).

Table 4.1.8.

General art education of participant.

Arts Education Level	**Frequency**	**Percent**
Not educated	57	73.1
Educated	21	26.9
Total	78	100

The median of the amount of visits to art galleries and museums in the last 12 months by the participants was "3-5 times" (N=39; see table 4.1.9). The variable, *frequency of visits* was recoded into binary variable with the values *little* (Not at all – 1-2 times; N=45) and *often* (3-5 times – about once a week; N=27) and *often* (3-5 times – about once a week; N=64).

Table 4.9.

Visiting *art galleries and museums in the last year*

Frequency of visits	**Frequency**	**Percent**
Not at all	14	1.3
1-2 times	13	16.7
3-5 times	39	50.0
6-11 times	17	21.8
At least once a month	6	7.7
About once every two weeks	2	2.6
Total	78	100

The variable, *childhood art consumption* was recoded into binary variable with the values *little* (Not at all – 1-2 times; N=45) and *often* (3-5 times – about once a week; N=33; see table 4.10). .

Table 4.1.10.

Visitating *art galleries and museums until the age of 18.*

Frequency of visits	**Frequency**	**Percent**
Not at all	16	20.5
1-2 times	29	37.2
3-5 times	18	23.1
6-11 times	12	15.4
At least once a month	3	3.8
About once every two weeks	0	0
Total	78	100

In order to increase the chance to find significant results during the r*epeated-measures ANOVA*, data driven binning of "familiarity with art" was performed to increase the reliability of between-group analyses. The reliability statistics of the scale of all the variables indicating "familiarity with art" (highest level of completed education, highest completed level of education of the participant's mother, highest level of education of the

participant's father, estimation of weekly average of art education during high school, art education after high school, art-history education after high school, visitations of art gallery and museums in the last year and the estimation of annual art gallery and museum visitations until the age of 18) showed a Cronbach's alpha of 0.725.

4.2 PARTICIPANTS' ART-APPRECIATION

The median of the scale from 1 (not interested at all) to 10 (extremely interested), that the participant indicated how interested s/he is in art is 7 (N=28) (see table 4.11).

Table 4.2.1.

Scale of *interest in art.*

Scale of interest	**Frequency**	**Percent**
4	3	3.8
5	0	3.8
6	5	6.4
7	28	35.9
8	23	29.5
9	8	10.3
10	8	10.3
Total	78	100

The median of the scale from 1 (not knowledgeable at all) to 10 (extremely knowledgeable), that the participant indicated how knowledgeable s/he is in art is 6 (N=19) (see table 4.12).

Table 4.2.2.

Scale of *knowledge in art.*

Scale of interest	**Frequency**	**Percent**
1	1	1.3
2	5	6.4
3	8	10.3
4	9	11.5
5	12	15.4
6	19	24.4
7	15	19.2
8	7	9.0
9	1	1.3
10	1	1.3
Missing	0	0
Total	78	100

The appreciation for each individual painting, with a minimum of 1 and a maximum of 100, is shown in tables 4.2.3 to 4.2.7 The painting Ober-Weimar, 1921, Lyonel Feiniger was considered the most beautiful. The painting The Lyrical by Kandinsky touched people the most emotionally. Both The Lyrical and Ober-Weimar were considered the most complex. Also, Ober-Weimar was considered the most interesting and most powerful.

Figure. 4.2.3.

Participant's Appreciation of *Compositie no. II, 1929 Piet Mondriaan*

I find this painting beautiful	Mean = 51.32 (N=78)
This painting touches me emotionally	Mean = 24.01 (N=78)
I find this painting complex	Mean = 25.31 (N=78)
I find this painting interesting	Mean = 54.42 (N=78)
I find this painting powerful	Mean = 57.02 (N=78)

Figure. 4.2.4.

Compositie met kleurvlakjes, 1917, Piet Mondriaan

I find this painting beautiful	Mean = 43.21 (N=78)
This painting touches me emotionally	Mean = 24.91 (N=78)
I find this painting complex	Mean = 32.47 (N=78)
I find this painting interesting	Mean = 43.19 (N=78)
I find this painting powerful	Mean = 3.36 (N=78)

Figure. 4.2.5.

Participant's Appreciation of *The Lyrical, 1911, Vasili Vasileevich Kandinsky*

I find this painting beautiful	Mean = 57.97 (N=78)
This painting touches me emotionally	Mean = 41.55 (N=78)
I find this painting complex	Mean = 48.55 (N=78)
I find this painting interesting	Mean = 48.60 (N=78)
I find this painting powerful	Mean = 58.47 (N=78)

Figure. 4.2.6.

Participant's Appreciation of *Ober-Weimar, 1921, Lyonel Feiniger*

I find this painting beautiful	Mean = 59.91 (N=78)
This painting touches me emotionally	Mean = 36.01 (N=78)
I find this painting complex	Mean = 65.36 (N=78)
I find this painting interesting	Mean = 62.17 (N=78)
I find this painting powerful	Mean = 59.81 (N=78)

Figure. 4.2.7.

Participant's Appreciation of *Der Astronom (Zyklus Arbeit) (De astronoom (werkcyclus)), 1919, Arthur Segal*

I find this painting beautiful	Mean = 43.46 (N=78)
This painting touches me emotionally	Mean = 29.72 (N=78)
I find this painting complex	Mean = 53.42 (N=78)
I find this painting interesting	Mean = 52.49 (N=78)
I find this painting interesting	Mean = 51.50 (N=78)

4.3 BOTTOM-UP SALIENCY REGIONS

Participants looked on average 24.07 percent of their viewing time at bottom-up regions (*s* = 6,49) with a minimum of 6.49% and a maximum of 39.25% (see figure 4.3.6). The bottom-up region of each painting consisted of 15% of the total surface, which means that participants looked on average more at "bottom-up saliency regions" than "top-down saliency regions", that is: more than one would expect if people's viewing was random rather than guided by visual salience. At the level of the individual paintings, three paintings scored below the average bottom-up perception of 24.07% (see figures 4.3.2; 4.3.3; 4.3.4).

Mean = 31.53
Std. Deviation = 16.12
Minimum = 1.33
Maximum = 64.34

Figure. 4.3.1: Participant's percentage bottom-up perception of *Compositie no. II, 1929 Piet Mondriaan*

Mean = 20.88
Std. Deviation = 9.28
Minimum = 2.05
Maximum = 48.28

Figure 4.3.2: Participant's percentage bottom-up perception of *Compositie met kleurvlakjes, 1917, Piet Mondriaan*

Mean = 23.54
Std. Deviation = 9.03
Minimum = 0.00
Maximum = 57.68

Figure 4.3.3: Participant's percentage bottom-up perception of The Lyrical, *1911, Vasili Vasileevich Kadinsky*

Mean = 19.72
Std. Deviation = 8.16
Minimum = 4.41
Maximum = 57.68

Figure 4.3.4: Participant's percentage bottom-up perception of *Ober-Weimar, 1921, Lyonel Feiniger*

Mean = 24.21
Std. Deviation = 11.96
Minimum = 0.56
Maximum = 39.25

Figure 4.3.5: Participant's percentage bottom-up perception of *Der Astronom (Zyklus Arbeit) (De astronoom (werkcyclus)), 1919, Arthur Segal*

Mean = 24.07
Std. Deviation = 6.49
Minimum = 6.57
Maximum = 39.25

Figure 4.3.6: Participant's percentage bottom-up perception across all paintings. Note that Mondriaan's composition no. II is notable positive, this might be caused by the bright, black straight lines and the great emptiness between the lines. Therefore, the visual information is more concentrated.

Referring back to my hypothesis that there is a relation between familiarity with art and the amount of bottom-up and top-down perception of the participant while looking at a painting, I have to check this relationship for each characteristic of the participants and each individual painting. Therefore I have run a single cross-tabulation between the degree of bottom-up perception of each painting and both the participant's background and the participant's cultural capital. The degree of bottom-up perception of each painting (e.g. the amount of bottom-perception of the participant while he or she is looking at a painting), and the average bottom-up (e.g. the average bottom-up perception of all 5 paintings) is represented in the columns and the participant's background characteristics and cultural capital indicators are represented in the rows. The complete correlation-table is shown in the appendix (Table A4.3.1 to A4.3.6), table 4.3.7 only has the significant correlations.

Table. 4.3.7

Cross tabulation of the five paintings (and the average of all paintings) for different variables.

Conditions	Average Bottom-Up	Painting 1* Bottom-Up	Painting 2* Bottom-Up	Painting 3* Bottom-Up	Painting 4* Bottom-Up	Painting 5* Bottom-Up
Highest level of participant's education						
Pearson Correlation		.223*				
Art-Education on high-school						
Pearson Correlation					.212*	
Knowledge of Art						
Pearson Correlation					.196*	
Amount of Art visits						
Pearson Correlation		.253*				
Painting 1: Interest						
Pearson Correlation	.217**	.285**				
Painting 1: Powerfulness						
Pearson Correlation	.280**	.233*	.230*			
Painting 2: Beauty						
Pearson Correlation					-.275**	
Painting 2: Emotion						
Pearson Correlation	.230*				.323***	
Painting 2: Interest						
Pearson Correlation		.222*				
Painting 3: Emotion						
Pearson Correlation	.245*		.207*	-.045**		
Painting 3: Powerfulness						
Pearson Correlation			.287**			
Painting 3: Complexity						
Pearson Correlation		.525**				
Painting 3: Interest						
Pearson Correlation	.218*					
Painting 3: Powerfulness						
Pearson Correlation	.239*					

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

1) “Compositie no II”, Piet Mondriaan, 1929; (2) “Compositie met kleurvlakjes”, Piet Mondriaan, 1917; (3) “The Lyrical”, Vasili Vasileevich Kandinsky, 1911; (4) “Ober-Weimar”, Lyonel Feininger, 1921; (5) “Der Astronom (Zyklus Arbeit)”, Arthur Segal, 1919. The first two works were considered “abstract”, the other three works “semi-realistic”.

As can be seen from table 4.3.7 there are several correlations between the degree of looking at bottom up regions and the different additional variables. I will shortly discuss the correlations between “bottom-up looking” and the familiarity with art indicators. I will also shortly discuss the correlations between participants’ appreciation of art, however I will only do this for the cases where appreciation and bottom-up saliency pertain to the same paintings because, although there also correlations between bottom-up looking and the appreciation of other paintings, I cannot explain this outcome by theory. Moreover, none of the variables that were not related to familiarity with art revealed significant correlations.

The amount of bottom-up looking in the painting *Compositie no II.* is positively correlated with the participant’s highest level of education. Thus, the higher someone is educated, the more s/he fixates his or her eyes to bottom-up saliency regions. This is not in line with my first hypothesis *“Familiarity with art is positively correlated with the percentage of eye fixations in the top-down saliency regions of a painting”* (I expected the opposite result). Moreover, the amount of bottom-up looking in this painting is also positively correlated with the participants’ amount of visits to art galleries or museums; the more s/he went, the more s/he fixates on bottom-up saliency regions. This is also the opposite of my first hypothesis. Furthermore, participants who stated that they found the painting interesting or/and powerful also looked more at bottom-up saliency regions than participants who found the painting less interesting or powerful. This conflicts with my second hypothesis *“Appreciation of the work of art is positively correlated with the percentage of eye-fixations in the top-down saliency regions of a painting”*.

When participant’s stated to be emotionally touched by the painting *The Lyrical* they fixated less on bottom-up saliency regions and looked more to the top-down saliency regions, which is in line with my second hyothesis *“Appreciation of the work of art is positively correlated with the percentage of eye-fixations in the top-down saliency regions of a painting”*.

Participants who were more educated in art during high-school or who possessed more knowledge of art compared to other participants, looked more at bottom-up saliency regions in the painting *Ober-Weimar*. This contradicts the first hypothesis *“Familiarity with art is positively correlated with the percentage of eye fixations in the top-down saliency regions of a painting”*.

The bottom-up salience of the painting *Der Astronom* revealed no correlations whatsoever with other variables.

Figure 4.3.7 visually shows all the correlations between the variables of "familiarity with art" and the variables of "appreciation" of the paintings. An arrow upwards means: positive correlation. An arrow downwards means: negative correlation.

"I find this painting beautiful" ↑

**Art visits last year
**Interest in art

"This painting touches me emotionally" ↑

*Art education after high school
**Interest in art

"I find this painting complex" ↑

**Education Mother
**Education Father
**Art-education on high-school
*Art-education after high-school
*Art visits until the year of 18

"I find this painting complex" ↓

***Age

"This painting touches me emotionally" ↑

***Education
**Art-education on high-school
**Art-education after high-school
*Interest in art
***Knowledge of art

"I find this painting complex" ↑

**Education father
*Art visits until 18

"I find this painting complex" ↓

*Age

"I find this painting interesting" ↑

*Education Father

"I find this painting beautiful" ↑

**Art visits until the year of 18
***Art visits last year
*Interest in art

"This painting touches me emotionally" ↑

*Education
*Art-education on high-school

			*Art-education after high-school **Art visits last year ***Interest in art ***Knowledge of art
	*"I find this painting complex"*	↑	*Education *Education mother *Education father **Art visits last Year
	*"I find this painting complex"*	↓	*Age
	*"I find this painting interesting"*	↑	***Education mother **Art visits last year **Interest in art
	*"I find this painting powerful"*	↑	***Education ***Education Mother *Education Father **Art visits until the year of 18 **Art visits last year **Interest in art **Knowledge of art
	*"This painting touches me emotionally"*	↑	***Education **Art-education after high-school **Knowledge of art
	*"I find this painting complex"*	↑	*Education Father
	*"I find this painting complex"*	↓	*Age
	*"I find this painting beautiful"*	↑	*Knowledge of art
	*"I find this painting beautiful"*	↓	*Age
	*"This painting touches me emotionally"*	↑	*Art education after high-school

"I find this painting complex"

**Education mother

**Education father

"I find this painting complex"

*Age

"I find this painting interesting"

***Education mother

***Education father

***Art visits until the year of 18

"I find this painting interesting"

*Age

"I find this painting powerful"

***Education mother

***Education father

**art visits until the year of 18

"I find this painting powerful"

***Age

Figure 5.18 All the correlations between "appreciation" and "familiarity with art"

4.4 WITHIN SUBJECT ANALYSES

The main effects of bottom-up saliency and its interaction with the participant's cultural capital were tested with a *factorial repeated measures ANOVA*. Statistics revealed violation of assumptions and significant main effects and interaction between the variables "participant's highest level of education", "participant's father highest level of education", "participant's mother highest level of education", "hours art-education on high school", "art education after high school" "visits to art galleries or museums with family or friends until the age of 18"and "art visits to art galleries or museums this year". Therefore I transformed them to one new variable "violations". In Appendix E, tables A4.4.1. to A4.4.5 show the factorial repeated measures with all the variables that are computed here in "violations" separately.

Table 4.4.1. shows the effects of gender, age, ethnicity, place of birth, place of residency, cultural capital, knowledge of art, interest in art and the appreciation of the painting itself (e.g. whether participants find the painting beautiful, emotional, complex, interesting and powerful) on the amount of looking to bottom-up regions in the painting *Compositie no. II, 1929 Piet Mondriaan*. Only "Ethnicity" (B = -2,701) and "Age" (*B* = -,287) revealed significant effects. This means that people who are not Dutch, focus less on bottom-up regions compared to Dutch people and that older respondents spend more time looking at bottom-up regions than the younger participants.

Table A4.1.1 shows that the education level of the participant's mother has a significant (*B.* = - *24,833*) negative effect on the degree of bottom-up perception while viewing the painting *Compositie no. II, 1929 Piet*

Mondriaan. This is in line with my hypothesis *"Familiarity with art is positively correlated with the percentage of eye fixations in the top-down saliency regions of a painting"*.

Table 4.4.1. Effects on the proportion of bottom-up looking for Painting: *Compositie no. II, 1929, Piet Mondriaan*

Coefficients [a]

Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	Sig.
(Constant)	14.143	15,075		.352
Gender	-.470	3.799	-.015	.902
Age*	.287	.147	.262	.056
Ethnicity**	-2.701	1.281	-.256	.040
Place of birth	7.496	6.325	.215	.241
Place or residence	-2.323	7.369	-.056	.754
Violations	3.876	5.740	.190	.502
Knowledge of Art	1.560	2.062	.185	.453
Interest in Art	-3.237	2.309	-2.77	.166
Painting 1 - Beauty	-.084	.126	-.130	.505
Painting 1 – Emotion	-.063	.108	-.089	.566
Painting 1 – Complexity	.036	.085	.058	.667
Painting 1 – Interest	.134	.106	.255	.213
Painting 1 – Powerfulness	.092	.098	.182	.355

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table 4.4.2. shows the effects of the same set of independent variables on looking at bottom-up regions in the painting *Compositie met kleurvlakjes, 1917, Piet Mondriaan*. None of the effects are significant. The degree of bottom-up processing of this painting is unrelated to background, cultural capital of the participants and aesthetic evaluation.

Table 4.4.2 Effects on the proportion of bottom-up looking for Painting: *Compositie met kleurvlakjes, 1917, Piet Mondriaan*

Coefficients [a]

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	Sig.
(Constant)	18.191	10.093		.077
Gender	-1.314	2.486	-.075	.799
Age	.099	.095	.161	.301
Ethnicity	.214	.835	.036	.799
Place of birth	4.562	3.774	.234	.232
Place or residence	-3.033	4.492	-.132	.507
Violations	.959	3.608	.083	.791
Knowledge of Art	-.741	1.355	-.149	.587
Interest in Art	-.093	1.392	-.015	.947
Painting 2 - Beauty	-.016	.079	-.043	.835
Painting 2 – Emotion	.011	.081	.028	.887
Painting 2 – Complexity	.040	.064	.110	.537
Painting 2 – Interest	-.055	.086	-.161	.525
Painting 2 – Powerfulness	.036	.082	.112	.664

[*] significant at the 0.10 level (1-tailed).

[**] significant at the 0.05 level (1-tailed).

[***] significant at the 0.01 level (1-tailed).

Table 4.4.3. shows the effects of the set of independent variables on the amount of looking to bottom-up regions in the painting *The Lyrical, 1911, Vasili Vasileevich Kadinsky*. Only the effects of age (B = 0.210) and the appreciation of beauty (B = -0.132) and emotion (B= -.113) revealed significant results. This means that older participants looked more at bottom-up regions and that participants who found the painting *The Lyrical* more beautiful and more emotionally touching looked less to bottom-up regions. This is in line with my hypothesis *Appreciation of the work of art is positively correlated with percentage of eye fixations in the top-down saliency regions of a painting"*

Table 4.4.3 Effects on the proportion of bottom-up looking for Painting *The Lyrical, 1911, Vasili Vasileevich Kadinsky*

Coefficients [a]

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	Sig.
(Constant)	16.083	8.803		.073
Gender	-1.810	2.134	-.106	.400
Age	.210**	.086	.342	.018
Ethnicity	-.083	.765	-.013	.914
Place of birth	1.657	3.447	.086	.632
Place or residence	-3.808	4.001	-.169	.345
Violations	5.015	3.275	.432	.131
Knowledge of Art	-.094	1.148	-.019	.935
Interest in Art	-1.365	1.297	-.207	.297
Painting 3 - Beauty	-.132*	.069	-.412	.060
Painting 3 – Emotion	-.113*	.063	-.379	.078
Painting 3 – Complexity	.003	.044	.009	.953
Painting 3 – Interest	.118	.086	.358	.178
Painting 3 – Powerfulness	.072	.077	.230	.354

* significant at the 0.10 level (1-tailed).

** significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table 4.4.4. shows the effects on the degree of looking at bottom-up regions in the painting *Ober-Weimar, 1921, Lyonel Feinige.*. Only interest in art (B = -3.271) revealed a significant effect. This effect is in the expected direction; those with a greater interest in the arts (and arguably more expertise) focus less on the salient regions and therefore use a more top-down viewing strategy.

Table 4.4.4. Effects on the proportion of bottom-up looking for Painting: *Ober-Weimar, 1921, Lyonel Feiniger*

Coefficients [a]

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	Sig.
(Constant)	20.952	8.731		.020
Gender	-.661	1.904	-.043	.730
Age	.092	.078	.166	.244
Ethnicity	-.552	.851	-.087	.519
Place of birth	-.866	2.928	-.050	.768
Place or residence	.321	3.789	.015	.933
Violations	5.840	2.939	.567	.052
Knowledge of Art	.331	1.005	.076	.743
Interest in Art	-3.271***	1.176	-.554	.007
Painting 4 - Beauty	.057	.058	.170	.333
Painting 4 – Emotion	.009	.048	.031	.843
Painting 4 – Complexity	.007	.055	.020	.899
Painting 4 – Interest	-.085	.069	-.261	.226
Painting 4 – Powerfulness	.031	.077	.097	.695

* significant at the 0.10 level (1-tailed).

** significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table 4.4.5. shows the effects on the amount of looking to bottom-up regions in the painting *Der Astronom (Zyklus Arbeit) (De astronoom (werkcyclus))*. None of the variables had a significance impact.

Table 4.4.5. Effects on the proportion of bottom-up looking for Painting: *Der Astronom (Zyklus Arbeit) (De astronoom (werkcyclus))*

Coefficients [a]

Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	Sig.
(Constant)	8.462	12.487		.501
Gender	-.226	2.917	-.010	.938
Age	.110	.127	.132	.390
Ethnicity	-1.371	1.146	-.162	.236
Place of birth	2.784	4.504	.109	.539
Place or residence	3.809	5.193	.125	.466
Violations	-5.833	4.416	-.371	.191
Knowledge of Art	2.194	1.628	.331	.183
Interest in Art	1.575	1.847	.182	.397
Painting 4 - Beauty	-.061	.078	-.145	.435
Painting 4 – Emotion	.043	.088	.087	.628
Painting 4 – Complexity	-.016	.069	-.035	.817
Painting 4 – Interest	.105	.098	.251	.287
Painting 4 – Powerfulness	-.019	.098	-.045	.846

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

4.5 CORRELATIONS BETWEEN "FAMILIARITY WITH ART" AND APPRECIATION

Because little significance was found between the bottom-up saliency and background characteristics of the participants for the five paintings, I decided to also analyse the relations between the variables that together form the "scale of cultural capital" and the appreciation for the five paintings. This will tell us if the lack of effects found above indicates that appreciation does not differ significantly between participants with more or less expertise. In Appendix D, tables A4.5.1. to A4.5.5 show, for each of the five paintings, the correlations between the variables that indicate cultural capital and appreciation of the artworks.

There were several correlations between the cultural capital variables and the appreciation for the painting *Compositie No II;* all the correlations mentioned below can be found in Appendix D, table A4.5.1.

Older participants found the painting less complex. This might be explained by the fact that older people have perceived more abstract works of art in their lives than younger people. The other findings,

however, cast doubt on this interpretation in terms of familiarity with art that would lower perceived complexity. Rather, the reverse effect seems more plausible. Parental education, having pursuedart education after high school and having visited more art galleries and museums during one's youth all positively affected the participants' assessment of complexity. This might be explained by the fact that art-experts search for deeper meaning behind the abstract painting; while laymen just perceive the painting as a squared scene.

When participants visited art galleries of museums often in the year preceding the experiment, and the more they reported being interested in art, the more beautiful they found the painting. This is in line with the assumption that art-experts appreciate complex paintings more than laymen.

Participants who had been enrolled in art-education after high-school or who stated to be interested in art, were more emotionally touched by the *compositie of Piet Mondriaan*.

The correlations pertaining to the painting *Compositie met kleurvlakjes* can be found in Appendix D: 4.5.2. Similar to the other painting made by Piet Mondriaan, older participants found the scene of this painting less complex than younger participants. Participants with a more intensive art-education in- and after high school, and who stated to be interested and knowledgeable in the arts, were more emotionally touched by this painting. However, higher educated participants were less emotionally touched by the painting. This finding makes clear that cultural capital does consist of a range of elements that can have contrary outcomes. Art education may open people up to the arts, but general education does not necessarily do so. Father's schooling level, however, does positively affect the degree to which participants were interested in the painting.

Correlations summed up fpr the painting *The Lyrical* can be found in Appendix D, table A4.5.3. Just like both Mondriaan paintings, this abstract painting made by Kandinsky was perceived as less complex by older participants.

Participants who visited art galleries and museums more frequently until the age of 18 and nowadays and who were more interested in art found the painting more beautiful.

Participants who were highly educated, followed art-education on and after high-school, and visited art galleries and museums frequently until the age of 18 and nowadays and who were interested and knowledgeable about art were all more emotionally touched by the painting of Kandinsky than participant's who didn't possess these characteristics.

Participants who found the painting more interesting or powerful had higher educated mothers, visited art galleries and museums more frequently and were more interested in art in general.

Correlations for the painting *Ober-Weimar* can be found in table A4.5.4. Again, older participants found this painting less complex than younger participants. On the other hand, father's schooling level was positively related to perceived complexity. Higher educated participants were less emotionally touched, but those who enrolled in art-education after high-school and were more knowledgably about art were more emotionally touched by the painting.

All the correlations that I will sum up between the variables that belonged to "familiarity with art" and the appreciation for the painting *Der Astronom (Zyklus Arbeit)* can be found in Appendix D,

Table A4.5.5. A strong, negative, correlation was found between age, on the one hand, and the appreciation of beauty, complexity, interest and powerfulness on the other. Clearly, the older participants were less impressed with this work by all these standards. However, bother mother's and father's education, participant's art education after high-school, art visits until the age of 18 and the self-reported knowledge of art all revealed positive correlations with the appreciation of the painting. Thus, the higher educated the father and the mother were, the more complex, interesting and powerful they found the painting. When participants visited art-museums and galleries often with their parents or family they also found the painting more interesting and powerful. Moreover, when participants pursued art-education after high school, they were more emotionally touched by the painting. Finally, those who reported more knowledge of the arts found the painting more beautiful and were more emotional touched by the painting.

5 CONCLUSSION

The results from the our experiment provided no strong evidence for influences of "familiarity with art" or other background characteristics on the eye-movements of participants during the pictorial perception of paintings. Only one out of five hypotheses has been confirmed. However, I did found some interesting results. I will elaborate on each hypothesis below.

1 *"Familiarity with art" is positively correlated with percentage of eye fixations in the top-down saliency regions of a painting.* ✗ NOT CONFIRMED

This hypothesis has not been confirmed. However, I did find some significant effects for the paintings *Compositie no. II*, *The Lyrical* and *Ober-Weimar*. but it is remarkable that all of these effects, with only one exception (the effect of mother's education), are in the opposite direction of my expectations. Figures 5.1 to 5.10 give a schematic overview, and explanation, of the significant effects and correlations found regarding this hypothesis.

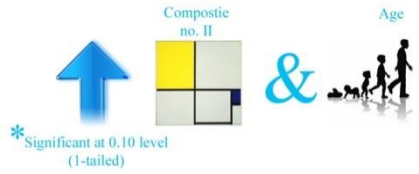


Figure 5.1 Positve Effect Age: Compositie no. II

There is a positive effect of age on the proportion of bottom-up looking at *Compositie no. II* (see table. 4.4.1), this means that older participant's fixate more at bottom-up saliency regions than younger participants. This debunks my hypothesis, for I suspected that older participants would have obtained more knowledge about art than younger participants during their lifetime, and therefore would look ,ore at the top-down saliency regions using this experience.

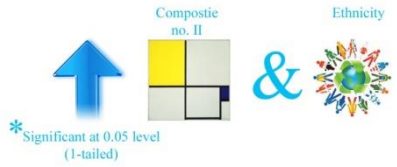


Figure 5.2 Positve Effect Ethnicity: Compositie no. II

There is a positive effect of ethnicity on the proportion of bottom-up looking at *Compositie no. II* (see table. 4.4.1), which means that participants who do not live in the Netherlands look more at bottom-up saliency regions than participant's who do live in the Netherlands.

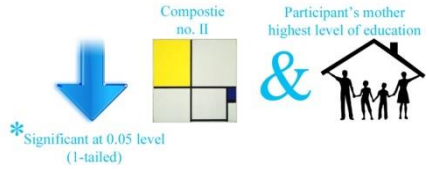


Figure 5.3 Negative Effect Particpan'ts mother highest level of communication: Compositie no. II

There is a negative effect of the highest level of education of the participant's mother on the proportion of bottom-up looking at *Compositie no. II* (see table. 4.4.1). This means that participants with higher educated mothers look less at bottom-up saliency regions compared to participants with lower educated mothers. This effect does support my hypothesis because it is more likely that higher educated mothers learn their children more about art than lower educated mothers.

Figure 5.4 Positve Effect Age: The Lyrical

There is a positive effect of age on the proportion of bottom-up looking at *The Lyrical* (see table. 4.4.3). Similar to *Compositie no. II*, this means that older participants look more at bottom-up saliency regions than younger participants.

Figure 5.5 Effect Age: Ober-Weimar

There is also a positive effect of age on the proportion of bottom-up looking at *Ober-Weimar* (see table 4.4.4). The same interpretation for this painting as the other two, *The Lyrical* and *Compositie no. II*,: older participants look more at conspicuous regions of the painting compared to younger participants.

Figure 5.6 Positve Effect General Interest in Art: Ober-Weimar

There is a positive effect between *Ober-Weimar* and the participants' general interest in art (e.g. self-reflection) (see table 4.4.4). Participants who stated to be more interested in art than others looked more at bottom-up saliency regions.

Figure 5.7 Positve Effect General Knoweledge of Art: Ober-Weimar

There is a positive effect between *Ober-Weimar* and the participants' general knowledge in art (e.g. self-reflection) (see table 4.4.4).This is also contradict to my hypothesis. However as this was a self-reflection question in the questionnaire, it might be the case that participant's stated to have a lot of knowledge about the arts but in fact didn't, or not as much higher than participant's who stated to have less-knowledge about the arts. Another explanation can simply be; experts also look at conspicuous regions of the painting and there is no real difference in viewing-strategies.

Apart from the seven significant effects I found between cultural capital and eye-fixations in bottom-up saliency regions, I also found four significant correlations.

There is a positive correlation between *Compositie no. II* and the participants "art education on high-school" (see table 4.3.7) This means, the more hours there were spent on art during high-school, the more participant's looked at "bottom-up saliency regions". This is opposite of what I expected, similar like the implication by the significant effect; maybe all these results just show that experts do look more at conspicuous regions of paintings instead of fixating less on conspicuous regions.

There is a positive correlation between *Compositie no. II* and the participants "amount of art visits" (see table 4.3.7). This means, the more visits to art museums or art galleries participants made, the more they fixated on conspicuous regions of the painting. Although, I can never check which kind of art-visits participants made (e.g. they can also visit dance- or music- art instead of visual arts) I cannot give an explanation for this result

apart from the fact that this again, implies that people who are more familiar with art, look more to "bottom-up saliency regions".

Just like the painting Compositie no II, *Ober-Weimar* also revealed a positive correlation with "art-education on high school" and the amount of fixations in "bottom-up saliency regions" (see table 4.3.7).

As I have found positive effect between *Ober-Weimar* and the participants' general knowledge in art (e.g. self-reflection) (see table 4.4.4), it is also logical I found a positive correlation (see table 4.3.7)

Thus to conclude, apart from the impact of mother's highest education, all the significant effects and correlations contradicted the first hypothesis; they all implied that "familiarity with art" is positively related to the degree of fixation on bottom-up saliency regions. This finding will be discussed more elaborately in the discussion.

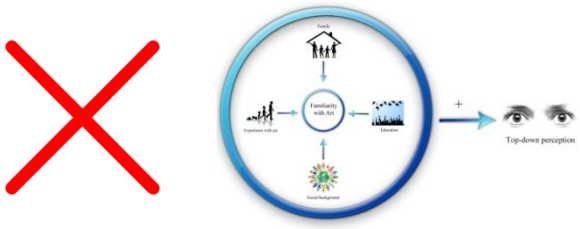


Figure 5.8: The hypothesis *"Familiarity with art is positively correlated with the percentage of eye fixations in the top-down saliency regions of a painting"* has not been confimed.

2 *Appreciation of the work of art is positively correlated with percentage of eye fixations in the top-down saliency regions of a painting* NOT CONFIRMED

Just like the contradict results for the hypothesis that familiarity with art causes more eye fixations in the "top-down saliency regions" of a painting, this hypotheses is also not confirmed and the effects and correlations also showed the opposite of what I expected. Participants who appreciated the painting more compared to other participants, looked more at the "bottom-up saliency regions" of the painting.

Participants who found the painting *Compositie no II* more interesting, powerful, and who were more emotionally touched by the painting compared to other participants fixated more on "bottom-up saliency regions" while viewing the painting (see table 4.4.3). This is not in line with my hypothesis *"Appreciation of the work of art is positively correlated with the percentage of eye-fixations in the top-down saliency regions of paintings"*.

Participants who found the painting *The Lyrical* more beautiful, and who were more emotionally touched by the painting compared to other participants fixated more on "bottom-up saliency regions" while viewing the painting (see table 4.4.3). This is not in line with my hypothesis *"Appreciation of the work of art is positively correlated with the percentage of eye-fixations in the top-down saliency regions of paintings"*.

Participants who found the painting *Ober-Weimar* more interesting than other participants fixated more on "bottom-up saliency regions" while viewing the painting (see table 4.4.4) This is not in line with my

hypothesis *"Appreciation of the work of art is positively correlated with the percentage of eye-fixations in the top-down saliency regions of paintings".*

3 *The more complex a work of art, the less the effect of cultural capital on eye-fixations.*

✗ NOT CONFIRMED

As familiarity with art has no strong effect on the eye-fixations in general (see the declining of hypothesis 1), this hypothesis cannot be answered convincingly anymore. Moreover, tables 5.1 to 5.10 did not show more effects for the abstract paintings than the (semi-) realistic paintings. Thus I can be short about this; this hypothesis cannot be confirmed.

4 *Familiarity with art is positively related with the appreciation of art works.*

✓ CONFIRMED

Tables in the Appendix E: 4.5.1. to 4.5.5. show a lot of positive correlations between familiarity with art and the appreciation of artworks. Apart from the negative correlation between age and complexity; older participants found paintings often less complex than younger participants, and three negative correlations with the painting *Der Astronom*, all correlations were positive. The only result that might gainsay this hypothesis is the fact that participants who are more familiar with art found most of the paintings more complex. However this can be explained by the fact that it is likely that they search for deeper meanings behind the abstract paintings, whereas un-experienced art-viewers just perceive them as abstract patterns.

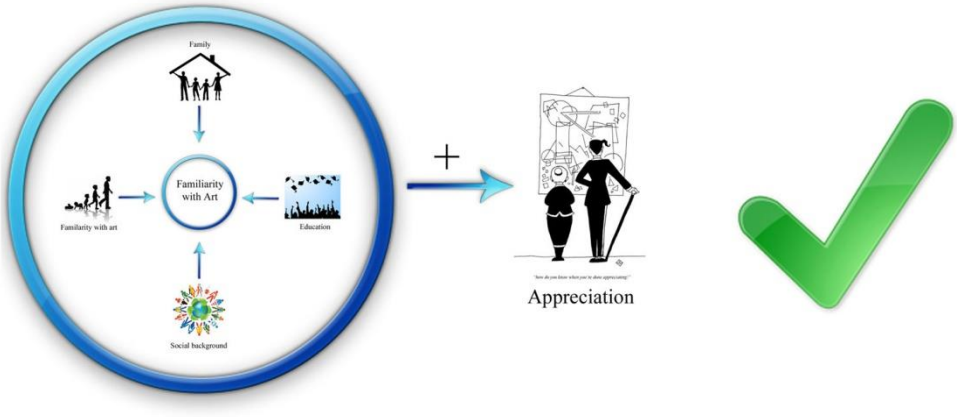


Figure 5.9 Familiarity with art is positively related with the appreciation of art works.

5 *The preference for realistic paintings is negatively correlated with cultural capital*

PARTLY CONFIRMED

This hypothesis has partially been confirmed. Higher educated participants found the painting *Compositie no II* more interesting than lower educated participants. Similarly, higher educated participants found Mondriaan's *Compositie met kleurvlakjes* more powerful and were more emotionally touched by the painting. Moreover, higher educated participant's found *Der Astronom (Zyklus Arbeit)* less beautiful than lower educated participants. As *Compositie no II* and *Compositie met kleurvlakjes* are considered the two most abstract paintings, and *The Lyrical*, *Ober-Weimar* and *Der Astronom (Zyklus Arbeit)* the three more realistic paintings used during the experiment, these results support the hypothesis. Nevertheless, since education is only one indicator of familiarity with art this finding offers only a partial confirmation of the hypothesis.

To conclude, results showed that familiarity with art has no influence on eye-movements. Thus, eye-fixations of people who are more familiar with art do not significantly differ compared to people who are less familiar with art. This also means that eye-movements are not a predictable factor for the appreciation of art. Familiarity with art, however, influence the appreciation of art works as expected. Figure 5.10 gives an schematic overview of the conclusion.

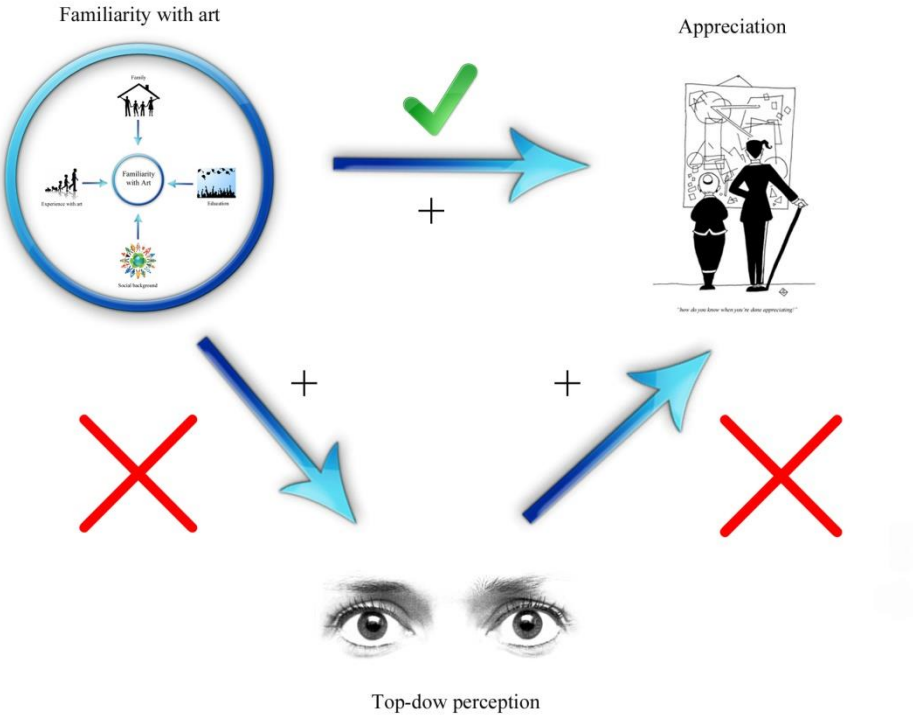


Figure 5.10 Conclusion: familiarity with art does not influence the eye-movements. Eye-movements are also n

6 DISCUSSION

6.1 IMPLICATIONS

In the light of the study's results and limitations, it can be said that eye fixations do not significantly differ according to levels of familiarity with art during the pictorial perception of paintings . To my astonishing I often found the opposite effect; people who are familiar with art focused more to bottom-up saliency regions than people who were less familiar with art. An explanation for the lack effects of familiarity with art on eye fixations in top-down saliency regions by experienced art-viewers could be that artists are well known (conscious and unconscious) with the effects of saliency regions, and therefore know how to direct their viewers' eyes, putting the most effort (e.g. technique, quality of painting skills) in these regions. The consequence might be that the bottom-up regions are the most interesting to look at, so that the experienced viewers prefer to look at bottom-up saliency regions, for they can better assess the quality of a painting through a focus on these regions. And un-experienced art-viewers just randomly look, without directing their eyes; their eyes are out of control and therefore also look at top-down saliency regions. This is of course only an implication, further research has to be conducted to test whether this could be true. Another note should be that the audience of a museum is not very diverse. The distinction between those with higher or lower levels of cultural capital is not really big among a museum-audience. Therefore, it would be interesting to see if my results would be confirmed when I had participants who were more diverse. For example, if the experiment would be conducted in a train-station, where all kind of different people would participate. This might result in clearer results.

This study did support the hypotheses that there is a correlation between cultural capital and art appreciation. This implies that my data confirm existing theories in this respect. I have also found differences in the appreciation of paintings between participants but these were not caused by different way of looking but rather by the different amount of familiarity. Thus, from this study it can be concluded that the correlation between cultural capital and appreciation of art is not established by differences in eye-fixations. Which raise the question; how does this correlation between cultural capital and appreciation establish? An explanation could be that the information processing does not take place at the moment of "looking" itself, but afterwards, purely in the mind, and that bottom-up- versus top-down-saliency differences are not likely to appear if there is no specific consecutive action that has to be followed up after the act of looking (e.g. people look at paintings just for the act of looking itself). Theory of Bushwell (1935) and Yarbus (1967) demonstrated that the eye movement pattern depends on the observer's objectives; during their experiments they gave participants instructions to search for certain parts in a scene. Which might indicate that top-down processing only takes place when someone is instructed to use his/her brains. Hence, this experiment consisted out of a free-viewing task; participants were instructed to look wherever they wanted. Maybe, there is no active connection between the brains and the eyes when there is no specific goal; the brains do not drive the eyes during free viewing, they just randomly look around and only remember what we found noticeable afterwards. Therefore, it would be interesting to look at other studies among free-viewing tasks (e.g. studies from normal life, for example: when someone is sitting on a couch in a living room, and looks around without a certain goal), if there is a correlation between bottom-up and top-down looking at that moment. If studies confirm there is no specific correlation between bottom-up and top-down looking during free-viewing, it would be valuable to conduct my experiment again. Instead of instructing participants with a free-viewing task, give them a task whereby it is necessary to apply their cultural capital on

the act of looking. For example, when participants are being asked what kind of painting technique the painter has used in his/her painting; or ask the participants to estimate the price of the painting. For these questions someone has to be familiar with art, and will use his/her brains to direct his/her eyes to certain parts of the scene on the painting to be able to provide the answer on these questions, whereby participants who are less familiar with art will also direct their eyes, but don't know where to find the answers. Maybe then, a clearer distinction between looking at bottom-up and top-down saliency regions will appear. Will experienced-art viewers then still look more at bottom-up regions than un-experienced art viewers or would the effect be the other way around this time? Or would there be no correlation at all? I am very curious about this question. I will read more theory and if I find evidence that support the idea for conducting my experiment again, as I proposed, hopefully find a funding to do further research into this topic.

6.2 LIMITATIONS

In the present research, I examined to what extent and how. familiarity with art, or cultural capital, influences the eye-movements during viewing of paintings. Although none of the hypotheses concerning eye-movements were confirmed, the interpretation of the results should take into account the limitations of the experiment and the data. Results might be affected by particularities of the experimental design and the available data. Moreover, it should take into account that although the results did not confirm my hypothesis, it did actively showed opposite results, as have been said before, this could be interesting for further research.

The results did confirm the fact that cultural capital influences the appreciation of art. But, as this is a finding that has been established in many studies before, these results only show that my material is in principle reliable and valid.

6.2.1. EXPERIMENT & STIMULI

Paintings were categorized as a function of variables affecting the top-down and bottom-up visual processing of original paintings. Because the data were gathered in the field, i.e., the Museum Boijmans van Beuningen, I was depending on people's willingness to co-operate. Therefore, I had a limited choice of rooms were I could conduct the experiment. Moreover, the museum was not willing to hang paintings in another order so I was also limited in my choice of stimuli. This resulted in seven prominent limitations:

1) Only European and American paintings were used for the experiment. The effect of familiarity with art on eye fixations in the top-down saliency regions, has therefore nothing to say about paintings from non-western cultures or other forms of art. Thus, this study can only proclaim that there is no positive correlation between familiarity with art and eye-fixations in top-down saliency regions of European and American paintings.
2) The lack of a (very) realistic painting might have influenced the results. Although three out of the five paintings showed recognisable scenes, they were still not photo-realistic based. Maybe I could have found stronger evidence for the appreciation for realistic paintings by participants with less cultural capital, and larger differences in the eye-movements in bottom-up regions if the contrast (e.g. realistic versus abstract) between the paintings were bigger.

3) The format of the paintings could be a potential limitation of my research; all the paintings differed in size, therefore not only the bottom-up regions could influence the gaze-pattern, also the size could have determined how participants looked at a painting.
4) Bias due to obviousness of the experiment. The experiment used straightforward questions, no filler questions were used and in the experimental conditions participants could also see other participants conducting the same test. Therefore, it might have lead participants to look at the paintings in a certain way, and fill in the questions in a certain manner with regard to what they thought the experiment was about, instead of their natural viewing of paintings.
5) Time limitation; participants were instructed to look at each painting for 20 seconds and then move over to the next painting. It is possible that some participants felt time-pressure and could not freely look in the way they normally do because they would feel stressed to look at all the things they wanted to see within the limited time duration.
6) The environment; sometimes it was really crowded in the museum room and sometimes it was really empty. This could have influenced the mood of the participants, which affects the way someone looks (relaxed or stressed). Moreover, it also influences the light on the painting (e.g. shadows of persons) which caused slightly different bottom-up saliency models of the painting for each individual. Therefore, the conditions were not exactly the same for each participant while viewing the paintings. This might influence the reliability of the results.
7) The exploratory nature of the experiment. Although previous research has been conducted on eye-movements and art-perception, these studies are limited and very recent. I believe that future studies can develop the role of saliency perception of paintings more elaborately.

6.2.2. DATA: PARTICIPANTS AND ANALYSES

1) Almost all of the participants had a White/Caucasian background. A cultural bias towards familiarity with arts might have caused the lack of background differentiation. Therefore this study can only be credited to people with a White/Caucasian background.
2) Small sample size. Although I have conducted the experiment by 83 participants (each viewing 5 paintings, so 415 viewings in total) which was enough according to the power analyses conducted, it might be too few for such an experiment. However, given the high demand put on respondents, the fact that the experiment had to be carried out in a museum within a given time, and the fact that each respondent was to be tested separately, a larger n could not be achieved.
3) Low scores on the familiarity with art variables. Only 21 participants completed an art or art-history course or college education after high school. When familiarity with art would have been divided more equally, this might have resulted into more reliable results.

6.3 FURTHER RESEARCH

Deducing from the limitations and implications of this study, several avenues for further research can be suggested. With regard to this particular experiment, it would be good to repeat the experiment with different paintings in another museum to confirm its results and gain a reliable indication of the actual effect of top-down saliency differentiations between experts and laymen during the pictorial perception of paintings. Paintings that

could be used for further research should be more diverse in level of realism and abstraction. It would also be a good idea to let people walk freely along the paintings instead of letting them stand all from the same distance, because this would increase the natural behaviour (and therefore, natural eye-movement behaviour) of people. However, if further research confirm my results; that there is no correlation, or a positive correlation, between the eye-fixations in bottom-up regions of paintings and the level of expertise, I would recommend to focus more on further research related to the brain-processing while viewing art than further research on eye-movements during art perception. It would be interesting to do further research into the question whether experienced-art viewers look with an internal cognitive plan to paintings, or that they purely process the visual information of a painting after the act of looking. As I have proposed by the implications, it would be interesting to conduct this experiment again but instead of using a free-viewing task, instruct the participant's to apply their cultural capital during the act of looking in order to be able to answer certain questions about the painting afterwards; whereby it should be examined if there appears clearer distinction between bottom-up an top-down perception.

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8. Appendix A: Participant questionnaire

Dankjewel voor het deelnemen aan dit onderzoek.
Hier volgt een korte vragenlijst. Deze is geheel anoniem en met de data zal discreet worden omgegaan.
Selecteer hieronder de taal waarin u de vragenlijst wilt beantwoorden en druk op de knop rechtsonder.

Thank you for participating in this study. Here you will answer a short questionnaire. It is completely anonymous and the data will be handled discretely. Select the language of your choice below and press the button in the bottom-right corner to begin.

Q1. Wat is uw geslacht?
- Man
- Vrouw
- Trans

Q2. In welk jaar bent u geboren?
- 1900 tot 2015

Q3. Wat is uw etniciteit?
- Blank/Kaukasisch
- Afrikaans Amserikaans
- Latijns Amerikaans
- Aziatisch
- Indiaan
- Afkomstig van de Stille Oceaan eilanden
- Afrikaans
- Anders

Q4. In welke provincie bent u geboren?
- Drenthe
- Flevoland
- Friesland
- Gelderland
- Groningen
- Limburg
- Noord-Brabant
- Noord-Holland
- Overijssel
- Utrecht
- Zeeland
- Zuid-Holland

Q1.What is your gender?
- Male
- Female
- Trans

Q2. What year were you born?
- 1900 to 2015

Q3. What is your race/ethnicity?
- Whitie/Causcasian
- African American
- Latin American
- Asian
- Native American
- Pacific Islander
- African
- Other

Q4. In which province were you born?
- Drenthe
- Flevoland
- Friesland
- Gelderland
- Groningen
- Limburg
- Noord-Brabant
- Noord-Holland
- Overijssel
- Utrecht
- Zeeland
- Zuid-Holland

- Overig, ik ben geboren in een ander land

Q5. Bent u geboren in een dorp of stad?

- Dorp
- Stad

Q6. In welke provincie woont u nu?

- Drenthe
- Flevoland
- Friesland
- Gelderland
- Groningen
- Limburg
- Noord-Brabant
- Noord-Holland
- Overijssel
- Utrecht
- Zeeland
- Zuid-Holland
- Overig, ik woon in een ander land

Q7. Woont u nu in een dorp of een stad?

- Dorp
- Stad

Q8. Wat is u hoogst behaalde opleidingsniveau?

- Minder dan middelbare school
- Middelbare School
- MBO
- HBO
- Bachelor WO
- Master WO
- Doctoraat / gepromoveerd

Q9. Wat is u hoogst behaalde opleidingsniveau van uw moeder?

- Minder dan middelbare school
- Middelbare School
- MBO
- HBO
- Bachelor WO
- Master WO

- Other, I was born in a different country

Q5. Were you born in a village or city?

- Village
- City

Q6. In which province do you life?

- Drenthe
- Flevoland
- Friesland
- Gelderland
- Groningen
- Limburg
- Noord-Brabant
- Noord-Holland
- Overijssel
- Utrecht
- Zeeland
- Zuid-Holland
- Other, I life in a different country

Q7. Do you reside in a village or city?

- Village
- City

Q8. What is the highest level of education you have completed?

- Less than High School
- High School / GED
- Some College
- 2-year College Degree
- 4-year College Degree
- Master Degree
- Doctoral Degree
- Professional Degree (JD MD)

Q9. What is the highest level of education your mother has completed?

- Less than High School
- High School / GED
- Some College
- 2-year College Degree
- 4-year College Degree
- Master Degree

- Doctoraat / gepromoveerd

Q10. Wat is u hoogst behaalde opleidingsniveau van uw vader?

- Minder dan middelbare school
- Middelbare School
- MBO
- HBO
- Bachelor WO
- Master WO
- Doctoraat / gepromoveerd

Q11. Hoeveel uur per week werd er gemiddeld besteed aan kunst-educatie op uw middelbare school?

- Geen
- 1 tot minder
- 2-3
- 4-5
- 6-7
- 8 en meer

Q12. 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

Q13. 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

Q14. Hoe vaak bezoekt u gemiddeld per jaar kunstgaleries of kunst musea? (geef een algeheel gemiddelde)

- Doctoral Degree
- Professional Degree (JD MD)

Q10. What is the highest level of education your father has completed?

- Less than High School
- High School / GED
- Some College
- 2-year College Degree
- 4-year College Degree
- Master Degree
- Doctoral Degree
- Professional Degree (JD MD)

Q11. 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

Q12. 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
- 2 year College Degree
- 4 year College Degree
- Master Degree
- Doctoral Degree
- Other

Q13. 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
- 2 year College Degree
- 4 year College Degree
- Master Degree
- Other

Q14. How many times have you visit art galleries and museums in the last 12 months? (give overall average)

- Not at all

- Nooit
- 1-2 keer
- 3-5 keer
- 6-11 keer
- Minstens een keer per maandag
- Ongeveer eens per twee weken
- Elke week

- 1-2 times
- 3-5 times
- 6-11 times
- At least once a month
- About once every two weeks
- Once a week

Q15. 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

Q15. 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

Q16. Op een schaal van 1(helemaal niet geïnteresseerd) tot 10 (extreem geïnteresseerd) kunt u aangeven hoezeer u geïnteresseerd bent in kunst?

Q16. On a scale from 1 (not interested at all) to 10 (extremely interested), can you indicate how much you are interested in art?

Q17. Op een schaal van 1(niet of nauwelijks kennis) tot 10 (extreem veel kennis) kunt u aangeven hoezeer u geïnteresseerd bent in kunst?

Q17. On a scale from 1 (not knowledgeable at all) to 10 (extremely knowledgeable), can you indicate how knowledgeable you are about art?

Q18. Compositie no. II, Piet Mondriaan

Op een schaal van 1 (oneens) 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 het schilderij complex
- Ik vind het schilderij interessant
- Ik vind het schilderij krachtig

Q18. Compositie no. II, Piet Mondriaan

On a scal from 1 (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 complex
- I find this painting interesting
- I find this painting powerful

Q19. Compositie met kleurvlakjes, 1917, Piet Mondriaan

Op een schaal van 1 (oneens) 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

Q19. Compositie met kleurvlakjes, 1917, Piet Mondriaan

On a scal from 1 (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

- Ik vind het schilderij complex
- Ik vind het schilderij interessant
- Ik vind het schilderij krachtig

Q20. Lyrisches, 1911, Vasili Vasileevich Kadinsky

Op een schaal van 1 (oneens) 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 het schilderij complex
- Ik vind het schilderij interessant
- Ik vind het schilderij krachtig

Q21. Ober-Weimar, 1921, Lyonel Feiniger

Op een schaal van 1 (oneens) 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 het schilderij complex
- Ik vind het schilderij interessant
- Ik vind het schilderij krachtig

Q22. Der Astronom (Zyklus Arbeit) (De astronoom (werkcyclus)), 1919, Arthus Segal

Op een schaal van 1 (oneens) 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 het schilderij complex
- Ik vind het schilderij interessant
- Ik vind het schilderij krachtig

- I find this painting complex
- I find this painting interesting
- I find this painting powerful

Q20. Lyrisches, 1911, Vasili Vasileevich Kadinsky

On a scal from 1 (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 complex
- I find this painting interesting
- I find this painting powerful

Q21. Ober-Weimar, 1921, Lyonel Feiniger

On a scal from 1 (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 complex
- I find this painting interesting
- I find this painting powerful

Q22. Der Astronom (Zyklus Arbeit) (De astronoom (werkcyclus)), 1919, Arthus Segal

On a scal from 1 (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 complex
- I find this painting interesting
- I find this painting powerful

Bedankt voor uw deelname. Als u opmerkingen heeft, kunt die hieronder achterlaten.
Als u op de hoogte van het onderzoek gehouden wilt worden, laat dan u email adres achter.

Thank you for participating. If you have any comments, please them below.
If you want to be kept informed about the research, please leave your email adress in the comment box.

8. APPENDIX B: MATLAB SOFTWARE, © Ir. J.F.M. DOMHOF

```
clear all;
close all;
clc;
warning('off','all');

tic
%% Vul hier de naam van de bestanden in
filename_video = 'recordings/1.1.mp4';  % <video.avi>
filename_textfile = fopen('recordings/1.1-[2c31f3bb-46dc-40f1-9ef2-
a21e535e8b4c]_1.1_001_Trial001 Samples.txt'); % <raw_data.txt>

movie = VideoReader(filename_video);
frames = read(movie);

%% Klik op de hoeken van het schilderij
frame = frames(:,:,:,round(end/2)); %frame is het middelste plaatje waar we alles op gaan
plotten

figure(1)
imshow(frame); hold on;
title('click on top left corner of the painting and bottom right corner');
[x,y] = ginput(2);

width = abs(x(2)-x(1));
heigth = abs(y(2)-y(1));

%Plot het vierkant dat zonet geselecteerd is
line([x(1); x(1)+width], [y(1); y(1)], 'LineWidth',5, 'Color',[0 0 0]);
line([x(1)+width; x(2)], [y(1); y(2)], 'LineWidth',5, 'Color',[0 0 0]);
line([x(2); x(1)], [y(2); y(1)+heigth], 'LineWidth',5, 'Color',[0 0 0]);
line([x(1); x(1)], [y(1)+heigth; y(1)], 'LineWidth',5, 'Color',[0 0 0]); hold on;
plot(x(1), y(1), '.k', 'MarkerSize',50);

%% Read text file
locationsPOR = [3,4];

data = [];
firstLineFound = 0;
tline = fgets(filename_textfile);
while ischar(tline)
    if(not(strcmp(tline(1), '#')))
        %Find location of Point of Gaze
        if(not(firstLineFound))
            %disp(tline);
            updatedString = regexprep(tline, '\t', ',');
            locations = strfind(updatedString, ',');

            firstLineFound = 1;
        else
            updatedString = regexprep(tline, '\t', ',');
            locations = strfind(updatedString, ',');
            data = [data;
str2double(tline(locations(locationsPOR(1)):locations(locationsPOR(2)))),
str2double(tline(locations(locationsPOR(2)):end))];
        end
    end

    tline = fgets(filename_textfile);
end

fclose(filename_textfile);
% Data(:,1) --> X
% Data(:,2) --> Y

%% Compute Saliency map
itti_in = frame(y(1):y(2), x(1):x(2));

out_itti = ittikochmap(itti_in);
saliency_map = out_itti.master_map_resized;

figure
```

```
imshow(saliency_map);

%% Threshold saliency map
saliency_map = out_itti.master_map_resized;
percentageBottomup = 15.0; %DEZE kan je aanpassen, het percentage bottom up pixels.

threshold = 1; %
stepsize = 0.001;
percentage = 0;

all_percentages = [];
while (percentage < percentageBottomup)
    mask = saliency_map > threshold;
    percentage= sum(sum(mask))/ (size(saliency_map,1) *size(saliency_map,2))*100;
    threshold = threshold - stepsize;
    all_percentages = [all_percentages; percentage];
end

disp(['Percentage bottom-up pixels: ', num2str(percentage)]);
if (percentage > 1.1*percentageBottomup | percentage < 0.9*percentageBottomup)
    %Als het hier een error geeft dan betekent het dat de het percentage
    %bottom up pixels teveel afwijkt van de gevraagde percentage.
    error('Percentage wijkt teveel af van percentageBottomup. Eventueel stepsize
veranderen.');
end

figure; imshow(mask);

%% Compute homography
%Dit stukje code zorgt ervoor dat we weten hoe het plaatje is verschoven
%ten opzichte van het middelste plaatje. H is een matrix die het plaatje
%roteert en transleert zodat het over het middelste plaatje komt te liggen.

checkHmatrix = false;
if checkHmatrix == true
    i = floor(rand*size(frames,4));

    imageDefault = rgb2gray(frame);
    ptsIm1  = detectSURFFeatures(imageDefault);
    [featuresImageDefault,  validImageDefault]  = extractFeatures(imageDefault,  ptsIm1);

    imageIn = rgb2gray(frames(:,:,:,i));
    ptsIm2  = detectSURFFeatures(imageIn);
    [featuresIm2, validPtsIm2] = extractFeatures(imageIn, ptsIm2);

    indexPairs = matchFeatures(featuresImageDefault, featuresIm2);
    matchedIm1  = validImageDefault(indexPairs(:,1));
    matchedIm2 = validPtsIm2(indexPairs(:,2));

    figure; ax = axes;
    showMatchedFeatures(frame,imageIn,matchedIm1,matchedIm2,'montage','Parent',ax);
    title(ax, 'Candidate point matches');
    legend(ax, 'Matched points 1','Matched points 2');

    figure; ax = axes;
    showMatchedFeatures(frame,imageIn,matchedIm1,matchedIm2,'Parent',ax);
    title(ax, 'Putative point matches');
    legend(ax,'Matched points 1','Matched points 2');

    [tform, inlierIm2, inlierIm1,status] = estimateGeometricTransform(...
    matchedIm2, matchedIm1, 'affine');

    H1 = tform.T;

    I3 = cat(2, imageIn, rgb2gray(frame));
    figure; imshow(I3); hold on; title('Click op vier punten in het linkerplaatje');
    testSet = ginput(4);

    for i=1:size(testSet,1)
        plot(testSet(i,1), testSet(i,2), 'ok');
        [xOut,yOut] = transformPointsForward(tform, testSet(i,1), testSet(i,2));
        [xOut2,yOut2] = transformPointsInverse(tform, testSet(i,1), testSet(i,2));
        plot(size(frame, 2)+ xOut, yOut, 'xg');
        line([testSet(i,1); size(frame, 2)+ xOut], [testSet(i,2); yOut]);
    end
else
    H = zeros(size(frames,4), 3, 3);
```

```
    imageDefault = rgb2gray(frame);
    ptsIm1  = detectSURFFeatures(imageDefault);
    [featuresImageDefault,  validImageDefault]  = extractFeatures(imageDefault,  ptsIm1);

    for i=1:size(frames,4)
        imageIn = rgb2gray(frames(:,:,:,i));
        H(i,:,:) = computeHomography(imageIn, imageDefault, featuresImageDefault,
validImageDefault);
    end
end
%% Test Homography
%Hier worden alle coordinaten getransformeerd naar het middelste plaatje.
%Zwarte kruisjes geven de 'foute' locaties aan en de groene kruisjes de
%nieuwe correcte locaties, waar dus de beweging uit is gehaald. Als je de
%waarde test = true doet dan kun je testen of het werkt. Als je gaat
%analyseren moet test = false; zijn.

checkConversionVideoToText = false; %false or true
checkRandomFrame = false;
XCorrected = [];
YCorrected = [];
if checkConversionVideoToText == true
    i = floor(rand*size(data,1));

    image =  rgb2gray(frames(:,:,:,floor(i*24/30)));
    I3 = cat(2, image, rgb2gray(frame));
    figure; imshow(I3); hold on; title('Click op vier punten in het linkerplaatje');
    pTransform = ginput(4);

    %Plot points
    for j=1:size(pTransform,1)
        plot(pTransform(j,1), pTransform(j,2), 'ok');
        text(pTransform(j,1)+20,pTransform(j,2),num2str(j),'Color',[1 1 1])
    end

    %Bepaal de goede punten
    title('Click op de vier goede locaties in het rechterplaatje');
    pGoed = ginput(4);

    correct = true;
    for j=1:size(pTransform,1)
%         plot(pTransform(j,1), pTransform(j,2), 'ok');
        [xOut,yOut] = transformPoint(pTransform(j,1), pTransform(j,2), i, H);
        if (sqrt( (size(frame, 2)+ xOut - pGoed(j,1) )^2 + (yOut - pGoed(j,2) )^2 ) < 30.0)
            plot(size(frame, 2)+ xOut, yOut, 'xg');
        else
            plot(size(frame, 2)+ xOut, yOut, 'xr');
            correct = false;
        end
        line([pTransform(j,1); size(frame, 2)+ xOut], [pTransform(j,2); yOut]);
    end
    if correct == true;
        title('CORRECT', 'Color', 'g', 'FontSize', 16);
    else
        title('INCORRECT', 'Color', 'r', 'FontSize', 16);
    end
elseif (checkRandomFrame == true)
    i = floor(rand*size(data,1));
    x_img = data(i,1);
    y_img = data(i,2);

    image =  rgb2gray(frames(:,:,:,floor(i*24/30)));
    I3 = cat(2, image, rgb2gray(frame));
    figure; imshow(I3); hold on;

    plot(x_img, y_img,'ok');
    [XOut, YOut] = transformPoint(x_img, y_img, i, H);
    plot(XOut+size(image,2), YOut, 'xg');
    line([x_img; XOut+size(image,2)], [y_img; YOut], 'Color',[1 1 1]);
else
    figure; imshow(frame); hold on;
    maxDistance = 0;
    for i=1:size(data,1)
       x_img = data(i,1);
       y_img = data(i,2);
       [XOut, YOut] = transformPoint(x_img, y_img, i, H);
       plot(data(i,1), data(i,2), 'xk');
```

```
        plot(XOut, YOut, 'xg');
        line([x_img; XOut], [y_img; YOut], 'Color',[1 1 1]);
        XCorrected = [XCorrected; XOut];
        YCorrected = [YCorrected; YOut];
    end
    axis([x(1), x(2), y(1), y(2)]);

    %Plot contour in image
    maskSaliency = zeros(size(frame));
    maskSaliency(y(1):y(2), x(1):x(2)) = mask;
    contour(rgb2gray(maskSaliency), 'LineColor', 'white');
end

%% Determine if subject is looking at top down or bottom up
%Hier tellen we het aantal bottom up en top down pixels en plotten die in
%het middelste plaatje(frame). Bottom up pixels zijn groene cirkels en top
%down rode kruisjes. Ook heb ik de contour geplot zodat je dat goed
%zichtbaar hebt.
iBottomup = 0;
iTopdown = 0;

figure
imshow(frame); hold on;

for i=1:size(data,1)
   y_painting = YCorrected(i) - y(1);
   x_painting = XCorrected(i) - x(1);

   if round(x_painting) > 0 && round(y_painting) > 0
       if round(x_painting) < size(mask,2) && round(y_painting) < size(mask,1)
           if mask(round(y_painting),round(x_painting)) == 1
               iBottomup = iBottomup + 1;
               plot(XCorrected(i), YCorrected(i), 'og');
           else
               iTopdown = iTopdown + 1;
               plot(XCorrected(i), YCorrected(i), 'xr');
           end
       end
   end
end
axis([x(1), x(2), y(1), y(2)]);

%Plot contour in image
maskSaliency = zeros(size(frame));
maskSaliency(y(1):y(2), x(1):x(2)) = mask;
contour(rgb2gray(maskSaliency), 'LineColor', 'white');

percentageTopDown = iTopdown/(iTopdown+iBottomup)*100
percentageBottomUp = iBottomup/(iTopdown+iBottomup)*100

S1 = strcat('Percentage top-down: ', num2str(percentageTopDown), ' [%]');
S2 = strcat('Percentage bottom-up: ', num2str(percentageBottomUp), ' [%]');
title([S1, ', ', S2]);

toc
```

8 Appendix C: Saliency frames of all participants conducted in matlab

Figure 8A:C.1. Conducted “saliency map: black/white” for the painting *Compositie no II*, for each participant (participants are indicated by numbers).

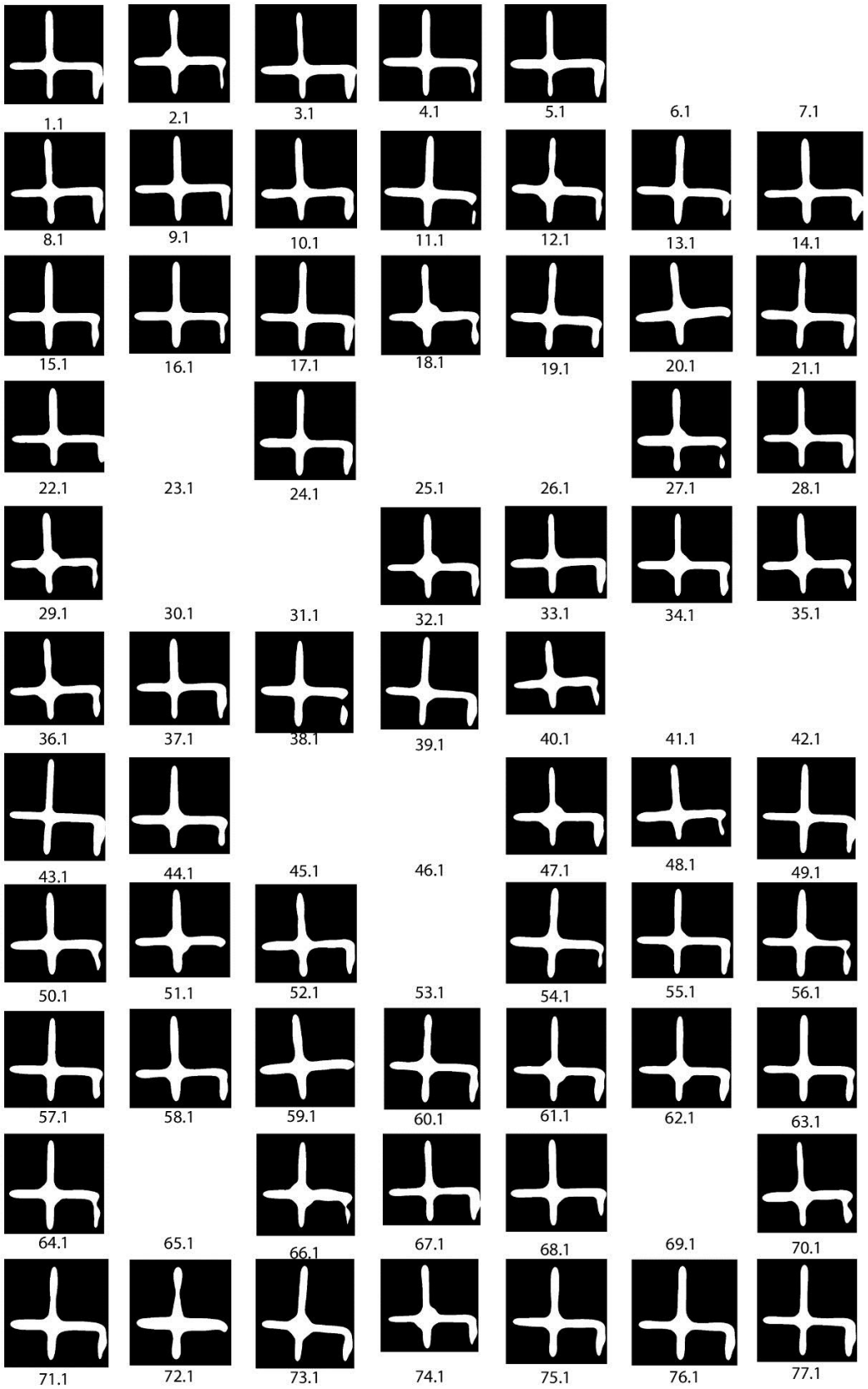
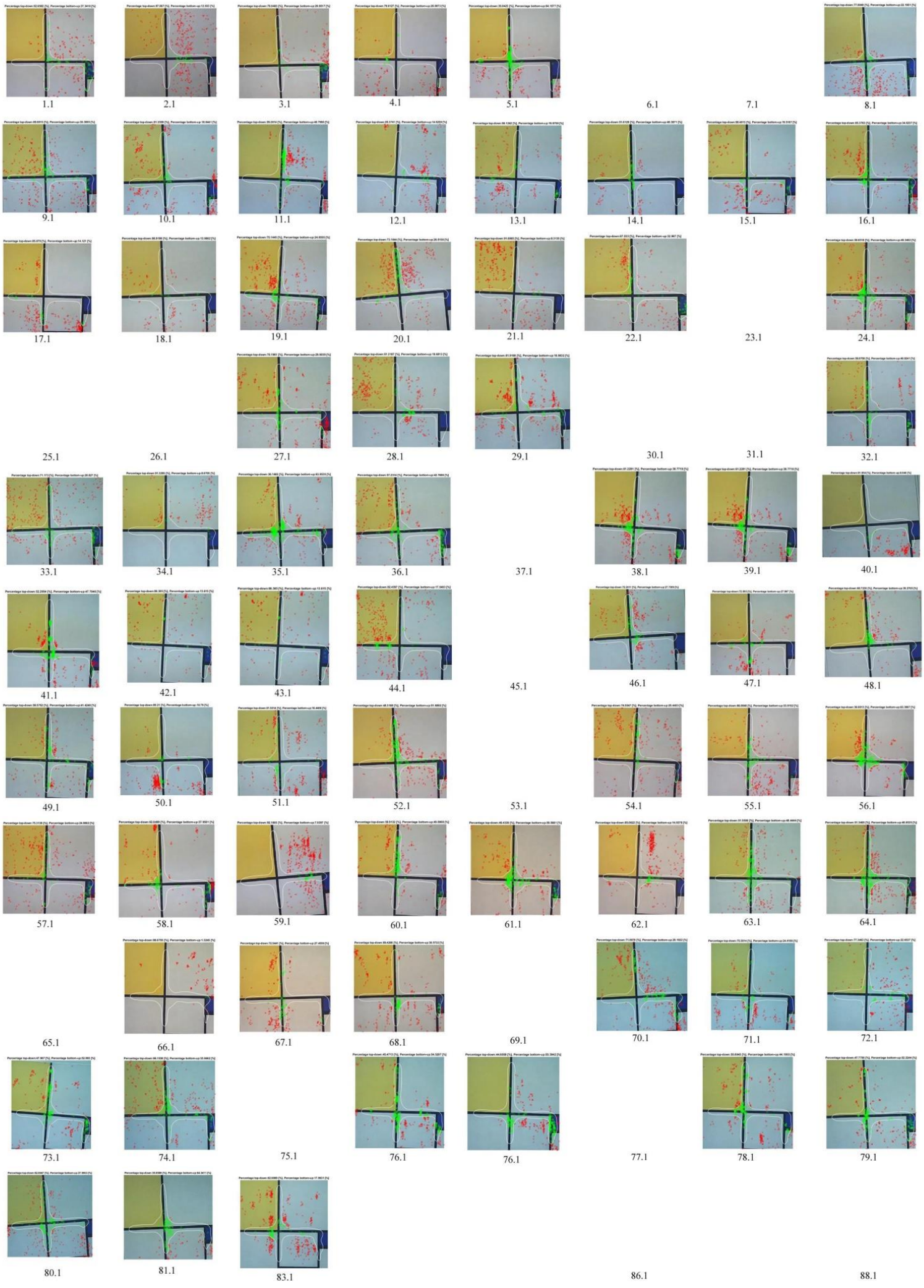


Figure 8A:C.2 Conducted “total map” for the painting Compositie no II, for each participant (participants are indicated by numbers)



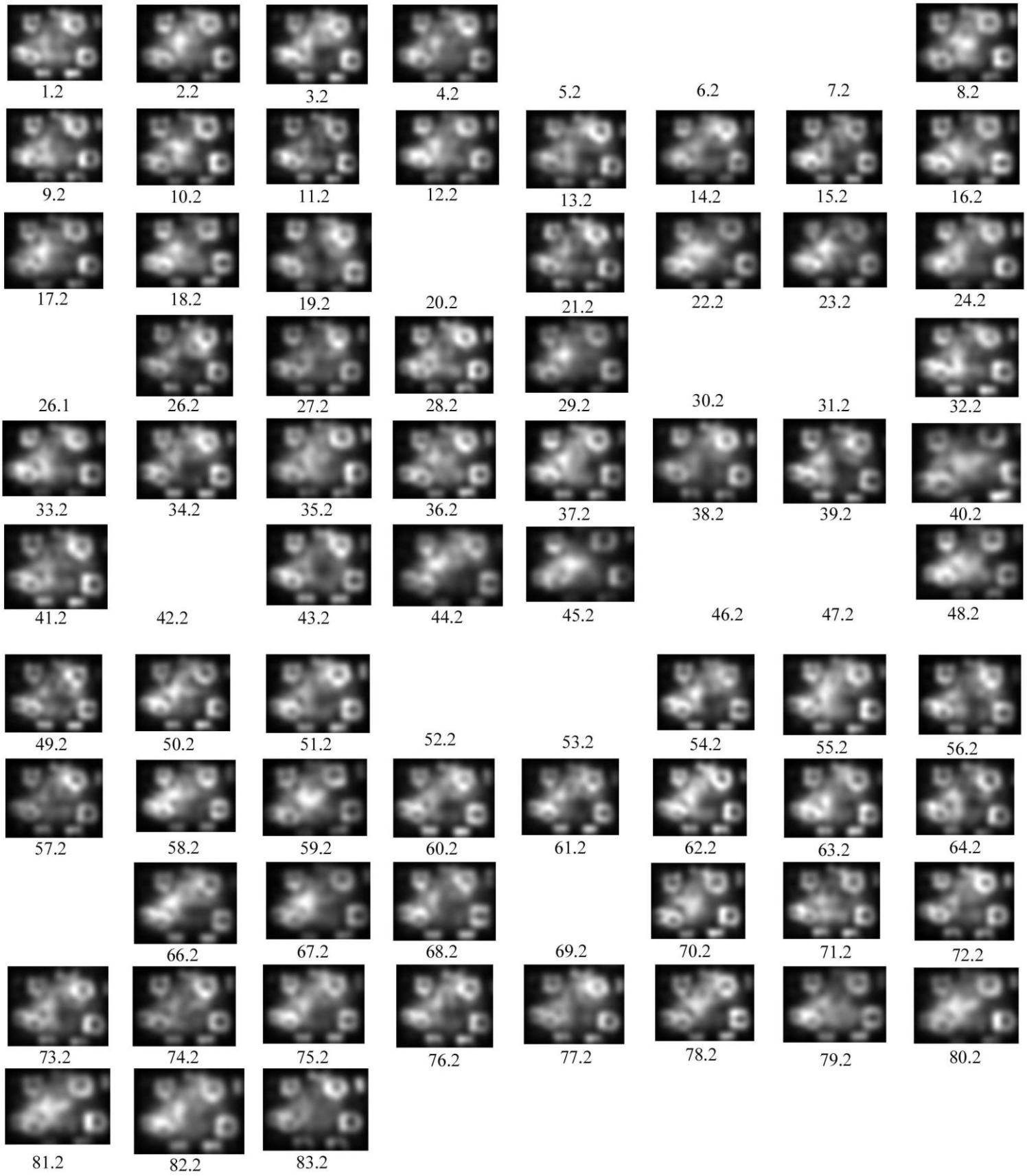


Figure 8A:C.3. Conducted "saliency map" for the painting Compositie met kleurvlakjes, for each participant (participants are indicated by numbers)

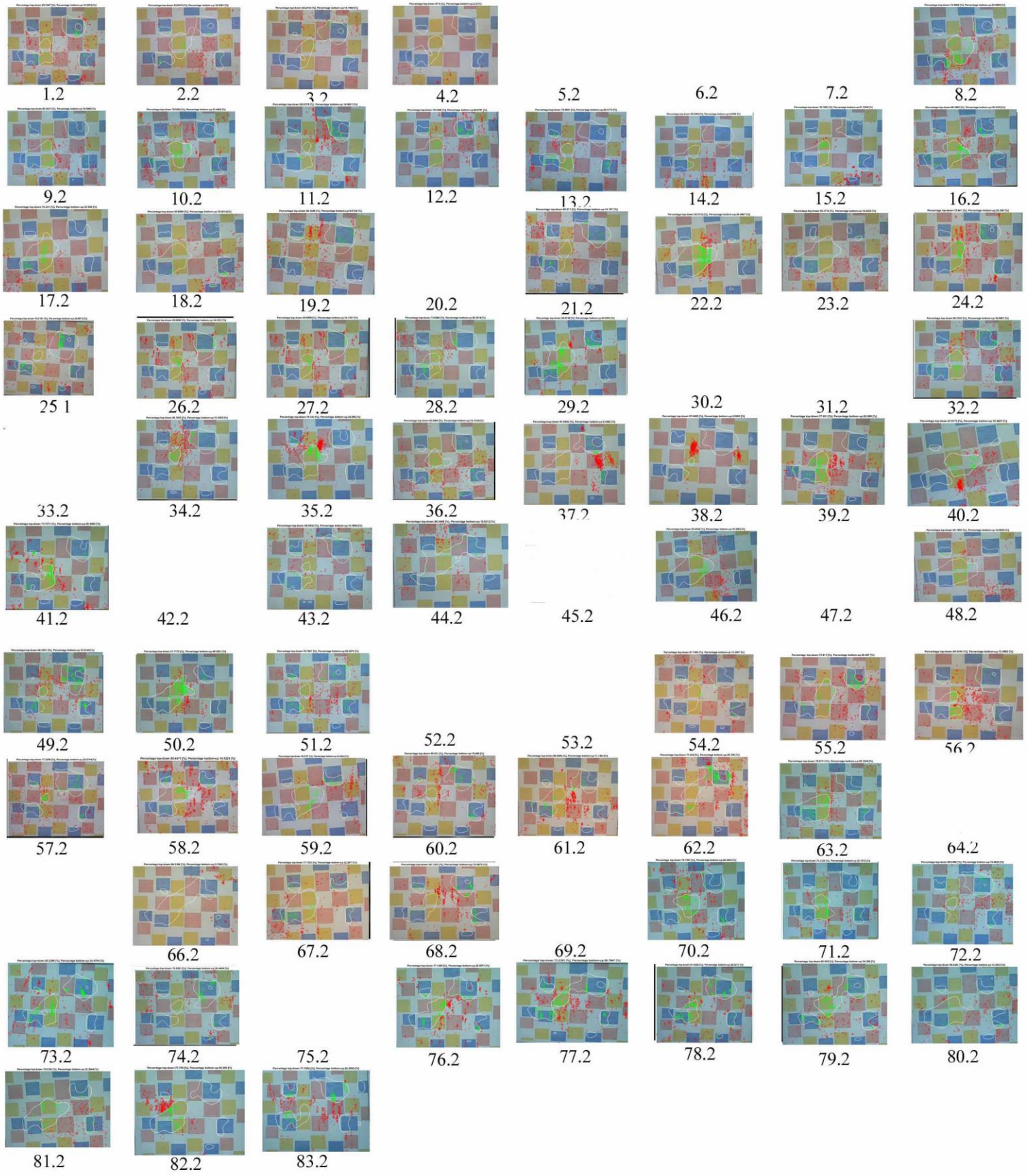


Figure 8A:C.4. Conducted “total map” for the painting Compositie met kleurvlakjes, for each participant (participants are indicated by numbers).

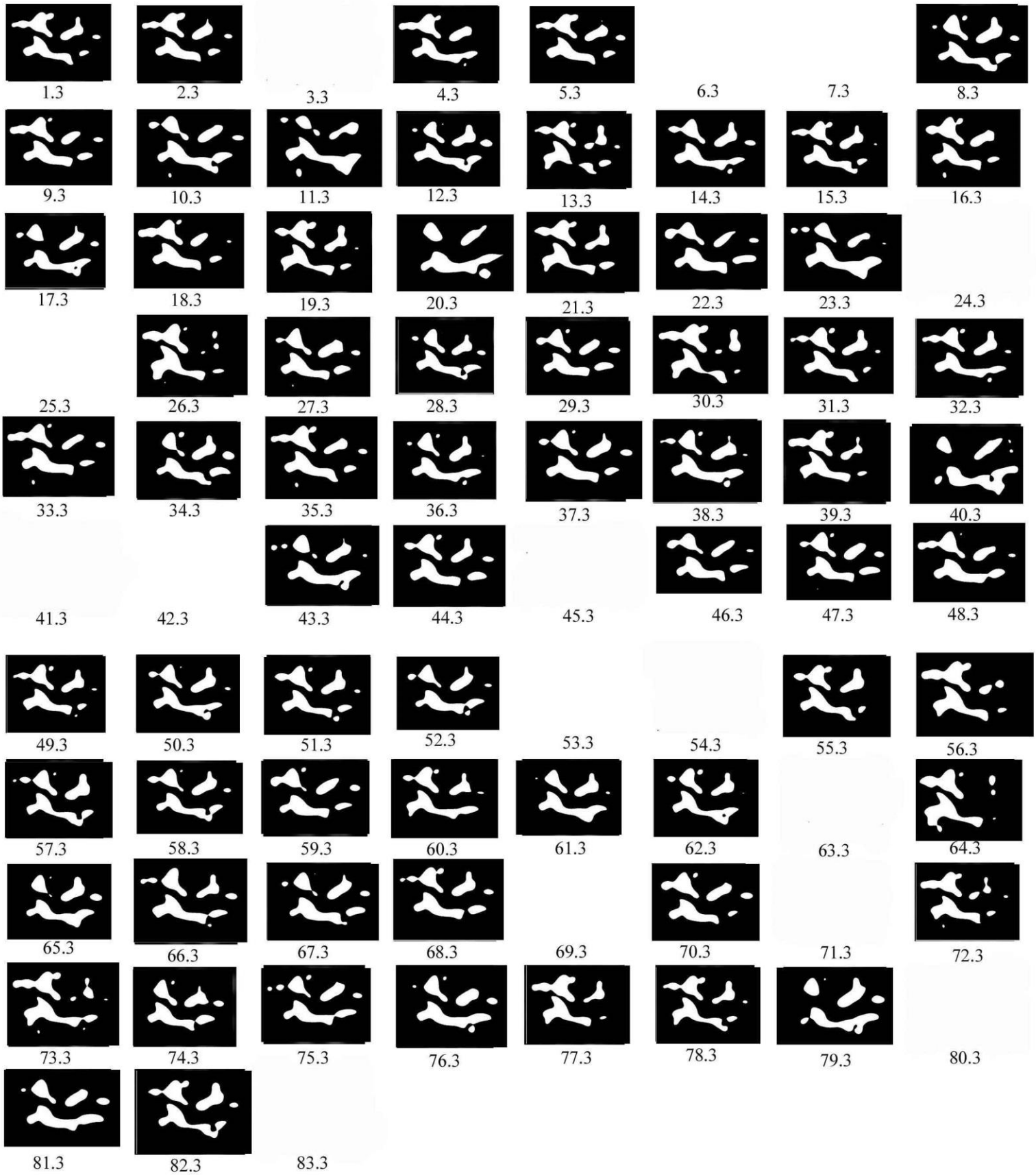


Figure 8A:C.1. Conducted "saliency map: black/white" for the painting The Lyrical, for each participant (participants are indicated by numbers).

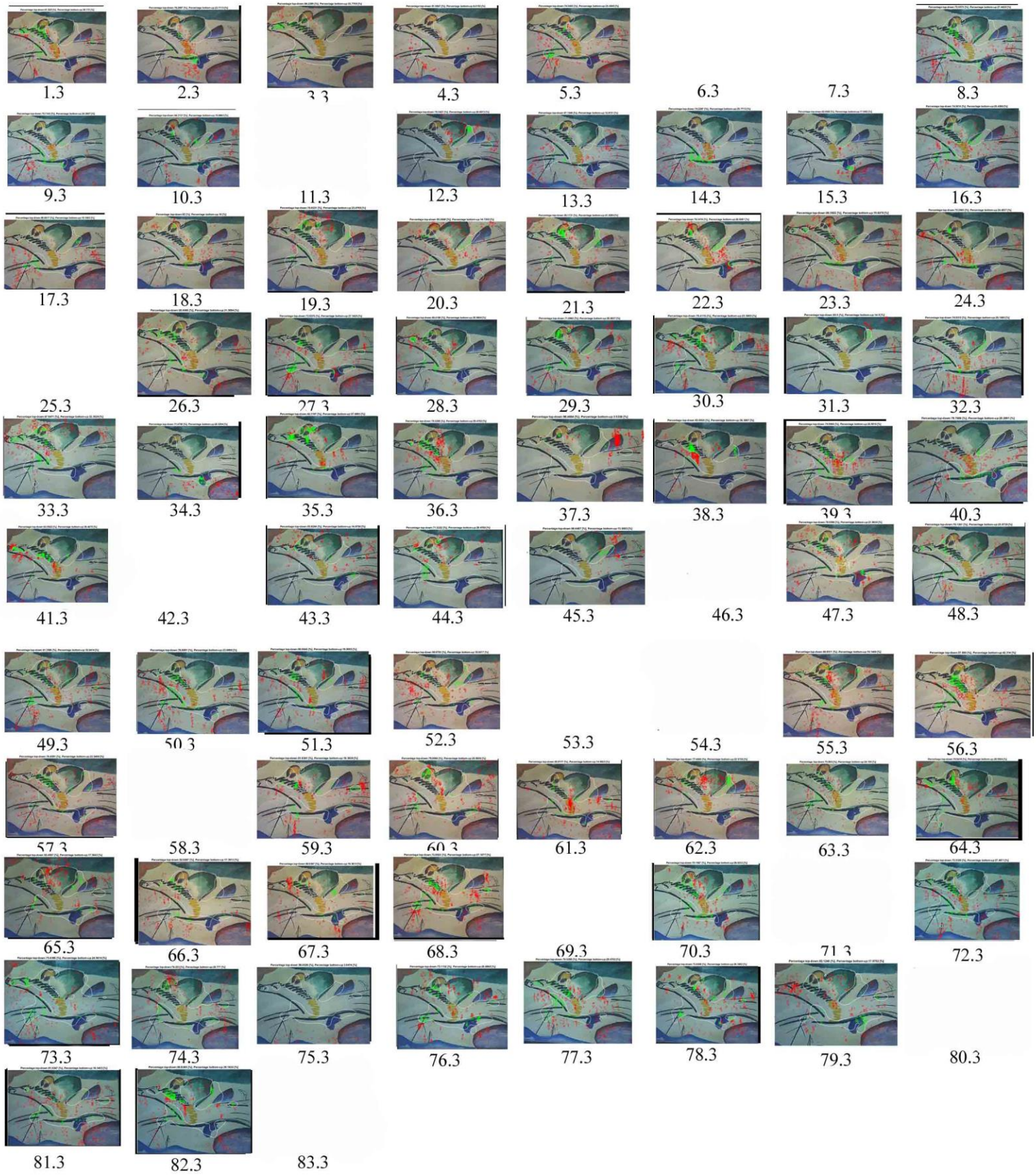


Figure 8A:C.6. Conducted “total map” for the painting Lyrisches, for each participant (participants are indicated by numbers).

Figure 8A:C.7. Conducted "saliency map" for the painting Ober-Weimar, for each participant (participants are indicated by numbers).

Figure 8A:C.8. Conducted "total map" for the painting Ober-Weimar, for each participant (participants are indicated by numbers)

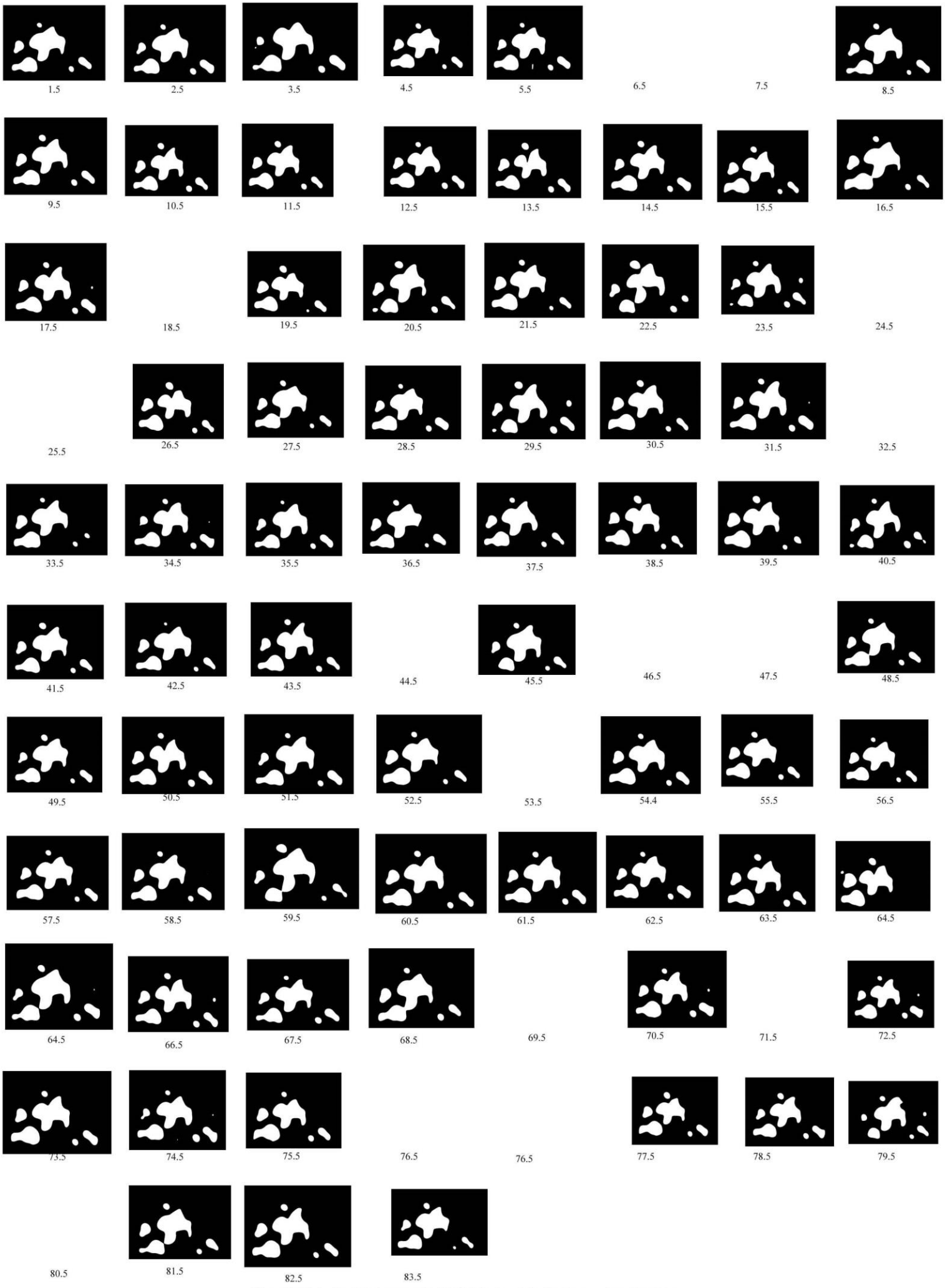


Figure 8A:C.9. Conducted "saliency map: black/white" for the painting Der Astronom for each participant (participants are indicated by numbers)

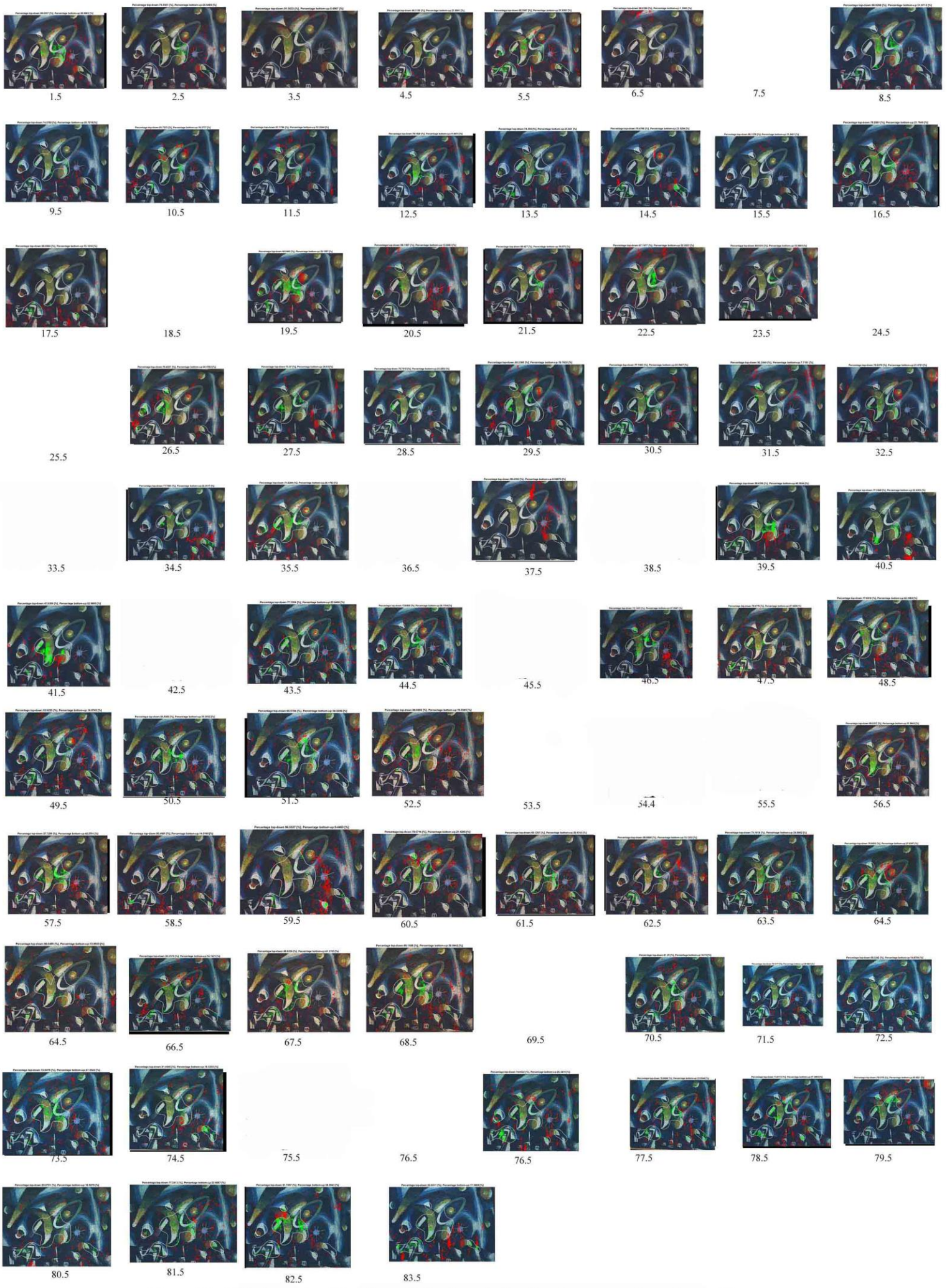


Figure 8A:C.10. Conducted "total map" for the painting Der Astronom, for each participant (participants are indicated by numbers)

8. APPENDIX D: ELABORATE TABLE RESULTS

Table A4.3.1. Correlations *with average Bottom-Up*

	Pearson Correlation	Sig (2-tailed)	N
Gender	-0.063	.633	60
Age	.221*	.090	60
Education	.119	.336	60
Education Mother	-.028	.832	60
Education Father	.146	.266	60
Art-Education on high-school	.011	.936	60
Art-Education after high-school	.125	.351	60
Art visits until 18	.163	.213	60
Art visits Last Year	.125	.349	58
Interest in Art	-.054	.679	60
Knowledge of Art	.172	.188	,191
Painting 1 - Beauty	.171	.191	60
Painting 1 – Emotion	.136	.300	60
Painting 1 – Complexity	-.089	.498	60
Painting 1 – Interest	.217**	.030	60
Painting 1 - Powerfulness	.280**	.030	60
Painting 2 - Beauty	.163	.241	60
Painting 2 – Emotion	.230*	.077	60
Painting 2 – Complexity	.025	.848	60
Painting 2 – Interest	.143	.275	60
Painting 2 - Powerfulness	.087	.509	60
Painting 3 - Beauty	.117	.372	60
Painting 3 – Emotion	.245*	.059	60
Painting 3 – Complexity	.209	.109	60
Painting 3 – Interest	.218*	.094	60
Painting 3 - Powerfulness	.239	.066	60
Painting 4 - Beauty	.005	.972	60
Painting 4 – Emotion	.122	.353	60
Painting 4 – Complexity	.006	.962	60
Painting 4 – Interest	-.083	.527	60
Painting 4 - Powerfulness	.079	.551	60
Painting 5 - Beauty	-.020	.877	60
Painting 5 – Emotion	.195	.136	60
Painting 5 – Complexity	.060	.651	60
Painting 5 – Interest	.127	.334	60

Painting 5 - Powerfulness	.124	.347	60

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.3.2. Correlations *with painting: Compositie no II", Piet Mondriaan, 1929*

	Pearson Correlation	Sig (2-tailed)	N
Gender	-.032	.795	70
Age	.166	.171	70
Education	.188	.119	70
Education Mother	-.177	.142	70
Education Father	.120	.321	70
Art-Education on high-school	-.027	.852	70
Art-Education after high-school	.102	.401	70
Art visits until 18	.007	.956	70
Art visits Last Year	.156	.204	68
Interest in Art	.011	.928	70
Knowledge of Art	.125	.302	70
Painting 1 - Beauty	.184	.127	70
Painting 1 – Emotion	.109	.369	70
Painting 1 – Complexity	.041	.737	70
Painting 1 – Interest	.285**	.017	70
Painting 1 - Powerfulness	.233	.052	70
Painting 2 - Beauty	.126	.298	70
Painting 2 – Emotion	.168	.165	70
Painting 2 – Complexity	.120	.323	70
Painting 2 – Interest	.222*	.065	70
Painting 2 - Powerfulness	.031	.797	70
Painting 3 - Beauty	.045	.709	70
Painting 3 – Emotion	.193	.110	70
Painting 3 – Complexity	.525**	.035	70
Painting 3 – Interest	.180	.136	70
Painting 3 - Powerfulness	.185	.124	70
Painting 4 - Beauty	-.003	.980	70
Painting 4 – Emotion	.073	.549	70
Painting 4 – Complexity	.031	.801	70
Painting 4 – Interest	-.009	.941	70
Painting 4 - Powerfulness	.062	.611	70
Painting 5 - Beauty	-.087	.474	70
Painting 5 – Emotion	.101	.404	70

Painting 5 – Complexity	.115	.344	70
Painting 5 – Interest	.045	.712	70
Painting 5 - Powerfulness	.072	.556	70

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.3.3. Correlations *with painting: Compositie met kleurvlakjes, 1917, Piet Mondriaan*

	Pearson Correlation	Sig (2-tailed)	N
Gender	-.092	.466	68
Age	.126	.305	68
Education	.004	.974	68
Education Mother	-.024	.844	68
Education Father	.062	.615	68
Art-Education on high-school	.078	.528	68
Art-Education after high-school	-.142	.254	66
Art visits until 18	.108	.381	68
Art visits Last Year	-.108	.390	66
Interest in Art	-.058	.672	68
Knowledge of Art	-0.52	.672	68
Painting 1 - Beauty	.008	.945	68
Painting 1 – Emotion	.008	.946	68
Painting 1 – Complexity	-.093	.448	68
Painting 1 – Interest	.137	267	68
Painting 1 - Powerfulness	.230*	.060	68
Painting 2 - Beauty	-.021	.864	68
Painting 2 – Emotion	.047	.702	68
Painting 2 – Complexity	.010	.935	68
Painting 2 – Interest	-.057	.643	68
Painting 2 - Powerfulness	-.005	.967	68
Painting 3 - Beauty	.128	.299	68
Painting 3 – Emotion	.207*	.091	68
Painting 3 – Complexity	.087	.479	68
Painting 3 – Interest	.188	.125	68
Painting 3 - Powerfulness	.287**	.018	68
Painting 4 - Beauty	.011	.930	68
Painting 4 – Emotion	-.004	.974	68
Painting 4 – Complexity	-.017	.888	68
Painting 4 – Interest	.076	.538	68

Painting 4 - Powerfulness	.045	.716	68
Painting 5 - Beauty	-.091	.461	68
Painting 5 – Emotion	.052	.674	68
Painting 5 – Complexity	.098	.427	68
Painting 5 – Interest	.119	.332	68
Painting 5 - Powerfulness	.114	.356	68

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.3.4. Correlations *with painting: Lyrisches, 1911, Vasili Vasileevich Kadinsky*

	Pearson Correlation	Sig (2-tailed)	N
Gender	-.024	.839	76
Age	.182	.116	76
Education	-.026	.825	76
Education Mother	-.164	.158	76
Education Father	.089	.446	76
Art-Education on high-school	-.034	.773	76
Art-Education after high-school	.172	.143	74
Art visits until 18	.116	.316	76
Art visits Last Year	.172	.142	74
Interest in Art	.038	.743	76
Knowledge of Art	.109	.348	76
Painting 1 - Beauty	-.088	.451	76
Painting 1 – Emotion	.020	.861	76
Painting 1 – Complexity	.026	.826	76
Painting 1 – Interest	-.053	.649	76
Painting 1 - Powerfulness	.026	.824	76
Painting 2 - Beauty	-.027	.818	76
Painting 2 – Emotion	.089	.444	76
Painting 2 – Complexity	.122	.294	76
Painting 2 – Interest	-.005	.964	76
Painting 2 - Powerfulness	121	.296	76
Painting 3 - Beauty	-.100	.390	76
Painting 3 – Emotion	-.045**	-.021	76
Painting 3 – Complexity	-.021	.859	76
Painting 3 – Interest	.011	.927	76
Painting 3 - Powerfulness	.041	.725	76
Painting 4 - Beauty	-.126	.279	76
Painting 4 – Emotion	-.032	.781	76

Painting 4 – Complexity	.013	.913	76
Painting 4 – Interest	-.057	.624	76
Painting 4 - Powerfulness	.085	.467	76
Painting 5 - Beauty	.016	.890	76
Painting 5 – Emotion	-.033	.776	76
Painting 5 – Complexity	-.042	.717	76
Painting 5 – Interest	.132	.256	76
Painting 5 - Powerfulness	.075	.519	76

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.3.5. Correlations *with painting: Ober-Weimar, 1921, Lyonel Feiniger*

	Pearson Correlation	Sig (2-tailed)	N
Gender	-.114	.341	72
Age	.124	.301	72
Education	.098	.413	72
Education Mother	.011	.928	72
Education Father	.088	.461	72
Art-Education on high-school*	.212	.074	72
Art-Education after high-school	.184	.121	72
Art visits until 18	.168	.160	72
Art visits Last Year	.172	.142	74
Interest in Art	-.064	.594	72
Knowledge of Art	.196*	.100	72
Painting 1 - Beauty	.176	.138	72
Painting 1 – Emotion	.184	.122	72
Painting 1 – Complexity	-.111	.354	72
Painting 1 – Interest	.110	.357	72
Painting 1 - Powerfulness	.071	.553	72
Painting 2 - Beauty	-.275**	.019	72
Painting 2 – Emotion	.323***	.006	72
Painting 2 – Complexity	-.115	.335	72
Painting 2 – Interest	-.218*	.066	72
Painting 2 – Powerfulness	.192	.107	72
Painting 3 - Beauty	-.010	.937	72
Painting 3 – Emotion	.131	.272	72
Painting 3 – Complexity	.023	.849	72
Painting 3 – Interest	.031	-.797	72
Painting 3 - Powerfulness	-.016	.896	72

Painting 4 - Beauty	.084	.482	72
Painting 4 – Emotion	.189	.113	72
Painting 4 – Complexity	-.026	.827	72
Painting 4 – Interest	-.072	.548	72
Painting 4 - Powerfulness	.073	.540	72
Painting 5 - Beauty	-.003	.981	72
Painting 5 – Emotion	.184	.121	72
Painting 5 – Complexity	.072	.548	72
Painting 5 – Interest	-.060	.619	72
Painting 5 - Powerfulness	.011	.927	72

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.3.6. Correlations *with painting: O Der Astronom (Zyklus Arbeit) (De astronoom (werkcyclus)), 1919, Arthur Segal*

	Pearson Correlation	Sig (2-tailed)	N
Gender	.027	.820	75
Age	.128	.275	75
Education	.104	.374	75
Education Mother	.135	.247	75
Education Father	.160	.171	75
Art-Education on high-school	-.102	.384	75
Art-Education after high-school	.135	.266	75
Art visits until 18	-.031	.793	75
Art visits Last Year	-.012	.919	75
Interest in Art	.095	.416	75
Knowledge of Art	.152	.194	75
Painting 1 - Beauty	-.114	.332	75
Painting 1 – Emotion	.041	.727	75
Painting 1 – Complexity	-.145	.215	75
Painting 1 – Interest	-.176	.131	75
Painting 1 - Powerfulness	-.132	.260	75
Painting 2 - Beauty	.002	.987	75
Painting 2 – Emotion	.091	.439	75
Painting 2 – Complexity	-.032	.786	75
Painting 2 – Interest	-.016	.892	75
Painting 2 - Powerfulness	.026	.826	75
Painting 3 - Beauty	.129	.112	75
Painting 3 – Emotion	.112	.339	75

Painting 3 – Complexity	.116	.320	75
Painting 3 – Interest	.165	.156	75
Painting 3 - Powerfulness	.192	.107	75
Painting 4 - Beauty	.046	.696	75
Painting 4 – Emotion	.103	.377	75
Painting 4 – Complexity	.146	.211	75
Painting 4 – Interest	-.026	.825	75
Painting 4 - Powerfulness	.046	.696	75
Painting 5 - Beauty	.003	.979	75
Painting 5 – Emotion	.131	.261	75
Painting 5 – Complexity	.032	.786	75
Painting 5 – Interest	.094	.422	75
Painting 5 - Powerfulness	.057	.626	75

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.4.1. Effects on the proportion of bottom-up looking for painting: *Compositie no. II, 1929, Piet Mondriaan*

Coefficients [a]

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	Sig.
(Constant)	29.713	25.459		.251
Gender	-.114	4.737	-.004	.981
Age	.004	.221	.004	.984
Ethnicity	-.833	1.658	-.085	.618
Place of birth	4.748	11.233	.109	.675
Place or residence	3.721	8.532	.104	.665
Knowledge of Art	1.292	2.019	.162	.526
Interest in Art	-2.193	2.423	-.202	.371
Participant's highest level of education	4.474	7.568	.147	.558
Participant's father highest level of education	-6611	15.457	-.189	.671
Participant's mother highest level of education**	-24.833	10.777	-.619	.027
Hours art- education on high school	.190	5.033	.006	.970
Art education after high school	16.286	17.144	.455	348
Art visits until the age of 18th	-.859	3.652	-.044	.815
Art visits last year	4.220	4.182	.200	.840
Painting 1 - Beauty	.067	.170	.105	.696
Painting 1 – Emotion	.088	.138	.125	.528
Painting 1 – Complexity	.004	.105	.006	.971
Painting 1 – Interest	.011	.138	.021	.939
Painting 1 – Powerfulness	.073	.107	.155	.500

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.4.2. Effects on the proportion of bottom-up looking for painting: *Compositie met kleurvlakjes, 1917, Piet Mondriaan*

Coefficients [a]

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	Sig.
(Constant)	18.483	16.309		.264
Gender	-1.835	2.821	-,106	.519
Age	.070	.133	.13	.600
Ethnicity	.944	.948	.160	.325
Place of birth	3.981	4.400	.202	.371
Place or residence	1.795	5.342	.077	.739
Knowledge of Art	-.131	1.272	-.026	.919
Interest in Art	.116	1.411	.018	.935
Participant's highest level of education	-1.387	3.319	-.076	.678
Participant's father highest level of education	2.405	8.908	.120	.788
Participant's mother highest level of education	-5.497	7.134	-.248	.445
Hours art- education on high school	2.057	3.279	.112	.534
Art education after high school	-14.214	8.874	-.642	.117
Art visits until the age of 18th	3.242	2.425	.274	.189
Art visits last year	-2.763	2.567	-.221	.288
Painting 2 - Beauty	-.058	.090	-653	.517
Painting 2 – Emotion	.037	.100	.081	.716
Painting 2 – Complexity	.013	.080	.036	.872
Painting 2 – Interest	-.033	.109	-.097	.762
Painting 2 – Powerfulness	.054	.092	.166	.560

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.4.3. Effects on the proportion of bottom-up looking for painting: *The Lyrical, 1911, Vasili Vasileevich Kadinsky*

Coefficients [a]

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	Sig.
(Constant)	10.082	13.902		.472
Gender	-1.482	2.524	-.085	.560
Age*	.221	.114	.348	.059
Ethnicity	.109	.888	.017	.903
Place of birth	1.579	4.960	-.118	.575
Place or residence	-2.803	4.960	-.118	.575
Knowledge of Art	.295	1.093	.060	.789
Interest in Art	-.480	1.359	-.072	.725
Participant's highest level of education	.451	2.851	.025	.875
Participant's father highest level of education	1.764	6.474	.087	.786
Participant's mother highest level of education	-5.832	4.982	-.264	.247
Hours art- education on high school	.002	2.620	.000	.999
Art education after high school	6.167	7.835	.273	.435
Art visits until the age of 18th	1.664	2.029	.137	.416
Art visits last year	2.098	2.178	.161	.340
Painting 3 - Beauty	-.103	.076	-.306	.183
Painting 3 – Emotion	-.120	.076	-.369	.123
Painting 3 – Complexity	.002	.053	.007	.969
Painting 3 – Interest	.132	.096	.384	.173
Painting 3 – Powerfulness	.048	.084	.148	.565

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*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.4.4. Effects on the proportion of bottom-up looking for painting: *Ober-Weimar, 1921, Lyonel Feiniger*

Coefficients [a]

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	Sig.
(Constant)	18.460	13.544		.180
Gender	-.747	2.370	-.048	.754
Age[*]	.120	.111	.210	.286
Ethnicity	-.324	1.006	-.050	.749
Place of birth	-1.629	3.632	-.090	.656
Place or residence	2.403	4.850	.108	.495
Knowledge of Art [*]	1.758	.947	.400	.070
Interest in Art[*]	-2.178	1.173	-.369	.070
Participant's highest level of education	1.118	2.586	.068	.667
Participant's father highest level of education	4.530	6.210	.252	.469
Participant's mother highest level of education	.176	4.767	.009	.971
Hours art- education on high school	3.072	2.527	.187	.230
Art education after high school	-5.754	7.430	-.284	.443
Art visits until the age of 18th	3.243	1.890	.300	.093
Art visits last year	-1.448	2.043	-.127	.482
Painting 4 - Beauty	.049	.071	.147	.497
Painting 4 – Emotion	.022	.059	.073	.703
Painting 4 – Complexity	.032	.064	.092	.620
Painting 4 – Interest[*]	-.149	.087	-.457	.092
Painting 4 – Powerfulness	.045	.093	.144	.629

[*]significant at the 0.10 level (1-tailed).

[**]significant at the 0.05 level (1-tailed).

[***] significant at the 0.01 level (1-tailed).

Table A4.4.5. Effects on the proportion of bottom-up looking for painting: *Der Astronom (Zyklus Arbeit) (De astronoom (werkcyclus))*

Coefficients [a]

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	Sig.
(Constant)	6.544	19.495		.739
Gender	-.256	3.607	-.011	.944
Age	.144	.168	.168	.394
Ethnicity	-1.947	1.393	-.227	.168
Place of birth	2.344	5.375	.089	.665
Place or residence	2.803	6.393	.087	.663
Knowledge of Art *	1.859	1.596	.274	.250
Interest in Art	.337	1.765	.039	.849
Participant's highest level of education	1.643	3.837	.068	.670
Participant's father highest level of education	.876	9.636	.071	.846
Participant's mother highest level of education	3.611	6.608	.122	.587
Hours art- education on high school	-.4.218	3.675	-.175	.257
Art education after high school	2.341	11.927	.075	.845
Art visits until the age of 18th	.934	2.862	.057	.746
Art visits last year	-3.779	3.158	-.220	.237
Painting 5 - Beauty	-.073	.095	-.174	.443
Painting 5 – Emotion	.008	.105	.017	.936
Painting 5 – Complexity	-.021	.087	-.043	.814
Painting 5 – Interest*	.124	.119	.292	.301
Painting 5 – Powerfulness	-.022	.114	-.053	.846

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.5.1. Correlations Familiarity with art with Appreciation of the Painting: *Compositie no. II, 1929, Piet Mondriaan*

		Painting 1 - Beauty	Painting 1 – Emotion	Paining 1 – Complexity	Painting 1 – Interest	Painting 1 - Powerfulness
Age	Pearson Correlation	.030	.128	-.336***	-.125	-.022
	Sig. (2-tailed)	.794	.264	.003	.274	.848
	N	78	78	78	78	78
Education	Pearson Correlation	-.061	.145	-.047	.062	-.004
	Sig. (2-tailed)	.595	.206	.685	.592	.969
	N	78	78	78	78	78
Education Mother	Pearson Correlation	-.129	-.089	.233**	.007	-.072
	Sig. (2-tailed)	.260	.440	.040	.951	.530
	N	78	78	78	78	78
Education Father	Pearson Correlation	-.128	-.054	.235**	.084	-.025
	Sig. (2-tailed)	.264	.639	.039	.465	.827
	N	78	78	78	78	78
Art-Education on high-school	Pearson Correlation	.096	.035	.212**	.063	.148
	Sig. (2-tailed)	.550	762	.039	.583	.196
	N	78	.78	78	78	78
Art-Education after high-school	Pearson Correlation	.143	.203*	.212*	.123	.061
	Sig. (2-tailed)	.211	.074	.063	.282	.598
	N	78	78	78	78	78
Art visits until 18	Pearson Correlation	-.071	.066	.237**	.115	.052
	Sig. (2-tailed)	.538	.566	.037	.317	.651
	N	78	78	78	78	78
Art visits Last Year	Pearson Correlation	,244**	.161	.161	.220	.209
	Sig. (2-tailed)	,031	.158	.158	.053	.067
	N	78	78	78	78	78
Interest in Art	Pearson Correlation	.290**	.241**	.135	.079	.159
	Sig. (2-tailed)	.,010	.033	.238	.494	.968
	N	78	78	78	78	78
Knowledge of art	Pearson Correlation	.162	.128	.073	-.079	-.022
	Sig. (2-tailed)	.157	.264	.523	.494	.848
	N	78	78	78	78	78

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.5.2. Correlations Familiarity with art with Appreciation of the Painting: *Compositie met kleurvlakjes, 1917, Piet Mondriaan*

		Painting 2 - Beauty	Painting 2 – Emotion	Paining 2 – Complexity	Painting 2 – Interest	Painting 2 - Powerfulness
Age	Pearson Correlation	.052	.115	-.269**	-.171	-.082
	Sig. (2-tailed)	.627	.314	.017	.133	.476
	N	78	78	78	78	78
Education	Pearson Correlation	-.030	.307***	.033	-010	-.013
	Sig. (2-tailed)	.792	.006	.775	.928	.911
	N	78	78	78	78	78
Education Mother	Pearson Correlation	-.113	-.068	.124	.112	.045
	Sig. (2-tailed)	.324	.555	.281	.330	.695
	N	78	78	78	78	78
Education Father	Pearson Correlation	-.070	.150	.268**	.189*	.141
	Sig. (2-tailed)	.534	.190	.018	.098	.218
	N	78	78	78	78	78
Art-Education on high-school	Pearson Correlation	-.046	.230**	.003	-.021	-.070
	Sig. (2-tailed)	.691	,043	.338	.858	.540
	N	78	78	78	78	78
Art-Education after high-school	Pearson Correlation	.152	.266**	.110	.125	.133
	Sig. (2-tailed)	.185	.019	.338	.275	.246
	N	78	78	78	78	78
Art visits until 18	Pearson Correlation	-.167	.149	.196*	.041	-.017
	Sig. (2-tailed)	.144	.193	.085	.719	.880
	N	78	78	78	78	78
Art visits Last Year	Pearson Correlation	-.022	.129	.116	.125	-.091
	Sig. (2-tailed)	.850	.260	.314	.275	.429
	N	78	78	78	78	78
Interest in Art	Pearson Correlation	.038	.189*	.144	.094	.006
	Sig. (2-tailed)	.742	.097	.207	.411	.959
	N	78	78	78	78	78
Knowledge of art	Pearson Correlation	.055	.299***	.052	.097	.024
	Sig. (2-tailed)	.631	.008	.653	.398	.835
	N	78	78	78	78	78

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.5.3. Correlations Familiarity with art with Appreciation" of the Painting: *The Lyrical, 1911, Vasili Vasileevich Kadinsky*

		Painting 3 - Beauty	Painting 3 – Emotion	Paining 3 – Complexity	Painting 3– Interest	Painting 3 - Powerfulness
Age	Pearson Correlation	-.005	.171	-.226**	-.134	-.026
	Sig. (2-tailed)	.965	.135	.047	.241	.818
	N	78	78	78	78	78
Education	Pearson Correlation	-.005	.249**	.202*	-.017	.733***
	Sig. (2-tailed)	.965	.028	.077	.886	.000
	N	78	78	78	78	78
Education Mother	Pearson Correlation	-.077	.053	.208*	.337***	.473***
	Sig. (2-tailed)	.503	.643	.071	.003	.000
	N	78	78	78	78	78
Education Father	Pearson Correlation	.036	.158	.221*	.204	.209*
	Sig. (2-tailed)	.757	.166	.052	.073	.066
	N	78	78	78	78	78
Art-Education on high-school	Pearson Correlation	.216	.204*	.106	.115	.234
	Sig. (2-tailed)	.057	.073	.358	.317	.039
	N	78	78	78	78	78
Art-Education after high-school	Pearson Correlation	.067	.321***	-.040	.161	.209
	Sig. (2-tailed)	.558	.004	.726	.160	.066
	N	78	78	78	78	78
Art visits until 18	Pearson Correlation	.231**	.121	.165	.196	.234**
	Sig. (2-tailed)	.042	.293	.148	.085	.039
	N	78	78	78	78	78
Art visits Last Year	Pearson Correlation	.310***	.255**	.247**	.238**	.299**
	Sig. (2-tailed)	.006	.024	.029	.036	.008
	N	78	78	78	78	78
Interest in Art	Pearson Correlation	.220*	.238**	.152	.258**	.393***
	Sig. (2-tailed)	.053	.036	.183	023.	.000
	N	78	78	78	78	78
Knowledge of art	Pearson Correlation		.308***	.140	.157	.252**
	Sig. (2-tailed)		.006	.221	.171	.026
	N		78	78	78	78

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.5.4. Correlations Familiarity with art with Appreciation of the Painting: Painting: *Ober-Weimar, 1921, Lyonel Feiniger*

		Painting 4 - Beauty	Painting 4 – Emotion	Paining 4 – Complexity	Painting 4 – Interest	Painting 4 - Powerfulness
Age	Pearson Correlation	-.172	.121	-.340***	-.156	-.072
	Sig. (2-tailed)	.133	.292	.002	.174	.532
	N	78	78	78	78	78
Education	Pearson Correlation	.075	.369***	.149	.092	.116
	Sig. (2-tailed)	.514	.001	.193	.421	.310
	N	78	78	78	78	78
Education Mother	Pearson Correlation	.028	-.130	.123	.112	-.012
	Sig. (2-tailed)	.811	.256	.285	.329	.917
	N	78	78	78	78	78
Education Father	Pearson Correlation	.040	.110	.274**	.133	.078
	Sig. (2-tailed)	.728	.338	.015	.249	.496
	N	78	78	78	78	78
Art-Education on high-school	Pearson Correlation	.178	.152	.187	.024	-.072
	Sig. (2-tailed)	.120	.184	.101	.833	.529
	N	78	78	78	78	78
Art-Education after high-school	Pearson Correlation	.068	.226**	-.109	-.081	.091
	Sig. (2-tailed)	.52	.047	.344	.482	.430
	N	78	78	78	78	78
Art visits until 18	Pearson Correlation	-063	.096	.149	.172	.133
	Sig. (2-tailed)	.586	.402	.193	.131	.245
	N	78	78	78	78	78
Art visits Last Year	Pearson Correlation	-.079	.061	.099	.019	015.
	Sig. (2-tailed)	.490	.595	.387	.866	.896
	N	78	78	78	78	78
Interest in Art	Pearson Correlation	.156	.170	.205	.070	.092
	Sig. (2-tailed)	.173	.137	.072	.540	.425
	N	78	78	78	78	78
Knowledge of art	Pearson Correlation	.075	.267**	0.74	.039	.112
	Sig. (2-tailed)	.514	.018	.522	.732	.330
	N	78	78	78	78	78

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).

Table A4.5.4. Correlations Familiarity with art with Appreciation of the Painting: Painting: *Der Astronom (Zyklus Arbeit) (De astronoom (werkcyclus))*

		Painting 5 - Beauty	Painting 5 – Emotion	Paining 5 – Complexity	Painting 5 – Interest	Painting 5 - Powerfulness
Age	Pearson Correlation	-.357***	.042	-.269**	-.342***	-.347***
	Sig. (2-tailed)	.001	.717	.017	.002	.002
	N	78	78	78	78	78
Education	Pearson Correlation	-.092	.052	.186	.091	.124
	Sig. (2-tailed)	.424	.654	.104	.430	.280
	N	78	78	78	78	78
Education Mother	Pearson Correlation	.177	.202	.233**	.396***	.293***
	Sig. (2-tailed)	.121	.075	.040	.000	.009
	N	78	78	78	78	78
Education Father	Pearson Correlation	.082	.202	.241**	.361***	.306***
	Sig. (2-tailed)	.474	.075	.034	.001	.007
	N	78	78	78	78	78
Art-Education on high-school	Pearson Correlation	.105	.140	.138	.100	.015
	Sig. (2-tailed)	.358	.223	.229	.384	.898
	N	78	78	78	78	78
Art-Education after high-school	Pearson Correlation	.156	.246*	-.164	.112	.037
	Sig. (2-tailed)	.172	.030	.150	.329	.750
	N	78	78	78	78	78
Art visits until 18	Pearson Correlation	.156	.101	.194	.373***	.266**
	Sig. (2-tailed)	.172	.379	.089	.001	.019
	N	78	78	78	78	78
Art visits Last Year	Pearson Correlation	.056	-.016	.017	.073	.048
	Sig. (2-tailed)	.628	.892	.880	.523	.678
	N	78	78	78	78	78
Interest in Art	Pearson Correlation	.102	.097	.127	.087	.036
	Sig. (2-tailed)	.375	.389	.268	.451	.753
	N	78	78	78	78	78
Knowledge of art	Pearson Correlation	.253**	.306***	.020	.122	.058
	Sig. (2-tailed)	.025	.006	.861	.286	.614
	N	78	78	78	78	78

*significant at the 0.10 level (1-tailed).

**significant at the 0.05 level (1-tailed).

*** significant at the 0.01 level (1-tailed).