UNIVERSITY OF SOUTHAMPTON

FACULTY OF ENVIRONMENTAL AND LIFE SCIENCES

Psychology Department

Spectatorship of Paintings by Naïve Viewers

by

Tobiasz R. Trawiński

Thesis for the degree of Doctor of Philosophy

October 2019

UNIVERSITY OF SOUTHAMPTON

FACULTY OF ENVIRONMENTAL AND LIFE SCIENCES

Psychology Department

Thesis for the degree of Doctor of Philosophy

SPECTATORSHIP OF PAINTINGS BY NAÏVE VIEWERS

by

Tobiasz R. Trawiński

ABSTRACT

The present thesis proposes a framework for understanding spectatorship of paintings. Specifically, the thesis explores eye movements of naïve viewers on representational paintings over four separate studies. Chapter 1 outlines the framework of spectatorship as described in previous literature. Chapter 2 described the first study of this thesis, exploring how participants looked at portraits when making liking judgments. The results showed that the presence of salient features in the context were positively associated with liking, and greater focus was made to the portrayed faces when the salient features were presented in the context rather than when they were absent. Chapter 3 demonstrates across two experiments that memory representations of painting's mostly rely on inspecting the paintings theme rather than the context. Only when there is uncertainty the focus on the context increased. The study reported in Chapter 4 explored cultural influence on spectatorship. It did so by comparing British and Chinese participants viewing Western and East Asian representational paintings. Chinese participants were observed to be more

influenced by culture (than the British participants), the Chinese spectators presented a relatively greater likelihood of inspection of the context other the theme, but only during discrimination target paintings from foils. Chapter 5 investigates if emphasizing motif category might influence the spectatorship of paintings, by again testing British and Chinese participants. The results showed spectatorship was influenced by efforts to make the motif explicit. For British participants, making the motif of painting explicit increased focus on the painting. In contrast, for Chinese participants, knowledge of the motif decreased focus on the painting. Finally, Chapter 6 summarizes and generalizes the findings from empirical work in the preceding chapters, and identifies a number of implications for further work.

Contents

List of Tables

List of Figures

Declaration of Authorship

I, Tobiasz R. Trawiński, declare that the thesis entitled *Spectatorship of Paintings by Naïve Viewers* and the work presented in the thesis are my own, and have been generated by me as the result of my own original research. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University;
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
- Where I have consulted the published work of others, this is always clearly attributed;
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
- I have acknowledged all main sources of help;
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
- Either none of this work has been published before submission, or parts of this work have been published as:
    - Chapter 2: Trawiński, T., Mestry, N., Harland, B., Liversedge, S. P., Godwin, H. J., & Donnelly, N. (2019). The spectatorship of portraits by naïve beholders. *Psychology of Aesthetics, Creativity, and the Arts.* Advance online publication. http://dx.doi.org/10.1037/aca0000248

Signed: ……..

Date: …….

Acknowledgements

The work presented in this thesis would not have been possible without help and support of many people. Firstly, I would like to thank my family – bez Waszego wsparcia nic z tego nie byłoby możliwe, dziękuję.

I would like to express my sincere gratitude to my supervisor Nick Donnelly, for his continuous support through this project, thousands of meetings, patience for my mistakes, and many insightful discussions. I could not have imagined having a better mentor for my PhD.

I am also very grateful to my supervisor team Natalie Mestry for her 'sharp eye' for details, Hayward Godwin for his programming expertise, and Simon Liversedge for his constructive critique. I would like to give a special mention to those who offered their expertise with particular projects: Chunali Zang for help in conducting cross-cultural studies and Beth Harland for her significant comments and enthusiasm for interdisciplinary research. Special thanks go also to Federica Degno for her advice in eye movement research.

Finally, I would like to thank all my office mates. Particularly, Mengsi Wang and Manman Zhang for wise words and friendship. Kate Mooney, Johnny Parr, and Ann-Kathrin Johnen for showing that the 'dark North' can be full of sun.

Abbreviations

c	-	criterion (bias)
d	-	*d*-prime (sensitivity)
EEG	-	Electroencephalogram
ERP	-	Event-related Potential
fMRI	-	Functional Magnetic Resonance Imaging
GLMM	-	Generalised Linear Mixed Model
LMM	-	Linear Mixed Model

Chapter 1

Introduction

Paintings form a particular class of visual stimuli that are sought out, explored, examined, and experienced for their own sake. In this thesis I explore the spectatorship of paintings. By spectatorship I mean the act of looking that leads to an aesthetic experience and a representation stored in memory. In Chapter 1, I begin by developing an account of the spectatorship of paintings as currently described in literature. The first step in discussing spectatorship of paintings must be a consideration of paintings as physical objects. To gain better understanding of act of spectatorship, we need to consider paintings as coloured marks. Then, we will need to look at these coloured marks as objects connotating a specific meaning. It is only when we see the act of spectatorship as the dynamic transition between bottom-up features and top-down knowledge that we can grasp its implication for the visuo-cognitive framework proposed in Chapter 1. I use this framework to formulate specific predictions about spectatorship made by naïve viewers. Then, I proposed to operationalize act of spectatorship as series of fixations made to the paintings. Finally, Chapter 1 is concluded by considering the implication of studying paintings as cognitive objects and unique types of human-made visual artefacts.

1.1 Paintings as coloured, spectated objects

As physical objects, paintings are coloured marks on a two-dimensional surface. The visual system is sensitive to three distinctive perceptual components of colour: hue, saturation (intensity), and lightness (luminance: HSL; Kuehni, 2003). Hue refers to the specific wavelength of that light, saturation refers to the purity of the hue, and lightness

refers to colour intensity. HSL is now a standard colour space used by artists (Zhang, Constable, Chan, Yu, & Junyan, 2018).

In the context of art history, Eugène Delacroix was the first artist to conscientiously separate saturation from lightness to achieve 'harmony' in painting (Zhang et al., 2018). Prior to Delacroix, the presence of highly saturated colours was thought to reduce the importance of lightness, and low saturation was thought to increase it (Figure 1.1).

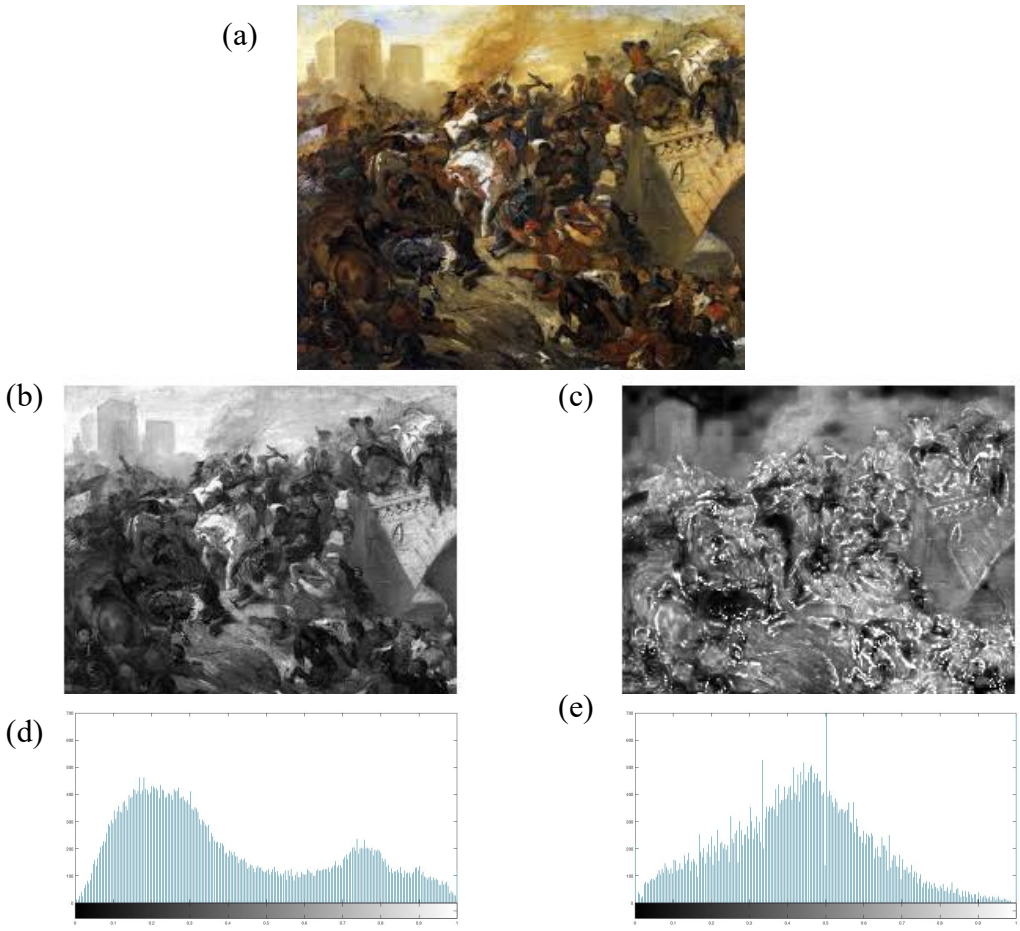


Figure 1.1. Top panel: (a) Delacroix, *Battle of Taillebourg* (c. 1837); Middle panel: (b) lightness and (c) saturation maps of Delacroix's *Battle of Taillebourg*; Bottom panel: (d) lightness and (e) saturation distributions of Delacroix's *Battle of Taillebourg.* The x-axis is representing color intensity from black to white, the y-axis is referring to the number of

pixels. *Note* the dramatic difference in the distribution of lightness and saturation. (© Tobiasz Trawinski)

Delacroix's distinction between saturation and lightness has had a significant impact on art, especially on abstract art. In fact, Mallon, Redies, and Hayn-Leichsenring, (2014) have recently reported evidence consistent with Delacroix's observation. They showed saturation and lightness to independently predict ratings of the beauty of abstract paintings made by participants.

(a) (b)

Figure 1.2. (a) Friedrich, *The Morning* (c.1820), as an example of depth-aware contrast; (b) compositional panels created by cropping of colour contrasts in a Friedrich's painting. *Note* the difference between depth planes. (© Tobiasz Trawinski)

More than fifty years after Delacroix's death, Henri Matisse, explicitly expressed why it is crucial to keep balance of coloured marks across a painting. He said "*It is necessary that the various marks I use be balanced so that they do not destroy each other. To do this I must organize my ideas; the relationship between the tones must be such that it will sustain and not destroy them. A new combination of colours will succeed the first and render the totality of my representation. I am forced to transpose until finally my picture may seem completely changed when, after successive modifications, the red has succeeded*

the green as the dominant colour. I cannot copy nature in a servile way; I am forced to interpret nature and submit it to the spirit of the picture. From the relationship I have found in all the tones there must result a living harmony of colours, a harmony analogous to that of a musical composition." (Matisse, 1908/1987, p. 37).

Coloured marks in paintings form regions of colour to establish the general properties of the overall composition that matter to spectatorship. Artists use contrasting colours to highlight specific objects and regions and to create the illusion of depth. It is colours and these contrasts that underpin all spectatorship of paintings by attracting and guiding spectator's attention to a specific location within paintings (Figure 1.2). For example, the importance of colour to the spectatorship of paintings was explored by Francuz (2013) in respect to spectatorship of Claude Monet's *Impression, Sunrise* (1872) painting. Using eye movements as an index of spectatorship, he demonstrated that the sun attracted fixations when it was seen as red, but not when in a monochrome version of the same painting.

With respect to colour contrasts, Zhang et al., (2018) distinguished six types of contrasts. Global contrast is a feature of the entire painting and typically differentiates painting from photograph. The local contrasts indicate the overall spatial scale over which difference between regions is computed. Neighbouring regional contrast allows for the selection of regions for comparison. Centre-corner contrast is a difference between peripheral part of the painting and its centre. Regional contrasts highlight differences between objects or regions. The depth-aware contrast is related to the organization of depth planes within paintings. The relations between areas of colour are, therefore, fundamental to the spectatorship of paintings.

As an example of the impact of the centre-corner contrast on spectatorship, Quiroga and Pedreira (2011) measured eye movements as participants viewed an original and a

modified version of the *An Old Man in an Interior with Winding Staircase* (Rembrandt, c. 1632; Figure 1.3). The modified version of the painting was identical to the original but with the region of darkness from the left side of the painting removed. The cropping of the dark region reduced the contrast and changed the spectator's gaze behaviour by increasing fixations to the figure on the bottom right of the painting relative to the original painting. This illustrates that colour contrast impacts what type of visual information is sampled during the act of spectatorship.

Figure 1.3. Rembrandt van Rijn, *An Old Man in an Interior with Winding Staircase* (c. 1632). The yellow rectangles indicate the cropped area in the alerted version. *Note* the strong exposition of central part of the painting as an example of chiaroscuro effect.

The coloured marks of paintings are also subject to the processes of perceptual organisation as defined by Gestalt grouping principles (Wade, 2012). Arnheim (1971) noted that artists use the fundamental Gestalt principles to structure objects in visual artworks such that perceptual organisation influences spectatorship. Through the

mechanisms of perceptual organisation, paintings are segmented into regions of figure and ground. There are five major laws, although research continues to propose new rules (see Brooks, 2015, for related papers). Proximity describes the tendency for grouping together things that are close. Similarity describes the tendency for grouping on the basis of shared colour, orientation, or shape. Good continuation shows that edges are grouped together to avoid changes. Closure describes the tendency to complete incomplete boundaries that define surfaces. Common fate principle states that objects moving into the same direction are grouped together as a part of single stimuli (Coren & Girgus, 1980).

So far, I have treated all coloured marks as equivalent. To do so, however, risks missing an important point with respect to spectatorship. The role of colour in painting has changed over time over the course of the history of art. From the renaissance through to the mid 19th century, colour was used to reflect those found in natural scenes (da Vinci, trans. 2010; Crary, 1992, pp. 1 - 24). However, at other times colour had either symbolic meaning or was used in a more evocative manner. For example, in medieval art gold was connected with power, green with life or resurrection. With the emergence of modernism in the mid 19th century, the role of colour was used to evoke emotions, mood, and vitality (Gombrich, 1995).

In the case of representational paintings, the painting of coloured marks is also influenced by the manner in which a painting is painted. Some artists choose to paint objects where their identity is linked to the use of a prototypical colour, whereas other artists play little regard to prototypical colour in order to focus on colour of the light (see Berns, 2016 for discussion about colour constany in paintings). For example, Gherardo di Jacopo Starnina in *The Beheading of Saint Margaret* painting (1409; Figure 1.4a) explores the object colour disregard from colour of the light. Instead Claude Monet's *Rouen Cathedral* (series, 1890s; Figure 1.4b) painting is a great illustration of the exaggerated

colour of light over the object colour. In understanding both kinds of paintings, spectators show that they can spectate paintings in a flexible manner.

(a)

(b)

Figure 1.4. (a) di Jacopo Starnina, *The Beheading of Saint Margaret Yellow* (1409); (b) Monet, *Rouen Cathedral* (1894). *Note* in Monet's painting how colour constancy was switched off and the colour of the light was exposed.

While I have outlined why the spectatorship of paintings requires more than consideration of coloured marks on a canvas, it is helpful to make one further observation. Considering paintings only as sets of coloured marks implies that anything capable of producing coloured marks is capable of being considered as forming paintings. In the late 1950s a British television programme showed 'Congo'. Congo was a chimpanzee at London Zoo who was trained by Desmond Morris to paint abstract images (Figure 1.5a). Congo's images contain well-balanced colour composition. He applied different contrasts between the colours. Some considered the style of his pictures as representative of abstract impressionism (Reynolds, 2005) and saw equivalence with the work of Jackson Pollock (Figure 1.5b).

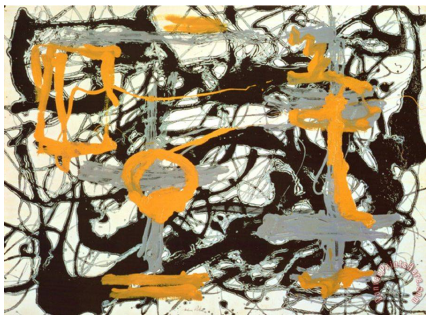
(a)  (b) 

Figure 1.5. (a) *Abstraction* (c. 1958) painted by chimpanzee Congo; (b) Pollock, *Yellow, Gray, Black* (1948).

There is a difference between the works of Congo and Pollock. Paintings are artefacts created by the human mind. We are not able to say whether or not the Congo's paint marks in the picture were motivated by his want of expressing some kind of concept. However, we know that Pollock's works are representations of his theory of art. Much the same point can be made in reference to the work of Mark Rothko. Rothko painted canvases of similar colours distributed across the painting. While Rothko's works can be interpreted in terms of colour alone his motivation was to understand the relationship between a

painting's meaning and the spectator's emotional reaction. Rothko noted: "*If you are only moved by colour relationships, you are missing the point*" ("Mark Rothko *No. 5/No. 22* 1950", n.d.). Following Rothko's thought, it is not sufficient to describe paintings in terms of the distribution of colours.

In the sum, when considering spectatorship of paintings, we need to take account of the fact that, as physical objects, paintings are coloured marks, but as spectated objects they have a meaning, a context, and a style. In the present thesis, I explore the spectatorship of representational paintings rather than abstract paintings. In representational paintings, coloured marks are organised into meaningful objects that capture some aspects of reality.

1.2 A framework for understanding the spectatorship of representational paintings

The spectatorship of representational paintings has two partially independent components that need to be considered. The first is the visual representation of the painting that we form. The second is the manner in which we explore that visual representation.

The result of visual representation and exploration is cognitive enrichment and an aesthetic experience (Leder, Belke, Oeberst, & Augustin, 2004; Leder & Nadal, 2014; Pelowski, Markey, Forster, Gerger, & Leder, 2017; Tinio, 2013). There are several psychological models of cognitive enrichment and aesthetic experience (e.g. Chatterjee & Vartanian, 2014; Koelsch & Siebel, 2005, Pelowski et al., 2017), but three models of art perception are the most influential. The first model, presented by Leder and his colleagues (Leder et al., 2004; Leder & Nadal, 2014) suggests that cognitive enrichment and aesthetic experience is the function of the context (e.g. museum), familiarity (experts versus non-experts), and features of paintings [e.g. complexity (Hogan, 1975), symmetry (Jacobsen & Höfel, 2003), or contrast (Mallon et al., 2014)].

The second model is that of Tinio (2013). He describes the aesthetic experience as a mirror act of the art-making process. The spectator begins with the surface features and reaches an emotional peak when a meaning within the artwork is reached. These perceptual stages correspond to the specific process of its creation. The phenomenological value of this process is expressed by increasing emotional arousal during the process of perception, through such channels as pleasure, challenge, or self-reference.

More recently, the Vienna Integrated Model of Art Perception was proposed by Pelowski et al., (2017). The model integrates bottom-up objects features and top-down mechanisms, which can predict how spectated form of art may influence a spectator. Pelowski et al. particularly emphasized the role of emotional processes in the spectatorship of art, such that artworks may be considered as moving, disturbing, pleasurable, and thrilling. The model also presents how cognitive mechanisms and specific brain regions are engaged in process of spectatorship. The additional advantage of Pelowski's model is that it takes into the account role of spectator's personality and knowledge, as well as the context, which may impact spectator's experience.

All these models postulate hierarchical flow of information from basic image properties acquired at low level of visual processing to more complex knowledge based visuo-cognitive processes. The models have merit in their efforts to understand aesthetic processing. However, their holistic nature makes it difficult to formulate specific predictions about what is spectated to form visual representations and lead to an aesthetic experience. It is this question that is central to the present thesis.

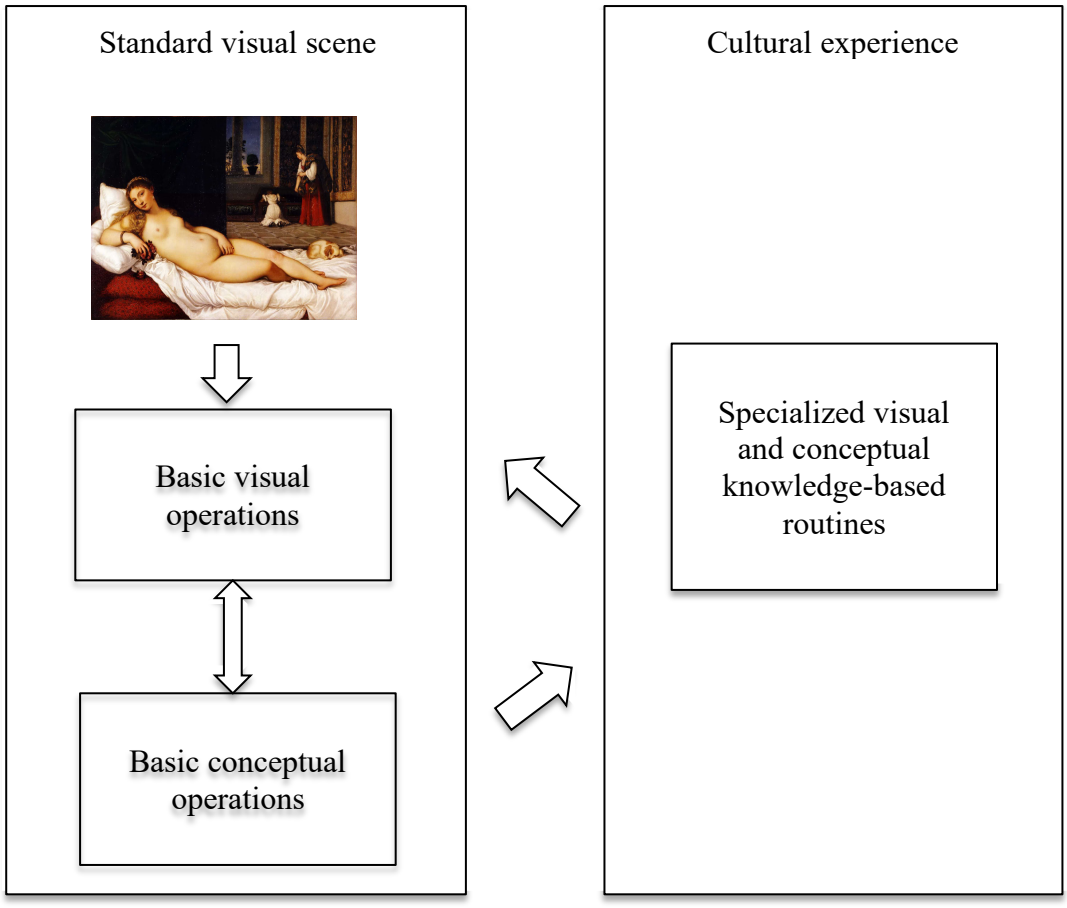


Figure 1.6. Visuo-cognitive framework of spectatorship process. The painting used in this framework is representing Titian, *Venus of Urbino* (1538).

Here I propose visuo-cognitive framework to help make specific predictions about spectatorship. The framework considers spectatorship process in terms of basic visuo-cognitive mechanisms (Figure 1.6). The present framework in-depth looks at the basic psychological mechanics of spectatorship, it does not purport to discuss the complexity of emotional or behavioral spectatorship as some models discussed above do. The present framework also restricts its focus to representational paintings, not other artistic domains such as music, theatre, or literature. The main aim of the current framework is to help in formulating predictions about where people choose to look at the representational painting during act of spectatorship.

To help us understand important differences in kinds of spectatorship, we must now take a moment know to focus on the original meaning of word *theoria*. In ancient Greece, the word 'theoria' was connected with a person who journeys abroad as an official witness of a spectacle, and then returns with a report of the spectated event (Nightingale, 2004, pp. 4 - 5). Theoria had to see the spectacle, make a decision what should be reported, and explain its meaning. Plato interpreted theoria's visual wisdom as an effect of an active process: the act of seeing connected with contemplation and reflection (Plato, trans. 1969). Additionally, Aristotle argued that theoria does not indicate *praxis* connected with the learning process and its outcome (Aristotle, trans. 1944).

Praxis is a type of action, which could occur even with a lack of theoretical visual wisdom or understanding. This distinction between praxis and theoria represents a useful paradigm that can be applied to spectatorship of representational artworks. The case of praxis refers to the perception of representational painting by naïve spectators. In this particular situation, the process of *looking at* painting is driven by bottom-up visual information and top-down non-art related knowledge. By using the word *looking at*, I assume an axiomatic equality between bottom-up and top-down processes. Second, spectatorship of representational paintings can extend from seconds to minutes and even hours and can be repeated over multiple occasions (see Clark, 2008). For naïve spectators the act of spectatorship is largely the same as during the perception of scenes. However, for expert spectators, spectatorship is contributed to by some additional top-down knowledge that is specific to paintings and knowledge of painters.

For both naïve and expert spectators, the spectatorship of paintings uses a network of perception (including multimodal perception), attention, memory, and thought processes (Cupchik, Vartanian, Crawley, & Mikulis, 2009; Leder & Nadal, 2014). Therefore, to understand spectatorship of representational painting we must understand how the network

of perception, attention, memory, and thought processes work together to influence what is inspected (Kass, Harland, & Donnelly, 2015; Sherman, Grabowecky, & Suzuki, 2015).

This framework for understanding spectatorship builds on models of object representation (specifically Ullman, 1984), scene perception (Torralba, Oliva, Castelhano, & Henderson, 2006), and visual search (Wolfe, Võ, Evans, & Greene, 2011). For example, the theoretical model of Torralba et al. (2006) comprises local low-level visual features of scenes with the contextual knowledge about an entire scene. The combinations of these two components in the early stage of visual processing predict the most attended region by an observer. Wolfe et al.'s (2011) model seeks to integrate visual search and scene perception in selective and non-selective pathways. The selective pathway refers to basic object features like colour, orientation, size, depth, and motion. The non-selective pathway is driven attention to capture specific object features, which are semantically coherent with an entire scene. Both models contextualise the spectatorship in terms of bottom-up and top-down processes.

To help illustrate this framework of the act of spectatorship I will use as an example: *Venus of Urbino* painted by Titian (1538). The standard visual scene processing contains three elements: painting, basic visual operations, and basic conceptual operations. The painting as an independent artefact in a situation of spectatorship brings the set of lines and colors into figure and ground, objects and context (Biederman, 1987). The painting surface is two-dimensional and requires decomposition to encode the three-dimensional scene. Titian used the lines as a contour to make elements on the painting identifiable, different intensities of colour to allow the beholder to understand the source of the light, and linear composition to show the depth of the space. In the first step, spectatorship requires basic visual operations: figure-ground segmentation, perceptual organization, gist processing, colour processing, and luminance processing.

The second step refers to basic conceptual operations such as scene recognition and object identification. This stage interacts with basic visual operations. During the spectatorship of Venus of Urbino, the spectator is able to segment the whole painting into the foreground and background, and then describe two aspects of the painting. In the foreground lies a nude woman, surrounded by pillows and a dog. There are two another woman in the background, next to the window and the coffer. In Titian's painting, experts will recognise theme of the painting as related to Venus the goodness of beauty. Representations of Venus have traditionally depicted nude woman in erotic pose. Art experts will know the female as a prostitute Zaffetta or the wife of the painting's first owner (Goffen, 1999). In terms of the second interpretation, they will recognise in the dog the symbol of loyalty, and in the two women in the background the allegory of maternity. They will also know that the painting was an inspiration to the later paintings, like Édouard Manet's *Olympia* (1863) or Pablo Picasso *Nude Woman with Necklace* (1963), providing further reference points that might inform their spectatorship (Figure 1.7) such that elements that contrast with other paintings that hold in memory will be of interest.

(a) (b)

Figure 1.7. (a) on the left Manet, *Olympia* (1863); (b) Picasso, *Nude Woman with Necklace* (1963).

It is important to note that both art experts and naïve viewers use knowledge during process of spectatorship of paintings. Minissale (2013, pp. 139-144) conceptualised the role of knowledge during spectatorship of contemporary art. He argued that spectatorship of contemporary paintings required moving from feature-based representation into representations based on relational knowledge. The process of grouping perceiving objects into semantic meaning is a qualitatively different between art experts and novices.

If Minissalle is correct then the influence of art familiarity on spectatorship must have a dimensional quality to it rather than being thought of in terms of familiarity or the lack of familiarity. Panofsky (1987, p. 40), similar to Minissale (2013, pp. 306-347), referred to the dimensional distribution of knowledge from the primary level (object familiarity), to the expertise level (specific knowledge). The primary level is associated with basic semantic representation about world and culture. Most of the time spectators are able to recognise various types of objects within paintings only in terms of object categories rather than in terms of specific identities. Beyond the primary stage will emerge knowledge about the content of paintings, and how content relates across paintings (Goldstone, Feng, & Rogosky, 2005, pp. 282 - 314). Panofsky argued that art experts alone are able to make an active comparison of the painting content with others. The comparisons that experts can make will be structural (formal principles like colour, line or composition) and semantic (subject as a specific motif or theme) features of the perceiving painting (Belke, Leder, Harsanyi, & Carbon, 2010; Panofsky, 1987, pp. 41-58). The highest level of art knowledge requires familiarity with specific jargon and art historical terms, as well as abilities to discriminate different genres.

Expertise may also be construed more broadly beyond scholarly artistic knowledge; for example, cultural expertise may result simply from geography of residence (e.g., living in the UK indicates being a part of Western culture whereas living in China is associated

with being a part of East Asian culture). Cultural frameworks develop a familiarity with cultural artefacts and help to formulate prototypical categories of seeing objects. The cultural experience we have may shape how art is perceived and interpreted (Bao & Pöppel, 2012; Pöppel, 2018). At the same time, a lack of cultural familiarity may make viewers naive to the subject of the foreign culture. There is some evidence of the effect of object familiarity on paintings preference. In Bao et al. (2016), cross-cultural study participants from China preferred East Asian paintings more than Western paintings; participants from Western countries preferred Western paintings over East Asian paintings. Bao et al. concluded that the lack of familiarity with artistic style from foreign culture decreased liking of those paintings. Our current knowledge about the role of culture in spectatorship process is limited and one of the aims of the present thesis is to extend our understanding of the effect of culture on spectatorship.

To quantify where spectators look when spectating paintings, the projects in this thesis measure eye movements. Recording eye movements and fixations provides an on-line measure of where viewers choose to fixate in paintings. A fixation on specific areas of the painting is defined by its position, duration, and the moment in time when a fixation is made. The act of spectatorship is implemented through a sequence of fixations. In the present thesis, spectatorship is characterized as series of fixations made to the painting.

Eye movements are required to bring different objects into high-resolution vision because of eye architecture. Only two degrees of the visual field has the highest visual acuity (foveal vision; Võ & Henderson, 2010). This small region of a retina is called fovea. Outside the fovea, acuity declines rapidly (Rayner, 1998, 2009). Of course, characterising spectatorship in terms of fixations does not imply that only those areas fixated are perceived. There is a discussion in the literature about how information included in the foveal and extrafoveal vision (peripheral vision; Henderson, Weeks, & Hollingworth,

1999; Loftus & Mackworth, 1978; Underwood, Templeman, Lamming, & Foulsham, 2008) contributes to the object scene integration and object-prioritization process. The results are mixed, however, the visual information placed outside the fovea seems to contribute to the process of looking at the scene and being process rather as a gist. Gist is typically thought of as being computed early in scene inspection from rapidly computed low spatial frequency information such that eye movements are made to informative locations within the scene (Castelhano & Henderson, 2008; Oliva & Torralba, 2006; Rayner, 2009). Therefore, the fixations that characterise spectatorship do so by showing which locations within a painting benefit from detailed inspection and which do not.

It is important to note that the pattern of eye movements made in response to a painting is not deterministic. It is impacted by stimulus features (e.g., Quiroga & Pedreira, 2011), type of task (Borji & Itti, 2014; Fuchs, Ansorge, Redies, & Leder, 2011; Henderson, Shinkareva, Wang, Luke, & Olejarczyk, 2013; Hristova, Georgieva, & Grinberg, 2011; Yarbus, 1967), and viewer's knowledge (e.g., Bubić, Sušac, & Palmović, 2017; Kristjanson, Antes, & Kristjanson, 1989). The interaction between bottom-up and top-down sources of eye movement guidelines in relation to proposed framework of spectatorship is considered presently.

In fact spectatorship of paintings is known to be typically quite limited, both spatially and temporally (Locher, Krupinski, Mello-Thoms, & Nodine, 2007). Locher et al. (2007) demonstrated that naive participants on average fixated only 46% of the spatial extent of paintings, self-terminating their spectatorship after 32.5 seconds when describing paintings and rating them for 'pleasingness'. Moreover, the areas fixated changed little after inspection for 7 seconds.

The visual psychological literature has many studies of features that tend to attract attention (Treisman, 1977; Treisman & Gelade, 1980). One suggestion is that attention is

attracted to regions of high salience with respect to low-level visual features (Itti, Koch, & Niebur, 1998; Koch & Ullman, 1987; Parkhurst, Law, & Niebur, 2002; Rosenholtz, 1999). In these salience models, feature maps of luminance, colour, and orientation are combined to detect regions of change. Unsurprisingly, the principles of detection of salience regions has gained popularity (Carneiro, Da Silva, Del Bue, & Costeira, 2012; Kennel, Puech, & Comby, 2017; Khan, Beigpour, Van De Weijer, & Felsberg, 2014; Sablatnig, Kammerer, & Zolda, 1998; Shamir, Macura, Orlov, Eckley, & Goldberg, 2010; Shamir & Tarakhovsky, 2012; Shen & Yi-Luen Do, 2009; Zujovic, Gandy, Friedman, Pardo, & Pappas, 2009) in terms of investigating paintings properties. For example Zujovic et al. (2009) used the saliency mapping to classify paintings into genres (see also Khan et al., 2014). Shamir et al.'s (2010) study proposed an automated process of classifying artists into three schools of art: impressionism, expressionism, and surrealism, bases on the salient regions.

Bylinskii et al., (2016) raised the question whether salient regions may efficiently predict which areas of the image are fixated when human figures are presented. For example, Kapoula, Daunys, Herbez, and Yang (2009) explored eye movements to the *The Alarm Clock* (Fernard Leger, 1914; Figure 1.8a) when title information was presented. They found a high concentration of fixations to the abstract version of the human face and clock in the right bottom corner of the painting. Kapoula et a., (2009) argue that semantic information included in painting's title influenced the act of spectatorship. However, there is an alternative explanation of this finding.

I have passed the *The Alarm Clock* through the Itti and Koch (2001) salience algorithm. The Leger's painting contains twenty-two highly salient regions (Figure 1.8b). There is a high correspondence between salient regions and fixations made to the painting.

This may suggest that the eye movements made to *The Alarm Clock* are influenced by presence and distribution of salient regions in the painting rather than the face.

Figure 1.8. The painting studied (from the left): (a) Leger, *The Alarm Clock* (1914); (b) the Leger's painting with 22 salience regions indicated by Itti and Koch (2001) algorithm (© Tobiasz Trawinski); (c) the pattern of eye movement exploration during free viewing task (source: Kapoula et al., 2009).

Despite the importance of the salient regions and objects meaning, there is also a suggestion that object placement may influence fixations. Objects placed in the central part of the scene are attended more often than the remained area of the scene (Nuthmann & Henderson, 2010). Nodine, Locher, and Krupinski (1993) found similar evidence when art-trained and non-trained participants were asked to judge the harmony and beauty of six pairs of paintings. Naïve spectators focused their eye movements more on the central part of the image, whereas art-trained participants had more dispersed eye movements.

The overarching framework for spectatorship that I have described suggests that specialized art knowledge modulates fixations to regions, objects, and features. Various studies have reported that expertise is associated with shorter but more numerous fixations when judging liking (Francuz, Zaniewski, Augustynowicz, Kopiś, & Jankowski, 2018;

Locher & Nodine, 1989; Nodine et al., 1993); expertise is also associated with greater saccadic length (Kapoula & Lestocart, 2006; Pihko et al., 2011; Vogt & Magnussen, 2007; Zangemeister, Sherman, & Stark, 1995), and with eye movements to structural elements of paintings beyond human figures (Harland et al., 2014; Locher, Gray, & Nodine, 1996; Locher et al., 2007; Locher, Krupinski, & Schaefer, 2015; Vogt & Magnussen, 2007; Zangemeister et al., 1995), and regions of high salience (Koide, Kubo, Nishida, Shibata, & Ikeda, 2015). These results have led some to argue that expertise is associated with ah holistic viewing strategy (see also Kundel, Nodine, Conant, & Weinstein, 2007).

It is important to note that the holistic viewing strategy, reported in studies which involved art expertise, might be domain specific. The perceptual expertise literature is rich with examples of experts that processing faces, chess boards, or X-ray pictures in more holistic manner; it is suggested that this effect is manifested by different types of behaviours (e.g., Bilalic, Langer, Ulrich, & Grodd, 2011; Bukach, Phillips, & Gauthier, 2010; Richler, Tanaka, Brown, & Gauthier, 2008; Leong et al., 2007). One common understanding is that holistic processing has a function goal, which is the optimal way to fulfil the task demand. For example, chess masters use their visuo-attentional system to examine the spatial relationships between elements on the chessboards to make the best decision about next movement. In contrast, art experts during acquisition of expertise develop the ability to discriminate highly similar objects on a subordinate level, for example by classifying paintings in terms of style, originality, or aesthetical value. Indeed, chess masters make fewer fixations than less skilled players in the check-detection task (Reingold, Charness, Pomplun, & Stampe, 2001), when art experts make more numerous fixations than naïve spectators during aesthetic judgement (e.g., Francuz et al., 2018). In both examples, observed eye movements could be classified as evidence of holistic viewing but be actually represented by different eye movement strategy which meets the functional goal of the task.

In sum, many studies have shown that experts use a different viewing strategy during spectatorship process (Francuz et al., 2018; Kapoula & Lestocart, 2006; Kundel et al., 2007; Pihko et al., 2011; Vogt & Magnussen, 2007; Zangemeister et al., 1995). While expert spectators differ from novices in terms of their art knowledge, they are also likely to have seen specific paintings more often. Clark (2008) presents an interesting insight into the effect of repeated viewing of Nicolas Poussin's *Landscape with a man killed by a snake* (1648). He noted that his emotional response and cognitive understanding to the painting changed across repetitions. His developing familiarity with the painting allowed a focussing on, and interpretation of, different visual stimuli. Clark argued that with repeated spectatorship comes a focussing on the relationship between objects and meaning.

The framework for understanding spectatorship considers act of looking at the paintings in terms of basic visuo-cognitive mechanisms. Surprisingly, the current state of knowledge about the role of the basic cognitive functions in the process of looking at the paintings is strongly limited. There is some evidence which suggests that artists in comparison to naïve viewers have some advantages in terms of basic perceptual processing. These include the ability to overcome shape constancy (Cohen & Jones, 2008), size constancy (Ostrofsky, Kozbelt, & Seidel, 2012), field independence (Gaines, 1975) and reduced attentional costs in switching between global and local aspects of visual displays (Chamberlain & Wagemans, 2015) as well as higher visual memory (Winner & Casey, 1992). Together these findings suggest that more expert viewers might be characterized by better visual memory and high executive control of attention. The follow-on question is whether these two aspects of cognitive abilities matter during the spectatorship of paintings by naïve viewers.

The present thesis aims to extend our understanding and explore the role of visuo-cognitive functions on the eye movements and behavioral performance of naïve spectators

made during looking at the paintings. It could be that the act of spectatorship of paintings by naïve viewers is moderated by the same visuo-cognitive functions as during looking at the scene images. There is a close link between eye movements, attention and working memory (Godijn & Theeuwes, 2004; Schmidt, Vogel, Woodman, & Luck, 2002; Theeuwes, Belopolsky, & Olivers, 2009). Specifically, executive aspects of attention are required to transfer perceptual representations into visual working memory (e.g., Belopolsky, Kramer, & Godijn, 2008) and there is an argument that this process is facilitated by eye movement (Theeuwes, Olivers, & Chizk, 2005). While specific details about the relationship between eye movements, attention, and working memory are beyond the present thesis there may be an association between the individual differences in eye movements made during spectatorship of paintings are associated with those in attention and working memory.

To test question about the role of attention and working memory on the act of spectatorship, I have chosen the Attention Network Test (Fan et al., 2002) and visuospatial and verbal versions of the 3-Back Task (Shackman et al., 2006). Attention Network Test (ANT) provides data related to three aspects of attention: altering, orienting and executive control. The ANT combines a flanker task and a cued reaction time task to measure the efficiency of each aspect of attention. Participants are instructed to classify as quickly and accurately as possible whether the central arrow points to the left or right. The central arrow is flanked by two pairs of distracter arrows. Flanker arrows either point in the same direction (congruent condition) or opposite direction (incongruent condition) as the target arrow.

The visuospatial and verbal versions of 3-Back Task is defined as a measure of visuospatial and verbal working memory performance. On each trial, participants press a key indicating whether the current memorandum did or did not match that presented three

trials previously (Shackman et al., 2006). The spatial task requires remembering locations and the verbal task requires remembering a letter and, in each case, there were six possible locations or letters that could appear. The task is continuous and every trial required a response to indicate either a match or non-match with the stimulus presented three trials previously.

The goal of taking these two individual measures is to explore whether the eye movements made during spectatorship of representational art are subject to influence from individual differences. To do so, I used the ANT and 3-Back Task as a standard battery of cognitive tasks across studies reported in the following empirical chapters (Chapter 2-5). I used an exploratory approach because of the lack of direct empirical evidence about the role of basic cognitive functions captured by these two measures and eye movement behavior during looking at the paintings. Following evidence about the relationships between eye movements, attention, and memory (see Theeuwes et al., 2009 for review), I hypothesize that eye movements made to the paintings during reaching specific functional goals (i.e., liking rating in Chapter 2 and memory task in Chapter 3-5) will be facilitated by the ability to move attention to relevant areas of the paintings and the ability to maintain visual representations paintings in working memory.

1.3 Discussion

Chapter 1 has introduced spectatorship of pictorial art in terms of the properties of paintings and spectator expertise. In reviewing the literature on perceiving pictorial art, this chapter has considered spectatorship as an active process that is reflected in, and measured by, eye movements. A range of factors related to the properties of paintings have been identified that can impact spectatorship outcome. The proposed framework was discussed in terms of theories of attention, in particular those from scene perception and visual

search. This review also identified the importance of knowledge to spectatorship (using Panofsky's art perception theory and Minissale's insight knowledge thought of as a dimensional construct).

The account of spectatorship of paintings that forms the basis for my thesis is a general one in the sense that it builds on Ullman (1984) who provided an account of visual object representation. It is important to recognise that the spectatorship of paintings is different from the visual representation of objects and scenes. I have already noted two important attributes of this argument. First, understanding the use of colour in paintings required knowledge of the time and context of painting. Second, paintings are artefacts generated by the human mind and cannot be fully understood in terms of their physical properties. Here I make two final clarifying observations regarding this framework.

First, spectatorship of paintings has a developmental characteristic through repetitive contact. While the painting remains constant, spectatorship can change over time (Clark, 2008; Trawinski, 2014). Leder (2001) has shown that repetitive exposure to Van Gogh's paintings increased their liking. Cutting (2003) showed that repeating exposure increases liking even when participants are unaware of the repetition (see Mere Exposure Effect; Zajonc, 1968). The effect of repetition is not limited to liking but can also change access to the semantic content of paintings. Kass, Harland, and Donnelly (2018) noted that repetitive spectatorship of painting improves a spectator's processing fluency. They considered how repetitive exposure to a gruesome *Death and Disaster Series* (Andy Warhol, 1963) changes the spectatorship process. Kass et al., (2018) argue that negative effect of the Death and Disaster Series is decreased across the time of repetitions due to an enhanced recognition of the negative semantic content.

Hedonic Fluency Theory (Reber, Schwarz, & Winkielman, 2004) is a great example of concept which combines the emotional and cognitive role of repetitive

exposure on spectatorship experience. The theory states that positive aesthetic response to the art is positively associated with processing fluency. Specifically, the liking of visual objects is driven by stimulus repetition, its prototypicality, and structure. The effect of processing fluency is crucial for understanding spectatorship in naïve viewers. Reber, Schwarz, and Winkielman argue that the 'pure' fluency effect is more likely to be observed during when first looking at images.

Another illustration of the influence of repeated exposure to paintings is seen in the case where paintings belong to the same category of motif. Motif in painting is understood as the narrative theme that is explored across many paintings. Commonly used motifs are the 'Bathers' (e.g. Walker, *The Bathers*, 1865; Seurat, *Bathers at Asnieres*, 1884; Cezanne, *The Bathers*, 1906), 'Venus' (e.g. Botticelli, *The Birth of Venus*, c. 1480; Velazquez, *The Rokeby Venus*, c. 1650; Picasso, *Venus and Love*, 1967), or Three Graces (Rubens, *Three Graces*, c. 1635; Raphael, *Three Graces*, c. 1505; Furini, *Three Graces*, 1633, see Figure 1.9) but there are many others. Paintings are related to each other even through visually and stylistic dissimilarities. Repeated exposure to different exemplars of motifs enable the formation of stable mental representation of motif category in the mind of the spectator (Kass et al., 2015). In this case, the spectators learn, abstract, and store the motif as a form of prototype (Posner & Keele, 1968). As the motif becomes better learnt the spectatorship acquires a relational aspect to it, as instances of motifs are compared.

The second observation in relation to why the spectatorship of paintings is different from of scenes is that the real world must be physically plausible. While the real world may generate illusory spatial relations, the accounts of these illusions must be based in the neural perceptual operations that otherwise do a good job of representing things. In contrast, paintings need not be constrained by the same constraints of physical reality. The question of consistency arises when considering spectators interpretation of perceptual

organisation in paintings.

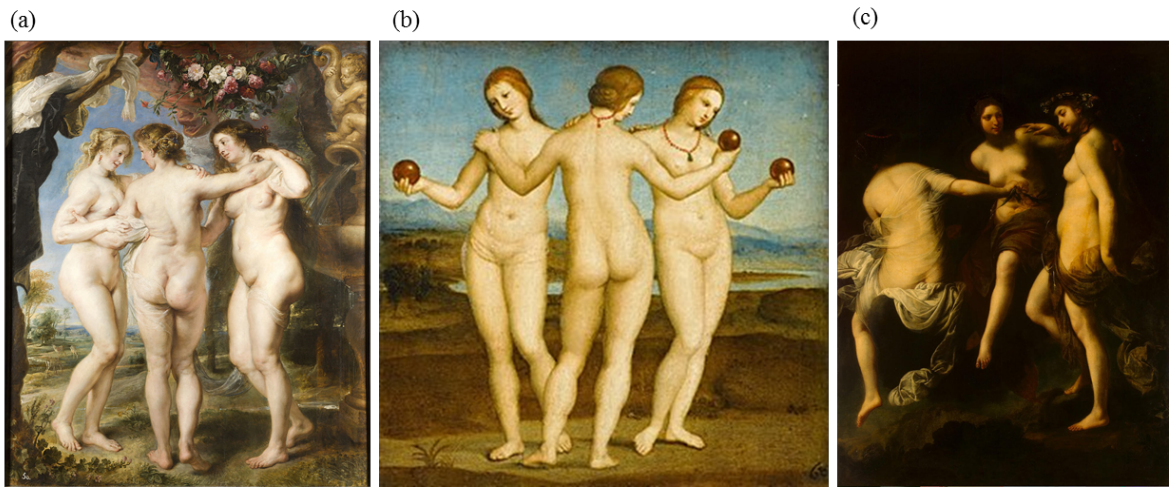


Figure 1.9. Motif of Three Graces; (a) Rubens, *Three Graces* (c. 1635); (b) Raphael, *Three Graces* (c. 1505); (c) Furini, *Three Graces* (1633).

There is a lot of evidence that the presence of inconsistent elements or impossible spatial relations in paintings does not disrupt a spectator (Gombrich, 1992). I will describe three examples. First, Cavanagh (2005) showed that spectators are largely unaware of the inconsistency in presumed lighting in *The Birth of the Virgin* (Fra Carnavale, 1467; Figure 1.10). Careful inspection of this painting shows that the angle of shadows cast by figures in foreground indicates a light source behind the spectator. In contrast, the direction of shading of the single figure changes the interpretation of figures depth (Figure 1.11; see also Ostrovsky, Cavanagh, & Sinha, 2005).

Figure 1.10. Fra Carnavale, *The Birth of the Virgin* (1467). *Note* the shadows inconsistency.

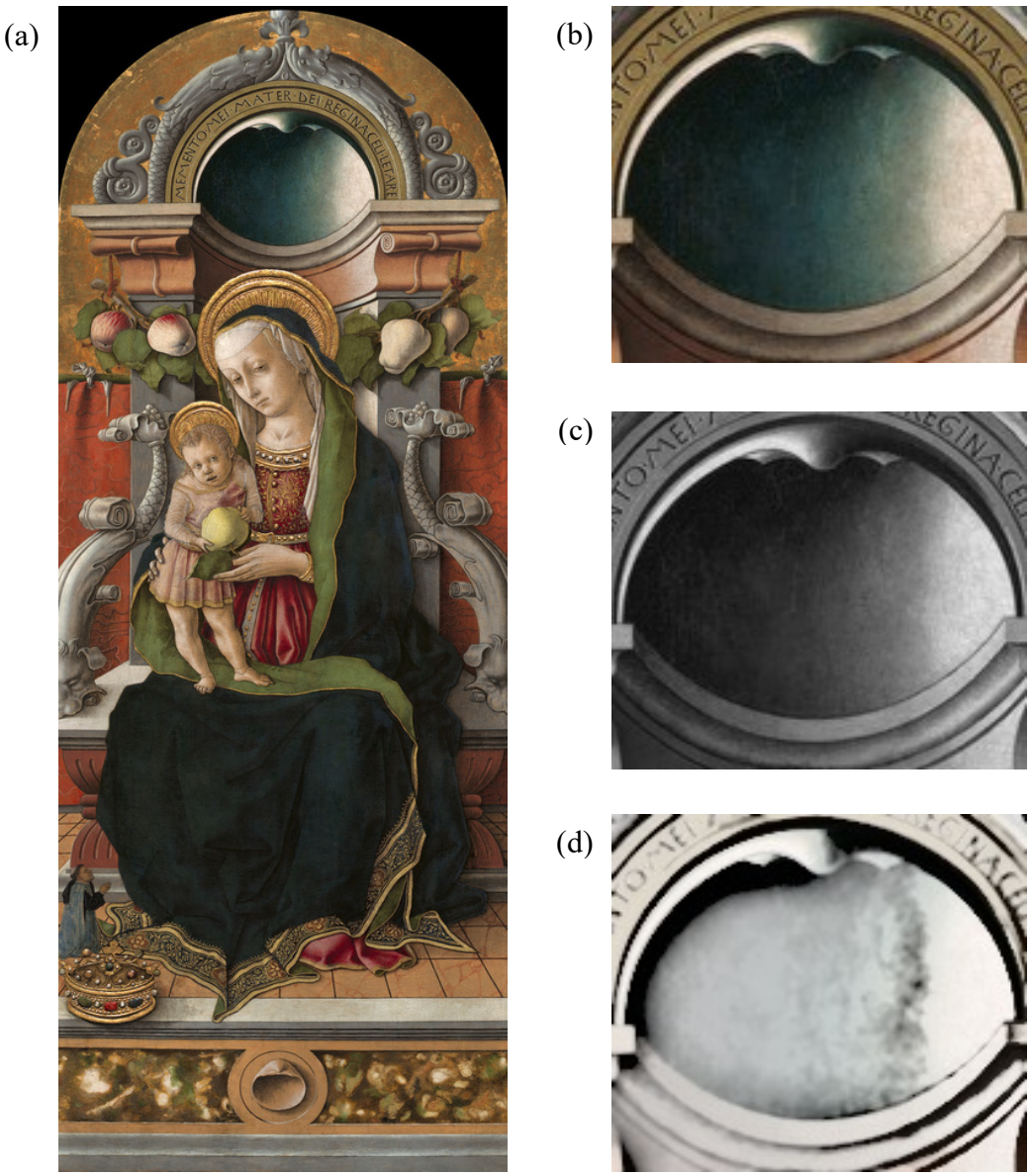


Figure 1.11. Examples illustrating the role of shadows for the interpretation of figure depth: (a) Crivelli, *Madonna with Child Enthroned* (c. 1470); (b) architectural detail from the background; (c) architectural detail in monochromatic version; (d) monochromatic version with inverted shadow. *Note* the dramatic difference in depth perception.

Second, the *The Toilet of Venus* (Diego Velasquez, c. 1650) shows Venus's face through reflection in a mirror. The Venus effect occurs when a spectator sees both Venus and a mirror. Her, and our, ability to simultaneously see the reflection is inconsistent with

the laws of reflection but is largely unnoticed by spectators (Bertamini, Latto, & Spooner, 2003).

Third, 'double images' consist of elements, which can be interpreted by spectators in a different way. Livingstone (2000) explored Leonardo da Vinci *Mona Lisa* (1503) painting and showed that the mystery of her 'changing' smile depends on spatial frequency. Central vision is dominated by significantly higher spatial frequencies than humans' peripheral vision. In the natural environment, this effect is achievable by the manipulation of the distance to the image. Being close to the image is associated with the processing of the high spatial frequencies visual information when increasing distance encourage processing of the low spatial frequencies visual information. Hence, in low spatial frequencies image Mona Lisa' smile appears, in contrast to high spatial, where her mouths are formed into a grimace. The *Slave Market With the Disappearing Bust of Voltaire* (1940) and *Gala Contemplating the Mediterranean Sea* (1976) by Salvador Dali illustrate related phenomenon (Bonnar, Gosselin, & Schyns, 2002; Harmon & Julesz, 1973; Oliva, 2013). Overall, spectators are insensitive to the overall plausibility of perceptual organization of whole paintings, and are untroubled by paintings may have more than one resolution.

In conclusion, paintings can be thought of in terms of their visual features. To do so requires considering how the coloured marks cohere together in to objects, regions, and compositions. While paintings exist in the real world, they are also artifacts within it. As visual artifacts, they are subject to the same laws of perceptual organization as real-world scenes but have the potential to deviate from a singular and consistent interpretation across whole paintings. The fact that this is the case confirms that paintings represent a special class of visual stimulus.

1.4 Summary

In this chapter the spectatorship of representational paintings by naïve and art experts has been considered. The spectatorship of the representational painting was defined as the act of looking that leads to an aesthetic experience and a representation stored in memory. I have started Chapter 1 from considering spectatorship of representational paintings as physical objects, where set of coloured marks are organized into complex and meaningful structure. Afterwards, I reviewed well-established models related to art perception to propose a simple visuo-cognitive framework for considering the spectatorship of representational paintings. According to the proposed framework, naïve viewers spectate representational paintings by applying the same basic processes used in perception of people, objects and scenes in the real world. In contrast, art experts use top-down art related knowledge to the act of looking that allows paintings to be explored in a different manner. I also offered to operationalize the act of spectatorship as the measurement of eye movements. I concluded Chapter 1 by making two additional observations. First, I reviewed the dynamic aspect of spectatorship through repetitive contact with paintings. Second, I discussed paintings as a special class of visual images for consideration.

Taken together, the present thesis examines spectatorship in relation to naïve spectators and their eye movements made on representational paintings while making liking judgments and encoding paintings for later recall. The remainder of this thesis examines this process in detail. Chapter 2 explores the impact of a painting's properties to the spectatorship of the portrait. Critical to the portrait theme is the inclusion and central focus of an individual or group surrounded by contextual information. Chapter 3 focuses on the role of implicit learning of a painting's theme to memory performance. Additionally, it discusses the implications of using the Navon task prior to painting

presentation. In Chapter 4, I explore the impact of culture on the spectatorship of paintings by Chinese and British naïve beholders. The Chapter 5 investigates the role of the motif category on the spectatorship process. In sum, the work presented in the following chapters makes a significant contribution to the literature on spectatorship of representational art. I now consider the rationale and research aims for the first empirical chapter.

1.5 Rationale and research aims for Chapter 2

Painters organize the people and objects in representational paintings to express a specific narrative. These different types of semantic information about painting content may be related to each other and may be considered as motif categories. The relationships between motif categories are usually appreciated only by art experts and are not recognized by naïve spectators. However, there is a specific type of motif, such as portraits where the human figure is a central focus. According to the visuo-cognitive framework proposed in Chapter 1, spectatorship of the portraits does not require such complex specialized visual and conceptual knowledge as in other types of motifs. Given that naïve viewers apply the visual processes involved in the perception of people, objects, and scenes to the spectatorship of representational paintings, then the question about the importance of the painting's properties might be worth consideration.

It is well-documented that human faces capture observer attention (for review see Young, 2018). However, it is less clear how in a painting faces interact with salient features in the area outside the human figure. The following chapter explores how faces and salient features influence the liking judgment of naïve participants. Additionally, Chapter 2 examines to which extent the gaze of the sitter influences spectatorship of portraits.

Chapter 2

The Spectatorship of Portraits by Naïve Beholders

2.a Abstract

The spectatorship of portraits by naïve viewers (beholders) was explored in a single experiment. Twenty-five participants rated their liking for 142 portraits painted by Courbet (36 paintings), Fantin-Latour (36 paintings) and Manet (70 paintings) on a 4-point Likert scale. The portraits were classified in terms of focussed versus ambiguous nature of sitter gaze and the presence of salient features in the context beyond sitters. Participants rated portraits while having their eye movements recorded. The portraits were split into regions of interest (ROIs) defined by faces, bodies and context. Participants also completed individual difference measures of attention and task focus. Results showed naïve spectatorship to be subject to attentional capture by faces. Paradoxically, the presence of salient features in the context amplified the attentional capture by faces through increasing participants liking of portraits. Attentional capture by faces was also influenced by sitter gaze and task focus. Unsurprisingly, the spectatorship of portraits by naïve beholders is dominated by faces, but the extent of this dominance is influenced by exogenous and endogenous attentional factors.

2.b Publication Note

The original version of this chapter was published as Trawiński, T., Mestry, N., Harland, B., Liversedge, S. P., Godwin, H. J., & Donnelly, N. (2019). The spectatorship of portraits by naïve beholders. *Psychology of Aesthetics, Creativity, and the Arts.* Advance online publication. http://dx.doi.org/10.1037/aca0000248

2.1 Introduction

Portraits are a specific type of painting motif. Critical to the portrait motif is the inclusion and central focus of an individual or group (henceforth the sitter(s)) in a painting. Previous consideration of the spectatorship of portraits has primarily considered eye position and the perception of gaze. Most notably, Tyler (1998) has shown that artists frequently position an eye in portraits on a vertical axis that runs through the centre of the painting, with perception of gaze influenced by sitter head and eye position (Todorović, 2006), and that is often interpreted as fixating the spectator (Boyarskaya, Sebastian, Bauermann, Hecht, & Tüscher, 2015). The consideration of the importance of gaze in the spectatorship of portraits should, we argue, be part of a larger endeavour to understand the spectatorship of the whole artwork that is the portrait, since portraits are not stimuli formed to deliver only gaze. The attributes of the context around sitter(s) provide information about, for example, social status and the time and place where the painting was created (see Gombrich, 1995, pp. 134-148; Reff, 1975).

The present study builds on the idea that the spectatorship of paintings is spatially limited (Locher et al., 2007). Locher et al. (2007) demonstrated this in two studies where participants who were naïve to art described their holistic impression for each work. In Experiment 1 the presentation time of paintings was limited to 100ms but in Experiment 2 presentation time it was unlimited. The unlimited presentation time in Experiment 2 allowed participants eye movements to be recorded as paintings were being described. Participant descriptions were coded into six independent categories of response. With respect to the present study, there were two striking results reported by Locher et al. First, the eye movement analysis showed only an average 46% of the spatial extent of paintings was inspected before participants self-terminated their spectatorship (after 32.5 seconds), and the areas that were inspected changed little from what had been inspected after 7

seconds. Second, the verbal descriptions offered by participants were largely limited to semantic details of objects and their arrangements, or statements about style or how much the paintings were liked. What emerges from the Locher et al. study is a view of naïve spectatorship of paintings as spatially incomplete, and driven by the semantic details of objects.

The spectatorship of portraits is dominated by the presence of faces. In fact, the presence of human faces in portraits will likely lead to the capture of attention (Fletcher-Watson, Findlay, Leekam, & Benson, 2008; Langton, Law, Burton, & Schweinberger, 2008). Faces are a special case of objects as they communicate evolutionally relevant information regarding emotion and identity. There has been much debate in the literature about whether faces are so important from a social/evolutionary perspective that they have a visuo-cognitive mechanism all to themselves, or whether face-specific processing is due to the expertise humans have developed for this class of object. There is automatic elicitation of a face-specific event related potential in response to finding faces (Bentin, Allison, Puce, Perez, & McCarthy, 1996; Johnston, Molyneux, & Young, 2015), and face specific activation in neural regions of the brain such as the fusiform face area in the fusiform gyrus (Haxby, Hoffman, & Gobbini, 2000). It is clear that faces are prioritised as they are highly relevant and have specialised processing architecture. Through the activation of processes set in motion by the prioritization of faces, the faces of those painted in portraits are represented and encoded for familiarity, emotional state, and gaze (Bruce & Young, 1986; Young, 2018).

It seems almost a ‘straw man’ hypothesis to explore the extent to which faces are prioritised in the visual inspection of portraits. To do so would require measuring eye movements to portraits (Rayner, 2009). In particular, measuring the likelihood of early fixations being made to faces, the extent to which fixations are allocated to faces

preferentially over other areas of the portrait, and the extent to which faces 'hold' gaze. In fact, such data can be found in studies of eye movements to a broad class of representational paintings. For example, first, Savazzi et al. (2014) measured eye movements while adolescents rated their liking of figurative paintings. Eye movements made to faces correlated positively with their liking. Second, Villani et al. (2015) measured eye movements to paintings of individuals and pairs engaged in some action. At least for paintings of individuals, there was a preference to looking at faces, especially for those who measured high in empathy. Third, Massaro et al. (2012) reported on the difference in eye movements to paintings classified as images of nature or humans, dynamic or static, color or monochrome. The importance of faces to gaze behaviour was revealed in two effects. First, gaze behaviour to paintings of nature was influenced by color and dynamism but visual inspection of painting showing human faces was not. From these studies we conclude that there is evidence that faces in portraits are prioritised for visual inspection[1]. Following on from these studies the first question we explore in the present study is if the prioritisation of faces is also found in the spectatorship of portraits specifically. We have little doubt that this will be so and that fixations will be prioritised to faces.

The exploration of the prioritisation of faces in portraiture logically precedes consideration of how sitter gaze might influence spectatorship. Gaze is important for humans and it is important from birth (Batki, Baron-Cohen, Wheelwright, Connellan, & Ahluwalia, 2000; Valenza, Simion, Cassia, & Umiltà, 1996). What starts as a bias to looking at eyes in general develops over the first three months of life into one for human eyes specifically (as opposed to, for example, the eyes of monkeys; Dupierrix et al., 2014).

[1] A similar conclusion emerges from work exploring how faces attract attention in more standard experimental paradigms (see Theeuwes & Van der Stigchel, 2006).

The importance of attending to eyes leads to gaze following at around nine months of age (Senju, Csibra, & Johnson, 2008).

Attending to gaze is important for social cognition (Birmingham, Bischof, & Kingstone, 2009; Frischen, Bayliss, & Tipper, 2007). In particular, it is important to the development of theory of mind, an important social function to understand the feelings and intentions of others (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Charman et al., 2000; Kampis, Fogd, & Kovács, 2017). With respect to faces, the neural mechanisms dedicated to determining gaze (e.g., Carlin & Calder, 2013) might provide spectators with a cue to what else should be attended beyond the face.

The influence of gaze on spectatorship is complex (Boyarskaya et al., 2015). Working within the tradition of art theory, Fried (1980) has suggested that portraits can be thought of as addressing spectators in an absorptive, theatrical manner, or in some cases as showing aspects of address that are both absorptive and theatrical (what Fried refers to as showing a 'double relation' of sitter to spectator). While there may be many influences on absorption and theatricality, it is evident that gaze is a major determinant of it (Donnelly et al., 2017). Gaze communicating theatricality occurs when it is directed out from the painting and towards spectators. These are the conditions that occur in portraits in which the sitter appears to look at the spectator continuously from many different vantage points (see Mona Lisa effect; Todorović, 2009). Gaze communicating absorption occurs when the sitter focuses attention on some action, object or person represented within the painting itself (Harland et al., 2014). In both cases, theatrical and absorptive gaze provide a reliable cue for spectatorship process.

A focal point for gaze in portraits can sometimes be hard to determine. When the focal point of gaze is ambiguous, it is hard to classify sitter gaze as absorptive or theatrical, and some artists have exploited this to create a specific effect. The portraiture of Édouard

Manet is striking with respect to the frequency with which he represented gaze in an ambiguous manner by painting misaligned pupils (Donnelly et al., 2017). The effect of ambiguous gaze is to create the double-relation between spectators and sitters, creating sitters that address spectators but are disengaged from them (Fried, 1980).

Although there are instances of artists producing portraits with marked gaze ambiguity prior to the 19th century, at this point a range of social and technological factors (Crary, 1992, pp. 6-14) led to portraits needing to be more than illustrations of people and their social status. For example, Manet's portraiture is often considered as showing figures, who are turned in upon themselves, temporarily preoccupied, "they are absent from the world" (Wollheim quoted in Fried, 1996, p. 344). The effect of Manet's mode of address has been described as "something like cognitive or musical dissonance," intended as a challenge, turned "towards the beholder with a strange, flamboyant indifference to that beholder" (Pippin, 2014, p. 48).

If we consider portraits from this period as types of pictures that communicate socio-cognitive information, we can think of absorptive and theatrical portraits as using gaze as a cue for spectator attention. Here we classify absorptive and theatrical portraits as providing a reliable cue for attention (i.e., it is either focussed on the spectator or on some other location within or outside the space of the painting). In contrast, portraits where the gaze is ambiguous provide an unreliable cue to gaze location but a reliable cue to disengagement from the sitter's face.

The second question we address in the present study is how sitter gaze influences the spectatorship of portraits. The focal point of attention inferred from sitter gaze might be the spectator themselves, as in the case of theatrical portraits, or some other person or object within the painting, as in the case of absorptive paintings. In the case of ambiguous gaze, where is difficult to determine the focal point of attention, sitter gaze may be a poor

cue for informing inspection of the painting beyond the sitter. Here we test whether gaze that unambiguously cues attention (i.e., is focussed) to a location limits the inspection of the context of portraits relative to when gaze is a poor cue for attention (i.e., is ambiguous; Donnelly et al., 2017).

In terms of contextual information we can consider two types of portraits. The first type of context shows artefacts and an identifiable environment, which provides information about, for example, a sitter's social status or role (e.g., *Zacharie Astruc* painted by Manet in 1866 shows a man in the chair next to books on the table bust, and a domestic scene in the background; Figure 2.1). The second type of context shows sitters on a colored background (e.g., *Henri Rochefort* by Manet painted in 1881 shows a man in black jacket painted on a dark background with a light yellow reflection). The inclusion of people, artefacts, and identifiable environmental objects in the context provide potential foci for spectatorship beyond the sitter. Artefacts and identifiable environmental objects in the context are likely to be salient visual features. Consideration of artefacts and identifiable environmental objects as salient visual features provides a helpful heuristic (Tatler, Brockmole, & Carpenter, 2017). It enables us to use a saliency algorithm to give an unbiased measure of the extent to which those artefacts and identifiable objects are visually salient within the context. In this study, therefore, we measured the presence of salient features by passing portraits through an image-processing algorithm designed to detect significant change in the presence of feature hue, luminance, and orientation (Itti & Koch, 2001; Figure 2.1). In a third question we ask how the presence of salient features in the context of portraits influences the spectatorship of portraits showing sitters with focussed or ambiguous gaze (see also Graham & Redies, 2010).

Figure 2.1. Examples of portraits used in the study with salient features indicated by Itti and Koch (2001) algorithm and heat maps grouped by gaze and saliency. First row: Manet, *Angelina* (1865; non-salient context and ambiguous gaze), reproduced with permission © RMN-Grand Palais (Musée d'Orsay) / Adrien Didierjean. Second row: Manet, *Henri*

Rochefort (1881; non-salient context and focused gaze), reproduced with permission © BPK, Berlin, Dist. RMN-Grand Palais / Elke Walford). Third row: Manet, *Zacharie Astruc* (1866; salient context and focused gaze), reproduced with permission © Bildarchiv Foto Marburg. Fourth row: Manet, *Young Woman Reclining in Spanish Costume* (1863; salient context and ambiguous gaze), reproduced with permission © Yale University Art Gallery. Bequest of Stephen Carlton Clark, B.A. 1903.

The question of the relative importance of the presence of faces and salient features in the context for spectatorship has been considered with respect to photographs. When measuring eye movements to photographs of natural scenes containing people, Cerf, Frady, & Koch (2009; see also Zhao & Koch, 2011) found the presence of faces to be prioritised relative to non-face locations with salient features, thereby demonstrating the attentional capture by faces. More importantly, Cerf et al. (2009) have shown that for locations containing salient non-face features to attract attention when those locations compete with faces at other locations, then it is necessary that their salience to be very high.

The spectatorship of paintings may be different to that of photographs and so it would be wrong to immediately generalise from the Cerf et al. (2009) findings. Painted portraits are the product of artistic skills, style, and paint materials; they cannot be considered as literal representations of reality. As such the manner of spectatorship may be governed by different principles to those of photographs. To the best of our knowledge we do not know any study that has explored the influence of the presence of salient regions on spectatorship in the context of portraits. It is for this reason that here we carry out such an investigation to assess the influence salient regions in the context of portraits on spectatorship.

It is possible that both sitter gaze and salience might influence a spectator's gaze behaviour by acting as exogenous or endogenous cues to attention. It is known that there is a tight relationship between gaze behaviour, attention, and working memory (Godijn & Theeuwes, 2004; Schmidt, Vogel, Woodman, & Luck, 2002; Theeuwes, Belopolsky, & Olivers, 2009). While the specific details of this relationship are beyond the current study, there may be some relationship between gaze behaviour, attention, and working memory in spectatorship. We examine this in the present study by exploring whether individual differences in gaze behaviour are associated with those in attention and working memory. To do so, we measure performance on the Attention Network Task (ANT: Fan, Mccandliss, Sommer, Raz, & Posner, 2002) and 3-back working memory capacity test (Shackman et al., 2006). The ANT provides a measure of executive, orienting, and alerting attention networks. Apart from measuring the working memory capacity, 3-back tests also provide a reliable measure of executive attention and task focus. Caggiano and Parasuraman (2004) has shown that working memory capacity test is associated with the ability to sustain attention over extended period of time. Additionally, there are evidence that maintaining attentional engagement (Sörqvist & Marsh, 2015) and flexibility in the allocation of attention (Bleckley, Durso, Crutchfield, Engle, & Khanna, 2003; Fukuda & Vogel, 2011) are also measured by working memory capacity test.

The goal in taking these individual difference measures was to explore whether the gaze behaviour made during spectatorship of portraits is subject to influence from individual differences in the tendency to orient attention or maintain task focus. The hypotheses is that an increased tendency to orient attention may lead to increased fixations to the context, whereas an increased task focus may lead to increased fixations to the face.

In summary, the present study explores how stimulus factors (gaze and salience) and cognitive factors (individual differences in orienting and task focus) influence the

spectatorship of portraits. We predict that the spectatorship of portraits will be characterised by prioritised attention to faces rather than to bodies or contexts. Prioritised attention to faces will be demonstrated by rapid and prolonged fixations to faces relative to other locations in portraits. In addition, we test the following hypotheses: The tendency to attend to the context will be increased by the presence of salient features and ambiguous sitter gaze. In relation to measures of individual differences, we test whether the tendency to attend to the context will be increased with increased orienting as measured by the ANT and whether the tendency to maintain focus on faces will increase with task focus.

Finally, eye movements to visual images are known to vary with task requirements (Borji & Itti, 2014; Fuchs et al., 2011; Henderson et al., 2013; Yarbus, 1967). For this reason, it is important to note that spectatorship in the present study was measured while participants provided ratings of their liking for portraits (see also Massaro et al., 2012; Savazzi et al., 2014).

2.2 Method

2.2.1 Participants

Twenty-five undergraduate students (9 males and 16 females; $M = 21.04$, $SD = 2.92$) from University of Southampton participated in the study. They were recruited through a university online survey responding that they were not knowledgeable about art and had received no art training. They received course credits for taking part. Participants completed a test of art knowledge (Jakesch & Leder, 2009) translated[2] to English from the

[2] The translation process consisted of a multistep process using a standardized methodology (Harkness & Schoua-Glusberg, 1998). In the first step a draft English version of the Art Questionnaire was prepared. One German native speaker developed this version with comments and changes. Two experts in the psychology of art modified the English translation in terms of the use of simple and correct language. A second German native speaker then translated the questionnaire back into German. A third native German

original German version of the questionnaire (see Appendix 1). Participant knowledge about art tended to be low (*M* = 8.42 [out of 48]; *SD* = 6.15; *Mdn* = 6.5; range = 2 - 27). The participants were therefore classified as naïve beholders of art.

2.2.2 Apparatus

Tasks were presented on a View-Sonic graphics Series G225f CRT monitor with screen size 40.60 cm x 30.80 cm in a darkened room. Participants were seated at a distance of 70 cm giving a visual angle of 30.11° by 23.75 ° for the screen. Screen resolution was 1024 x 768 with a refresh rate of 120 Hz. Viewing was binocular, though only movements of the right eye were recorded using an SR Research Limited Eye-Link 1000 eye tracker operating at 1000Hz. Head movement was stabilized using a chin and headrest. Participants responded by pressing one of the four buttons on a button-box.

2.2.3 Stimuli

One hundred and forty-two portraits were used in this experiment (Table 2.1). The image set consisted of 70 portraits by Edouard Manet, 36 by Henri Fantin-Latour, and 36 by Gustav Courbet. The portrait set represents artists from a consistent art historical context. The high-resolution reproductions of paintings were uploaded from Google Image Search. All signatures were removed using Adobe Photoshop CS6. Ninety-four of the portraits were used in Donnelly et al. (2017) study.

speaker, judged the coherence between these two German versions. The level of similarity was evaluated for each sentence from 1 to 6 with each sentence scoring under 5 being retranslated. Taking note of the comments of this third native German speaker, six sentences were re-translated. A final meeting with the same two experts in psychology of art produced the definitive English translation of the German questionnaire.

In a pre-test, a different set of 16 participants (4 males and 12 females; $M = 20.69$, $SD = 2.57$) was presented with the 142 paintings in random order on a computer screen. They were asked to rate on a scale of 0 (no ambiguity) to 5 (ambiguous): "How ambiguous is the gaze of the primary figure in the portrait?" They received the set of standardized instructions from Donnelly et al. (2017) to outline ambiguous gaze[3]. Paintings were shown one at a time so were rated separately. The set of paintings was presented in a different random order for each participant.

The mean categorisation ratings are shown in Table 2.1. These values were divided into three categories regarding to level of ambiguity: focused (scores of 0 -1.66), moderately ambiguous (scores of 1.67 – 3.33) and highly ambiguous (scores of 3.34 – 5). As a result of rating categorization, 51 paintings were classified as focused, 87 as moderately ambiguous, and 4 as highly ambiguous. For the further analyses, the 91 moderately and highly ambiguous portraits were merged into one category (ambiguous) because of the small number of paintings in the highly ambiguous category[4].

[3] Eyes are typically aligned to fixate an object or face. This is evident when the pupils are aligned so that they focus on a single point in space. Humans are very good at knowing where others are looking, regardless of whether they are the subjects of that gaze or the gaze is directed at another point. Sometimes the two eyes do not align to allow us to confirm a single point of fixation. When this is the case, the shared focal point of the two eyes is difficult to determine. We refer to this difficulty as an ambiguity of gaze. You are asked to categorize whether the primary figure in each of the paintings presented has a pattern of gaze where the eyes are aligned or are not aligned. Sometimes a failure to align occurs because the pupils do not align on the horizontal axis (e.g. one pupil points further left than expected given the other pupil). Sometimes they fail to align on the vertical axis (e.g. one pupil points further up than the other). We are interested in exploring the gaze in a series of portraits, with reference to the primary figure in each painting (ignore any other figures in the scene). You will be asked to answer to question for each portrait and respond using the number keys on the keyboard.

[4] Ratings for the 94 portraits used in Donnelly et al. (2017) correlate significantly with those gained in the present study ($r(94) = .59$, $p < .001$). In addition, tests using the normal approximation to the binomial distribution confirm the findings of Donnelly et al. (2017) that gaze ambiguity is more common in portraits by Manet than in the combined set of Courbet and Fantin-Latour ($z = 2.13$, $p < .05$). Splitting the Courbet and Fantin-Latour set

Each portrait painting was split into regions of interest (ROIs) of face[5], body, and context. Some paintings contained only a single instance of each ROI while others contained multiple face and body ROIs. The hypotheses laid out in the Introduction require specification of faces and contexts only. To do so leaves the body part of portraits unspecified. Rather than leaving portraits partially defined, we also specified a body ROI. We specific this ROI despite having no specific hypothesis with respect to it in order that all fixations are considered in the analyses.

The paintings were also passed through the Itti and Koch (2001) saliency toolbox using its default settings. As a result of the running of the Itti and Koch, 41 paintings were classified as containing no salient features in the context (23 ambiguous, 18 focused) and 101 paintings with salient features in their context (68 ambiguous, 33 focused). The mean number of salient features present in the context ROI, when at least one was present, was 2.59 (*SD* = 2.46) and 2.33 (*SD* = 2.58) for paintings where the sitter had an ambiguous and focused gaze respectively. The classification of images as ambiguous or focused, the number of faces ROIs and salient regions identified in the context of each painting is reported in Table 2.1. Portraits were presented centrally on the screen, retaining their original ratios but scaled to fit a height of 24.50 cm on the screen and giving the visual angel of 19.85°. Widths varied between 17.29 and 50.38 cm. this creased a visual angles between 14° and 40.82°.

shows this contrast with Manet to remain significant for Courbet ($z = 6.38$, $p < .001$) but to be only a trend for Fantin-Latour ($z = 1.70$, $p = .089$).

[5] A portrait could have multiple ROIs of faces and bodies if more than one person was present in the portrait.

Table 2.1

List of all portraits used in experiment collapsed by authors, number of salient features in the context, and also the mean categorization gaze rating and number of ROIs in Face and Body ROIs.

Artists and painting	Year	Saliency	Gaze category	ROIs Face(s); Bodies
Manet				
Spanish Singer	1860	1	1.5	1; 1
Boy With Cherries	1860	3	2.31	1; 1
Madam Brunet	1860	2	1.81	1; 1
Nymph Surprised	1861	3	1.31	1; 1
Boy With a Dog	1861	2	1.5	1; 1
Boy With the Sword	1861	0	1.38	1; 1
Gypsy With Cigarette	1862	5	2.44	1; 1
Lola de Valenca	1862	1	1.38	1; 1
Victorine Meurent	1862	3	1.56	1; 1
Mlle Victorine in the Costume of an Espada	1862	4	1.69	3; 3
Street Singer	1862	1	1.81	1; 1
Young Woman Reclining in Spanish Costume	1863	4	2.93	1; 1
Young Man in the Costume of a Majo	1863	2	1.75	1; 1
Head of Christ	1864	0	2.38	1; 1
The Tragic Actor	1865	3	1.44	1; 1
Beggar With Duffle Coat	1865	0	1.94	1; 1

Angelina	1865	0	2.81	1; 1
The Fifer	1866	4	1.88	1; 1
Zacharie Astruc	1866	5	1.44	2; 2
The Philosopher	1866	3	1.94	1; 1
Young Lady With Parrot	1866	1	1.88	1; 1
The Lecture (Manet's wife)	1866	10	2.44	2; 2
Soap Bubbles	1867	3	1.69	1; 1
Emile Zola	1868	7	1.63	1; 1
Young Man Peeling a Pear	1868	1	3.19	1; 1
Theodore Duret	1868	5	2.13	1; 1
Eva Gonzales	1870	2	2.63	1; 1
In the Garden	1870	5	3.19	3; 3
Repose: Berthe Morisot	1870	3	2.25	1; 1
Suzanne Manet	1870	0	2.5	1; 1
Monsieur Tillet	1871	0	1.94	1; 1
Berthe Morisot Holding a Bunch of Violets	1872	2	1.31	1; 1
Berthe Morisot Reclining	1872	0	2.81	1; 1
The Brunette With Bare Breasts	1872	0	3.13	1; 1
Veiled Young Woman	1872	0	3.88	1; 1
Woman With Fans	1873	5	2.31	1; 1
Gare Saint Lazare	1873	6	1.75	2; 2
Le Bon Bock	1873	0	.81	1; 1
Margaite de Conflanins Wearing a Hood	1873	5	3.38	1; 1
Berthe Morisot With Fan	1874	5	2	1; 1
Berthe Morisot With Hat, in Mourning	1874	1	3.56	1; 1

Young Woman With a Book	1875	4	2.38	1; 1
Gilbert Marcellin Desboutin	1875	3	2.25	1; 1
Woman With Umbrella	1875	3	2.5	1; 1
Stephane Mallarme	1876	5	3.25	1; 1
Nana	1877	5	1.56	2; 2
Antonin Proust, Study	1877	0	1.81	1; 1
The Plum	1877	6	2.38	1; 1
Faure as Hamlet	1877	0	2.13	1; 1
Self Portrait With a Palette	1878	1	1.75	1; 1
Le Journal Illustre	1878	8	2.81	1; 1
Self Portrait With Skull Cap	1878	1	1.88	1; 1
Lady With a Black Fichu	1878	3	2.69	1; 1
Marguerite Gauthier	1878	2	3	1; 1
Lina Campineanu	1878	3	2.44	1; 1
Monsieur Brun	1879	1	1.69	1; 1
Madame Manet in the Conservatory	1879	11	1.19	1; 1
Woman With a Gold Pin	1879	3	2.69	1; 1
Isabelle Lemonnier (Jeane Femme en Robe du Bal)	1879	0	2.63	1; 1
Emilie Ambre in the Role of Carmen	1879	2	2	1; 1
Isabelle Lemonnier with White Scarf	1879	1	1.56	1; 1
Corner of the Café Concert	1880	3	2.25	4; 3
Isabelle Lemonnier	1880	1	1.88	1; 1
Antonin Proust	1880	0	1.69	1; 1
The Promenade	1880	2	2.56	1; 1

Isabelle Lemonnier With a Muff	1880	1	2.13	1; 1
Pertuiset, Lion Hunter	1881	4	2.56	1; 1
Henry Bernstein as a Child	1881	2	.88	1; 1
Henri Rochefort	1881	0	1.5	1; 1
Head of Jean Baptiste Faure	1882	0	3.31	1; 1
Courbet				
Portrait of a Spanish Lady	1855	3	2.25	1; 1
Portrait of Jules Valles	1865	0	.81	1; 1
Portrait of Juliette Courbet	1844	5	1.69	1; 1
Portrait of Pierre Joseph Proudhon (1865)	1865	0	2.38	1; 1
Portrait of Chenavard	1869	1	2.13	1; 1
Self-Portrait (Man with Pipe)	1848	1	2.19	1; 1
Portrait of H. J. van Wisselingh	1846	1	2.25	1; 1
Portrait of Pierre Joseph Proudhon (1853)	1853	5	1.38	3; 3
Portrait of Mlle. Jacquet	1857	0	1.44	1; 1
Jo, la Belle Irlandaise	1866	0	2.5	1; 1
The Cellist, self-portrait	1847	0	1.25	1; 1
Portrait of Paul Verlaine	1871	0	1.19	1; 1
Self-Portrait (The Wounded Man)	1854	1	2.19	1; 1
The Village Girl With A Goatling	1860	0	3.38	1; 1
A Young Woman Reading	1866	10	1.31	1; 1
Portrait of Zelie Courbet	1842	4	1.5	1; 1
Young Man in a Landscape	1845	4	2.06	1; 1
Portrait of Alfred Bruyas	1854	3	1.88	1; 1
Portrait of Gabrielle Borreau (The Dreamer)	1862	4	3	1; 1

Proudhon and His Children	1853	1	1.81	1; 1
Self-Portrait (Man with Leather Belt)	1880	1	1.44	1; 1
The Desperate Man	1843	0	.94	1; 1
Self-Portrait (Courbet with Black Dog)	1844	3	1.44	1; 1
Louis Gueymard (1822-1880) as Robert le Diable	1857	4	1.75	3; 3
Gypsy in Reflection	1869	0	1.69	1; 1
The Young Bather	1866	4	2.25	1; 1
Portrait of Charles Baudelaire	1848	4	1.19	1; 1
Woman with Garland	1856	10	2.56	1; 1
The Sleepwalker	1865	2	1.75	1; 1
Portrait of Young Woman in the style of Labille-Guiard	c. 1866	5	.81	1; 1
Portrait of a Young Girl from Salins	1860	2	2	1; 1
Portrait of Madame Proudhon	1865	0	1.69	1; 1
Portrait of a Woman	1850	0	2.06	1; 1
Woman of Frankfurt	1858	9	2.06	1; 1
Madame Mere Gregoire	1856	1	2.13	1; 1
The Young Lady on the Banks of the Seine	1857	4	2.06	1; 1
Fantin-Latour				
Self-Portrait (1859)	1859	2	1.31	1; 1
Charlotte Dubourg	1882	3	1.19	1; 1
Portrait of Sonia	1890	2	.56	1; 1
A Leitura	1870	0	.94	2; 2
Portrait of Madame Leon Maitre	1882	2	1.38	1; 1
Portrait of Leon Maitre	1886	0	.88	1; 1

Portrait of Eduouard Manet	1867	0	1.44	1; 1
Madeleine Lerolle	1882	7	1.56	1; 1
Mademoiselle de Fitz James	1867	0	1.19	1; 1
Self-Portrait (1867)	1867	0	1.25	1; 1
Portrait of James McNeil Whistler	1865	0	1.13	1; 1
Portrait of a Woman	1885	0	1.25	1; 1
Self Portrait (1858)	1858	0	2.56	1; 1
Bathsheba	1903	5	2.31	1; 1
Portrait of Eva Callimachi-Catargi	1881	0	2.63	1; 1
Young Lady Reading	c. 1890	6	2.44	1; 1
Portrait of a Man	c. 1871	0	1.31	1; 1
The Reader	1861	2	.93	1; 1
Portrait of Ruth Edwards	1864	2	1.44	1; 1
Head of a Young Girl	1870	0	1.19	1; 1
Portrait of Mrs. Madeleine Burty Haviland	1893	0	1.75	1; 1
Adolphe Jullien	1887	2	.81	1; 1
Self Portrait (1861)	1861	4	1.94	1; 1
Reveil de Venus	1903	8	2.44	1; 1
Victoria Dubourg	1873	2	.81	1; 1
Madame Leopold Gravier	1889	3	1.06	1; 1
Reclining Nude	1892	0	2.06	1; 1
Portrait of Mademoiselle Marie Fantin-Latour	1859	0	.94	1; 1
Mr and Mrs Edwin Edwards	1875	0	1.5	2; 2

Immortality	1889	4	1.56	1; 1
Drawing Lesson	1879	6	1.94	2; 2
Woman at Her Toilette	1898	2	1.75	2; 2
Portrait of the Artist's Wife	1883	3	1	1; 1
Danaé	c. 1904	4	2.13	2; 2
The Two Sisters	1859	4	2.19	2; 2
Venus and Cupid	1902	7	3.44	2; 2

Note. In third column is shown number of salient regions in the context. Gaze categories (0 = *unambiguous*, 5 = *completely ambiguous*) are shown in Column 4.

2.2.4 Design and Procedure

Participants were tested on a computerised battery of tasks prior to the portrait rating study. These tests measured executive functions as working memory capacity test in two versions of the 3-back task: visuospatial and verbal (Shackman et al., 2006); and the orienting, alerting, and executive components of the Attention Network Test (Fan et al., 2002). Participants then completed the rating study of the portraits while their eye movements were recorded. The rating study began with a standard nine-point calibration procedure. The eye tracker was calibrated to less than 0.5^{o} error. Trials started with a fixation point centred on the screen. Once this point was fixated, a portrait was presented and remained on the screen until a response was made (M = 4.67 s; SD = 2.39 s). Participants were asked to judge their liking of the portraits on a four-point scale (1 – not pleasant at all, 4 – very pleasant). Responses were made via a four-button response box. The inter-trial interval was 500 ms. Participants rated all portraits and the order in which

the portraits were presented was randomised. In sum, rating study and battery of cognitive tasks took around two hours to complete.

2.3 Results

The results are structured to consider (a) eye movements to face, body and context ROIs; (b) the impact of sitter gaze and salient features in the context ROI on eye movements to all ROIs, and (c) the association of attentional orienting and task focus, and liking on gaze behaviour. Analyses of eye movements were focussed on the number of fixations to ROIs and the mean fixation duration (see Rayner, 2009).

2.3.1 Outliers and Exclusion

Fixations shorter than 60 ms or longer than 1200 ms were removed. Fixations that coincided with display onset or the response were also removed. This led to 3.87 % of data being excluded. The final data set consisted of 59056 fixations. One participant was excluded from all analyses because of a technical failure, which had led to some eye movements not being recorded.

2.3.2 Data Normalization

The face, body and context ROIs areas were divided by portrait size in order to express the mean ROI area as percentage of whole paintings. To normalise the number of fixations to ROIs percentages were divided by proportions of mean fixations made to ROIs relative to the mean total number of fixations for each painting. The ratio of normalised fixations gives a score of 1 if the proportionate number of fixations matches the proportionate area of ROIs. A score exceeding 1 indicates more fixations being made to an ROI than predicted by a uniform distribution. A score below 1 indicates fewer fixations being made to an ROI than predicted by a uniform distribution.

Fixations durations were calculated as the mean fixation duration for each ROI. The descriptive eye movement statistics are presented in Figure 2.2.

The fact that there are different numbers of paintings within each category as well as different numbers of paintings within each category contributed by each artist is potentially problematic. To overcome potential difficulties associated with different numbers of stimuli per condition, we analysed data using Linear Mixed-effects Models (LMMs). The analyses are ordered such that questions are addressed separately. All of them were processed in R version 3.3.2 (Team R Core, 2016). Models were fitted using the lmer4-package (Bates, Mächler, Bolker, & Walker, 2014) and MASS-package (Venables & Ripley, 2002). The random effects were structured for items and participants including slopes for all fixed effects and correlation. The full random structure was trimmed down for those models that did not converge or had a correlation equal zero or one[6]. The *t*-values equal to 1.96 or higher were interpreted as significant because of the fact that for high degrees of freedom the *t* statistic in LMMs approximates the *z*-statistic (Baayen, Davidson, & Bates, 2008).

[6] In the LMM model for ROIs (face vs. body vs. context), the random structure was (1 | Subject) + (1 | Stimuli) with respect to both normalised number of fixations and mean fixation duration. With respect to eye movement measures the random structure for the GLM of binary transformed number of fixations for body and context it was (1 | Subject) + (1 | Stimuli). The random structure in the GLM of binary transformed mean fixation duration for body was (1+ gaze | Subject) + (1 | Stimuli) and for context it was (1 | Subject) + (1 | Stimuli). For eye movement measures the random structure for the LMM for log-transformed normalised number of fixations for face it was (1 | Subject) + (1 | Stimuli), for body it was (1+ gaze | Subject) + (1 | Stimuli) and for context it was (1+ gaze + saliency | Subject) + (1 | Stimuli). With respect to log-transformed mean fixation duration for faces, body and context the random structure in the LMM was (1 | Subject) + (1 | Stimuli).

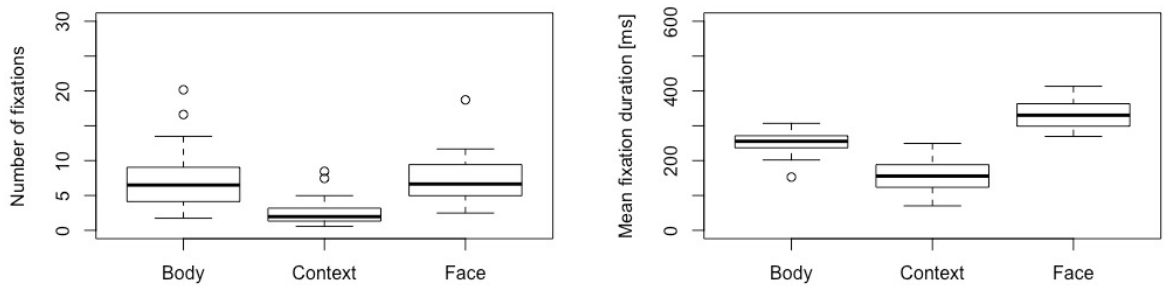


Figure 2.2. Boxplot for mean number of fixations and mean fixation durations for Body, Context, and Face ROIs.

2.3.3 Overall fixations to faces, bodies and contexts

Participants made in average 15.17 (*SD* = 9.06) fixations before judged their liking of the portraits. The 78 % of their first eye movement after the offset of the fixation cross was made to the faces, 17 % bodies, and 5 % contexts. We then tested whether participants made more and longer fixations to face than body and context ROIs. The fixed factor in the LMM was type of ROI (face versus body versus context) with normalised fixations made to faces as the baseline. More fixations were made to faces than to bodies or the context (*M* = 40.15, *SD* = 44.28 versus *M* = 7.09 *SD* = 5.34; *M* = .14, *SD* = .18; respectively; see Table 2.2). With respect to mean fixation duration, fixations were longer to faces than to bodies or contexts (*M* = 330.78, *SD* = 121.85; *M* = 251.60, *SD* = 127.02; *M* = 159.40, *SD* = 156.22; see Table 2.2). In sum, fixations were made extensively to faces relative to bodies or contexts and for a longer duration.

Table 2.2

Fixed effect estimates from the Linear Mixed Models for normalised number of fixations and mean fixation duration on type of ROIs.

	Fixations			Mean fixation duration (ms)		
	b	*SE*	*t*	*b*	*SE*	*t*
Intercept	39.15	1.11	**10.77**	330.78	5.46	**60.63**
Body	- 31.89	0.58	**- 55.47**	- 79.18	3.24	**- 24.43**
Context	- 39.01	0.58	**- 67.85**	- 171.38	3.24	**- 52.88**

Note. Eye movement made to face ROIs was treated as the baseline. Significant effects are indicated in bold.

Table 2.3

Mean (and Standard Deviation) Eye Movement Measures for each ROIs area as a function of type of sitter's Gaze and Saliency in the context.

	Gaze		Saliency	
Number of fixations	Focused	Ambiguous	Salient	No-salient
Face	7.20 (5.66)	7.48 (6.24)	7.48 (6.08)	7.15 (5.92)
Body	7.21 (7.30)	7.30 (7.14)	7.35 (7.22)	7.06 (7.13)
Context	2.77 (5.26)	2.62 (4.36)	2.66 (4.81)	2.72 (4.43)
Mean fixation duration (ms)				
Face	332.00 (124.05)	330.10 (120.62)	332.20 (123.30)	327.30 (118.19)
Body	250.08 (125.84)	252.45 (127.69)	250.72 (125.93)	253.78 (129.69)
Context	163.91 (159.113)	156.87 (154.55)	160.23 (156.79)	157.35 (154.89)

Note. The mean and standard deviation is calculated across participants.

2.3.4 The impacts of sitter gaze and feature saliency on spectatorship

With respect to analyses of normalised number of fixations and fixation durations, the LMM modelling was processed in three steps for both Body and Context ROIs because on some trials participants made no fixations to the Body or Context ROIs. First, we tested the models which assumed Poisson distribution of the data to overcome difficulty associated with non-Gausian distribution of fixations across ROIs; unfortunately these models failed to converge. Second, logistic GLMMs were carried out for the number of fixations (participants who made at least one fixation to the context vs. participants who have not made fixation to the context). Third, the LMMs were run using log-transformed normalised fixation data to increase the normality of the data distribution. Only trials where fixations were made to ROIs were included in the LMM. The means and standard deviations are reported in Table 2.3, the results of the GLMM's are reported in Table 2.4, and the results of the LMM's are reported in Table 2.5. The fixed factors in these models were type of Gaze (ambiguous versus focused) and Saliency areas in the context (salient versus non-salient).

With respect to normalised fixations made to faces, these data were processed using the log-transformed normalised data only. Because the faces were rarely skipped during looking at the portrait, we do not report the GLMM analysis of this measure. As fixations were almost always made to faces, only the LMM analysis provide meaningful results.

Table 2.4

Fixed effect estimates from the Generalized Linear Mixed Models for binominal transformed number of fixations and mean fixation duration on type of gaze and salient condition.

	Body			Context		
Fixations	*b*	*SE*	*z*	*b*	*SE*	*z*
Intercept	3.20	0.30	**10.77**	0.51	0.16	**3.24**
Gaze	- 0.17	0.25	- 0.68	0.05	0.08	0.62
Saliency	- 0.03	0.25	- 0.12	0.07	0.08	0.85
Gaze*Saliency	- 0.29	0.33	- 0.88	0.22	0.17	1.33
Mean fixation duration (ms)						
Intercept	3.17	0.31	**10.38**	0.44	0.16	**2.77**
Gaze	- 0.11	0.23	- 0.49	0.05	0.08	0.62
Saliency	- 0.21	0.17	- 1.23	0.07	0.08	0.86
Gaze*Saliency	- 0.29	0.34	- 0.86	0.22	0.17	1.33

Note. Ambiguous gaze with non-salient features in the context was treated as the baseline. Significant effects are indicated in bold.

Table 2.5

Fixed effect estimates from the Linear Mixed Models for log-transformed and normalised number of fixations and mean fixation duration on type of gaze and salient condition.

	Face			Body			Context		
Fixations	*b*	*SE*	*t*	*b*	*SE*	*t*	*b*	*SE*	*t*
Intercept	3.10	0.08	**36.56**	1.80	0.04	**42.16**	- 1.70	0.03	**- 49.86**
Gaze	0.02	0.15	0.12	- 0.10	0.07	- 1.35	- 0.01	0.04	0.31
Saliency	0.62	0.15	**4.21**	0.08	0.07	1.17	- 0.09	0.04	**- 2.36**
Gaze*Saliency	0.01	0.30	0.05	0.11	0.14	0.75	0.04	0.07	0.54
Mean fixation duration (ms)									
Intercept	5.77	0.02	**243.35**	5.55	0.02	**279.17**	5.52	0.02	**261.99**
Gaze	- 0.01	0.01	- 0.42	0.00	0.01	.84	0.02	0.02	0.84
Saliency	0.02	0.01	1.65	0.01	0.01	.67	- 0.01	0.02	- 0.74
Gaze*Saliency	0.05	0.02	**2.27**	0.03	0.03	.89	- 0.04	0.04	.31

Note. Ambiguous gaze with non-salient features /in the context was treated as the baseline. Significant effects are indicated in bold.

2.3.4.1 Number of fixations to the face. With respect to the LMM analyses, the main effect of salience was significant, but the main effect of gaze and the interaction between gaze and saliency did not reach significance. Participants made more fixations to faces when salient features were present in the context than when they were absent.

2.3.4.2 Number of fixations to the body. With respect to the GLMM, neither of the main effects of gaze and saliency nor the interaction between gaze and saliency reached significance. With respect to log-transformed normalised fixations and LMM, neither the main effects of saliency and gaze nor the interaction between them reached significance.

2.3.4.3 Number of fixations to the context. With respect to GLMM, neither the main effects of gaze or salience nor their interaction approached significance. With respect to log-transformed normalised fixations, the main effect of saliency was significant but the main effect of gaze and the interaction between gaze and saliency did not reach significance. When fixations were made to the context, more were made when salient features were absent than present.

2.3.4.4 Mean fixation duration to the face. With respect to GLMM, neither the main effects of gaze and salience nor their interaction approached significance. With respect to log-transformed mean fixation duration, the main effect of saliency and the main effect of gaze did not reach significance but the interaction effect between gaze and saliency approached significance. The mean fixation durations to the face ROIs were significantly shorter when the context did not contain salient features and sitter's gaze was focused (Figure 2.3).

2.3.4.5 Mean fixation duration to body and context. No main effects or interactions reached significance in either GLMM or LMM analyses.

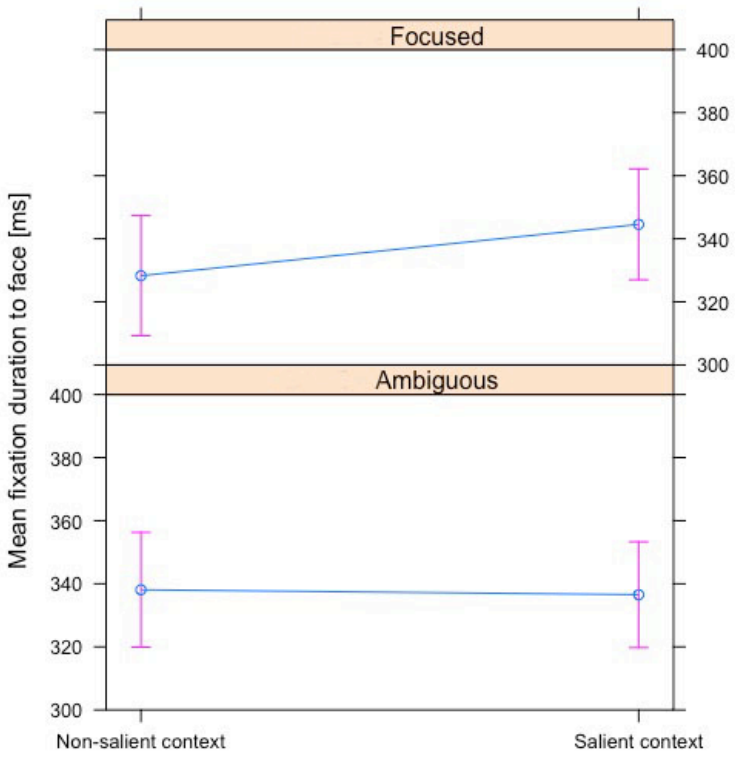


Figure 2.3. The mean fixation duration (in ms with 95% CI) to face ROIs in portraits. The data are shown for both type of Gaze (ambiguous versus focused) and the presence of salient features in the context (salient context versus non-salient context).

2.3.5 Liking Judgments

2.3.5.1 Power Analysis. Brysbaert and Stevens (2018) noted that repeated measures designs will have sufficient power to detect a typical effect size in psychology when the number of participants multiplied by the number of stimuli exceed 1600 observations per condition. In the present study the total number of observations was 3408.

In addition, simulations were run using simR to estimate the power of the experiment to reveal significant results for eye movements made to faces (Green & Macleod, 2016; Green, MacLeod, & Alday, 2016). The power was estimated on the basis

of 1000 random samples. With respect to the number of fixations made to faces, the power for the saliency as a fixed factor was 98.8% for the observed effect size. With respect to the mean fixation duration to faces, the power to find the interaction between gaze and saliency fixed factors was 62% for the observed effect size.

Finally, we note that one participant had a higher art knowledge score than the other participants (27 versus a maximum score of 20). The set of analyses were re-run excluding this participant. The significance and pattern of effects was unchanged.

2.3.5.2 Liking Judgments. The normalised mean number of fixations and fixation durations to face, body and context ROI were calculated for each portrait and correlated with mean liking judgments. This analysis explored whether there was a relationship between eye movements behaviour and liking judgments (see Table 2.6). Liking was positively associated with the normalised number of fixations made to face but not to the body or context ROIs.

We reported earlier that the presence of salient features in the context increased the number of fixations to face ROIs. A stepwise multiple regression was performed where mean liking was predicted by the number of salient regions in the context and normalised number of fixations to explore whether the association between liking judgements and normalised number of fixations to faces was mediated by the presence of salient features in the context. A significant regression equation was found, $F(1,140) = 7.87$, $p < .01$. The multiple correlation coefficient was .23, indicating approximately 5% of the variance in liking judgments was accounted for by the number of salient features in the context. Each additional salient feature in the context increased liking of paintings by .03.

The normalised number of fixations was not entered into the equation at step 2 of the analysis ($t = 1.71$, $p = .09$). The regression model was significant and showed the number of salient features in the context to predict liking.

Table 2.6

Means, standard deviations, and Pearson's r correlations with confidence intervals between eye movement measures for each ROI, salient features in the context, and participants' mean liking rating to each portrait (N = 142).

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. FixFace	40.16	35.27							
2. FixBody	7.09	3.18	.47** [.33, .59]						
3. FixContext	0.14	0.03	-.10 [-.26, .06]	-.06 [-.23, .10]					
4. FixDurFace	330.78	23.08	.08 [-.09, .24]	-.10 [-.26, .07]	.02 [-.15, .18]				
5. FixDurBody	251.60	26.91	-.07 [-.23, .10]	.11 [-.05, .27]	-.19* [-.34, -.02]	.06 [-.10, .23]			
6. FixDurCotext	159.40	30.82	-.03 [-.20, .13]	-.05 [-.21, .12]	.49** [.35, .61]	-.06 [-.22, .11]	-.05 [-.21, .11]		
7. LJ	2.33	0.32	.23** [.07, .38]	-.05 [-.21, .12]	-.02 [-.19, .14]	.01 [-.15, .18]	.01 [-.15, .18]	.05 [-.12, .21]	
8. SF	2.50	2.50	.45** [.31, .58]	.35** [.20, .49]	-.08 [-.24, .08]	.15 [-.01, .31]	-.05 [-.21, .12]	-.08 [-.24, .08]	.23** [.07, .38]

Note. * indicates $p < .05$; ** indicates $p < .01$. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. FixFace – mean normalised number of fixations for face ROIs; FixBody – mean normalised number of fixations for body ROIs; FixContext – mean normalised number of fixations for context ROIs; FixDurFace – mean fixations duration for face ROIs; FixDurBody – mean fixations duration for body ROIs; FixDurContext – mean fixations duration for context ROIs; LJ – participants' mean liking judgement SF – number of salient features in the context.

Table 2.7

Means, standard deviations, and Pearson's r correlations with confidence intervals between mean normalised number of fixations for each ROI with participants' scores in the battery of cognition tests (N = 24).

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. FixFace	40.17	6.99							
2. FixBody	7.09	1.15	-.91** [-.96, -.80]						
3. FixContext	0.14	0.04	-.66** [-.84, -.35]	.34 [-.07, .66]					
4. ATN: ORIENT	23.21	66.84	-.13 [-.51, .28]	-.08 [-.46, .34]	.45* [.05, .72]				
5. ATN: ALERT	25.19	34.57	.10 [-.32, .48]	-.10 [-.48, .32]	.01 [-.39, .41]	.02 [-.39, .42]			
6. ATN: EXEC	67.49	45.94	-.09 [-.47, .33]	-.05 [-.44, .37]	.11 [-.30, .49]	.22 [-.20, .57]	.30 [-.12, .63]		
7. 3-BACK: SPATIAL	40.62	24.98	.48* [.09, .74]	-.58** [-.80, -.23]	-.17 [-.53, .25]	.06 [-.35, .46]	.10 [-.31, .49]	.16 [-.26, .53]	
8. 3-BACK: VERBAL	48.50	28.33	.39 [-.01, .69]	-.48* [-.74, -.09]	-.18 [-.54, .24]	.08 [-.34, .47]	.06 [-.35, .46]	.14 [-.28, .52]	.87** [.71, .94]

Note. * indicates $p < .05$; ** indicates $p < .01$. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. FixFace – mean normalised number of fixations for face ROIs; FixBody – mean normalised number of fixations for body ROIs; FixContext – mean normalised number of fixations for context ROIs; ATN: ORIENT – orienting component of the Attention Network Test; ATN: ALERT – alerting component of the Attention Network Test; ATN: EXEC –executive component of the Attention Network Test; 3-BACK: SPATIAL – visuospatial version of 3 – back task; 3-BACK: VERBAL – verbal version of 3 – back task.

Table 2.8

Means, standard deviations, and Pearson's r correlations with confidence intervals between mean fixations duration for each ROI with participants' scores in the battery of cognition tests (N = 24).

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. FixDurFace	330.78	40.46							
2. FixDurBody	251.60	32.83	-.20 [-.56, .22]						
3. FixDurCotext	159.40	50.04	-.16 [-.53, .26]	.50* [.12, .75]					
4. ATN: ORIENT	23.21	66.84	.13 [-.29, .51]	.35 [-.06, .66]	.38 [-.02, .68]				
5. ATN: ALERT	25.19	34.57	.27 [-.15, .61]	-.14 [-.51, .28]	.12 [-.30, .50]	.02 [-.39, .42]			
6. ATN: EXEC	67.49	45.94	.36 [-.05, .66]	.06 [-.35, .45]	.27 [-.15, .61]	.22 [-.20, .57]	.30 [-.12, .63]		
7. 3-BACK: SPATIAL	40.62	24.98	.14 [-.28, .51]	-.25 [-.59, .17]	-.24 [-.59, .18]	.06 [-.35, .46]	.10 [-.31, .49]	.16 [-.26, .53]	
8. 3-BACK: VERBAL	48.50	28.33	.01 [-.39, .42]	-.27 [-.61, .15]	-.20 [-.56, .22]	.08 [-.34, .47]	.06 [-.35, .46]	.14 [-.28, .52]	.87** [.71, .94]

Note. * indicates $p < .05$; ** indicates $p < .01$. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. FixDurFace – mean fixations duration for face ROIs; FixDurBody – mean fixations duration for body ROIs; FixDurContext – mean fixations duration for context ROIs; ATN: ORIENT – orienting component of the Attention Network Test; ATN: ALERT – alerting component of the Attention Network Test; ATN: EXEC –executive component of the Attention Network Test; 3-BACK: SPATIAL – visuospatial version of 3 – back task; 3-BACK: VERBAL – verbal version of 3 – back task.

2.3.6 The association of spectatorship with cognitive abilities

Performance on the ANT and the verbal and spatial 3-back tasks was correlated with participants' normalised mean fixations and fixation duration, averaged across all paintings (see Table 2.7 and 2.8). Two facts are worth noting. First, there is evidence that attentional orienting is positively associated with fixations to the context. Second, there is evidence that performance in the verbal and spatial 3-back task is negatively correlated to normalised mean fixations to the body but positively associated with fixations made to the face. The correlations are not corrected for multiple comparisons.

2.4 Discussion

The present study provides evidence in support of four key findings with respect to spectatorship when naïve beholders rated their liking of portraits. First, fixations to portraits are primarily made to faces rather than to bodies or the context, with these fixations being of long duration. Moreover, first fixations were typically made to the face rather to the body or context. Second, the presence of salient features in the context increased the number of fixations to faces (but not bodies) and reduced fixations to the context. Third, the sitter's gaze influenced the length of fixations to faces but only when salient features were not present in the context. Fourth, better attentional orienting was associated with increased numbers of fixations to the context, and better ability to maintain task focus was associated with shifting fixations from bodies to faces. Finally, considering all portraits together, the number of salient features in the context also predicted spectators liking of portraits. We now consider what these findings mean in relation to the hypotheses laid out in the Introduction.

The spectatorship of portraits by naïve beholders is dominated by fixations to faces. In fact, dividing normalised fixations shows that fixations to faces were 286 times more

likely than to the context. This difference is further magnified by the fact that fixations to faces had longer fixation durations than those made to either bodies or contexts. Faces are known to capture attention in visual search type experiments (see Bindemann & Lewis, 2013) but the images of paintings used in the present study are quite different stimuli to those used in visual search studies. More broadly, the images of paintings used in the present study are very different from the photographs used in many other visuo-cognitive experiments, as pictorial artworks are not photographs or representations of moments in time in the real world. Furthermore considered in terms of their representation of faces, faces in painted portraits tend to exhibit proprieties different from those shown in photographs (e.g. Costa & Corazza, 2006; Graham, Pallett, Meng, & Leder, 2014; Hayn-Leichsenring, Kloth, Schweinberger, & Redies, 2013; Humphrey & McManus, 1973; Schirillo, 2007). Despite these differences, the present study supports the findings of Massaro et al. (2012) in confirming the over-riding importance of faces when naïve spectators attend to painted portraits.

The fact that we report faces to exert such a striking influence on spectatorship of portraits must be understood in a specific context. For the most part participants in experiments rarely view images for longer than is required to achieve some functional goal (i.e., to find or recognise a face). However, paintings do not exist to achieve a simple functional goal or to be viewed in the minimum possible time. Rather they are often stylised, have aesthetic value, and are intended to be the subject of prolonged visual exploration and judgement. The participants in the present study we able to explore the images for as long as they wished before rating them. The fact that faces captured attention in the present study is striking in that the act of spectatorship might be thought of as implicitly encouraging exploration beyond faces to the context.

The importance of this finding would be compromised if faces always appeared at the same position in relation to the initial fixation cross. The position of the fixation cross was centred on the screen and most likely to be within the body ROI of the paintings following its offset. This being the case, the position of the initial fixation cross cannot have benefitted the face over the body. The point to conclude is that the evidence of attentional capture by faces in portraits is not compromised by the position of faces relative to centred fixation cross.

In contrast to the fact that the evidence of a raised fixation rate to faces is not compromised by the position of faces in portraits, the same is not true for fixations to bodies. We had no specific predictions with respect to fixations to bodies but the data showed bodies to be fixated less than faces but more than contexts. The fact that the fixation cross tended to sit within the area of the body ROI raises the possibility that the raised fixations to bodies relative to the context is an artefact of the initial fixation, post the offset of the fixation cross. The likelihood that this is the case is raised by virtue of the fact that the individual difference data show task focus to be negatively associated with the number and length of fixations to bodies.

To provide some relevant data, Figure 2.4 plots the probability of fixating the body and face as a function of number of fixations made to the paintings. Figure 2.4 confirms the early capture of attention by faces. However, it does not suggest the fact that bodies are fixated immediately after stimulus onset. In fact, fixations to bodies peak around the fifth fixation. We conclude that the evidence of raised fixation probability to the bodies is not compromised by their position with respect to the fixation cross. In other words, fixations to the bodies are more likely than to the context, but not as great as to faces.

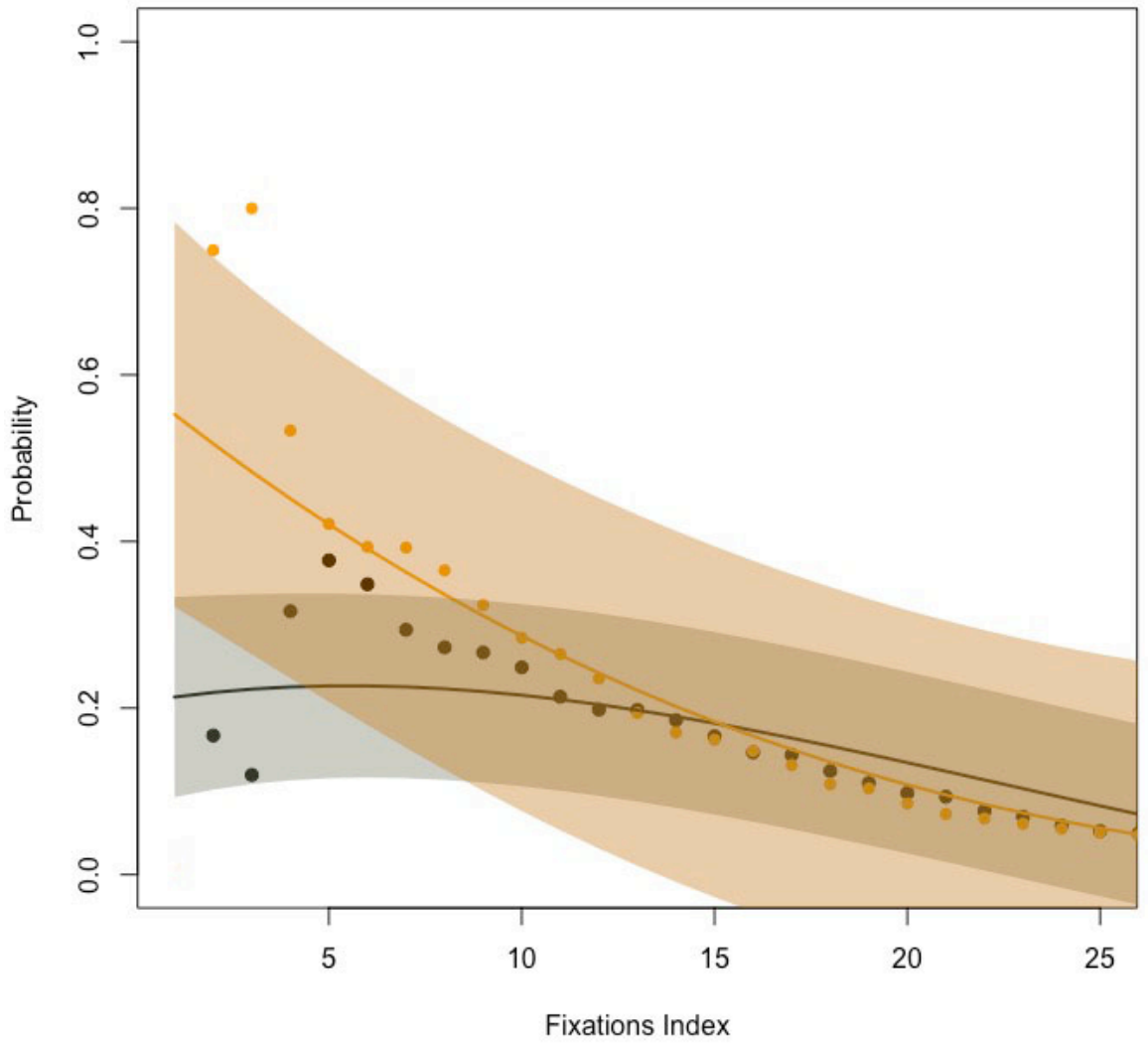


Figure 2.4. Probability of sampling information from the body (black line) and face ROIs (orange line). The shading area around function refers to 95% confidence interval.

The presence of salient features in the context of portraits raised fixations to the face more than to the context itself. Salient features in the context may have attracted attention for those participants with a propensity to orient attention. It is important to remember that in this study we used evidence of salient features as a proxy measure for artefacts (i.e. objects, buildings etc.) but it is neutral in respect of the scene/object semantics associated with the presence of artefacts in the context. It seems likely that the

coherence in the arrangement of artefacts in the context provides a gist in which to consider the sitter. Gist is typically thought of as being computed early in scene inspection from rapidly computed low spatial frequency information such that eye movements are made to informative locations within the scene (Castelhano & Henderson, 2008; Oliva & Torralba, 2006; Rayner, 2009). What the current study suggests is that naïve spectators of portraiture do not prioritise the inspection of contextual information but process it as a scene gist. The existence of objects and places in the gist provides an important contribution to the experience of the spectator. In fact, the more salient features present in the gist, the more the spectatorship is focussed on the face, and liking increased. To provide some relevant data, we have conducted additional analysis and found that there was a positive relationship between total viewing time and a number of salient regions in the context ($r = .40$, $p < .001$, 95% CI [0.20, 0.49]). In other words, contextual information, even when not directly inspected contributes to the act of spectatorship by extended viewing time at the paintings. It is noteworthy that recent models of visual search that also consider issues from scene perception place selective search in a distinct processing pathway from gist processing (Wolfe et al., 2011). Relating this model to the present case of the naïve spectatorship of portraiture suggests faces are captured by attention in the selective pathway and the gist is processed in the non-selective pathway.

Sitter gaze exerted strikingly little influence on the eye movements performed to faces or contexts during spectatorship. We hypothesised that gaze ambiguity would allow increased inspection of the context, in part because of the challenge that such gaze poses for determining the sitter's focal point of attention (see Donnelly et al., 2017, experiment 2). However, no such effect was found. One conclusion we draw is that when determining liking, the spectatorship of naïve spectators does not automatically follow gaze or seek to establish foci of attention from gaze. It is, however, important to note that the task used in

the present study required only determining liking, and the failure to show gaze as important does not mean that spectators are always insensitive to gaze. Previously we have reported gaze ambiguity to increase fixations to the eye region relative to those not displaying ambiguity (Donnelly et al., 2017) when asked to consider how sitters 'address' spectators.

What emerges from this study is an account of the spectatorship of portraits by naïve beholders that is subject to the influence of attentional capture by faces, but also by the processing of scene gist. We make one further point in relation to this conclusion. It might have been that faces were prioritised by spectators but that, given time, they would also attend more to the context. If this was the case, and participants felt rushed to make their liking judgements, then it would change our conclusion from one of overall strategy to one of time-course. With respect to this point we refer back to the study of Locher et al. (2007) and the fact that the mean time to make a decision in the present study was 4.67 sec. While enforcing a longer viewing time might have increased fixations to the context, we suspect that this would probably not happen. Enforcing prolonged viewing would probably not change the overall pattern of spectatorship (see Locher et al., 2007; for a related finding in relation to searching for improvised explosive devices in the real world scenes Godwin et al. 2015).

We do not know if the present results would generalise to the presentation of real portraits in actual galleries as opposed to digital reproductions on a monitor. Many factors are different across these two modes of presentation (i.e. visual angle, stimulus size, texture, body and head movements, initial point of fixation, material presence, atmosphere etc.). These are general concerns that might be raised of any study showing paintings to participants via a computer screen. What we can say is that it is for future studies to explore whether these factors transform naïve spectatorship such that its strategy is

qualitatively different from that described in this study. Our intuition is that viewing portraits in a gallery may not lead to data much different from those generated in the present study.

There is one piece of evidence that is pertinent to the issue of the inspection of faces in the context of a painting viewed in a gallery setting is from Harland et al. (2014) study of inspection of the Bar at the Folies Bergère. In that study, participants were asked to describe the painting, as their eye movements were measured. The task implicitly opened up the issue of the inspection of the whole painting. The data showed that, for naïve spectators, the face of the woman who is the focus of the painting dominated viewing (see Figure 3A in Harland et al., 2014), with patterns of inspection often moving between the triad of the woman, her reflection, and that of a man set to the right of the painting. Despite changes in task and context of the display of the image between that study and the present one, the fundamental importance of the face to rating liking and evaluating the paintings remained similar.

Some may consider that the results presented here represent findings that relate only to the portraits used here, or more precisely, are affected by the selection of paintings by three artists that formed the stimulus set. The works were chosen from artists where, together, the set of images would form works from roughly the same period, working within the same style (Fried, 1996, 407-412); have a range of types of contexts from busy to sparse, gaze would vary from ambiguous to focussed. Any systematic variation across artists was controlled statistically rather than through the partial selection of images. Moreover, our participants were naïve to pictorial artworks and ill-informed as to specific artists and their works, status, place in art history, etc. We found no evidence to suggest that specific items drove the effects reported in our analyses despite works from each artist

sitting within each of the four categories formed from the presence or absence of salient features in the context and focussed or ambiguous gaze.

It is right, however, to be cautious in drawing conclusions. Three issues might limit the generality of the findings. First, it might be that the dominance of faces and the effect of salience on inspection of faces on spectatorship would be different in more abstract paintings. In particular, atypical face shape (e.g. Modigliani, *Madame Zborowska,* 1918), organisation (e.g. Picasso, *Portrait of Ambroise Vollard,* 1910), and threatening facial expressions (e.g. Bacon, *Study after Velazquez Portrait of Pope Innocent X*, 1953) may reduce attentional capture. Likewise, gist processing may be impeded by abstract representations of scene structure (e.g. Chagall, *The Blue Circus,* 1950), colouring (e.g. Matisse, *Harmony in Red,* 1926-27), and depth (e.g. Picasso, *Jacqueline in Turkish Costume*, 1955). It would be interesting for further studies to determine if the findings we report in the present study generalise to these types of portraits.

The second reason to be cautious about the findings is that the present data reveal the viewing strategy used by naïve beholders when rating their liking of portraits. The ratings taken in the present study were judgements of whole paintings. Schulz and Hayn-Leichsenring (2017) suggest that the physical beauty of a sitter's faces, as distinct from the rest of the painting, is also important in determining liking. If participants had interpreted our instructions as one of determining facial beauty alone then it is likely that the importance of salient features in the context would, we suggest, have been minimal as a result of enhanced selective attention to faces.

The third reason to be cautious about the findings relates to the sample in the present study. The sample was not balanced by gender and some have claimed gender to be important in aesthetic experience (Chatterjee & Vartanian, 2014). Nevertheless, Smith

and Smith (2001); Smith, Smith, and Tinio (2017); Tröndle, Kirchberg, and Tschacher (2014) found no evidence of an effect of gender on viewing time on paintings.

There are also a number of methodological issues that might be important to consider. First, our estimates of gaze ambiguity were determined from participant ratings. This seems appropriate given that what is of concern is our experience of gaze. Nevertheless, it might be that gaze should be measured more formally using geometrical analyses (e.g. Todorović, 2006). Second, participants were given as long as they wished in which to rate their liking of paintings. The use of an unlimited viewing period was to simulate the conditions of picture inspection in a gallery context. It is possible that using a fixed viewing time might have led to different gaze behaviour. In the absence of actual data, we would hypothesise that truncating viewing time would increase the focus on faces, making the findings in relation to faces more extreme than those reported in the presented study (see Figure 2.4).

The viewing strategy of naïve participants suggests that they view portraits by focussing on faces with the context providing a gist. The data open up a range of questions about spectatorship by more expert viewers. Two questions in particular strike us as worthy of future study. First, is expertise manifest in focussed attention being allocated to contexts rather than being allocated to faces? If the answer to this question is “yes” then this suggests that experts have some ability to control and overcome more reflexive aspects of visual function when viewing paintings. In turn, if this is the case, then a second, follow-up question pertains to whether there is a time-course to the allocation of attention to different aspects of the painting. For example, it seems at least possible that experts may initially allocate attention to faces, and only later transfer attentional resources to other aspects of the painting within the context. Exploration of these questions is beyond the

scope of the present study but stating them provides a clear direction for future experiments investigating the influence of expertise on the spectatorship of portraiture

2.5 Rationale and research aims for Chapter 3

Chapter 2 provides evidence that the majority of the fixations are made to the faces and bodies during spectatorship of portraits and little focus is made to the painting's context. There are two main limitations of the approach presented in Chapter 2. First, Chapter 2 explores only the aesthetical part of the spectatorship process. In the present thesis, spectatorship was defined as an act of looking that leads to an aesthetic experience and a representation stored in memory. Chapter 2 does not address the *stored memory* aspect of proposed framework; it is Chapter 3 that addresses the question about the importance of paintings properties to representation stored in memory formed during the act of spectatorship.

The second limitation of Chapter 2 is that it examined the spectatorship of portraits which are a specific type of representation paintings. The limited focus on the context region reported in Chapter 2 may be driven not only by the task but also by the type of stimuli which were used. To overcome this issue, in the following chapter naïve participants were asked to encode a set of representational paintings drawn from five motif categories, which reflects much complex narration than the portrait's motif. Furthermore, in the following chapter, face and body areas were unified into the theme area, which reflects the core narrative of the painting's motif. The context region was defined as an area beyond the theme which is in line with the approach presented in Chapter 2. I hypothesize that by changing the task and type of stimuli, the objects included in the context of representational paintings could be potentially more attended than those presented in the context area of portraits.

Following the visuo-cognitive framework proposed in Chapter 1, Chapter 3 examines to what extent naïve viewers use basic visual routines to construct memory representation of the painting. Specifically, it focuses on two fundamental questions. First, to which extent the information sampled from theme and context form memory representation of the painting. Second, whether the visual strategy observed during making liking judgment by naïve viewers is different from those presented when encoding and later discriminating seen paintings from foils.

Chapter 3

Memory Representations of Paintings are Contributed to by Eye Movements made to the Theme but not the Context

3.a Abstract

The eye movements made by naive participants when encoding and later discriminating seen representational paintings from foils was explored in two experiments. In Experiment 1, eye movements were recorded as participants viewed 100 paintings for later discrimination from foils. The results showed that eye movements made at encoding to the theme but not the context were associated with discrimination accuracy. These results held even when encoding was preceded by presentation of a Navon figure in a randomised position the identity of whose global or local letter had to be reported after encoding of the painting had finished (Experiment 2). The results are interpreted as showing the importance of making direct fixations to the theme, but not the context, when forming memory representations of paintings.

3.1 Introduction

The viewing (henceforth spectatorship) of a painting leads to an aesthetic experience and a representation stored in memory (Cupchik et al., 2009). Aesthetic experience is usually measured using a rating scale reflecting liking (Kapoula & Lestocart, 2006; Nodine et al., 1993; Pihko et al., 2011; Zangemeister et al., 1995). Memory representations are measured in a discrimination paradigm where the target paintings stored at encoding are distinguished from foils (Ishai, Fairhall, & Pepperell, 2007; Vogt & Magnussen, 2007; Yago & Ishai, 2006). In this study we focus on two basic questions. First, what information is sampled to form memory representations of paintings at encoding? Second, how is the information sampled at encoding related to later discrimination accuracy? These questions are explored by measuring eye movements made when initially encoding paintings and when later discriminating them from foils.

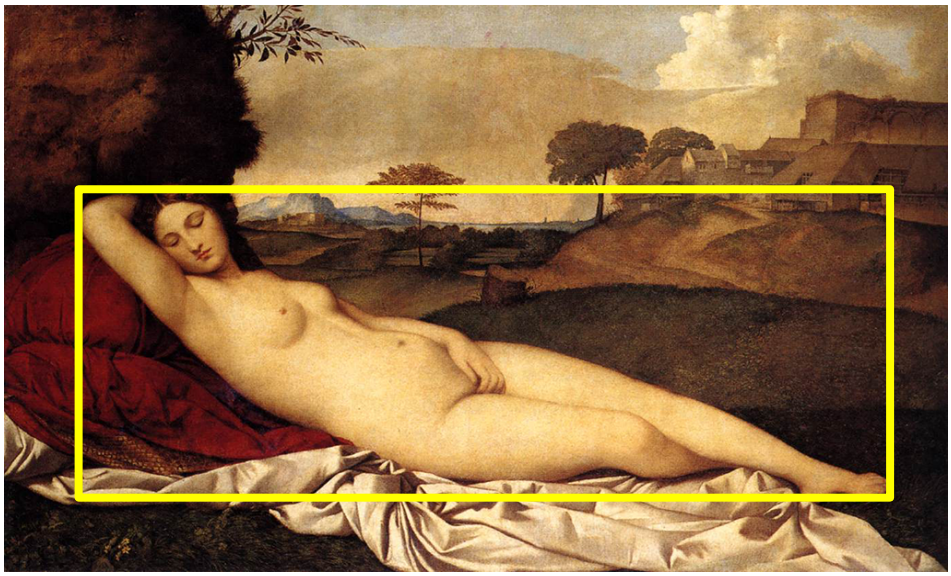


Figure 3.1. Giorgione, *The Sleeping Venus* (c. 1509-1510). The rectangle indicates the theme area.

The spectatorship of paintings is not an exhaustive sampling of all available visual details (Locher et al., 2007). There is, however, structure to the eye movements made

during the spectatorship of paintings. One distinction that helps to clarify this structure is between a spatial region that contains information detailing a paintings primary theme and its context (see Figure 3.1). The theme is usually in the geometric centre of the painting, placed in the foreground, and highlighted by luminance and hues[7] and presents the core narrative of the painting (which typically focuses on human figures). As a result of all of these factors, eye movements made by naïve spectators tend to be made towards the theme rather than the context, and the available experimental data in relation to the making of aesthetic judgements is consistent with this being the case (Locher et al., 2007, 2015; Massaro et al., 2012; Nodine et al., 1993; Pihko et al., 2011).

A striking example of the dominance of the theme in attracting fixations during spectatorship is portraiture. In the case of portraiture, the context captures information about the place and environment in which human figures are presented. The context adapts the theme to the place, environment and historical circumstances of the painting. Experimental evidence shows that the majority of fixations to portraits are made to the faces of the sitters, at least when making aesthetic rating judgements (Massaro et al., 2012; see also Chapter 2). Those fixations that are made to the context, tend to be made to salient features in the context, but only for paintings which do not depict people (Fuchs et al., 2011).

In the present study, we explore if the strategy of sampling from the theme rather than the context is also present when spectatorship is aimed at encoding paintings into

[7] The four pictorial techniques that achieve this effect: *sfumato, cangiante, unione,* and *chiaroscuro* (Hall, 1994). Sfumato creates an image that has no line or edges, which may expose the theme from the background. For Cangiante mode, the theme area is exposed by light and bright colour. Using unione technique, artist attempts to create a slow gradation of colours between theme and background area but unlike sfumato, deploying high-saturated colours. The chiaroscuro technique exposes them area by changing hue in order to depict shadows and highlights the main figures.

memory so that they can be discriminated from foils at a later time. While it might be that the eye movements made during spectatorship of paintings are unaffected by its goal, this cannot be taken for granted. There are at least two reasons why eye movements made during acts of spectatorship aimed at encoding paintings into memory might be different from those made when making aesthetic rating judgements. First, when encoding paintings into memory, it is important to sample as much information as will help in discrimination, and this may include fixations to the context (e.g. Castelhano & Heaven, 2010; Castelhano, Mack, & Henderson, 2009; Hollingworth, 2009 for a related findings with respect to visual search and scene perception), but this need not be the case when determining liking. Second, the features and objects shown in the theme of representational paintings are known to repeat across paintings. Repeating themes across paintings form categories (Minissale, 2013, pp. 37 – 43; Rosch, 1999, pp. 190 – 203) that are referred to as motifs[8] defined by paintings with similar semantic and structural features (Panofsky, 1987, pp. 40 - 55). Much like other visual categories, the individual paintings within a motif category can be thought of as exemplars. Viewing exemplars from categories might benefit from fluent processing and associated hedonic marking (Belke, Leder, Strobach, & Carbon, 2010), a sense of familiarity through mere exposure (Cutting, 2003), and the representation of an average (Kass et al., 2015). To the extent that spectators are aware of instances and categories, this may influence their spectatorship by allowing them to focus on features that differentiate paintings rather than features than reveal the similarity between paintings.

[8] Commonly used motifs are the 'Bathers' (e.g. Walker, *The Bathers*, 1865; Seurat, *Bathers at Asnieres*, 1884; Cezanne, *The Bathers*, 1906), 'Venus' (e.g. Botticelli, *The Birth of Venus*, c. 1480; Velazquez, *The Rokeby Venus*, c. 1650; Picasso, *Venus and Love,* 1967), or 'Judith' (e.g. Cranach, the Elder, *Judith with the Head of Holoferenes*, c.1530; Caravaggio, *Judith Beheading Holofernes*, 1599; Klimt, *Judith and the Head of Holofernes*, 1901).

Over time this might lead spectators to explore the context more as they become aware of how the themes repeat.

To explore the spectatorship of representational paintings for later recall by naive participants, participants were asked to view paintings in an initial encoding phase so that they would be able to later discriminate them from other paintings. Participant eye movements were recorded during initial encoding in the viewing phase and during the discrimination session. If spectatorship at encoding for later discrimination is similar to that when making aesthetic judgements, then fixations to the theme should dominate our viewing of paintings. The alternative is that participants hope to aid discrimination with a more complete initial encoding of paintings, specifically with increased sampling of the context to aid discrimination.

3. 2. Experiment 1

3.2.1 Method

3.2.1.1 Participants. Participants were 13 undergraduate students (2 males and 11 females; $M = 19.54$, $SD = 2.91$) from the University of Southampton, an opportunity sample who were recruited through an online system for advertising studies and received course credits to compensate for their time. Expertise in art was measured with an art knowledge questionnaire translated to English (see Chapter 2) from the original German version of the questionnaire (Jakesch & Leder, 2009). Participant knowledge about art was in the first quartile of the possible scores ($M = 7.23$ [out of 48]; $SD = 4.83$) with an upper score of 18. The participants were therefore classified as naïve.

3.2.1.2 Apparatus. Stimuli were presented on a View Sonic graphics Series G225f CRT monitor with screen size 40 cm x 30 cm in a darkened room. Participants were seated at a distance of 70 cm giving a visual angle of 30.11° by 23.75 ° for the screen. Screen

resolution was 1024 x 768 with a refresh rate of 120 Hz. Viewing was binocular, though the only movements of the right eye were recorded using an SR Research Limited Eye-Link 1000 eye tracker operating at 1000Hz. Head movement was stabilized using a chin and headrest. Participants responded by pressing one button on a four buttons response box.

3.2.1.3 Stimuli. The 150 high-resolution paintings reproductions were uploaded from the Google Image Search (Appendix C). All signatures were removed using Adobe Photoshop CS6. Each painting was split into regions of interest (ROIs) of theme and context. The area covered by people, in the central part of the foreground on the painting was defined as theme ROIs (see Locher et al., 2007 for a further discussion). The area of the painting beyond the theme ROI was defined as the context. Themes and contexts covered, on average, 58% and 42% of the area of paintings respectively. Paintings were presented centrally on the screen against grey backgound. The height varied between 7.81 and 27.09 cm on the screen and giving a visual angle between 6.35° and 21.79°. Widths varied between 11.38 and 20.32 cm this created visual angles between 16.17° and 28.48°.

The set of paintings consisted paintings taken from five motifs categories: Three Graces, Judith, Bathers, Odalisque, and Venus. Paintings within each motif category are visuo-semantically related. For example, the theme regions in the motif of Judith always show a woman with a severed man's head (Holofernes) and the tool used its decapitation (Figure 3.2).

Figure 3.2. Examples of paintings used in the present study, which belongs to motif of Judith. From the right: Titian, *Judith (Salome)* (c. 1515); Catena, *Judith and Holofernes* (1525); Giorgione, *Judith* (1504).

3.2.1.4 Design and Procedure. The design of experiment was the within-subjects for encoding, with the independent variables of regions of interest (2: theme and context). The within-subjects design was also applied in discrimination session, with the independent variables of regions of interest (2: theme and context), and Test Item (2: old paintings which were presented at encoding session and new paintings). Number of fixations, mean fixation duration and total fixation duration in each session and accuracy of painting discrimination were the dependent variables.

Participants took part in encoding and discrimination sessions. In the encoding session, participants were asked to try to remember each of the one hundred paintings for later recall in the discrimination session. Trials started with a fixation point centred on the screen. Once this point was fixated, a painting was presented and remained on the screen until a response indicated that they had finished viewing (M = 4.62s, SD = 4.23s). These responses were made via pressing a button on a response box. The inter-trial interval was 500 ms.

Of these paintings displayed in the encoding session, there were 20 from each of the five motif categories and the presentation order of paintings was randomised. The break between encoding (around 25 min) and discrimination (around 15 min) session was 30 minutes. During the break participants completed a battery of cognitive and psychological tests, which we do not report here[9].

Fifty paintings shown during the encoding session and fifty new paintings were presented in a randomized order during the discrimination session. There were 20 paintings for each category of motif, of which ten were previously seen paintings, and ten were new paintings. Participants were asked to judge whether they had seen the painting in the encoding session or not. Each participant judged the same set of the paintings during discrimination session. Once the fixation point was fixated a painting was presented and remained on the screen until a response was made (M = 2.46 s, SD = 1.92 s). Responses were made via pressing one of two buttons on a response box.

Eye movements were recorded during both encoding and discrimination sessions. Each session began from nine-point calibration. The eye tracker was calibrated to less than 0.5^0 error.

3.2.2 Results

Data was analysed across ROI (2: theme vs. context). The fact that paintings consist of different visual features and artistic styles create a challenge for the analyses. We analysed data using Linear Mixed-effects Models (LMMs) for eye movement to overcome

[9] The standard battery of cognitive and psychological tests was used across all experiments described in Chapter 3-5. In contrast to Chapter 2, Chapters 3 – 5 used the same experimental paradigm. Due to the rising issue of statistical power in studies exploring the effect of individual differences (Maxwell, 2004; Yarkoni, Braver, 2010), the summary analyses of the association between spectatorship and basic cognitive functions are presented in Chapter 6 (see section 6.2.5).

potential difficulties associated with paintings visual properties. The data were processed in R version 3.5.0 (Team R Core, 2016). Models were fitted using the lmer4-package (Bates et al., 2014) and MASS-package (Venables & Ripley, 2002). The random effects were structured for items and participants including slopes for all fixed effects and correlation. The full random structure was trimmed down for those models that did not converge or had a correlation equal zero or one[10]. The *t*-values equal to 1.96 or higher were interpreted as significant because for high degrees of freedom the *t* statistic in LMMs approximates the *z*-statistic (Baayen et al., 2008).

The results are structured to consider the (a) eye movements in encoding and discrimination sessions, and (b) the relationship between accuracy in discrimination of paintings and eye movements at encoding. We report the eye movements in the discrimination session of the experiment but we make no specific prediction in relation to these data. Analyses of eye movements' data were conducted using number of fixations, mean fixation durations, and total fixation durations (as a sum of all fixation durations in each ROI). Table 3.1 and 3.2 presents means and standards deviations for each condition in the encoding and discrimination sessions.

[10] For eye movement measures the random structure for the LMM for log-transformed normalised number of fixations was (1+ROIs | Subject) + (1+ROIs | Stimuli), log-transformed fixation duration and log-transformed total fixation duration was (1+ROIs | Subject) + (1 | Stimuli). With respect to discrimination session the random structure for the LMM for log-transformed normalised number of fixations and log-transformed total fixation duration was (1 | Subject) + (1 | Stimuli), for log-transformed fixation duration was (1 + Test item| Subject) + (1 | Stimuli).

Table 3.1

Mean (and Standard Deviation) Eye Movement Measures for each ROIs area in encoding and discrimination session for the Experiment 1.

	ROI			
	Theme		Context	
ROI	*M*	*SD*	*M*	*SD*
Mean no. fixations				
Encoding	24.77	17.83	6.68	8.22
Discrimination	11.97	7.65	5.71	6.84
Mean fixation duration [ms]				
Encoding	279.81	56.45	257.53	88.61
Discrimination	240.61	42.61	244.36	73.59
Total fixation duration [ms]				
Encoding	6622.24	4166.48	1741.83	2155.58
Discrimination	2825.21	1793.97	1460.84	1887.68

Note. The mean and standard deviation is calculated across participants.

.

Table 3.2

Mean (and Standard Deviation) Eye Movement Measures for each ROIs area as a function of presentation and accuracy in discrimination session for the Experiment 1.

	Test Item		Response Accuracy	
Number of Fixations	Old	New	Correct	Error
Theme	10.49 (6.68)	13.39 (8.24)	11.81 (7.62)	12.63 (7.74)
Context	6.09 (6.25)	5.47 (7.20)	5.50 (6.53)	6.77 (8.23)
Mean Fixation Duration (ms)				
Theme	243.43 (47.26)	237.90 (37.44)	240.08 (42.90)	242.89 (41.36)
Context	248.91 (73.42)	241.50 (73.67)	242.90 (72.60)	251.73 (78.46)
Total Fixation Duration (ms)				
Theme	2489.09 (1531.99)	3148.14 (1961.41)	2780.58 (1781.85)	3016.42 (1836.41)
Context	1573.79 (1742.05)	1389.71 (1973.52)	1392.55 (1769.15)	1804.91 (2381.68)

Note. The mean and standard deviation is calculated across participants.

3.2.2.1 Outliers and Exclusion. Fixations shorter than 60 ms or longer than 1200 ms were removed. Fixations that coincided with display onset or the response were also removed. This led to 3% of data being excluded for the encoding session and 3% of data being excluded for the discrimination session. The final data set consisted of 38187 fixations in the encoding session and 16924 fixations in the discrimination session.

3.2.2.2 Data Normalization. All eye movement data were log-transformed to normalise the data distribution. The number of fixations was normalised by the theme and context ROIs area (i.e. the number of fixations made to the theme/context was divided by the size of the area of the theme/context). The eye movement made to context or theme ROIs were divided by area of context or theme (determined by pixels), respectively for each painting.

3.2.2.3 Encoding Session. With respect to the number of fixations, participants made more fixations to the theme than the context ROI (b = 1.50, SE = 0.08, t = 19.28). With respect to mean fixation duration, participants made longer fixations to the theme than the context ROI (b = 0.06, SE = 0.02, t = 3.06). The total fixation duration was longer to the theme than context ROI (b = 1.86, SE = 0.07, t = 26.86). In sum, more and longer fixations were made to the theme than the context ROI.

We also explored the time course of sampling information from the theme and context ROIs during encoding session. The probability function of looking to the context was calculated across all trials for first twenty-five fixations made to each painting (Figure 3.3). The probability of fixations to the theme ROI is the inverse of these data. The probability of fixating the theme is highest immediately post onset whereas the probability of fixating the context peaks at around tenth fixations.

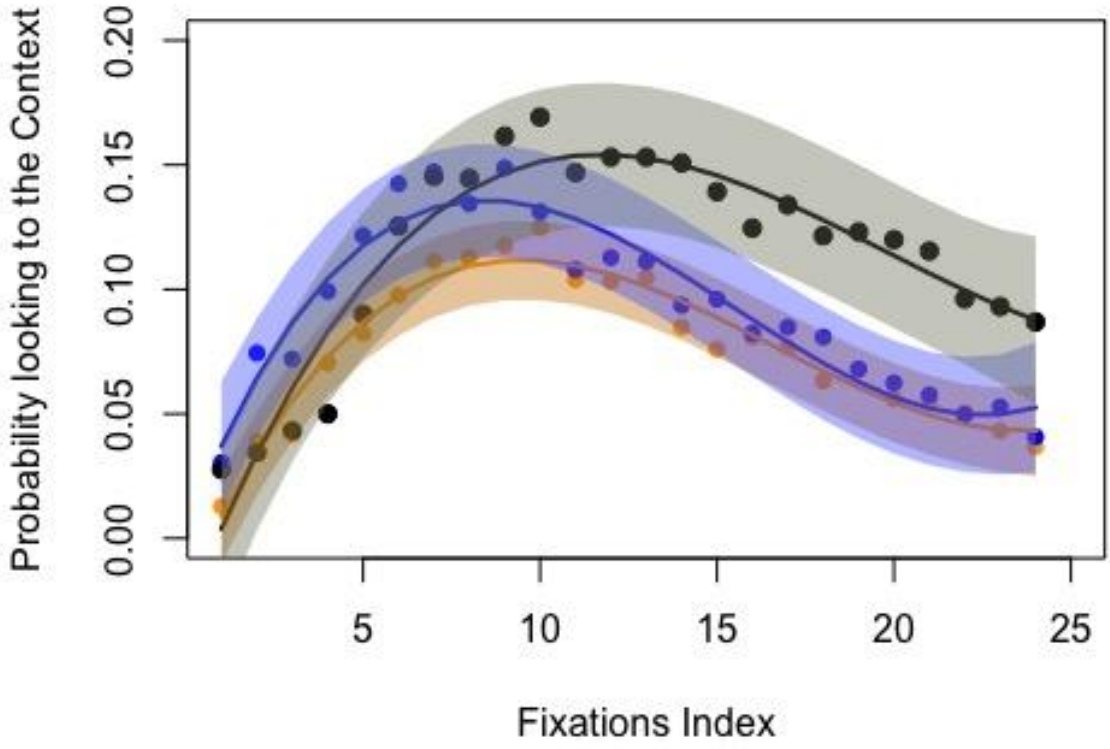


Figure 3.3. Probability of sampling information from the context during the encoding session in Experiment 1 (black line), global and local condition in Experiment 2 (blue and orange line, respectively). The shading area around function refers to 95% confidence interval.

3.2.2.4 Discrimination Session. Two additional fixed factors were added to the model: Test Item (2: old vs. new) and Response Accuracy in the discrimination session (2: correct vs. error).

With respect to the number of fixations, participants made more fixations to the theme than to the context ROI (b = 1.35, SE = 0.05, t = 27.17). The number of fixations was higher when making incorrect than correct responses (b = 0.21, SE = 0.11, t = 2.01). The interaction between Test Item and ROI was significant. The difference between

fixations made to the theme and context was greater for new than for the old paintings (b = - 0.35, SE = 0.08, t = - 4.45). No other interactions reached significance (ts < 1.71).

With respect to mean fixation duration, no main effects or interactions reached significance (ts < 1.80).

With respect to total fixation duration, participants fixated the theme longer than context ROI (b = 1.56, SE = 0.05, t = 30.57). Total fixation duration was longer to the new than old paintings (b =0.20, SE = 0.07, t = 2.72; M = 2614.33, SD = 2124.13; M = 2285.69, SD = 1625.20; respectively). The interaction between Test Item and ROI was significant. The difference in total fixation durations to theme and context was larger for new than old paintings (b = - 0.44, SE = 0.08, t = - 5.51). No other main effects or interactions reached significance (ts < 1.53).

3.2.2.5 Discrimination of Paintings. The hit and false alarm rates were used to create measures of sensitivity (d') and bias (c; Macmillan & Creelman, 2004). The eye movement measures correlated with sensitivity and bias scores (see Table 3.3). Sensitivity was positively associated with the total fixation duration and the number of fixations made to theme and context. Bias was negatively associated with the total fixation duration of fixations made to the context.

A multiple regression was performed to explore if sensitivity at discrimination was predicted by the number of fixations made to the theme and context ROIs at encoding. Fixations to the theme were entered in the first step as a significant predictor of sensitivity (Table 3.4). The number of fixations made to the context ROI was not entered into the equation at step 2 of the analysis.

.

Table 3.3

Means, standard deviations, and correlations with confidence intervals for gaze behavior in encoding session and memory to the paintings in Experiment 1.

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. Sensitivity (*d'*)	1.33	0.51							
2. Bias (*c*)	-0.10	0.42	-.63* [-.88, -.12]						
3. NF_Theme	8.57e-05	5.12e-05	.74** [.28, .91]	-.27 [-.71, .33]					
4. FD_Theme	279.81	30.05	-.23 [-.69, .37]	-.19 [-.67, .41]	-.54 [-.84, .01]				
5. TFD_ Theme	6622.24	3384.93	.79** [.42, .93]	-.44 [-.80, .15]	-.30 [-.73, .30]	.96** [.86, .99]			
7. NF_Context	2.39e-05	1.11e-05	.72** [.32, .92]	-.37 [-.77, .23]	-.45 [-.80, .13]	.93** [.76, .98]	.92** [.74, .97]		
6. FD_Context	256.73	37.81	.09 [-.48, .61]	-.34 [-.75, .26]	.80** [.44, .94]	-.23 [-.70, .36]	-.01 [-.56, .54]	-.12 [-.63, .46]	
8. TFD_Context	1656.33	723.69	.78** [.41, .93]	-.62* [-.87, -.10]	-.14 [-.64, .45]	.81** [.47, .94]	.91** [.72, .97]	.21 [-.38, .68]	.91** [.73, .97]

Note. M and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). * indicates $p < .05$. ** indicates $p < .01$. NF_ Theme - – mean normalised number of fixations for theme ROIs; FD_Theme - mean fixations duration for theme ROIs; TFD_ Theme – mean total fixations duration for theme ROIs; NF_Context - – mean normalised number of fixations for context ROIs; FD_Context - mean fixations duration for context ROIs; TFD_Context – mean total fixations duration for context ROIs.

Table 3.4

Regression results using sensitivity (d') as the criterion and eye movements made to theme and context ROIs as predictors.

Predictor	*beta*	*beta* 95% CI [LL, UL]	sr^2	sr^2 95% CI [LL, UL]	*r*	Fit	Difference
Block 1:							
NF_Theme	0.74**	[0.26, 1.18]	.52	[.07, .72]	.72**		
						R^2 = .519**	
						95% CI[.07,.72]	
Block 2:							
NF_Theme	0.24	[-1.00, 1.47]	.01	[-.06, .07]	.74**		
NF_Context	0.52	[-0.72, 1.76]	.04	[-.10, .18]	.72**		
						R^2 = .558*	ΔR^2 = .039
						95% CI[.02,.73]	95% CI[-.10, .18]

Note. beta indicates the standardized regression weights. sr^2 represents the semi-partial correlation squared. *r* represents the zero-order correlation. *LL* and *UL* indicate the lower and upper limits of a confidence interval, respectively. * indicates $p < .05$; ** indicates $p < .01$, NF_Theme/Context – mean number of fixations for theme/context ROIs.

3.2.3 Discussion

The findings of Experiment 1 show that the spectatorship of paintings by naïve participants was dominated by looking at the theme rather than the context. This is evident across four key findings. First, more and longer fixations were made to the theme than to the context in both encoding and discrimination phases of the experiment. Second, fixations to theme ROI at encoding predicted discrimination sensitivity but those to the context did not. Third, the focus on making fixations to the theme ROI was maintained throughout the time course of the encoding of specific paintings. Fourth, a finding we did not predict but which is relevant to the emerging account is that fixations to the context only increased when making response to new paintings in the discrimination phase. In other words, fixations to the context were higher when fixations to the theme left some residual uncertainty as to whether paintings had been seen at encoding.

Given the importance of fixations to the theme at encoding, it is unsurprising that sensitivity at discrimination is associated with them. While we anticipated the importance of the theme, it is striking that we did not find any influence of fixations to the context on sensitivity. The absence of any effect of fixations to the context on sensitivity may reflect aspects of the stimulus presentation. In particular participants were cued to a fixation point at the centre of paintings (and therefore within the theme area). In providing a fixation point we may also have inadvertently set participants attentional scale to be local. In Experiment two, we address these concerns.

3.3 Experiment 2

In Experiment 2 we explore possible reasons why the method used in Experiment 1 may have led to a very low number of fixations to the context ROI. We do so by interleaving a pseudo-randomly positioned Navon figures between the fixation point and

presentation of each painting. Navon figures consist of a big (global) letter containing of smaller (local) letters (see Figure 3.4). Requiring participants to the pseudo-randomly positioned Navon figure might encourage fixations to the context in two ways. First, by virtue of where participants are likely to be fixating at the offset of the Navon figure. Second, through the possibility that participants might adopt a global spatial scale for initial encoding (Kimchi, 1992; Kimchi & Palmer, 1982; Navon, 1977, 1981) that might make information in the context more salient to spectators. If the findings from Experiment 1 are replicated when the encoding of paintings is preceded by the Navon stimuli, which are presented in locations other than the theme area and may induce a large spatial scale (i.e. global condition), then this would give greater confidence that fixating the theme is necessary for supporting later discrimination.

Using this experimental paradigm that incorporates reporting global/local dimension of the Navon stimuli to extend/reduce spatial scale is widely studied. Macrea and Lewis (2002) showed that focusing on global dimension of Navon figure improve face identification through configural processing (see also Perfect, 2003; Perfect, Dennis, & Snell, 2007; Perfect, Weston, Dennis, Snell, 2008). Also, scene categorisation process is facilitated following global Navon task (Brand & Johnson, 2014; Flevaris, Bentin, & Robertson, 2011). However, there are at least two additional reasons for believing that extending spatial scale has direct implications for spectatorship.

First, trained artists in comparison to naïve viewers have ability to reduce attentional costs in switching between global and local aspects of visual display (Chamberlain & Wagemans, 2015). Specifically, Chamberlain et al., (2013) argue that enhanced global processing may be associated with developing drawing skill. In the line of this argument, Perdeau and Cavanagh (2013) demonstrated that individuals who can draw more accurately are better at integrating local elements of a whole objects across eye

movements (see also Reingold et al., 2001 for role of extended visual span among chess players).

Second, various studies have reported that art experts are able to gather visual information beyond the central area of the paintings (Nodine, Locher, & Krupinski, 1993) and their eye movements are more widely distributed than those of naïve spectators (Harland et al., 2014; Locher, Gray, & Nodine, 1996; Locher et al., 2007; Locher, Krupinski, & Schaefer, 2015; Vogt & Magnussen, 2007; Zangemeister et al., 1995). There is an argument in the literature that this effect is not only driven by art related-knowledge but also training which developed this particular manner of looking at the paintings (Ishiguro et al., 2019). While the extending spatial scale by using global Navon figure cannot be equated with expertise training, it does offer the possibility of testing whether adopting global spatial scale can influence the spectatorship of the context of representation paintings by naïve viewers.

3.3.1 Method

3.3.1.1 Participants. Participants were 25 undergraduate students (5 males and 20 females; $M = 23.80$, $SD = 9.20$) from the University of Bournemouth who took part in the study for course credits or payment (£15). As in the Experiment 1, expertise in art was measured with art knowledge questionnaire. Participant knowledge about art was in the lower half of the possible answers ($M = 8.32$ [out of 48]; $SD = 4.25$) with an upper score of 16. The participants were therefore classified as naïve participants.

3.3.1.2 Apparatus. Tasks were presented on an Iiyama Vision Master Pro 510 monitor and eye movements were measured using an SR Research Limited Eye-Link 1000 eye tracker operating at 1000Hz. Head movement was stabilized using a chin and headrest.

The screen size and resolution, visual angle, and presentation distance remained the same as in Experiment 1. Participants responded by pressing one of two buttons on a button-box.

3.3.1.3 Stimuli. The same set of 150 representational paintings used in Experiment 1 was used in Experiment 2. Paintings were presented centrally on the screen with the same background colour used in Experiment 1. The distance of presentation, width and height of the paintings remained the same giving the same visual angles as in Experiment 1.

The Navon stimuli were created in Adobe Photoshop CS6. Twenty letters (E or H) made an incongruent global letter (i.e. E made out of Hs or H made out of Es). The size of the global letter (256 x 341 pixels) was 20 times as large as smaller local letters (12.8 x 17.05 pixels). The visual angle was 13.52° to 13.51° for width and height respectively. All of the letters were presented in black on a grey background (Figure 3.4). The colour matched the background on which paintings were presented.

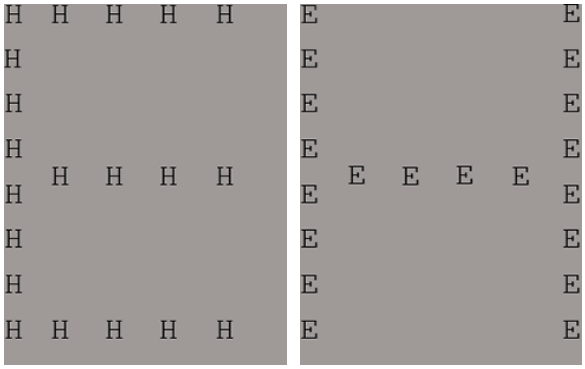


Figure 3.4. The incongruent Navon's stimuli used in Experiment 2.

3.3.1.4 Design and Procedure. The design of Experiment 2 was the same as in Experiment 1 with two exceptions. The within-subjects variable of a Navon condition (2: global and local) was added to the encoding session. With respect to discrimination session, the Test Item variable was replaced by the within-subjects variable of condition (3: global, local, and new).

The procedure of Experiment 2 was similar to that used in Experiment 1 but with one difference. In the encoding session, once the fixation point was fixated one of two possible sentences was presented for 2 s; either "*please focus on the big letter*" or "*please focus on the small letters*" representing the global and local condition respectively. The sentence indicated which letter of Navon stimulus should be reported after painting presentation. The location of the Navon stimulus on the screen was pseudo-randomised, while ensuring that the full global figure was always visible on the screen. After 2s of presentation of Navon stimuli (Hedden et al., 2012), the painting was presented until response was made (encoding session: M = 2.58s, SD = 2.31s). Next, participants were asked to report which global or local letter was presented prior to the presentation of the painting (E or H) by pressing one of two buttons on a response box. With respect to paintings from each motif category, half were preceded by the need to focus on the local figure and half by the need to focus on the global figure. The paintings proceeded by the need to focus on the local or global letter was held constant across participants.

The discrimination session followed as in an Experiment 1 with paintings remaining on the screen until a response was made (M = 1.95 s, SD = 1.48 s). Of the fifty paintings shown at encoding and then during the discrimination session, these were counterbalanced across global and local conditions and motifs.

3.3.2 Results

3.3.2.1 Outliers and Exclusion. The eye movement data were processed as in Experiment 1. Only data from trials where the Navon letter was correctly reported were analysed. Data was analysed across Condition at encoding (2: local vs. global) and ROI (2:

theme vs. context)[11]. The Navon task was performed with high accuracy in local and global condition (*M* = 94%, *SE* = 1%; *M* = 95%, *SE* = 1%; respectively). Fixations that coincided with display onset or the response were also removed as in Experiment 1. This led to 1.33% of data being excluded for encoding and 2.76% for the discrimination session. The final data set consisted of 38630 fixations in the encoding session and 34720 fixations in the discrimination session.

3.3.2.2 Data Normalization. Data were transformed and normalised as in Experiment 1. The means and standard deviations are reported in Table 3.5 for the encoding session and Table 3.6 for the discrimination session.

[11] For eye movement measures the random structure for the LMM for log-transformed normalised number of fixations, log-transformed fixation duration and log-transformed total fixation duration was (1 | Subject) + (1 | Stimuli) in encoding session. With respect to discrimination session the random structure for the LMM for log-transformed normalised number of fixations and log-transformed total fixation duration was (1 | Subject) + (1 | Stimuli), for log-transformed fixation duration was (1 + Condition| Subject) + (1 | Stimuli). 3. For eye movement measures the random structure for the GLMM for question accuracy was (1 + Experiment| Subject) + (1 | Stimuli).

Table 3.5

Mean (and Standard Deviation) Eye Movement Measures for each ROIs area as a function of presentation in encoding session of Experiment 2.

		Condition	
Number of Fixations		Global	Local
	Theme	12.21 (8.82)	12.67 (9.49)
	Context	5.71 (6.02)	4.79 (5.19)
Mean Fixation Duration (ms)			
	Theme	262.55 (86.73)	263.09 (85.89)
	Context	261.05 (74.55)	267.74 (80.00)
Total Fixation Duration (ms)			
	Theme	3138.77 (2349.63)	3224.19 (2441.10)
	Context	1491.35 (1668.01)	1257.99 (1407.63)

Note. The mean and standard deviation is calculated across participants.

Table 3.6

Mean (and Standard Deviation) Eye Movement Measures for each ROIs area as a function of presentation and accuracy in discrimination session of Experiment 2.

		Condition			Response Accuracy	
Number of Fixations		Global	Local	New	Correct	Error
	Theme	10.04	9.58	11.2	10.51	10.57
		-6.7	-5.05	-5.59	-5.98	-5.31
	Context	3.07	3.02	2.8	2.83	3.09
		-3.72	-3.06	-2.63	-2.91	-3.15
Mean Fixation Duration (ms)						
	Theme	240.56	237.55	234.61	235.95	238.49
		-52.18	-45.05	-43.42	-46.46	-45.12
	Context	246.95	250.53	250.57	251.03	247.26
		-90.31	-86.21	-88.34	-88.4	-87.7
Total Fixation Duration (ms)						
	Theme	2375.5	2248.06	2595.59	2442.18	2495.93
		-1632.71	-1210.7	-1363.22	-1442.1	-1315.11
	Context	722.35	727.22	667.82	673.79	736.51
		-854.72	-724.37	-613.29	-680.79	-729.84

Note. The mean and standard deviation is calculated across participants.

3.3.2.2 Encoding Session. With respect to the number of fixations, participants made more fixations to the theme than to the context ROI (b = 0.96, SE = 0.03, t = 30.50). Fewer fixations were made in the local than global condition (b = - 0.30, SE = 0.07, t = - 4.07). The interaction between ROI and Condition was significant. The difference in fixations to the theme and context ROIs was greater in the local than the global condition (b = 0.33, SE = 0.04, t = 7.56) such that fixations were more focussed on the theme than context ROI in the local than global condition.

With respect to mean fixation duration, no main effects or interactions reached significance (ts < 1.79).

With respect to total fixation duration, participants fixated the theme longer than the context ROI (b = 1.17, SE = 0.04, t = 33.00). Total fixation duration was shorter in the local than global condition (b = - 0.13, SE = 0.04, t = - 3.04). The interaction between ROI and Condition was significant. The difference in total fixations durations to the theme and context ROI was larger to paintings in local than global condition (b = 0.18, SE = 0.05, t = 3.69) such that fixations were more focussed on the theme than context ROI.

With respect to the time course of sampling from the theme and context during the encoding session, the probability function of looking at the context was calculated across all trials, for first twenty-five fixations made to each painting (Figure 3.3). The probability function reaches a peak between the fifth and tenth fixations for global and local condition.

3.3.2.3 Discrimination Session. The eye movement data in the discrimination session were processed for Condition (3: global vs. local vs. new) referring to paintings that followed correctly-reported Navon features in the local and the global conditions in the encoding session and the new 'foil' paintings. They were also analysed by ROI (2: theme vs. context), and Response Accuracy (2: correct vs. error).

With respect to number of fixations, participants made more fixations to the theme than to the context ROI (b = 1.50, SE = 0.03, t = 47.19). The number of fixations was higher when making error then correct responses (b = 0.25, SE = 0.05, t = 5.07). The interaction between response accuracy and ROIs was significant. The difference between fixations made to the theme and context ROIs was bigger for correct than error responses (b = -0.28, SE = 0.06, t = - 4.82) indicating that errors were associated with increased looking to the context. The interaction between Condition and ROIs and the three-way interaction with Response Accuracy was significant with respect to one contrast (b = - 0.25, SE = 0.06, t = - 4.15; b = - 0.15, SE = 0.06, t = - 2.50; b = 0.25, SE = 0.11, t = 2.34; respectively). The difference between fixations made to the theme and context was greater for new paintings relative to old paintings. This was only the case when making a correct response (see Figure 3.5). No other main effect or interactions reached significance (ts < 1.52).

With respect to the mean fixation duration, participants made longer fixations to the context than the theme ROI (b = - 0.10, SE = 0.04, t = - 7.37). No other main effect or interactions reached significance (ts < 1.94).

With respect to the total fixations duration, participants fixated longer to the theme than context ROI (b = 1.59, SE = 0.01, t = 47.02). The interaction between Response Accuracy and Condition was significant with respect to one contrast. The difference between new paintings and those presented in the global condition was higher when making correct than for error responses (b = 0.26, SE = 0.10, t = 2.62). The interaction between ROI and Condition was significant with respect to one contrast. The difference between theme and context ROIs was larger for new paintings than for old paintings presented in the local condition (b = - 0.20, SE = 0.06, t =- 3.21). No other main effect or interactions reached significance (ts < 1.78).

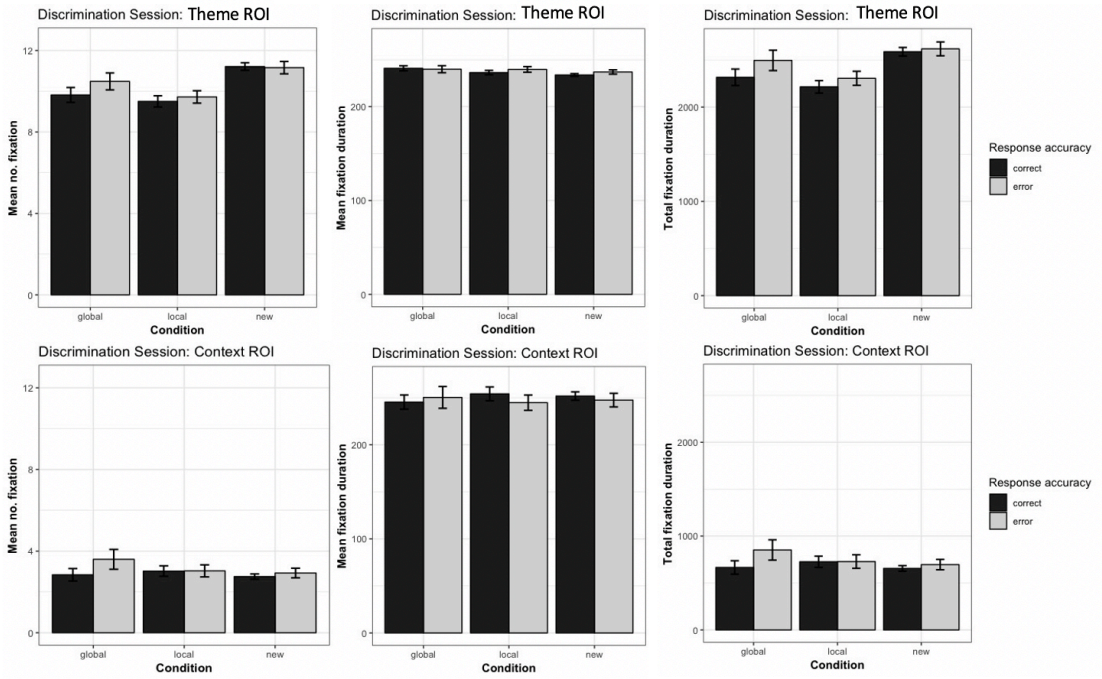


Figure 3.5. Eye movements made to the theme and context, for correct and error responses, and for global, local, and new items during discrimination session.

3.3.2.4 Discrimination of paintings. The data were processed as in Experiment 1 (see Table 3.7). Hits[12] were positively associated with the number of fixations and the total fixation duration made to the theme ROI. Hits were positively associated with mean fixation duration to the context.

A set of multiple regression models were computed to explore if hit rates were predicted by the number of fixations and by mean fixations duration to the theme and context ROIs at encoding (see Table 3.8). The number of fixations to the theme, and the duration of fixations to the context, in both local and global Navon conditions, predicted hit rate in the discrimination phase.

[12] Only the hit rate was analysed in Experiment 2 since it was not possible to separate out sensitivity (*d'*) and bias (*c*) for the target paintings. This is because calculating *d'* and *c* requires the use of the false alarm rate. Since participants were shown images from local and global conditions, we were unable to determine which condition any false alarms arose from.

Table 3.7

Means, standard deviations, and correlations with confidence intervals for gaze behavior in encoding session, memory to the paintings in local and global condition.

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13
1. HIT_G	0.68	0.19													
2. HIT_L	0.63	0.19	.83** [.66, .92]												
3. NF_Theme.L	0.00	0.00	.44* [.05, .71]	.40* [.01, .69]											
4. FD_Theme.L	262.78	36.23	.16 [-.25, .52]	.26 [-.15, .59]	-.26 [-.60, .15]										
5. TFD_Theme.L	3228.99	1767.95	.43* [.04, .71]	.42* [.03, .70]	.99** [.97, .99]	-.15 [-.51, .26]									
6. NF_Theme.G	0.00	0.00	.41* [.02, .69]	.36 [-.04, .66]	.99** [.97, 1.00]	-.28 [-.61, .13]	.97** [.94, .99]								
7. FD_Theme.G	263.22	37.59	.21 [-.20, .56]	.30 [-.10, .62]	-.21 [-.56, .20]	.97** [.92, .98]	-.11 [-.48, .30]	-.24 [-.58, .18]							
8. TFD_Theme.G	3131.67	1730.41	.43* [.04, .71]	.40* [.00, .69]	.98** [.95, .99]	-.14 [-.51, .27]	.99** [.98, 1.00]	.98** [.95, .99]	-.08 [-.46, .32]						
9. NF_Context.L	0.00	0.00	.31 [-.10, .63]	.30 [-.11, .62]	.93** [.84, .97]	-.16 [-.52, .25]	.95** [.89, .98]	.93** [.84, .97]	-.10 [-.48, .30]	.95** [.89, .98]					
10. FD_Context.L	266.84	32.60	.35 [-.05, .66]	.44* [.05, .71]	.10 [-.30, .48]	.44* [.05, .71]	.18 [-.23, .53]	.06 [-.34, .45]	.57** [.23, .79]	.19 [-.22, .55]	.19 [-.22, .54]				
11. TFD_Context.L	1086.29	574.16	.36 [-.05, .66]	.37 [-.03, .67]	.90** [.79, .96]	-.03 [-.42, .37]	.94** [.86, .97]	.88** [.75, .95]	.05 [-.36, .43]	.94** [.86, .97]	.97** [.92, .99]	.37 [-.02, .67]			
12. NF_Context.G	0.00	0.00	.36 [-.04, .66]	.34 [-.06, .65]	.95** [.89, .98]	-.15 [-.51, .26]	.97** [.93, .99]	.95** [.90, .98]	-.12 [-.49, .29]	.97** [.93, .99]	.94** [.86, .97]	.08 [-.33, .46]	.90** [.79, .96]		
13. FD_Context.G	262.58	45.05	.48* [.10, .73]	.40* [.01, .69]	.05 [-.35, .44]	.74** [.48, .88]	.13 [-.28, .50]	.03 [-.37, .42]	.77** [.55, .90]	.16 [-.25, .52]	.04 [-.36, .43]	.71** [.43, .86]	.20 [-.21, .55]	.09 [-.31, .47]	
14. TFD_Context.G	1297.03	683.49	.35 [-.05, .66]	.36 [-.04, .66]	.90** [.79, .96]	.01 [-.38, .41]	.94** [.88, .98]	.90** [.78, .95]	.07 [-.33, .45]	.95** [.89, .98]	.89** [.76, .95]	.27 [-.14, .60]	.91** [.81, .96]	.95** [.89, .98]	.30 [-.11, .62]

Note. M and SD are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval

for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). * indicates $p < .05$. ** indicates $p < .01$. HIT_G – hits for paintings in global condition; HIT_L – hits for paintings in local condition; FA – false alarm; NF_Theme.L - – mean number of fixations for theme ROIs in local condition; FD_Theme.L - mean fixations duration for theme ROIs in local condition; TFD_Theme.L – total fixations duration for theme ROIs in local condition; NF_Theme.G - – mean number of fixations for theme ROIs in global condition; FD_Theme.G - mean fixations duration for theme ROIs in global condition; TFD_Theme.G – total fixations duration for theme ROIs in global condition; NF_Context.L - – mean number of fixations for context ROIs in local condition; FD_Context.L - mean fixations duration for context ROIs in local condition; TFD_Context.L – total fixations duration for context ROIs in local condition; NF_Context.G - – mean number of fixations for context ROIs in global condition; FD_Context.G - mean fixations duration for context ROIs in global condition; TFD_Context.G – total fixations duration for context ROIs in global condition.

Table 3.8

Regression results using Hit as the criterion and eye movements made to theme and context ROIs as predictors.

Predictor	*beta*	*beta* 95% CI [LL, UL]	sr^2	sr^2 95% CI [LL, UL]	*r*	Fit	Difference
Global Condition							
Block 1: NF_Theme	0.41*	[0.02, 0.81]	0.17	[.00, .41]	.41*		
						R^2 = .170*	
						95% CI[.00,.41]	
Block 2:							
NF_Theme		0.71 [-0.62, 2.04]		0.05 [-.10, .19]	.41*		
NF_Context		-0.31 [-1.64, 1.02]		0.01 [-.06, .08]	0.36		
						R^2 = .179	ΔR^2 = .009
						95% CI[.00,.40]	95% CI[-.06, .08]
Local Condition							
Block 1: NF_Theme	0.40*	[0.01, 0.80]	0.16	[.00, .41]	.40*		
						R^2 = .163*	
						95% CI[.00,.41]	
Block 2:							
NF_Theme		0.9 [-0.17, 1.97]		0.11 [-.11, .33]	.40*		
NF_Context		-0.54 [-1.60, 0.53]		0.04 [-.10, .18]	0.3		
						R^2 = .202	ΔR^2 = .039
						95% CI[.00,.42]	95% CI[-.10, .18]
Global Condition							
Block 1: FD_Theme		0.21 [-0.21, 0.64]		0.05 [.00, .27]	0.21		
						R^2 = .046	
						95% CI[.00,.27]	
Block 2:							
FD_Theme		-0.39 [-0.98, 0.20]		0.06 [-.10, .22]	0.21		
FD_Context	0.78*	[0.19, 1.37]	0.24	[-.04, .53]	.48*		
						R^2 = .287*	ΔR^2 = .242*
						95% CI[.00,.50]	95% CI[-.04, .53]
Local Condition							
Block 1: FD_Theme		0.26 [-0.16, 0.68]		0.07 [.00, .30]	0.26		
						R^2 = .068	
						95% CI[.00,.30]	
Block 2:							
FD_Theme		0.08 [-0.36, 0.52]		0.01 [-.05, .06]	0.26		
FD_Context		0.4 [-0.04, 0.84]		0.13 [-.11, .37]	.44*		
						R^2 = .200	ΔR^2 = .132
						95% CI[.00,.42]	95% CI[-.11, .37]

Note. beta indicates the standardized regression weights. sr^2 represents the semi-partial correlation squared. *r* represents the zero-order correlation. *LL* and *UL* indicate the lower and upper limits of a confidence interval, respectively. * indicates $p < .05$;
NF_Theme/Context – mean number of fixations for theme/context ROIs;
FD_Theme/Context - mean fixations duration for theme/context ROIs.

3.3.2.5 Discrimination Performance in Experiment 1 and 2. The impact on response accuracy during the discrimination session of performing the Navon task at encoding was compared to Experiment 1. The response accuracy was treated as binominal variable with using logistic General Linear Mixed Model. The fixed factors were structured for Experiment (2: Experiment 1 vs. Experiment 2) and Test Item (2: old versus new). The procedure of finding the right random structure for the model was the same as in previous models[13].

With respect to the accuracy, participants were more accurate in Experiment 1 than in Experiment 2 (b = - 0.51, SE = 0.21, z = - 2.38). The interaction between Test Item and Experiment was significant (b = - 0.37, SE = 0.18, z = - 2.11). The difference in accuracy to the old and new paintings was greater in Experiment 2 than in Experiment 1 (see Figure 3.6). No other main effect reached significance ($z < .28$).

[13] With respect to encoding session the random structure for the LMM for log-transformed total fixation duration was (0+ROIs+Experiment | Subject) + (1 | Stimuli). For log-transformed total fixation duration was (1+ROIs | Subject) + (1 | Stimuli) in discrimination session.

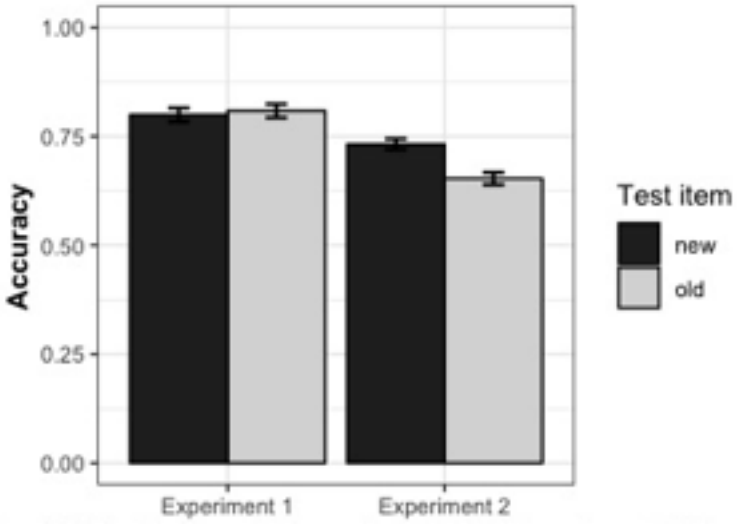


Figure 3.6. The mean accuracy (with error bars) in Experiment 1 and 2 for old and new paintings.

3.3.3 Discussion

The global Navon task achieved the aim of increasing spatial scale through number of fixations and total fixation duration. In contrast, for the local condition at encoding fixations were targeted more to the theme. However, the introduction of the Navon task to the encoding session reduced overall performance relative to Experiment 1 and biased responses to 'new'. These data suggest that cognitive resources were split across Navon and encoding tasks leading to impoverished memory representations being accessed in the discrimination phase.

Spectatorship was largely dominated by fixations to the theme ROI in Experiment 2 as it was in Experiment 1. The regression analyses, however, showed two influences at encoding on hit rate. Both the number of fixations made to the theme and the duration of fixations made to the context were associated with hit rate: specifically, hit rate was positively associated with number of fixations to the theme and duration of fixations to the context.

The finding of the regression analyses with respect to the number of fixations to the theme replicates that found in Experiment 1. The findings with respect to the mean fixation duration to the context were not found in Experiment 1 and needs explaining. Experiment 2 differed from Experiment 1 in three ways and there is a question as to which of these accounts for the finding of the importance of the mean fixation duration to the context ROI in Experiment 2 that was not found in Experiment 1. First, the Navon task forced participants into adopting either a more global or local spatial scale immediately prior to the presentation of a painting in Experiment 2, whereas there was no such manipulation in Experiment 1. Second, the timing and position of the presentation of the Navon figure forced participants to begin their spectatorship from a randomised position that had a .42 likelihood of being in the context ROI in Experiment 2 when the starting point for spectatorship was fixed to the centre of the painting, and was always within the theme ROI in Experiment 1. Third, there was an increased memory load in Experiment 2 relative to Experiment 1, associated with remembering the appropriate response to the Navon figure.

The fact that fixation duration at encoding of fixations to the context ROI was associated with subsequent hit rate in the discrimination phase was not found in Experiment 1 and needs an explanation. The fact that the effect was found when reporting the global and local letters in the Navon task excludes the manipulation of attentional scale from the possible explanations of why the duration of fixations to the context ROI were associated with hit rate in the discrimination phase We suggest it reflects a forced shift in encoding strategy in Experiment 2 relative to that used in Experiment 1. Participants intentionally look at the theme areas but doing so in a meaningful way requires some planning. When starting spectatorship in the context ROI, it is more informed if participants take time to plan their fixations. It is this planning that, we suggest, leads to the association between the duration of fixations to the context and hit rate in the

discrimination phase. Figure 3.3 provides some limited support of this hypothesis. It shows a relative increase likelihood of fixating the context early in spectatorship in Experiment 2 relative to Experiment 1.

The memory load associated with performing the Navon task does seems to have had a negative effect on encoding, evidenced by the markedly reduced hit rate and total fixation durations in Experiment 2 relative to Experiment 1. It must also have been the case that spectatorship had a more variable starting point in Experiment 2 relative to Experiment 1. We suggest, therefore, that the importance of fixation duration to the context in Experiment 2 comes from a need to plan subsequent fixations post painting onset. Planning that leads to good picture encoding through fixations to the theme takes time achieve and this is reflected in the importance of fixation duration to the fixations made to the context ROI in Experiment 2.

3.4 General Discussion

The spectatorship of representational paintings by naive beholders, when that spectatorship is made for later discrimination from foils, is strongly dominated by fixations to a painting's theme rather than its context. While the starting point for spectatorship may have a marginal influence on this pattern of fixations, the theme was found to be overriding importance for fixations in Experiments 1 and 2.

The importance of fixations to the theme is seen in how information sampled during a fixation contributes to our ability to discriminate 'old' from 'new' paintings. The results of both Experiments 1 and 2 suggest that information sampled from fixations to themes is used in discriminating 'old' from 'new' paintings. Many aspects of paintings support the focus on the theme. In the Introduction we noted how the theme contains the narrative as well as increased contrast, luminance, and people, relative to the context. The dominance of fixations to themes over contexts is, perhaps, unsurprising.

Experiment 2 did find that the mean fixation duration to the context was associated with hit rate when the starting point for spectatorship was varied across paintings. This finding is a helpful reminder that the context is also important in discriminating 'old' from 'new' paintings. However, to the extent that information from the context is used when making discrimination decisions, unless circumstances demand it, it is usually extracted without having been directly fixated. The extraction of information without fixation is consistent with the idea that the context is only encoded as a gist. We define gist here in operational terms as information extracted without being directly fixated. The rapid extraction of gist is an attribute of at least one model of spectatorship (Locher et al., 1996, 2007). In Locher et al's account, eye movements are guided on the basis of gist to the most reach semantic region by the global representation of entire painting. There is substantial evidence that scene contexts do influence the allocation of attention in the real world (Oliva & Torralba, 2006; Rousselet, Joubert, & Fabre-Thorpe, 2005; Torralba et al., 2006; Wolfe et al., 2011).

Discriminating 'old' from 'new' paintings requires comparing the seeing objects from foil paintings. The finding that 'old' decisions were made faster and more accurately than 'new' decisions can be accounted for in two ways. First, it might be a response bias in favour of responding 'old'. Second, it may be a decision on 'old' trials following a self-terminating process and a decision on 'new' trials following a more exhaustive search [i.e. when the match between 'new' paintings and foils is low (Sternberg, 1969)]. The higher number of fixations evident in the eye movement data cannot definitively distinguish between these two explanations of the data but are more intuitively seem more consistent with 'new' decisions following a more exhaustive decision process than 'old' decisions.

The eye movements made during the discrimination phase do allow us to go further in relation to the issue of how decisions are made. Experiments 1 and 2 show a consistent

pattern whereby fixations to the context ROI are increased for error relative to correct responses. It seems to be the case that fixations to the context ROI are made when fixations to the theme cannot lead to definitive 'hit' or 'reject' response. In other words, fixations to the context ROI during the discrimination task reflect response uncertainty.

In the Introduction, we raised the idea that fixations may be made more to the context to help with discrimination. Some may consider that the importance of fixations made to the context may depend on the type of foils being used. In the present study, the foil paintings reflected the same set of five motif categories which were used at the encoding session. We have no evidence that participants were aware of the different motifs used in the studies or that different motifs could impact the eye movements at the discrimination session. In the absence of actual data, we would hypothesize that emerging awareness of the different motifs would increase focus on the theme (Fuchs, Ansorge, Redies, & Leder, 2011, see also Chapter 5). Additionally, it is important to note that participants were not aware whether the paintings presented at discrimination would share some aspects of visual similarity with those presented at the encoding session.

In conclusion, the encoding of representational paintings for later recall is dominated by fixations to the theme. The number of fixations to the theme is associated with later discrimination performance. Only when there is uncertainty in the starting point of spectatorship is there an association between fixations to the context (specifically mean fixation duration) and later discrimination. Taking together, throughout both experiments, the context is attended when information in the theme is insufficient for accurate discrimination.

3.5 Rationale and research aims for Chapter 4

The implications of Chapter 3 speak to the importance of making direct fixations to the theme when forming memory representations of paintings. Evidence suggest that little focus is made to the paintings' context, typically. This naturally leads to the question of role of the context in the spectatorship of paintings. While our naïve participants only seem to have used the context to establish gist, there are two groups of participants who might have fixated the context more than those in the present study. These are art experts and participants drawn from East Asian (collectivist) societies. Art experts make more eye movements to contexts than do naïve participants when rating liking (Harland et al., 2014; Kristjanson et al., 1989; Nodine et al., 1993; Pihko et al., 2011; Vogt & Magnussen, 2007). Participants from collectivist societies (i.e. East Asians) have been reported as using a more distributed visual encoding strategy than Western participants (Caucasians). Masuda and Nisbett (2001, 2006) have shown that Western observers are more likely to focus on the central part of the image in contrast to East Asians who present more distributed visual strategy when viewing natural scenes.

Recall that the present thesis examines the act of spectatorship in relation to naïve observers, leaving for further studies to determine what type of visual information contributes to memory representations of paintings in a group of art experts. However, according to the visuo-cognitive framework of spectatorship (Chapter 1), expertise might be defined more broadly, as being an expert of one's own culture. In this case, expertise is driven by the fact of living in a specific place, such as UK (individualistic culture) or China (collectivist culture) and being familiar with artistic style dominating in a particular culture (Cutting, 2003; Pöppel, 2018).

As such, the following chapters (Chapter 4 and 5) will explore the idea that participants drawn from collectivist culture would be less focussed on fixating themes than

contexts then the participants form individualistic culture. Additionally, Chapter 4 addresses the question of whether the effect of cultural background is moderated by painting style.

Chapter 4

Cross-Cultural Differences in Spectatorship of Western and East Asian Paintings

4.a Abstract

The eye movements made by Chinese and British participants when encoding and later discriminating seen paintings from foils were explored. Eye movements were recorded as participants viewed 100 paintings drawn from East Asian or Western art for later discrimination from foils. The paintings were split into regions of interest defined by theme and context. The results show little influence of culture on the spectatorship of Western or East Asian paintings when being encoded. In contrast, there were two distinct effects of culture that emerged when discriminating targets paintings from foils. First, Chinese participants looked less at the theme of Western paintings than did British participants. Second, Chinese participants were more likely to spend time exploring the context of East Asian paintings than were British participants when a positive identification of a target could be made. Both effects might be interpreted as evidence of the relatively greater likelihood of inspection of the context other the theme by Chinese than by British participants. However, any such interpretation must be nuanced by the fact that these differences emerge only at discrimination and not at encoding.

4.1 Introduction

Visual encoding of images differs across individuals drawn from collectivist and individualist cultures (Masuda & Nisbett, 2001, 2006). Masuda and Nisbett (2001) argued that individuals from collective cultures encode objects at the focal point of scene and context as one representation, whereas participants from individualist cultures store focal point of scene and context independently. In establishing relationships between elements in the context and at the focal point, participants from collectivist cultures are thought to encode scenes in a holistic manner. In contrast, those from individualistic cultures encode visual stimuli in an analytic manner (Ji, Peng, & Nisbett, 2000; Kitayama, Duffy, Kawamura, & Larsen, 2003; Ko, Lee, Yoon, Kwon, & Mather, 2011; Masuda, Ellsworth, et al., 2008; Mickley Steinmetz, Sturkie, Rochester, Liu, & Gutchess, 2018; Stanley, Zhang, Fung, & Isaacowitz, 2013; Yang et al., 2013). Some studies, however, have failed to find evidence consistent with a cultural difference in the holistic and analytic representation of scenes (e.g. Wong, Yin, Yang, Li, & Spaniol, 2018).

If culture influences the visual representation of scenes, then one might think that this would be reflected in gaze behaviour during encoding. Consistent with this suggestion, Chua, Boland, and Nisbett (2005) report evidence of a difference in gaze behaviour of American and Chinese participants when viewing scenes. Their participants were asked to look at scenes for three seconds and to rate them in terms of liking (while trying to memorise them in order that they could be recognised later). Chua et al., (2005) found that Chinese participants made more fixations to the background (defined as the area beyond the focal figure) than did Americans. There is a suggestion that this finding may not generalise beyond scenes that contain only a single object at the focal point (see Rayner, Li, Williams, Cave, & Well, 2007, though see Boland, Chua, & Nisbett, 2008 for a counter-argument). Here we further explored whatever there are in fact differences in the

construction of visual representations of scenes across cultures, and moreover if any such that difference may be underpinned by differences in gaze during encoding.

Cross-cultural studies exploring visual representation typically use culturally neutral scenes. They may illustrate focal animals or objects, and they may contain richly detailed backgrounds, for example, a train-yard picture, where a train placed in the foreground is considered as the focal object (Chua et al., 2005). However, the representational paintings that have emerged from collectivist and individualistic cultures seem to contain attributes of that might reflect cultural differences in viewing style (Masuda, Gonzalez, Kwan, & Nisbett, 2008; Miyamoto, Nisbett, & Masuda, 2006; Nisbett & Masuda, 2003; Ueda & Komiya, 2012). For example, Western painters have often used mathematical rules to develop a notion of space and precisely organize the spatial relations between objects in the painting (Delahaye, 1993). In contrast, Chinese artists typically structure paintings in a manner independent of a literal representation of objects in space (Cameron, 1993; Sullivan, 1984). Also, Western artists typically use linear perspective whereas Chinese artists use floating perspective (Masuda, Gonzalez, et al., 2008), and Western artists typically seek to capture a moment in time such that a viewer must adopt a specific position with respect to the scene whereas Chinese artists ordinarily require viewers to assume a panoramic viewpoint where there is no single fixed position assumed for the viewer (Bao et al., 2016; Pöppel, 2018). Finally, Western artists usually determine a light source to emphasize the core narrative elements of a painting whereas Chinese artists usually use a generalised and diffused light source in paintings. These differences between Western and Chinese painting come together such that Western painters tend to place the theme of their paintings centrally whereas the theme is more distributed in Chinese paintings (see Figure 4.1).

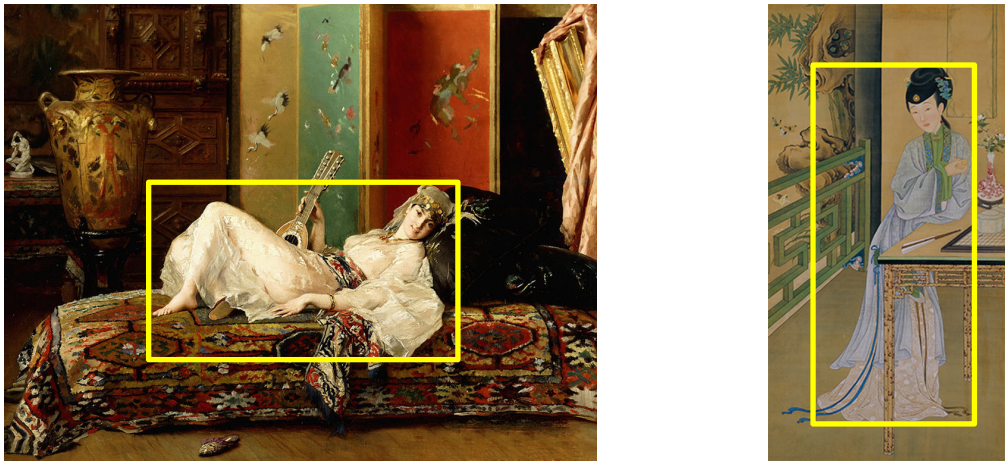


Figure 4.1. The picture on the left represents an example of Western painting (de Jonghe, *A Reclining Odalisque,* c.1870). The picture on the right is an example of East Asian painting (unknown, *Watching Butterflies in the Summer*, Qing dynasty). The yellow rectangle indicates the theme area.

In the present study we explore whether the cultural differences in visual representation that seem to be present when viewing neutral scenes might be made more striking when viewing paintings drawn from Western and East Asian cultures. As we have noted, paintings are strongly influenced by conventions of the culture in which they were produced. For this reason, paintings can be understood as visual images which capture important characteristics of a specific culture (Masuda, Gonzalez, et al., 2008; Nand, Masuda, Senzaki, & Ishii, 2014; Senzaki, Masuda, & Nand, 2014). Here we ask, whether systematic cultural difference in artistic style will influence eye movement behaviour.

We examine this question by recording eye movements as British and Chinese participants view examples of Western and East Asian paintings in order to encode them so that they can be discriminated from similar paintings (foils) at a later time. We predict that culture will have a marked effect on discrimination accuracy and on the gaze, behaviour used at encoding when viewing Western and East Asian paintings. Specifically, we predict that cultural familiarity with a style of painting will lead to better discrimination

targets from foils. In addition, we predict that the eye movements made by British and Chinese participants as they encode paintings will be influenced by their experience of looking at paintings of that style (see Bao et al., 2016; Masuda, Gonzalez, et al., 2008; Pöppel et al., 2013). More specifically, we think that Chinese participants will engage in more distributed viewing of paintings than do British participants, especially when viewing East Asian paintings. We also hypothesize that the eye movements of British participants will be more focused on focal objects of the paintings in comparison to Chinese participants and we ask whether this difference is moderated by painting style.

In summary, in this study we explore the influence of culture on the spectatorship of East Asian or Western paintings. We do so to test whether our experience of viewing culturally specific paintings has a profound influence on the spectatorship of all paintings.

4.2 Method

4.2.1 Participants

Participants were 32 Chinese (13 males and 19 females; $M = 22.5$, $SD = 2.83$) and 28 British (4 males and 24 females; $M = 21$, $SD = 4.38$) undergraduate students from the Tianjin Normal University (PRC), University of Southampton (UK), and Liverpool Hope University (UK). An opportunity sample was recruited through an online survey advertising the studies. All of the Chinese participants were born and completed their pre-university education in China and were enrolled at the Chinese university. Group of British participants represented students who completed their pre-university education in the UK and were studied at British university. Participants received course credits or payment

(£12) to compensate for their time. All participants self-reported having a low level of art knowledge[14].

4.2.2 Apparatus

Stimuli were presented on a View-Sonic graphics Series G225f CRT monitor with screen size 40 cm x 30 cm in a darkened room. Participants were seated at a distance of 70 cm giving a visual angle of 30.11° by 23.75 ° for the screen. Screen resolution was 1024 x 768 with a refresh rate of 120 Hz. Viewing was binocular, though the only movements of the right eye were recorded using an SR Research Limited Eye-Link 1000 eye tracker operating at 1000Hz. Head movement was stabilized using a chin and headrest. Participants terminated each presentation by pressing one button on a four button response box.

4.2.3 Stimuli

Western and East Asian paintings were shown in the study. The two sets of 150 high-resolution painting reproductions were uploaded from the Google Image Search. All signatures and descriptions were removed using Adobe Photoshop CS6. Paintings were presented centrally on the screen against grey background. The height varied between 3.84 and 26.99 cm on the screen and giving a visual angle between 6.21° and 41.56°. Widths varied between 6.69 and 20.11 cm increasing a visual angle to 14.31° and 41.32°.

[14] In an attempt to confirm this, participants completed a test of art knowledge translated to English and Chinese from the original German version of an art knowledge questionnaire (Jakesch & Leder, 2009; Trawinski et al., 2019). One inevitable limitation is that the questionnaire explores knowledge of Western art. We are unaware of equivalent test of knowledge East Asian art. Participant knowledge about art tended to be low (Chinese: M = 1.94 [out of 48]; SD = 1.86; Mdn = 1; range = 0 - 8; British: M = 9.19; SD = 6.20; Mdn = 7; range = 0 - 25). The participants were therefore classified as naïve beholders of art.

Each painting was split into regions of interest (ROIs) of theme and context. We operationalised theme as the area covered by people, in the central part of the foreground on the painting. Objects placed in the theme area may be thought of as a focal part of the paintings. The area of the painting beyond the theme ROI was defined as the context. The themes covered, on average, 58% of the area of Western paintings and 32% of East Asian paintings; remaining areas were designated as context. The area of the theme of Western paintings was relatively larger than the theme area of East Asian paintings ($t(298) = 16.88$, $p < .001$). Correspondingly, the area of the context of East Asian paintings was relatively larger than the context area of Western paintings ($t(298) = 2.25$, $p = .025$).

In the present study we used groups of themes (motifs), which may be recognised as common within a specific culture. Motifs can be thought of as any visual category. Paintings within each motif category share similar semantic and structural features (Panofsky, 1987, p. 40 - 41). In the present study, we used paintings drawn from ten motif categories. The set of Western paintings consisted paintings taken from five motifs categories: Three Graces, Judith, Bathers, Odalisque, and Venus. The set of East Asian paintings consisted of other five motifs categories: Palace Children, Rohan, Bodhisattva, Nobel Women and Emperor. Each motif category contained 30 paintings (see Appendix C and D for a list of all paintings, motifs and artists). It should be pointed out that it is almost impossible to match the content of themes across paintings from different cultures.

Figure 4.2. The top panel shows examples of motif of Three Graces: Raphael, *The Three Garces* (1504-1505); Cranach the Elder, *The Three Graces* (1535); Furini, *The Three Graces* (c. 1633). The bottom panel shows examples of motif of Palace Children: unknown, *Palace Children Playing* (Song Dynasty); unknown, *Children Cooking Pao-Tzu* (Yuan Dynasty); Su-Hanchen, *One Hundred Children in the Long Spring* (Northen Song Dynasty).

4.2.4 Design and Procedure

The experiment had five stages and all participants completed all stages. In the first stage, participants completed either a test of visuospatial and verbal working memory capacity (3-back task; Shackman et al., 2006) or they completed an art knowledge questionnaire (Jakesch & Leder, 2009; Trawinski et al., 2019).

In the second stage (encoding session), participants were asked to try to memorise each of one hundred Western or East Asian paintings for recall in a later discrimination

session[15]. Eye movements were recorded requiring the second stage to begin with a nine-point calibration procedure. The eye tracker was calibrated to less than 0.5^0 error. Once calibration was complete, the presentation of paintings began. Paintings were presented in random order. The presentation of each painting was preceded by a fixation cross presented central to the screen. Once this point was fixated, a painting was presented and remained on the screen. Each painting was presented individually and remained on the screen until a key press response indicated that they had finished viewing. These responses were made via pressing one button on four buttons response box. The inter-trial interval was set to 500 ms.

The break between second (encoding) and fourth (discrimination) stage was set to 30 minutes. The third stage was completed during this 30-minute interval. Participants completed whichever of the working memory capacity test or art knowledge questionnaire that they had not completed in the first stage.

In the fourth stage (discrimination session), participants' eye movements were re-calibrated and then measured again. In this discrimination session fifty foil paintings were shown, randomly mixed in with fifty of the paintings shown during the encoding session. Twenty paintings were shown from each motif category of which ten had been previously seen. All participants saw the same set of paintings during the discrimination session. Participants were asked to judge whether they had seen the painting in the encoding session or not with paintings remaining on the screen until a target or foil response was made. Responses were made by participants pressing one of two buttons on a response box.

[15] We applied between- as opposed to within-subject design to avoid possible influence of familiarity with East Asian or Western paintings on the act of spectatorship. Increasing familiarity with the style of paintings from foreign cultures could diminish the effect of the participant's cultural background on the spectatorship process (Pöppel, 2018). However, it would be less likely without prior exposition to another style.

In the fifth and final stage, participants completed a battery of cognitive and psychological tests, which we do not report here.

4.3 Results

Data analyses were conducted in R version 3.5.0 (R Core Team, 2016). We measured working memory capacity as there has been a discussion in the literature whether there is a quantitative or qualitative differences in memory across culture (Millar, Serbun, Vadalia, & Gutchess, 2013). For information we report that the British and Chinese participants were matched on verbal working memory capacity ($t(58) = 1.16$, $p = .253$; $M = 62.71$, $SD = 18.05$; $M = 67.53$, $SD = 14.19$; respectively), but they were not matched on visuospatial working memory capacity. Chinese participants had a higher capacity on visuospatial working memory capacity ($t(58) = 2.25$, $p = .028$; $M = 63.75$, $SD = 14.06$; $M = 54.25$, $SD = 18.6$; respectively).

Behavioural and eye movement data were fitted in (generalised) Linear Mixed-effects Models ((G)LMMs) using the lmer4-package (Bates et al., 2014) and MASS-package (Venables & Ripley, 2002). The random effects were structured for items and participants including slopes for meaningful fixed effects and correlation. The full random structure was trimmed down for those models that did not converge or had a correlation equal to zero or one[16]. The *t*/*z*-values equal to 1.96 or higher were interpreted as significant because for high degree of freedom the *t*-statistics in (G)LMMs approximates the *z*-statistics (Baayen et al., 2008).

[16] For eye movement measures the random structure for the LMM for both normalised log-transformed number of fixations and log-transformed total fixation duration was (1+ROI | Subject) + (1 | Stimuli), for log-transformed fixation duration was (1+ROI | Subject) + (0+ROI | Stimuli) in encoding session. In discrimination session the random structure for the LMM for log-transformed normalised number of fixations and log-transformed total fixation duration was (1+ROI+Test Item | Subject) + (1 | Stimuli), for log-transformed fixation duration was (1| Subject) + (1 | Stimuli). For accuracy the random structure for the GLMM was (1+Test Item| Subject) + (1 | Stimuli).

The results are structured to consider the (a) eye movements in encoding and discrimination session, (b) accuracy in discrimination of paintings from foils, and (c) relationship between accuracy in discrimination of paintings and eye movements at encoding. Analyses were carried out on the following eye movement measures: number of fixations, mean fixation durations, and total fixation durations (as a sum of all fixation durations in each ROI).

4.3.1 Eye Movements

4.3.1.1 Outliers and exclusion. Fixations shorter than 60 ms or longer than 1200 ms were removed. Fixations that coincided with display onset or the response were also removed. This led to 4% and 3% of data being excluded for encoding and discrimination session respectively. The final data set consisted of 207272 fixations in encoding session and 75624 fixations in discrimination session.

4.3.1.2 Data normalization. All eye movement data were log-transformed to increase the normality of the data distribution. The number of fixations was normalised to overcome potential difficulties associated with the fact that each ROI had a different area. To normalise number of fixations, the theme and context areas were computed. The eye movement measures computed for each theme/context area were then divided by that theme/context area, respectively for each painting.

With respect to eye movements made in the encoding session, data were analysed using three fixed factors: Ethnicity (2: Chinese versus British), Style (2: Western versus East Asian paintings), and ROI (2: theme versus context). With respect to the discrimination session, one additional fixed factor was added to the model: Test Item (2: target versus foil). The set of 'target' paintings consisted from those which were presented at encoding and 'foil' paintings were those which were new. The analyses of eye

movements made during the discrimination session were conducted only for paintings which were correctly identified as target or foils.

4.3.1.3 Encoding session. With respect to the number of fixations during encoding, participants made more fixations to the theme than to the context (b = 1.67, SE = 0.07, t = 25.08; M[17] = 24.87, SD = 19.79; M = 11.92, SD = 14.42; respectively). Fewer fixations were made to Western than East Asian paintings (b = - 0.51, SE = 0.21, t = - 2.46; M = 18.26, SD = 18.32; M = 19.67, SD = 19.01; respectively). The interaction between ROI and Ethnicity were significant as was the interaction between ROI, Ethnicity, and Style (b = - 0.95, SE = 0.10, t = - 9.76; b = 1.07, SE = 0.14, t = 7.45; respectively). Fewer fixations were made to Western than East Asian paintings except when British participants were inspecting the theme in Western paintings (see Figure 4.3). No other main effects or interactions reached significance (ts < |0.88|).

[17] *Note*: Reported *Ms* and *SDs* for eye movements refer to the actual data (not normalised and log-transformed) The mean fixation duration and total fixation duration is presented in ms.

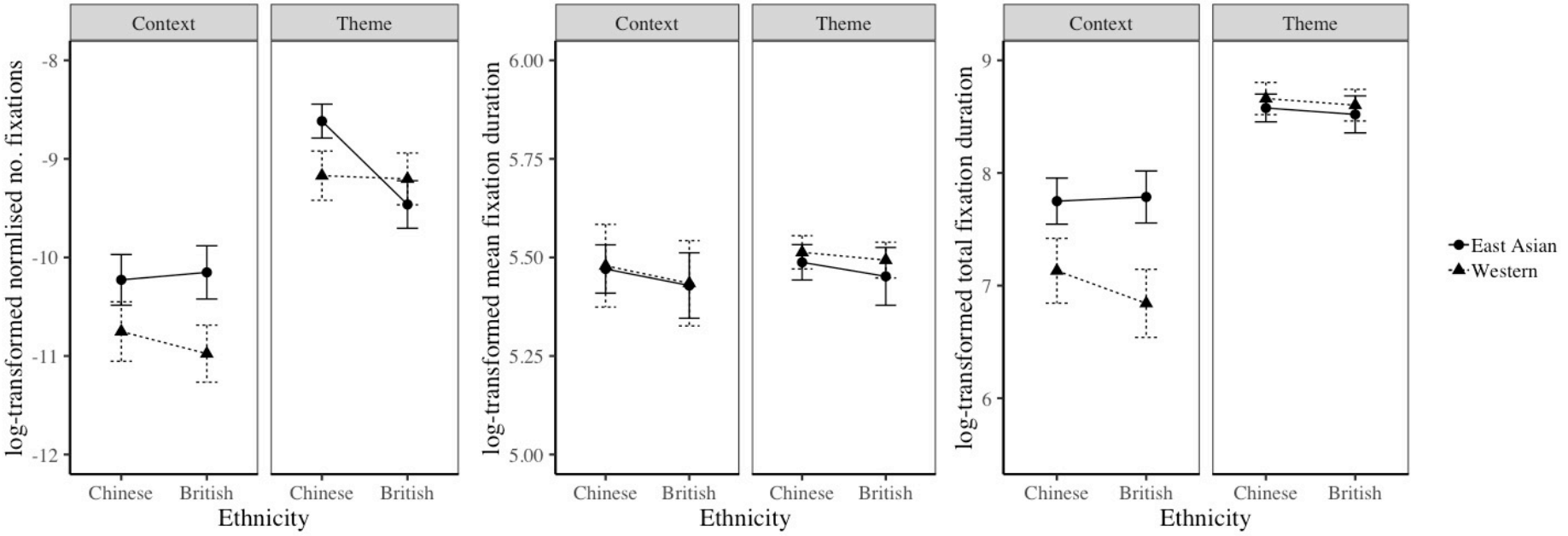


Figure 4.3. Effect estimates from the linear mixed model for normalised log-transformed number of fixations (*Note.* Values closer to zero on y-axis are related to greater number of fixations), log-transformed mean fixation durations, and log-transformed total fixation durations (with 95% CI) as a function of ROI, style and ethnicity in encoding session.

With respect to mean fixation duration, no main effects or interactions reached significance (*ts* < |1.32|).

With respect to total fixation duration, participants fixated the theme longer than context (*b* = .88, *SE* = 0.07, *t* = 12.63; *M* = 6838.09, *SD* = 5281.21; *M* = 3162.16, *SD* = 3866.73; respectively). Total fixation durations were shorter for Western than East Asian paintings (*b* = - 0.73, *SE* = 0.21, *t* = - 3.50; *M* = 5006.88, *SD* = 4867.19; *M* = 5330.36, *SD* = 5169.10; respectively). The interaction between ROI and Style was significant for the context but not the theme, such that the context was inspected for at less time in Western than East Asian paintings (*b* = 0.82, *SE* = 0.10, *t* = 7.99). No other main effects or interactions reached significance (*ts* < |1.83|).

To sum up, the analyses of eye movements made during encoding provide evidence for three key results. First, spectatorship of the theme dominates over that of the context in both Western and East Asian paintings. Second, more time was spent spectating the context in East Asian than the context in Western paintings. Third, there was little evidence that the cultural background of participants influenced encoding. We now consider gaze behaviour during the discrimination session.

4.3.1.4 Discrimination session. With respect to number of fixations, fewer fixations were made to the context than theme (*b* = 2.16, *SE* = 0.08, *t* = 26.87; *M* = 4.42, *SD* = 4.42; *M* = 9.27, *SD* = 6.61; respectively), to Western than East Asian paintings (*b* = - 0.49, *SE* = 0.18, *t* = - 2.68; *M* = 7.42, *SD* = 5.98; *M* = 8.91, *SD* = 7.11; respectively) and to target than foil paintings (*b* = - 0.34, *SE* = 0.10, *t* = - 3.39; *M* = 7.39, *SD* = 5.79; *M* = 8.57, *SD* = 7.02; respectively).

The interactions between ROI and Test Item were significant. The difference in number of fixations made to the theme and context was greater for foil than target paintings (*b* = - 0.19, *SE* = 0.05, *t* = - 3.93).

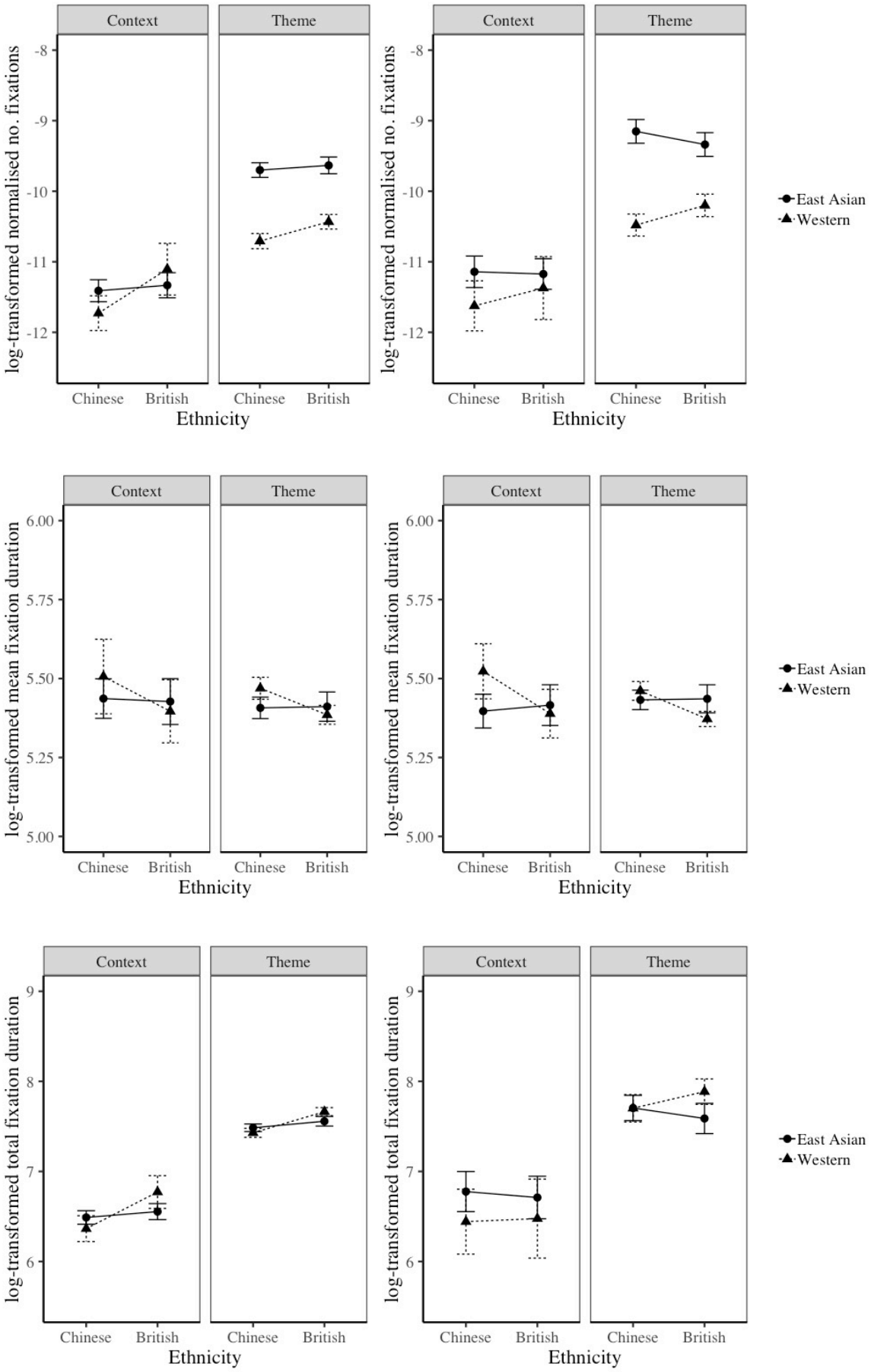

Context
Theme
log-transformed normalised no. fixations
-8
-9
-10
-11
-12
Chinese
British
Ethnicity
East Asian
Western
log-transformed mean fixation duration
6.00
5.75
5.50
5.25
5.00
log-transformed total fixation duration
9
8
7
6

Figure 4.4. Effect estimates from the linear mixed model for normalised log-transformed number of fixations (*Note.* Values closer to zero on y-axis are related to greater number of fixations), log-transformed mean fixation durations, and log-transformed total fixation duration (with 95% CI) as a function of ROI, style and ethnicity in discrimination session. The left column shows data for target paintings, when the right shows data for foil paintings.

The two-way interaction between ROI and Style was significant (b = - 0.88, SE = 0.12, t = - 7.26; Figure 4.4), as was the three-way interaction between ROI, Ethnicity and Style, and four-way interaction with Test Item were also significant (b = 0.42, SE = 0.18, t = 2.40; b = - 0.26, SE = 0.12, t = - 2.18; respectively). The effect of Ethnicity found in the encoding session whereby Chinese participants made more fixations to East Asian than Western paintings was found again but with respect to the new paintings and not to those which have been seen at encoding session. No other main effects or interactions reached significance (ts < |1.91|).

With respect to the mean fixation duration, participants made longer fixations to the Western paintings than the East Asian paintings (b = 0.12, SE = 0.06, t = 2.16; M = 256.52, SD = 78.34; M = 251.63, SD = 59.77; respectively), and to target paintings than foil paintings (b = 0.04, SE = 0.02, t = 2.33; M = 255.15, SD = 73.92; M = 254.07, SD = 69.49; respectively).

The two-way interactions between Ethnicity and Style and Ethnicity and Test Item were significant. Chinese participants made longer fixations to the Western paintings than British participants did (b = - 0.15, SE = 0.08, t = - 1.97) and to foil paintings than target paintings (b = - 0.06, SE = 0.02, t = - 2.74).

The interactions between ROI and Style, ROI and Test Item, Style and Test Item, and three-way interaction between ROI, Style, and Test Item were all significant (b = -

0.08, *SE* = 0.02, *t* = - 3.48; *b* = - 0.06, *SE* = 0.02, *t* = - 3.09; *b* = - 0.07, *SE* = 0.03, *t* = - 2.02; *b* = 0.09, *SE* = 0.03, *t* = 2.52; respectively). Mean fixation duration was shorter to East Asian than Western paintings, but only to the context of foils. No other main effect or interactions reached significance (*ts* < |1.91|).

With respect to the total fixations duration, participants fixated on the theme longer than the context (*b* = 0.94, *SE* = 0.08, *t* = 12.61; *M* = 2465.25, *SD* = 1664.85; *M* = 1106.18, *SD* = 1147.84; respectively), on East Asian paintings longer than Western paintings (*b* = - 0.37, *SE* = 0.16, *t* = - 2.36; *M* = 2199.81, *SD* = 1775.19; *M* = 1855.38, *SD* = 1527.48; respectively), and on foils longer than targets (*b* = - 0.25, *SE* = 0.07, *t* = - 3.92; *M* = 2133.45, *SD* = 1768.52; *M* = 1834.27, *SD* = 1465.52; respectively).

The two-way interaction between Style and Test Item and three-way interaction of these factors with ROI were significant (*b* = 0.24, *SE* = 0.11, *t* = 2.24; *b* = - 0.29, *SE* = 0.10, *t* = - 2.94; respectively). Total fixation duration was longer when looking at East Asian than when looking at Western paintings, but this effect was only observed with foils, not targets.

The two-way interaction between ROI and Style, and the interaction of these factors with three-way interaction with Ethnicity were significant (*b* = 0.36, *SE* = 0.12, *t* = 3.12; *b* = 0.39, *SE* = 0.17, *t* = 2.33; respectively). When viewing theme of Western paintings, the total fixation duration was longer for British participants than for Chinese participants. No other main effect or interactions reached significance (*ts* < |1.63|).

With respect to discrimination session, we replicated the effect of Style and ROI found at encoding. Additionally, British participants fixated on the theme in Western paintings more than in East Asian paintings, especially when shown foils. We now consider accuracy in discrimination targets from foils.

4.3.1.4 Growth Curve Analysis. The interaction of culture and number of fixations found in relation to the viewing of East Asian paintings was explored with respect to the time of course of sampling information from the theme and context. The probability function of fixating the context was calculated across all trials for 5000 ms of trial duration (Figure 4.5) within bins of 200 ms. The probability of fixations to the theme ROI is the inverse of these data. Looking at this analysis, there are three things worth noticing. First, the probability of fixating on the theme of paintings is the highest immediately post onset, except for East Asian paintings during encoding session when the peak is around 1500ms. Second, both Chinese and British participants were more likely to fixate context of East Asian than Western paintings regardless the stage of the study. Third, while the probability functions are almost identical at the encoding session, differences start to emerge at discrimination session. In the time window between 4000 – 4500 ms, and after 1500 ms for East Asian and Western paintings respectively, Chinese participants are more likely to sample information from the context than are British participants.

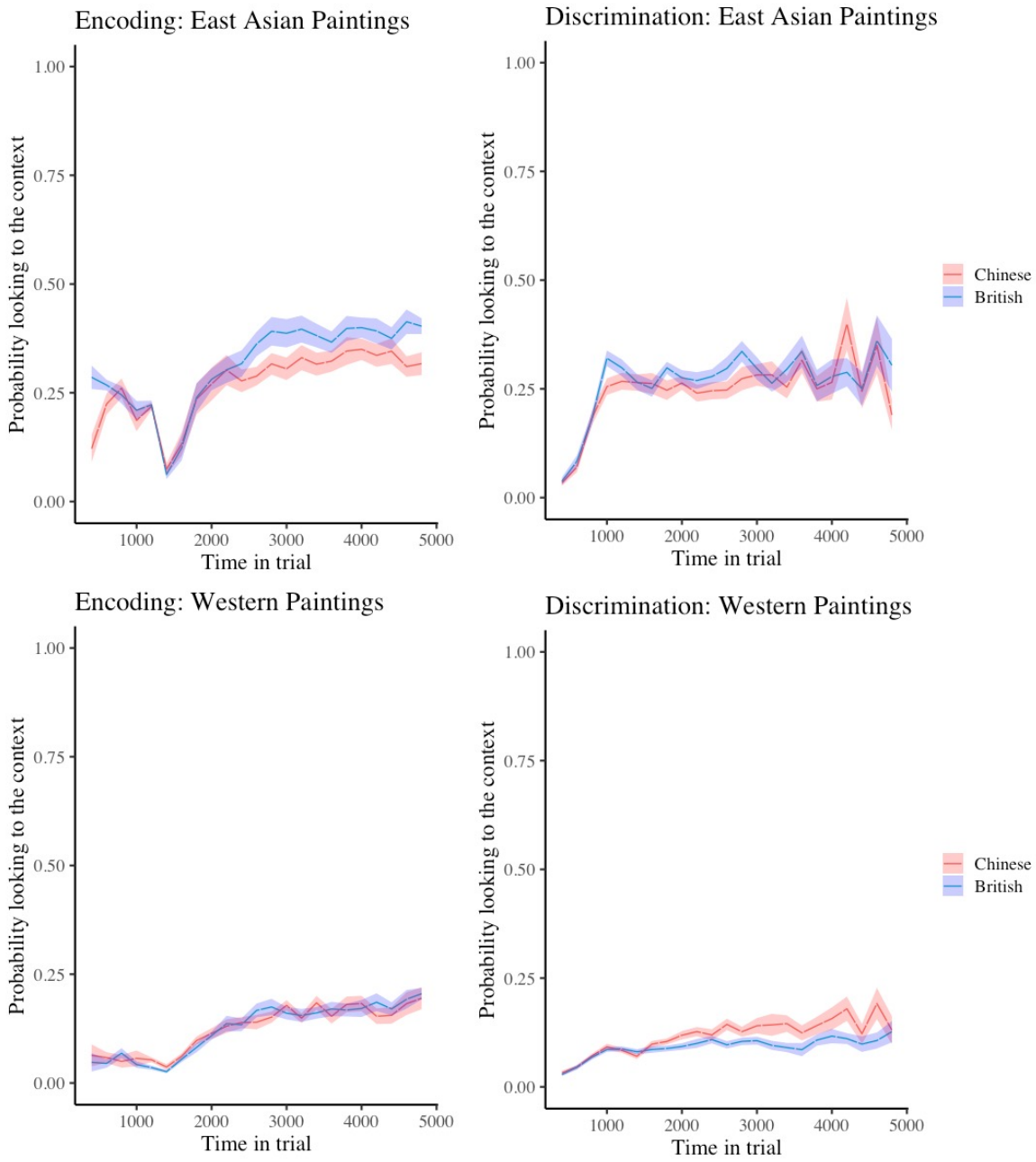


Figure 4.5. Probability of sampling information from the context during the encoding and discrimination session of East Asian (top panel) and Western (bottom panel) paintings for Chinese (red line) and British (blue line) participants. The shading area around function refers to 95% confidence interval.

4.3.2 Discrimination of Paintings

Discrimination of paintings was analysed in three steps. First, the accuracy was processed as binomial dependent variable in a GLMM. The fixed factors were Ethnicity (2: Chinese versus British), Style (2: Western versus East Asian), and Test Item (2: target versus foil). Second, the hit and false alarm rates were used to create measures of sensitivity (*d'*) and bias (*c*; Macmillan & Creelman, 2004), which were analysed using analysis of variance. Sensitivity and bias were used as dependent variables, and Ethnicity and Style were between subject factors. Third, the eye movement measures were correlated with sensitivity and bias scores[18].

With respect to the accuracy, British participants were more accurate than Chinese participants (b = 0.70, SE = 0.27, z = 2.64; M = .82, SD = .39; M = .78, SD = .42; respectively). The interactions between Ethnicity and Test Item and three-way interaction of Ethnicity, Test Item and Style were significant (b = - 1.42, SE = 0.39, z = - 3.60; b = 1.45, SE = 0.58, z = 2.50; respectively). The difference in accuracy between Chinese and British participants was only found when 'old' Western paintings were presented (Figure 4.6). No other main effects or interactions reached significance (ts < |1.75|).

[18] We measured working memory capacity at the beginning of the experiment or during the break between encoding and discrimination session. It could be that performing a working memory capacity test during the break between sessions may have an effect on encoding accuracy. Here we report that doing the working memory capacity test at the beginning of the experiment or during the break did not influence on the accuracy during discrimination target paintings from the foils (t(58)= 1.22, p = 0.227, M = 0.79, SE = 0.1 ; M = 0.77 SE = 0.1).

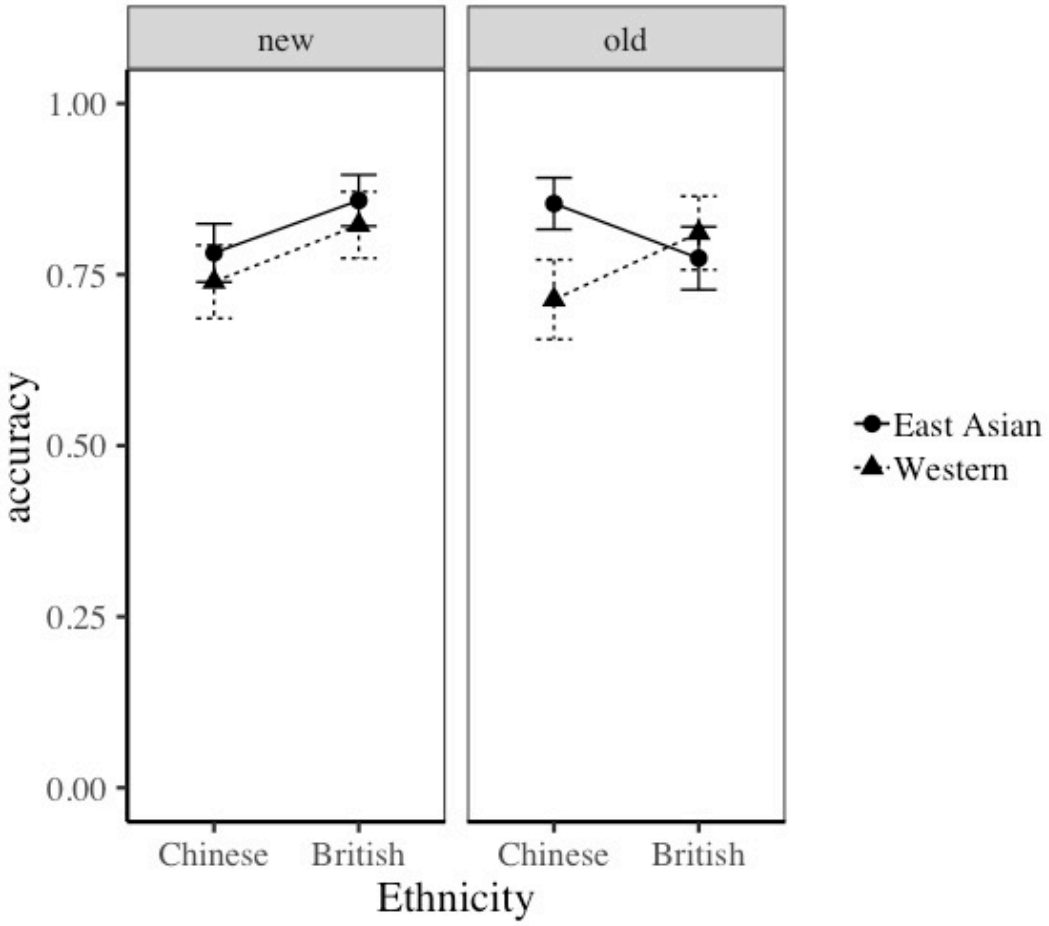


Figure 4.6. Effect estimates from the general linear mixed model for accuracy (with 95% CI) as a function of ethnicity, style and test item.

Table 4.1

Mixed ANOVA results using sensitivity and bias as the criterion.

Sensitivity							
Predictor	Sum of Squares	*df*	Mean Square	*F*	*p*	$_{partial}\eta^2$	$_{partial}\eta^2$ 90% CI [LL, UL]
(Intercept)	34.37	1	34.37	157.82	.000		
Style	1.74	1	1.74	7.97	.007	.12	[.02, .26]
Ethnicity	0.00	1	0.00	0.02	.896	.00	[.00, .03]
Style x Ethnicity	0.59	1	0.59	2.72	.105	.05	[.00, .16]
Error	12.19	56	0.22				
Bias							
(Intercept)	1.74	1	1.74	9.11	.004		
Style	0.80	1	0.80	4.21	.045	.07	[.00, .19]
Ethnicity	2.51	1	2.51	13.15	.001	.19	[.06, .33]
Style x Ethnicity	1.61	1	1.61	8.43	.005	.13	[.02, .27]
Error	10.67	56	0.19				

Note. LL and UL represent the lower-limit and upper-limit of the partial η^2 confidence interval, respectively.

With respect to *d'*, the main effect of Style was significant (Table 4.1). Sensitivity was higher for East Asian than Western paintings. No other main effects or interactions reached significance (*Fs* < 2.72). With respect to *c* the main effects of Style, Ethnicity and the interaction between them were significant. British participants were more likely to report that they had seen East Asian paintings during the encoding session than were Chinese participants (Figure 4.7).

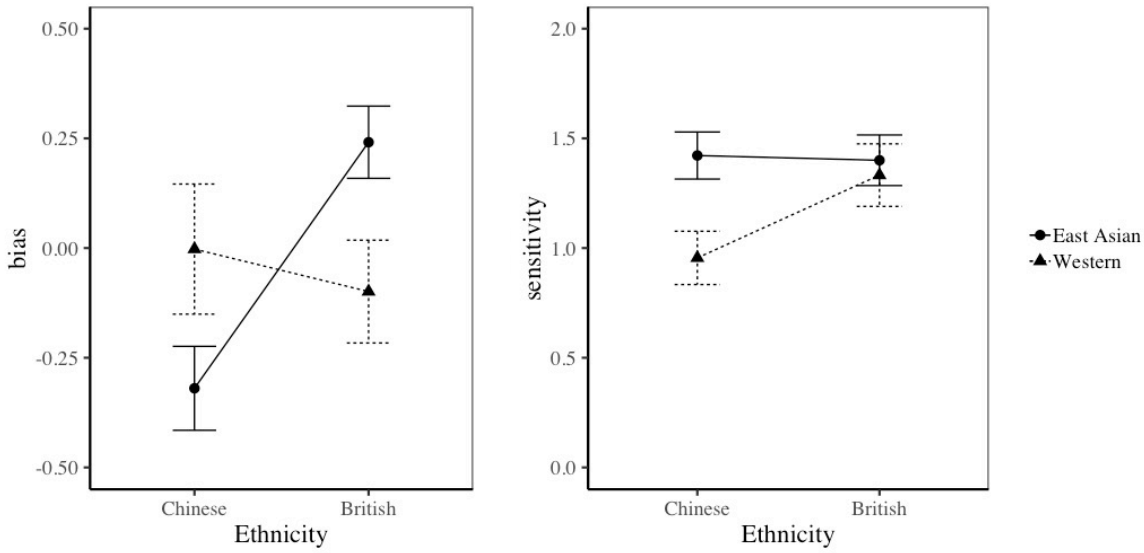


Figure 4.7. Means for bias and accuracy (with *SE*) as a function of ethnicity and style.

With respect to correlations, sensitivity was positively associated with the number of fixations made to theme and context across the groups[19] (Table 4.2).

[19] The correlations analysis between sensitivity and eye movements made to the theme and context ROIs were also conducted for four groups separately. In all four cases sensitivity positively correlated with number of fixations made to the theme ROIs (Chinese encoded Western paintings: $r(15)= .62$, $p = .014$; $r(15)= .48$, $p = .072$; British encoded Western paintings $r(13)= .82$, $p < .001$; $r(13)= .84$, $p < .001$; Chinese encoded East Asian paintings $r(17)= .57$, $p = .017$; $r(17)= .51$, $p = .038$; British encoded East Asian paintings $r(15)= .77$, $p < .001$; $r(15)= .72$, $p = .002$, for number of fixations made to the theme and context ROIs respectively).

Table 4.2

Means, standard deviations, and correlations with confidence intervals for gaze behaviour in encoding session and memory to the paintings .

Variable	*M*	*SD*	1	2	3
Chinese					
1. *d'*	1.20	0.51			
2. *c*	-0.17	0.51	-.41*		
			[-.66, -.07]		
3. NF_Theme	-8.88	0.56	.69**	-.29	
			[.44, .84]	[-.58, .07]	
4. NF_Context	-10.56	0.65	.61**	-.11	.89**
			[.33, .79]	[-.45, .24]	[.79, .95]
British					
1. *d'*	1.37	0.47			
2. *c*	0.08	0.40	-.17		
			[-.51, .22]		
3. NF_Theme	-9.34	0.57	.75**	-.20	
			[.53, .88]	[-.53, .19]	
4. NF_Context	-10.57	0.71	.62**	.25	.56**
			[.33, .81]	[-.13, .57]	[.23, .77]

Note. M and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. * indicates $p < .05$. ** indicates $p < .01$.

There are two key findings to report with respect to the discrimination of targets from foils. First, Chinese participants had relatively low accuracy in recognising Western

paintings shown at encoding. Second, discrimination sensitivity of targets from foils was associated with fixations made at encoding.

We now consider what the findings reported in the Results section mean in relation to the hypotheses laid out in the Introduction.

4.4 Discussion

The different artistic styles of Western and East Asian paintings did influence spectatorship as indexed by eye movement behaviour. Specifically, while there was a general trend for spectatorship to be focussed on the theme than the context, this effect was more striking when viewing Western than East Asian paintings. In the Introduction we outlined why this might be so (e.g. Masuda, Gonzalez, et al., 2008; Nand et al., 2014; Pöppel et al., 2013; Senzaki et al., 2014). The effort made by East Asian artists to emphasize the context as an integral part of the image and of Western artists to predominantly emphasize the theme is reflected in the manner of spectatorship.

While there is evidence of an influence of the type of painting on spectatorship, there was little evidence of an influence of the culture of the participants on eye movements at encoding. In contrast, there is evidence for an influence of the culture of participants when discriminating targets from foils, and evidence that this influence is specific to the type of painting. Chinese participants fixate[20] the theme in Western paintings, especially those of foils, less than do the British participants. It is a difference that presumably underpins their low accuracy with respect to discriminating between Western paintings.

The fact that Chinese participants showed reduced looking at the themes of Western paintings relative to British participants when discriminating between targets and

[20] Here we focus on total fixation duration as a global eye movement measure which captures a multiplicative relation between number of fixations and mean fixation duration (Rayner, 2009).

foils is a subtle but important fact. Considered in terms of the relative extent of looking at theme and context, it might be interpreted as a form of the finding originally reported by Masuda and Nisbett (2001) where the context seems more important to individuals from collective culture than to individuals from individualistic culture. However, such an interpretation is problematic. Strictly speaking the finding is of reduced looking at the theme by Chinese participants looking at Western paintings. It is not a finding that relates to spectatorship of contexts beyond Western paintings to Chinese paintings, nor to the original encoding of Western paintings by Chinese participants. Rather the finding seems to relate to usefulness for Chinese participants of whatever is attended in the theme to facilitate discrimination.

Discriminating targets from foils requires comparing a painting with those stored in memory after encoding. Spectatorship of the theme is often dominated by fixating human faces and figures. In fact, the majority of fixations made to Western portraits (at least when making aesthetic rating judgments) are made to faces (Massaro et al., 2012; Savazzi et al., 2014; Chapter 2). We hypothesise that there are structural factors that focus spectatorship of Western paintings so strongly on the theme, and that these structural factors focus spectatorship particularly on faces. While for British participants this focus is in a stimulus for which they have fine discrimination, this is not the case for the Chinese participants. In other words, the Chinese participants experience a form of Other Race Effect (e.g. Blais, Jack, Scheepers, Fiset, & Caldara, 2008; Fu, Hu, Wang, Quinn, & Lee, 2012; Hayward, Crookes, & Rhodes, 2013) when spectating Western paintings. The reason why no similar effect is found with British participants spectating East Asian paintings is because the paintings are structured differently such that attention is more focussed on the context.

It is not entire clear the extent to which any of the factors we have described here as contributing to effect of culture on spectatorship in fact relate to the broader issue of how

culture influences scene perception. The stimuli used in the present study are paintings that have an uncertain and unnecessary relationship to the structure of real scenes (Cavanagh, 2005; Graham & Redies, 2010; Ostrovsky et al., 2005). Nevertheless, the response of Chinese participants to the presence of Western faces in paintings as measured in eye movements may provide a basis for some experimentation on the influence of culture on scene perception with scenes containing people and without people (see Boland et al., 2008; Rayner et al., 2007).

There was one other effect of culture on eye movements. Eye movements made by Chinese participants were different from those of British participants when viewing East Asian paintings: in these cases, Chinese participants made more and longer duration to the context, but this was only the case when rejecting foils. We suggest that Chinese participants had a better appreciation of the information to support discrimination accuracy of information in the context than did British participants (Mickley Steinmetz et al., 2018). When inspection of the theme did not provide sufficient information to make a positive identification of targets, then attention was focussed on the context to help make an accurate decision. Only in the case of East Asian paintings was this is a particularly helpful strategy and Chinese participants seem better set to exploit this information.

There has been a suggestion made that differences in perception and memory tasks between participants from individualistic and collective culture may be influenced by memory capacity (Millar et al., 2013). The working memory capacity of all participants in the present study was measured using the 3-back task. Our Chinese participants showed a higher working memory capacity than did our British participants. However, the British participants were more accurate discriminating target paintings from the foils than Chinese. The important point in relation to these data is that the cultural differences in discrimination sensitivity and spectatorship cannot be accounted for by differences in

working memory capacity or the factors that this measure is known to be associated with (such as executive attention and task focus).

In conclusion, the results show little influence of culture on the spectatorship of Western or East Asian paintings when being encoded for recall in a later discrimination task. This was the case despite differences in spectatorship emerging from the encoding of Western and East Asian paintings. In contrast, there were two distinct effects of culture that emerged when discriminating targets from foils. Chinese participants looked less at the theme of Western paintings than did British participants and we suggest that this is a result of a form of the Other Race Effect. Chinese participants were also more likely to spend time exploring the context of East Asian paintings than were British participants when a positive identification of a target could not be made. Both effects might be interpreted as evidence of the relatively greater likelihood of inspection of the context other the theme by Chinese than British participants. However, any such interpretation must be nuanced by the fact that these differences emerge only at discrimination and not at encoding.

4.5 Rationale and research aims for Chapter 5

In Chapter 1, was noted that participant knowledge about painting style and motif may influence the act of spectatorship. The study presented in Chapter 4 has partially addressed this issue. It has been shown that the act of spectatorship is influenced by the style of the painting being inspected. Specifically, the context of East Asian paintings was more likely to be inspected than Western paintings. However, I do not yet have evidence to support the argument that emphasizing the motif category may influence on the act of spectatorship. The following chapter addresses this issue.

Chapter 5 has two aims. The first aim is to explore whether developing an idea of motif has an implication for spectatorship. To engage in this exploration, Chinese and British viewers were asked to encode set of paintings which were grouped or grouped and

named base on their motif. The second aim is to replicate the effect reported in Chapter 4, that Chinese participants were less likely to spend time exploring the theme of Western paintings when discriminating target paintings from foils.

In contrast to Chapter 4, the set of stimuli consisted of Western paintings only. This decision was motivated by the fact that Chinese participants presented poorer memory performance for Western paintings than British viewers (Chapter 4). It was argued the visual information presented in the theme of Western painting does not provide Chinese participants enough information to make recognition strategy efficient. In Chapter 4, I suggested that this result is a form of the Other Race Effect. The Other Race Effect literature provides evidence that East Asian faces are easier to remember than Western faces (for review see Meissner & Brigham, 2001). It was suggested that in contrast to Asian observers, Western participants are able to apply different types of visual strategies during learning other- than own-race faces. It is important to note that in the present thesis, theme area was defined by the group of human figures which implicate the presence of human faces. It has been shown that the presence of human faces leads to capture attention (for review see Young, 2018). However, it also has been shown that Chinese participants look at the scene more holistically than Western viewers. I hypothesis that emphasizing the motif category will help Chinese participants to use their cultural advantage and learn to look beyond the theme area to differentiate between different examples of Western paintings. In contrast, British participants will focus more on the focal area of the painting which is defined by theme ROI when the motif is emphasized.

Chapter 5

The Influence of Knowledge of Painting Motifs on Spectatorship

5.a Abstract

In the present study we explore if emphasizing the motif of paintings influences the eye movements that spectators make to representational paintings. To do so, participants were drawn from the UK and China and were shown images of 100 paintings during an encoding session for later recall in a discrimination session conducted 30 minutes later where participants were asked to discriminate target paintings from foils. The 100 paintings shown at encoding and discrimination were composed of twenty paintings from each of five motifs. During the encoding phase, the order of paintings was either randomized, blocked by motif, or blocked and named by motif of the painting. We found evidence that emphasizing information about motif had an effect on the spectatorship of representational paintings. Specifically, emphasizing the motif increased total fixation duration to paintings at encoding among British participants but reduced it among Chinese participants. The effect of emphasizing the motif did not influence sensitivity at discrimination. In addition, the results also confirmed the effect of culture on fixation to theme and context ROIs when discriminating targets from foils reported in Chapter 4. The implication of motif category and cultural background on spectatorship process are considered.

5.1 Introduction

Representational paintings are painted such that each element comes together (Gombrich, 1992) to generate in a spectator an overall aesthetic experience alongside a representation stored in memory (Cupchik et al., 2009; Leder & Nadal, 2014; Pelowski et al., 2017). With respect to the representation formed in memory, representational paintings can be thought of as exemplars of a categorical system (Minissale, 2013). The two most common types of categorical systems in which paintings are considered are style and motif (Wolfflin, 1950; pp. 18 -32). Style is defined in terms of a particular medium, period of time and geographical place that influence the structural rules of form and composition (Iversen, 2003; Panofsky & Heckscher, 1995). In contrast a motif is a theme that repeats across paintings. More precisely, motif refers to visuo-semantic attributes that results in a categorical similarity between paintings (Panofsky, 1987, pp. 40 - 41; Wolfflin, 1950, pp. 75 - 106). Previous studies (Augustin, Leder, Hutzler, and Carbon, 2008, Augustin, Defranceschi, Fuchs, Carbon, & Hutzler, 2011) have shown that non-art trained (naïve) spectators more quickly accesses the motif of a painting (defined in these studies as paintings of trees, flowers, houses, people).

The motif of a representational painting is typically defined by specific figures and objects presented in an area that defines it. This theme area which is usually centred toward the middle of the painting. Beyond the theme area is the context. For example, paintings representing the mythological motif of Venus show the nude woman across a variety of contexts that differ in place and time (for example, Botticelli, *The Birth of Venus,* 1486; Cranach the Elder, *Cupid Complaining to Venus,* 1525; Titian, *Venus of Urbino,* 1534; see also Figure 5.1). The spatial arrangement of theme and context can be stated within the language of eye movement studies as defining regions of interest (ROIs). In this paradigm, the eye movements of spectators viewing representational paintings can

be considered as falling within the theme ROIs, and therefore focussed on the motif, or as falling within the context ROIs.

In the present study we explore if an emerging familiarity with the idea of specific motifs might influence the eye movements that spectators make to representational paintings. To do so, we measured eye movements made when initially encoding Western paintings drawn from five motif categories and when later discriminating some of these paintings from foils drawn from the same categories. We compare performance of naïve spectators viewing randomized sequences of paintings, relative to paintings organized into motif categories. We suggest that grouping paintings by motif may help spectators to form a categorical representation of each motif (Kass et al., 2015; Rosch, 1999), especially so when they are informed of the motif category label.

The first question we explore in the present study is whether a spectator developing an idea of motif has any implications for their spectatorship across theme and context ROIs. There is at least one reason for believing that it may have an influence. Experts are very familiar with the motifs of representational paintings and there are reports that their eye movements are more widely distributed than those of naïve spectators (Francuz et al., 2018; Harland et al., 2014; Nodine et al., 1993; Pihko et al., 2011). While the very modest amount of experience provided in this study to naïve spectators cannot be equated with expertise, it does offer the possibility of testing whether emphasizing the notion of motifs can influence the spectatorship of representational paintings.

How might emphasizing a motif influence the spectatorship of representational paintings by naïve viewers? In contrast to art experts, eye movements made by naïve spectators cannot be controlled by the top-down mechanisms (e.g., knowledge about painting style) and guided into the area which may help them to individuate objects presented on the painting. We hypothesize that emphasizing the idea of the motif will

indicate the relational strategy of looking at the representation paintings during encoding. More precisely, participants will be presented greater focus on the theme as this region reflects motif content and remains more stable across the exemplars of a motif than the area beyond the theme.

In Chapter 4, culture was shown to influence spectatorship at encoding and discrimination in a task where participants had to first encode target paintings and then discriminate these target painting from foils. In that study, and with respect to encoding session, British participants made more fixations to the theme than did Chinese participants (see Chua, Boland, & Nisbett, 2005 for similar findings in scene perception study). However, when Western target paintings were being discriminated from foils, Chinese participants were less focused on the theme of paintings and more on the context relative to British participants.

The explanation offered for the opposing effects of culture on eye movements to ROIs was that while British participants made use of the faces in the paintings to aid discrimination, focussing on faces did not help the Chinese participants as they experienced a kind of 'Other Race Effect' (Blais et al., 2008; Fu et al., 2012; Hayward et al., 2013). As a result of difficulty in discriminating faces, Chinese participants were forced to seek information in the context to help in the discrimination of targets from foils. This difference found between British and Chinese participants in Chapter 4 is critical to the motivation of the present study. Following the explanation offered in Chapter 4, the question we explore in the present study is if emphasising the idea of motif during the encoding session will have contrasting effects on act of spectatorship made by British and Chinese participants.

According to the perceptual expertise account, if an individual has only limited contact with members of race other than one's own race, this leads to difficulty in

differentiating facial information of other-race group members; this influences how other-race faces are encoded (e.g., Goldinger, He, & Papesh, 2009). To make encoding strategy efficient, observers need to seek additional information beyond faces to overcome potential difficulties associated with presence of the other-race faces. If the structural factors that focus spectatorship of Western paintings so strongly on the theme are driven by presence of the faces, then the prioritisation of theme area (accomplished by emphasizing idea of motif) should influence gaze behaviour of British and Chinese participants.

Taken together, the present study tests a single hypothesis. We hypothesise that emphasizing motifs at encoding will have contrasting effects on British and Chinese participants relative to a randomized condition where motif is not emphasized. British participants will focus more on the theme ROI than the context when the motif is emphasized relative to the randomised condition. In contrast, Chinese participants will do the opposite as they learn to look beyond the theme and to the context to find information that helps them differentiate between different exemplars of the motif. Specifically, we predict that Chinese participants will present less focus on the theme ROI than British viewers because the emphasizing motif category will not provide enough information to make the focus on the theme ROI efficient to encode the painting. Both effects would be evidence that emphasizing the motif can influence the spectatorship of representational paintings.

5.2 Method

5.2.1 Participants

Participants were 46 Chinese (22 males and 24 females; $M = 22.22$, $SD = 2.37$) and 39 British (5 males and 34 females; $M = 19.72$, $SD = 1.77$) undergraduate students from the Tianjin Normal University (PRC) and University of Southampton (UK), respectively.

All of the Chinese participants were born and completed their pre-university education in China and were enrolled at the Chinese university. Group of British participants represented students who completed their pre-university education in the UK and were studied at British university. An opportunity sample who were recruited through an online system for advertising studies. Participants received course credits or payment (£15) to compensate for their time. Expertise in art was measured with an art knowledge questionnaire translated to English (Trawinski et al., 2019) or Chinese from the original German version of the questionnaire (Jakesch & Leder, 2009). Participant knowledge about art tended to be low (Chinese: M = 2.96 [out of 48]; SD = 2.60; Mdn = 2; range = 0 - 16; British: M = 7.36; SD = 3.97; Mdn = 7; range = 1 - 18). The participants were therefore classified as naïve.

5.2.2 Apparatus

Tasks were presented on a View-Sonic graphics Series G225f CRT monitor with screen size 40 cm x 30 cm in a darkened room. Participants were seated at a distance of 70 cm giving a visual angle of 30.11° by 23.75° for the screen. Screen resolution was 1024 x 768 with a refresh rate of 120 Hz. Viewing was binocular, though the only movements of the right eye were recorded using an SR Research Limited Eye-Link 1000 eye tracker operating at 1000Hz. Head movement was stabilized using a chin and headrest. Participants responded by pressing one button on a five buttons response box.

5.2.3 Stimuli

The paintings set consisted of Western paintings taken from five motifs categories: Three Graces, Judith, Bathers, Odalisque, and Venus. Each motif category contained 30 paintings (see Appendix 1 for a list of all paintings, motifs and artists). In total 150 high-

resolution paintings reproductions were uploaded from Google Image Search. All signatures were removed using Adobe Photoshop CS6. Each painting was split into ROIs of theme and context. We operationalised theme as the area covered by people, in the central part of the foreground on the painting which reflect the motif itself. Objects placed in the theme area may be thought of as a focal part of the paintings. The area of the painting beyond the theme ROI was defined as the context. The themes covered, on average, 58% of the area of paintings; the rest was designated context. Paintings were presented centrally on the screen against grey background. The height varied between 7.81 and 27.09 cm on the screen and giving the visual angle between 6.35° and 21.79°. Widths varied between 11.38 and 20.32 cm and increasing the visual angle to 16.17° and 28.48°.

5.2.4 Design and Procedure

The experiment had five stages and all participants completed all stages. In the first stage, participants completed an art knowledge questionnaire. In the second stage (encoding session), participants were asked to try to memorise each of one hundred paintings for recall in a later discrimination session. The second stage began with participants completing a nine-point calibration procedure for accurate eye movement recording. The eye tracker was calibrated to less than 0.5^0 error. Once calibration was complete, the presentation of paintings began. Paintings were presented in three independent conditions. Participants viewed paintings either in randomized sequences (randomized condition) or organized into five groups base on motif categories (blocked condition), or blocked and presented with name of each motif (i.e. Three Graces; Judith; Bathers; Odalisque; Venus) prior painting exposition (blocked-named condition). The paintings were presented in random order within each motif category in the blocked and

blocked-named condition, but block order was fixed. In contrast, paintings presentation was fully randomized in the randomized condition.

The order of blocks was determined by the visual complexity of the painting's theme which depicted the motif. The first four blocks contain paintings derived from motifs representing a single narrative aspect. The final block is a motif defined by more than one narrative (see Damisch, 1996, pp. 61-76; 125-156). In doing so, the visual similarity of the final block tends to be lower than in the first four blocks (Figure 5.1). Two concepts are essential to explain our definition of visual similarity: structural and narrative properties of the painting. The structural properties refer to the organization of the painting when the narrative aspect reflects the story illustrated in the painting. For example, regarding the motif of Judith, the spectator perceives a woman with a severed head and decapitation tool in the geometric centre of the painting and placed in the foreground. The narrative aspects of the painting refer to the unique biblical story when Judith, a beautiful widow, kills an Assyrian general (Holofernes) who was about to destroy Judith's home city. Across of instances of exemplars used to emphasize four motifs in four training blocks, the same principle of structural and narrative aspects of visual complexity was applied. In contrast, the last block (motif of Venus) contained paintings which were more visually complex in terms of narrative properties. The structural properties always show a nude figure, which is again in the central part of the painting, placed in the foreground. However, the narrative aspect of painting could depict mythological stories related to of birth of Venus, her relationship with her son Cupid, or her lover Mars.

Taken together, the present experimental design follows the traditional framework which describes object perception as a process of categorization at different levels of abstraction (Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976) and category learning

process as developing the ability to differentiate objects by levels of abstraction (Wong & Gauthier, 2007).





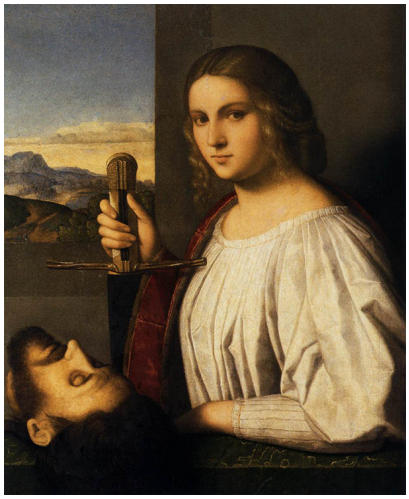
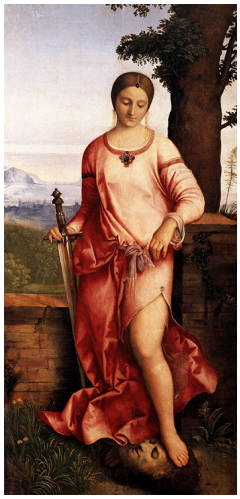
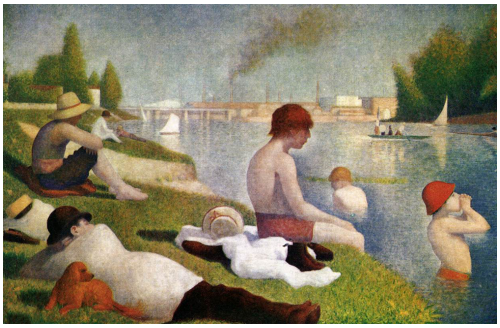




Figure 5.1. Examples of paintings used in the present study, which belongs to motif of Three Graces, Judith, Bathers, Odalisque and Venus. From the top right: Raphael, *The Three Graces* (1504); von Aachen, *The Three Graces* (1604), Rubens, *The Three Graces* (1639), Titian, *Judith (Salome)* (c. 1515); Catena, *Judith and Holofernes* (1525); Giorgione, *Judith* (1504); Seurat, *Bathers at Asnières* (1884); Bazille, *Bathers (Summer Scene)* (1869); Renoir, *The Large Bathers* (1887); Renoir, *Odalisque* (*An Algerian Woman)* (1870); Schiavoni, *Odalisque* (1845); Delacroix, *Odalisque* (1857); Botticelli, *The Birth of Venus* (1486); Titian, *Venus of Urbino* (1534); Cranach the Elder, *Cupid Complaining to Venus* (1525).

The presentation of each painting was preceded by a fixation cross presented central to the screen. Once this point was fixated, a grey screen (randomized condition), or block number (blocked condition), or motif name (blocked-named condition) was presented for 1000 ms. Then each painting was presented individually and remained on the screen until a key press response indicated that they had finished viewing. These responses were made via pressing any one button on five buttons response box. The inter-trial interval was set to 500 ms.

The third stage was completed during the 30-minute interval between the second and fourth stages. Participants completed tests which measured visuospatial and verbal working memory in a 3-back task (Shackman et al., 2006).

In fourth stage (discrimination session), participant eye movements were measured again following re-calibration. In this discrimination session, fifty foil paintings were shown randomly mixed in with fifty of the paintings shown during the encoding session. Twenty paintings were shown from each motif category of which ten were previously seen. All participants saw the same set of paintings during discrimination session. Participants were asked to judge whether they had seen the painting in the encoding session or not, with paintings staying on until a target or foil response was made. Responses were made via the pressing one of two buttons on a response box.

In the fifth and final stage participants completed a remained part of the battery of cognitive and psychological tests. The the orienting, alerting and executive components of the Attention Network Test (Fan et al., 2002) were measured.

5.3 Results

Data analyses were conducted in R version 3.5.0 (Team R Core, 2016). Behavioural and eye movement data were fitted in Linear Mixed-effects Models (LMMs)

using the lmer4-package (Bates et al., 2014) and MASS-package (Venables & Ripley, 2002). The random effects were structured for items and participants including slopes for meaningful fixed effects and correlation. The full random structure was trimmed down for those models that did not converge or had a correlation equal to zero or one[21]. The *t*-values equal to 1.96 or higher were interpreted as significant because the *t*-statistic in LMMs approximates the *z*-statistic for high degrees of freedom (Baayen et al., 2008).

The results are structured to consider the (a) eye movements in encoding and discrimination session, and (b) accuracy in distinguishing targets paintings from foils. Analyses of eye movement data were conducted using number of fixations, mean fixation durations, and total fixation durations (as a sum of all fixation durations in each ROI).

For supplementary information we report that the British and Chinese participants had similar scores on verbal working memory and attention network tests[22] (Table 5.1); they were significantly different on visuospatial working memory capacity, art knowledge, or age. Chinese participants were older, had a higher capacity on visuospatial working memory capacity, and lower knowledge about Western art than British participants.

[21] For eye movement measures the random structure for the LMM for log-transformed normalised number of fixations and log-transformed total fixation duration was (1| Subject) + (1| Stimuli), for log-transformed mean fixation duration was (1+ROIs| Subject) + (1| Stimuli) in encoding sesssion. With respect to discrimination session the random structure for the LMM for log-transformed normalised number of fixations, for log-transformed fixation duration, and log-transformed total fixation duration was (1 | Subject) + (1 | Stimuli).

[22] The further analysis of results of battery of cognition tests and their impact on spectatorship process was not reported here (see Chapter 6).

Table 5.1

Demographic Information.

	Chinese		British		*p* value
	M	*SD*	*M*	*SD*	
Age	22.22	2.39	19.72	2.20	> .001*
3-Back: Spatial	63.54	13.60	52.08	18.92	.004*
3-Back: Verbal	65.07	14.52	60.36	21.71	.253
ANT: EXEC	68.17	22.88	79.56	38.73	.169
ANT: ORIENT	33.97	22.71	37.94	43.36	.523
ANT: ALERT	19.07	22.39	32.78	32.44	.100
Art Knowledge	2.96	2.62	7.36	4.02	> .001*

*Significant at $p < .05$.

5.3.1 Eye Movements

5.3.1.1 Outliers and Exclusion. The data were analysed only for paintings for the motif of Venus. The paintings of Venus presented in the random condition formed the baseline. With respect to the blocked and blocked named condition, paintings which belonged to remained 4 motifs categories (Three Graces, Judith, Bathers, and Odalisque) were used to familiarise participants with the concept of motifs as specific kinds of visual categories and were not analysed.

Table 5.2

Means and standard deviations for eye movements at encoding session as a function of the ROI, Ethnicity and Condition.

	Ethnicity				Condition					
	Chinese		British		random		blocked		blocked-named	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Number of Fixations										
Context	10.35	12.12	11.05	13.91	10.38	12.09	10.90	12.43	10.76	14.41
Theme	19.79	14.24	23.24	15.98	21.83	16.88	21.61	13.16	20.70	15.20
Fixation Duration										
Context	277.85	83.49	271.75	83.49	273.55	85.74	268.70	78.30	283.05	85.86
Theme	293.69	60.86	284.34	55.36	290.81	58.84	286.51	58.55	290.83	58.32
Total Fixation Duration										
Context	2858.18	3414.10	3022.63	4230.65	2768.13	3163.81	2932.67	3435.90	3114.21	4717.50
Theme	5738.41	4175.86	6557.40	4965.45	6135.90	4415.39	6058.08	3769.93	6147.39	5365.69

Note. M and *SD* represent mean and standard deviation, respectively.

Table 5.3

Means and standard deviations for eye movements made in discrimination session as a function of the ROI, Ethnicity and Condition.

	Ethnicity				Test Item			
	Chinese		British		foil		target	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Number of Fixations								
Context	4.03	3.79	3.89	3.86	3.87	4.18	4.08	3.32
Theme	8.81	5.78	11.31	6.41	12.88	6.88	7.50	4.12
Fixation Duration								
Context	281.23	99.12	239.10	76.35	256.63	81.90	262.21	100.15
Theme	259.36	57.56	243.87	50.49	245.47	44.51	257.12	62.05
Total Fixation Duration								
Context	1082.43	1048.47	930.74	936.86	989.56	1117.40	1019.48	807.78
Theme	2269.79	1603.45	2711.37	1556.10	3139.67	1789.55	1895.69	1091.44

Note. M and *SD* represent mean and standard deviation, respectively.

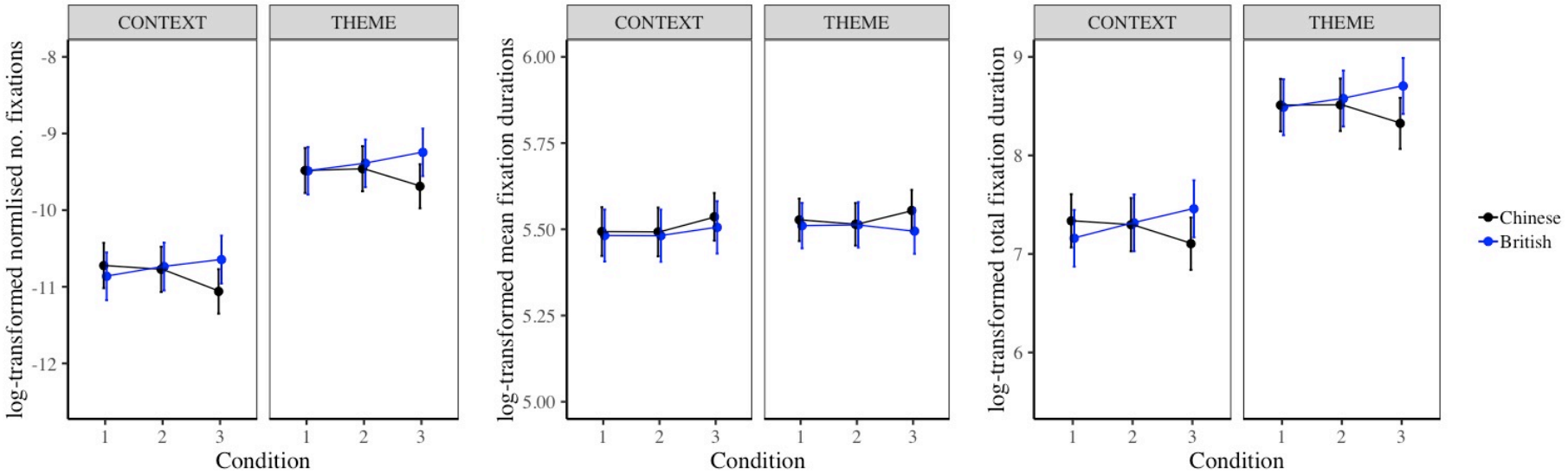


Figure 5.2. Effect estimates from the linear mixed model (with 95% confidence intervals) for normalised log-transformed number of fixations (*Note.* Values closer to zero on y-axis are related to greater number of fixations), log-transformed mean fixation durations, and log-transformed total fixation durations made in encoding session as a function of ROI, Ethnicity and Condition (1 – randomized; 2 – blocked; 3 – blocked-named condition).

With respect to eye movements data, fixations shorter than 60 ms or longer than 1200 ms were removed. Fixations that coincided with display onset or the response were also removed as well as fixations made to the paintings representing motifs of Three Graces, Judith, Bathers, and Odalisque. The final data set consisted of 53 705 fixations in the encoding session and 19 944 fixations in the discrimination session made to paintings represented motif of Venus.

5.3.1.2 Data Normalization. All eye movement data were log-transformed to increase the normality of the data distribution. The number of fixations was normalised to overcome potential difficulties associated with the fact that each ROI has different area. To normalise number of fixations, the theme and context areas were computed. The eye movement made to theme/context were divided by theme/context area, respectively, for each painting.

With respect to eye movements made at encoding session, data was analysed using three fixed factors: Ethnicity (2: Chinese versus British), Condition (3: randomized versus blocked versus blocked named), and ROI (2: theme versus context). With respect to discrimination session, one additional fixed factor was added to the model: Test Item (2: target versus foil). The analysed of eye movements made in discrimination session was conducted only for paintings which were correctly recognised as targets or foils. Table 5.2 and 5.3 show means and standard deviations for encoding and discrimination session.

5.3.1.3 Encoding Session. With respect to the number of fixations, participants made more fixations to the theme than to the context ROI (b = 1.24, SE = 0.04, t = 28.36).

Ethnicity interacted with ROI and with Condition. British participants made less fixations to the context than Chinese participants (b = 0.14, SE = 0.06, t = 2.13; Figure 5.2). British participants made more fixations in the blocked-named condition than in the random condition whereas Chinese participants made fewer fixations in the blocked-

named condition than in the random condition (b = 0.56, SE = 0.26, t = 2.11). No other main effects or interactions reached significance (ts < |1.89|).

The interaction between ROI and Condition was also significant. Overall fewer fixations were made to the theme in the blocked-named than random condition (b = 0.13, SE = 0.06, t = 2.12).

With respect to mean fixation duration, no main effects or interactions reached significance (ts < |1.56|).

With respect to total fixation duration, participants fixated the theme longer than the context ROI (b = 1.17, SE = 0.07, t = 17.97). The interaction between Ethnicity and Condition was significant. British participants looked longer in the blocked-named than the random condition wherease Chinese participants did the opposite (b = 0.53, SE = 0.27, t = 2.00). No other main effects or interactions reached significance (ts < |1.63|).

5.3.1.4 Discrimination Session. With respect to the number of fixations, participants made more fixations to the theme than to the context ROI (b = 1.62, SE = 0.10, t = 16.57). ROI interacted with Ethnicity and with Test Item. British participants made more fixations to the theme than did Chinese participants (b = 0.47, SE = 0.13, t = 3.58, Figure 5.3) and fewer fixations were made to theme of target paintings than to the theme of foil paintings (b = - 0.29, SE = 0.14, t = - 2.05). No other main effects or interactions reached significance (ts < |1.87|).

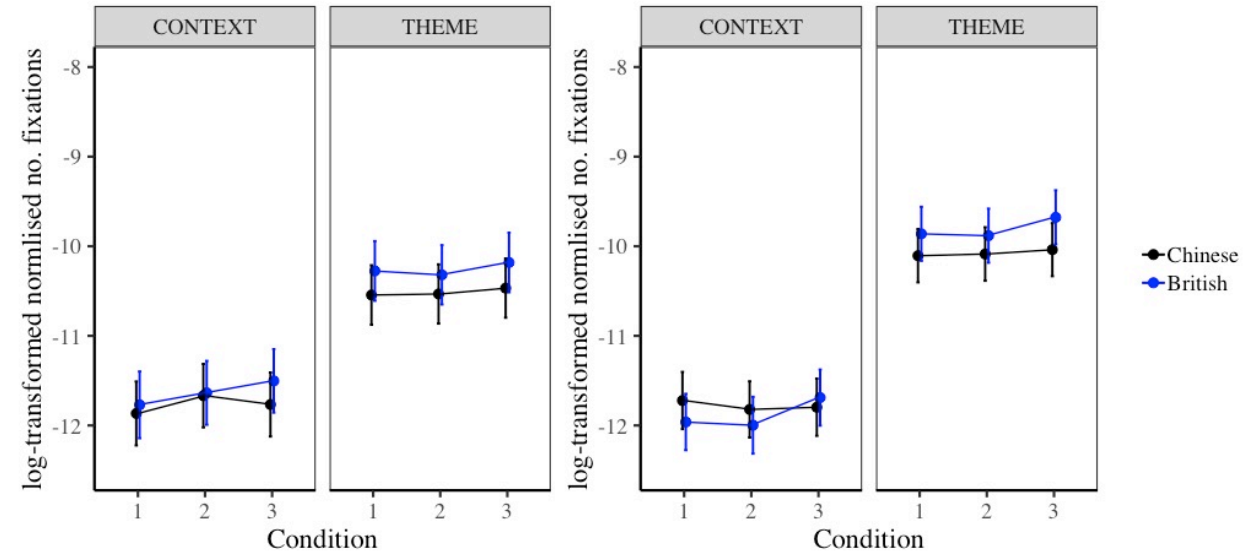
With respect to mean fixation duration, shorter fixations were made to the theme than to the context ROI (b = - 0.12, SE = 0.03, t = - 3.07). British participants made shorter fixations than did Chinese participants (b = - 0.14, SE = 0.06, t = - 2.37). No other main effects or interactions reached significance (ts < |1.80|).

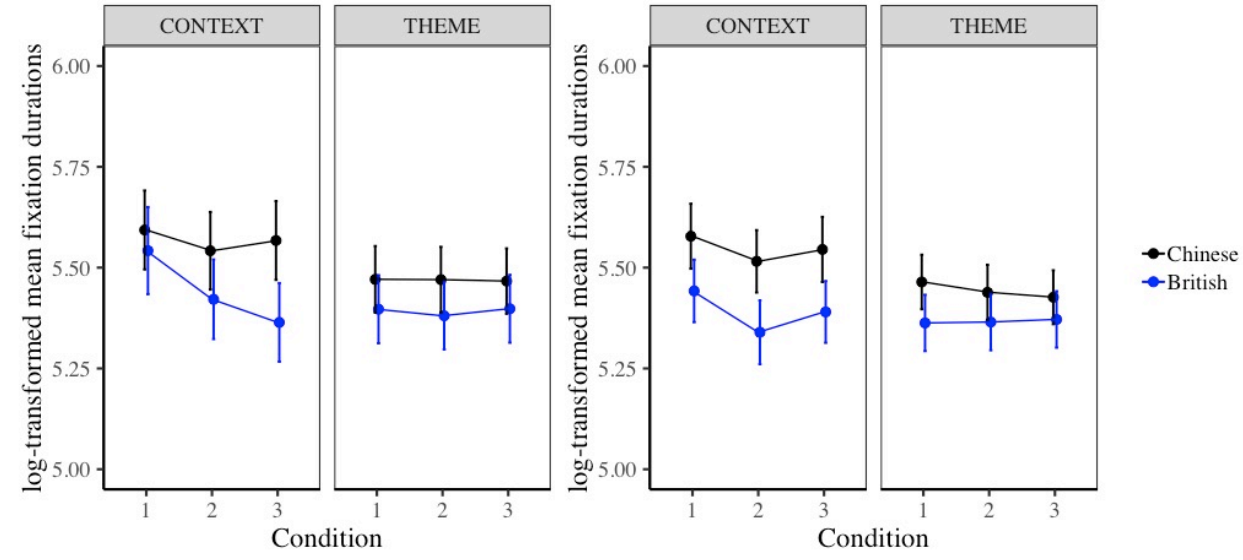
With respect to the total fixation duration, participants fixated the theme longer than the context ROI (b = 1.25, SE = 0.11, t = 11.61) and British participants looked at the paintings for less time than did Chinese participants (b = - 0.43, SE = 0.14, t = - 2.96).

Ethnicity interacted with ROI. The difference in total fixation duration between theme and context ROIs was bigger for British than Chinese participants (b = 0.57, SE = 0.14, t = 3.96).

Ethnicity also interacted with Test item (b = 0.50, SE = 0.18, t = 2.73) and Test Item and Condition (b = - 0.56, SE = 0.25, t = - 2.25). Chinese participants looked at the foils longer than did British participants.

The interaction between ROI and Test item was also significant (b = - 0.63, SE = 0.15, t = - 4.08). The difference in total fixation duration between theme and context was longer when viewing the foil than target paintings. No other main effect or interactions reached significance (ts < |1.76|).


CONTEXT
THEME
log-transformed normlised no. fixations
-8
-9
-10
-11
-12
1
2
3
Condition
Chinese
British


CONTEXT
THEME
log-transformed mean fixation durations
6.00
5.75
5.50
5.25
5.00
1
2
3
Condition
Chinese
British

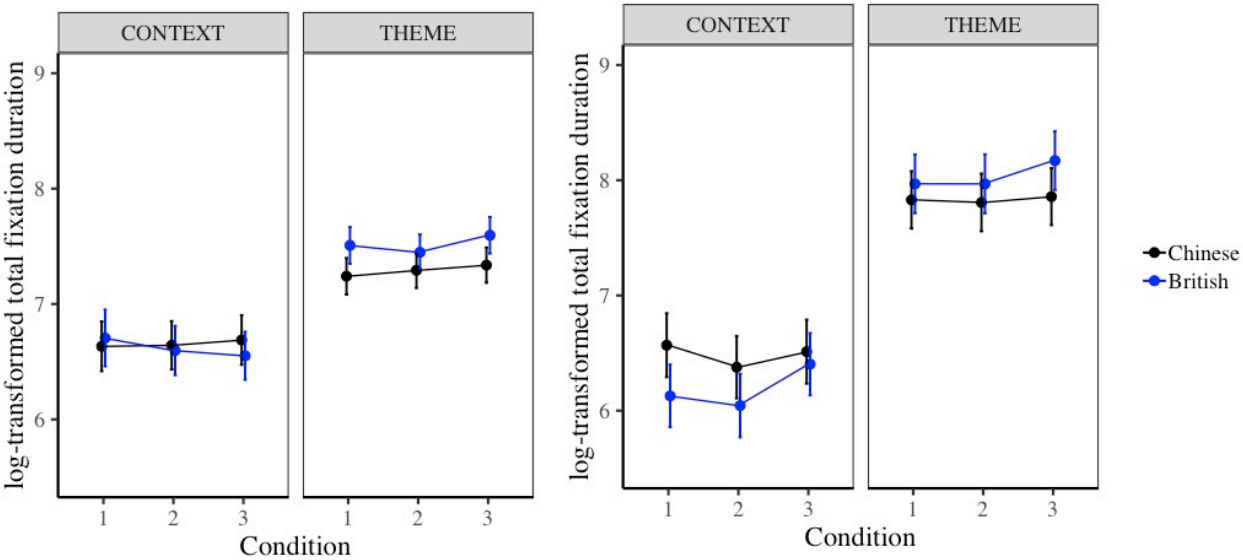

CONTEXT
THEME
log-transformed total fixation duration
9
8
7
6
1
2
3
Condition
Chinese
British

Figure 5.3. Effect estimates from the linear mixed model for normalised log-transformed number of fixations (*Note.* Values closer to zero on y-axis are related to greater number of fixations), log-transformed mean fixation durations, and log-transformed total fixation durations made in discrimination session as a function of ROI, Ethnicity and Condition (1 – randomized; 2 – blocked; 3 – blocked-named condition). The left column shows data for target paintings, whereas the right shows data for foil paintings.

5.3.1.5 Growth Curve Analysis. The data were also explored within the time course of sampling information from the theme and context ROIs during encoding and discrimination session. The probability function of looking to the context was calculated across all trials for 5000 ms of trial duration (Figure 5.4) with time bins of 100 ms. The probability of fixations to the theme ROI is the inverse of these data. The probability of fixating the theme is highest immediately post onset whereas the probability of fixating the context peaks at around 2000 and 2500 ms in encoding and discrimination session, respectively. When the probability functions are almost identical at encoding session, a difference starts to emerge at discrimination session. In the time window between 2500 – 3000 ms, Chinese participants are around 10% more likely to sample information from the context than were British participants.

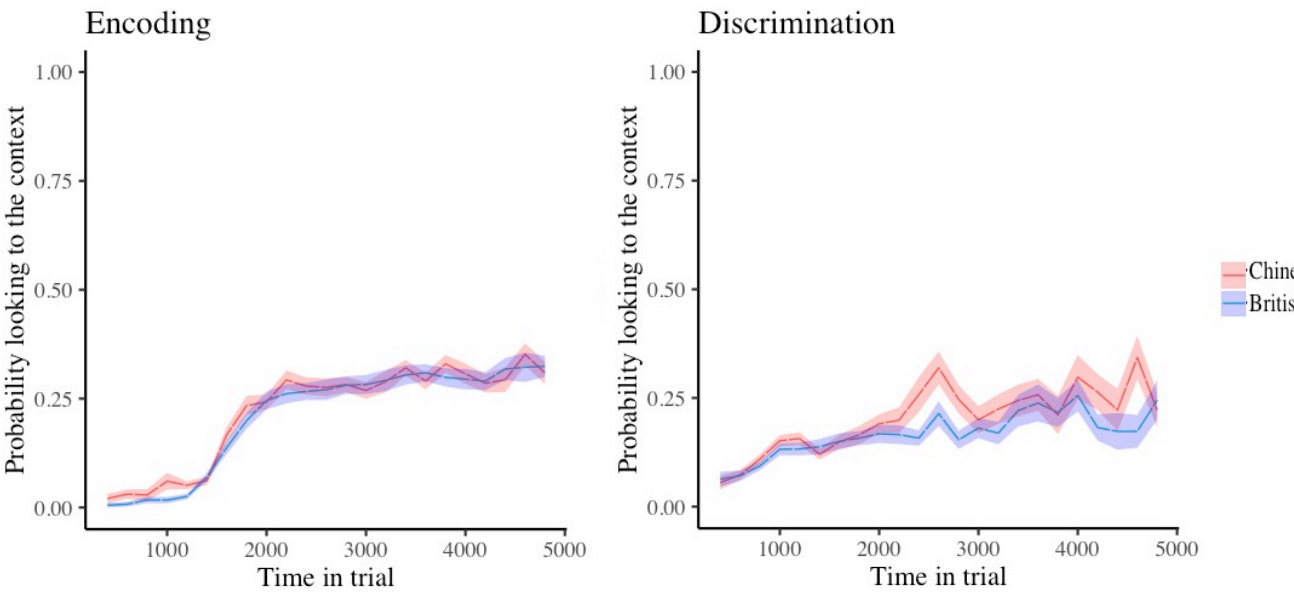


Figure 5.4. Probability of sampling information from the context during the encoding and discrimination session for Chinese (red line) and British (blue line) participants. The shading area around function refers to 95% confidence interval.

5.3.2 Discrimination of Paintings

The hit and false alarm rates were used to create measures of sensitivity (*d'*) and bias (*c*; Macmillan & Creelman, 2004), which were analysed using analysis of variance. Sensitivity and bias were used as dependent variables, and Ethnicity and Condition were between subject factors.

With respect to *d'*, the main effect of Ethnicity was significant (Table 5.4). Sensitivity was higher for British than Chinese participants (Figure 5.5). No other main effects or interactions reached significance. With respect to *c,* no main effects or interaction reached significance.

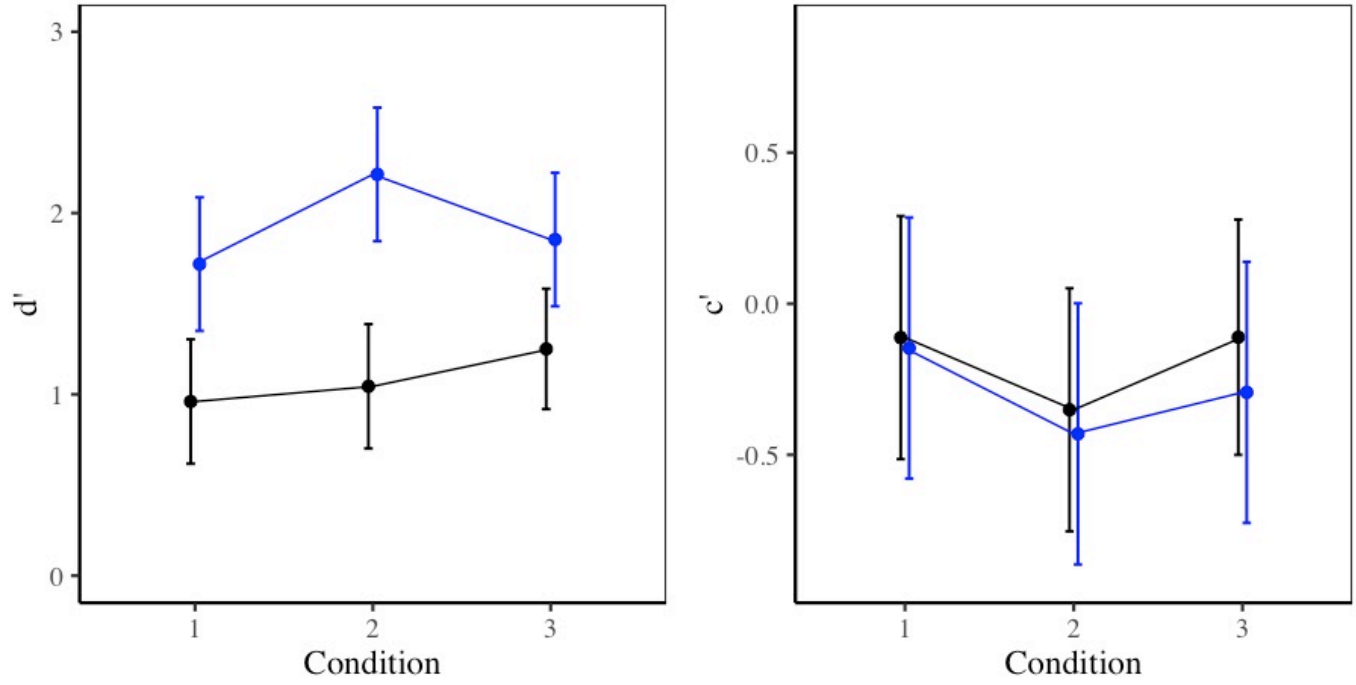


Figure 5.5. Means for sensitivity and bias (*SE*) as a function of Condition and Ethnicity.

Table 5.4

Mixed ANOVA results using sensitivity and bias as the criterion.

Predictor	Sum of Squares	*df*	Mean Square	*F*	*p*	$_{partial}\eta^2$	$_{partial}\eta^2$ 90% CI [LL, UL]
Sensitivity							
(Intercept)	13.84	1	13.84	30.16	.000		
Condition	0.70	2	0.35	0.76	.472	.02	[.00, .08]
Ethnicity	4.00	1	4.00	8.72	.004	.10	[.02, .21]
Condition x Ethnicity	1.20	2	0.60	1.31	.276	.03	[.00, .10]
Error	36.25	79	0.46				
Bias							
(Intercept)	0.19	1	0.19	0.30	.587		
Condition	0.58	2	0.29	0.46	.633	.01	[.00, .06]
Ethnicity	0.01	1	0.01	0.01	.908	.00	[.00, .01]
Condition x Ethnicity	0.08	2	0.04	0.06	.938	.00	[.00, .00]
Error	49.89	79	0.63				

Note. LL and UL represent the lower-limit and upper-limit of the partial η^2 confidence interval, respectively.

5.4 Discussion

The influence of emphasizing motifs on spectatorship of Western representational paintings was explored with respect to eye movements made by British and Chinese participants as they encoded targets for later discrimination from foils. We hypothesized that emphasizing the motif would lead British participants to focus fixations more on the theme than the context while it would have the opposite effect on Chinese participants when encoding Western paintings. The results showed cultural background did influence how emphasizing the motif affected the spectatorship of representational paintings. British participants increased their total fixation duration at encoding when the motif was emphasized. In contrast, Chinese participants reduced their total fixation duration when motif was emphasized. In other words, cultural influence affected how emphasizing the motif impacted on total fixation duration and not just to the distribution of fixations over paintings.

The possible explanation is that Chinese participants found it difficult to match semantic information included in the motif label with the visual information presented in the theme of Western painting. As an effect, their relational encoding was less exhaustive than British participants. In the Introduction, we hypothesized that Chinese participants should focus more on the context ROI if sampling information from the theme was not sufficient. However, our prediction was not correct. It could be that looking beyond the theme of Western paintings is in general less likely (see Chapter 3 and 4). The visual information represented in the context of Western paintings is not as salient as for example in East Asian art (for review Masuda, Wang, Ito, & Senzaki, 2012).

While culture influenced how emphasizing the motif impacted on spectatorship it did not influence sensitivity or bias to the paintings at discrimination. The Chinese participants had lower sensitivity overall than British participants. Additionally, Chinese

participants had lower knowledge about Western art than British spectators. Together these findings meet our expectations that visual information and form of artistic expression depicted in the Western paintings were less familiar for Chinese viewers.

Emphasizing the motif influenced total fixation duration during encoding among British and Chinese participants without changing sensitivity at discrimination. It could be that providing more complex semantic information such as a full description of the attributes of the motif category may improve the overall sensitivity. Alternatively, the emphasizing information about painting style, which for naïve viewers is more demanding than a simple visual category (Augustin et al., 2011, 2008), may influence memory to the painting. Exploration of these possibilities is beyond the scope of the present study but stating them provides a clear direction for future experiments investigating the influence of visual category on the spectatorship of representational paintings.

Culture did influence spectatorship when discriminating targets from foils. It did so by increasing British participants focus on the theme ROI at the expense of the context relative to that of Chinese participants. In this sense, our finding replicates that reported in Chapter 4. The explanation we offered in Chapter 4 was that these contrasting effects reflect how useful participants find the presence of faces in paintings when discriminating between paintings. There is no reason to change the interpretation offered in Chapter 4 to account for the present data.

It is important to note that the fact that there was a significant influence of participants cultural background on the total fixation duration across theme and context ROIs at discrimination but not at encoding; this replicates the finding reported in Chapter 4. If the effect of culture had been found on both encoding and discrimination then the results could be interpreted within the Masuda and Nisbett (2001; Nisbett & Masuda, 2003) theory about the effect of cultural background on scene perception. As in Chapter 4,

the current findings show an effect of culture on the total fixation duration across theme and context ROIs only when targets are being discriminated from foils and not when targets are being encoded initially.

It might be a concern that Chinese participants were less motivated than British participants given that the paintings shown in the experiment were drawn from Western artworks. However, there is no evidence that this is the case. Most notably, overall Chinese participants looked longer at the context ROIs of foils than did British participants. It is as if Chinese participants made decisions with higher level of uncertainty than did British participants such that they sought information for longer from foils.

To sum up, we found evidence that emphasizing information about the motif of a painting has an effect on the spectatorship of representational paintings. Emphasizing the motif increased total fixation duration to paintings at encoding among British participants but reduced it among Chinese participants. The effect of emphasizing the motif did not influence sensitivity at discrimination. In addition, the results also confirmed the effect of culture on fixation when discriminating targets from foils reported in Chapter 4.

Chapter 6

General Discussion

6.1 Motivation for Thesis

The experiments in this thesis explore the spectatorship of representational paintings by naïve viewers. Representational paintings show some aspect of reality in a straightforward manner. By spectatorship of the representational painting I mean the act of looking that leads to an aesthetic experience and a representation stored in memory. Naïve viewers are those with little scholarly knowledge of painting or paintings.

Chapter 1 presented a model intended to capture the underlying processes that contribute to spectatorship of representational paintings by naïve and expert viewers. According to this model, naïve viewers perceive representational paintings using the same basic processes used in perceiving people, objects, and scenes in the real world. In contrast, art experts can also apply top-down art-related knowledge to their perception that allows paintings to be explored in a different way.

Given that naïve viewers apply similar visual processes across the perception of people, objects, scenes, or representational paintings, then it might seem that there are few questions of interest that can be asked beyond those that underpin visual cognition more generally. This notion, however, is misguided, because painters organize the people and objects in representational paintings to express a specific narrative. The studies in the current thesis explore how this organisation and narrative impacts spectatorship. In doing so the studies move beyond studies of the visual inspection of people, objects and scenes.

The measurement of spectatorship in this thesis was achieved through the measurement of eye movements. In particular, we measured where eyes focussed with

respect to theme areas and context areas of representational paintings. Measurements were made during aesthetic judgement (Chapter 2), and memory tasks (Chapters 3-5).

There are situations when considering the act of spectatorship solely in terms of spatially distributed attention to themes and contexts is insufficient. In Chapter 1, I noted two ways in which paintings are related to each other over time such that they form categories: by motif and style. Motif reflects the visuo-semantic structure of a painting that relates it to other paintings. Those relationships across paintings require that we consider how knowing or not knowing the visuo-semantic similarity across paintings might influence spectatorship. This issue was considered in Chapter 3-5.

Style is typically taken to refer to the school of painting (e.g. French Impressionism) that influences how marks are made on a canvas. An alternative is to consider style more broadly in terms of how people, objects, time, and space are represented in paintings. In this sense style can also refer to the cultural context in which paintings were made. In the present thesis the style of Western and East Asian art was compared with respect to exploring how familiarity with style might influence spectatorship (Chapter 4).

In the sum, the empirical work presented in this thesis explored the spectatorship of naïve viewers to representational paintings. In doing so, the studies explored how information presented in the theme and context contributed to both (1) aesthetic experience and memory representations; and (2) how emerging category knowledge and cultural familiarity modulate spectatorship of theme and context.

6.2 Key Findings, Implications, and Limitations

6.2.1 Faces and the spectatorship of portraits.

Experiment 2.1, reported in Chapter 2, explored how participants looked at portraits when making liking judgments. The results showed that the number of salient features in the context was positively associated with liking, and more fixations were made to the faces with salient context features than to faces without salient context features. Additionally, shorter fixations were made to the sitter's face when their gaze was focused and salient features were present in the context. In other words, naïve viewers like paintings with salient features in the context, but their presence increases fixations to the face.

With increasing expertise might come an ability to focus fixations away from faces, especially later in spectatorship after the initial attraction of faces has subsided. Harland et al., (2014) studied the inspection of Manet's *Bar at the Folies Bergère* (1882), partially addressing this question. In that study, naïve participants and art experts were asked to describe the painting as their eye movements were measured. Naïve spectators focussed on a triad of people. In contrast, art experts looked beyond the triad to objects in the context.

6.2.2 Memory representations of paintings mostly rely on fixating the theme.

Experiments 3.1.and 3.2, reported in Chapter 3, explored the information sampling from representational paintings to form a visual representation. The experiments differed only by virtue of the inclusion of an incongruent Navon figure prior to the presentation of each painting during encoding. Fixations were focused on the theme rather than the context and discrimination accuracy was associated with number of fixations made at encoding. Only when there is uncertainty in the starting point of spectatorship reached by

presentation of Navon figure there is an association between mean fixation duration to the context and accuracy of painting discrimination. Fixations made to the context at discrimination increased when participants made errors, suggesting the context is attended when information in the theme is insufficient for accurate discrimination.

It is important to be cautious in drawing a general conclusion about the effect size of theme ROI on spectatorship of representational paintings. In the present thesis (Chapters 2 – 5), the theme ROIs were distinguished from the context as rectangular areas. Here, we followed Locher et al. (2007) study where theme ROIs were defined in the similar manner (see also Locher et al., 1996, 2015; Nodine et al., 1993). There are two alternative approaches in defining ROIs within the paintings. First, it is to conduct post hoc cluster analyses of fixations with the high density (Massaro et al., 2012; Savazzi et al., 2014; Majkowski, Francuz, Rak, & Augustynowicz 2018). Second, it is to draw a more fine-grained distinction between ROIs (Harland et al., 2014). It is possible that using a different approach in defining the theme ROIs could influence the effect size reported in the present thesis however we would hypothesize that the pattern of results remains similar.

6.2.3 Cultural influence on spectatorship.

Experiment 4.1, reported in Chapter 4, explored the influence of culture on representational paintings to form a visual representation. It did so by comparing British and Chinese participants viewing Western and East Asian representational paintings. Experiment 4.1 replicated experiments 3.1 and 3.2 in showing the importance of fixations to the theme at encoding for supporting discrimination. However, when Western target paintings were being discriminated from foils, Chinese participants were less focused than their British counterparts on the theme of paintings and more on the context. The underlying reason for this three-way interaction is potentially important.

In this thesis, paintings were split into ROIs that define theme and context regions. Theme and context were operationalized in light of the discourse of art history (Gombrich, 1992). However, while these ideas may make sense for expert spectators, a simpler account might work for naïve spectators. One explanation of the effect of culture on discrimination of Western paintings is that Chinese participants were less able than their British counterparts to represent Western faces (e.g., Blais, Jack, Scheepers, Fiset, & Caldara, 2008; Fu, Hu, Wang, Quinn, & Lee, 2012; Hayward, Crookes, & Rhodes, 2013 for examples of Other Race Effect studies) when initially encoding paintings. As a result, Chinese participants were forced to seek information in the context to help discrimination.

To explore this hypothesis further, data from the encoding session of Experiment 4.1 were reanalysed using ROIs defining faces and context (Figure 6.1). To be clear, in this experiment, the area of the painting beyond the face ROI was defined as the context. I present only the total fixation duration (as a sum of all fixation durations in each ROI)[23]. This post hoc analysis supports the idea that spectatorship of paintings is indeed a subject of the form of the Other Race Effect. It seems that for naïve spectators it may make more sense to split paintings into ROIs that define faces and context rather than theme and context.

[23] Data was analysed using LMM for three fixed factors: Ethnicity (2: Chinese versus British), Style (2: Western versus East Asian), and ROI (2: face versus context). The random structure for log-transformed total fixation duration was (1| subject) + (1| Stimuli). With respect to total fixation duration participants looked longer to the context than face ROI (b = -1.36, SE = 0.02, t = - 58.66). The two-way interactions between ROI and Ethnicity, ROI and Style were significant as was three-way interaction between ROI, Style and Ethnicity (b = -.54, SE = 0.04, t = - 15.72; b = .19, SE = 0.03, t = 5.66; b = .37, SE = 0.05, t = 7.29; respectively). No other main effects or interactions reached significance (ts < |1.88|).

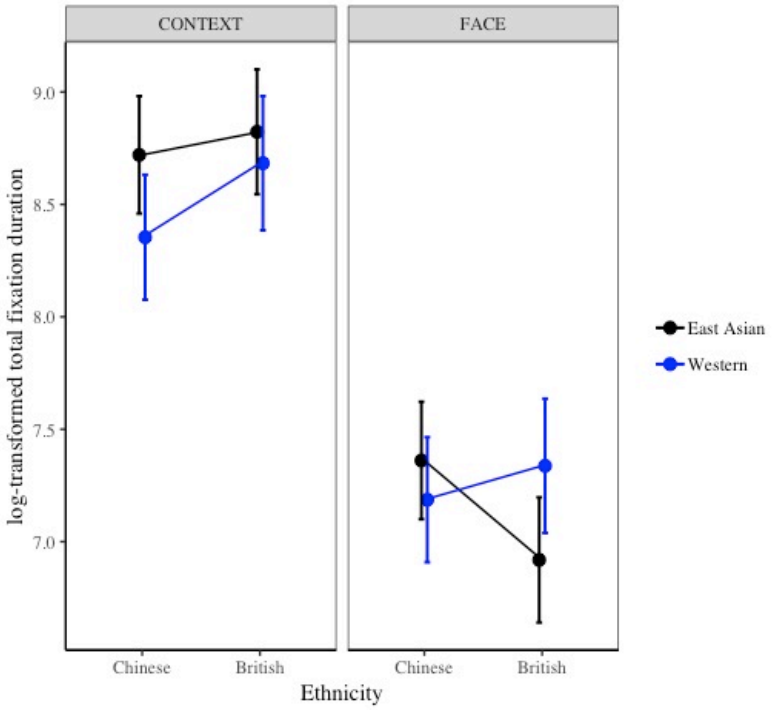


Figure 6.1. Effect estimates from the linear mixed model for log-transformed total fixation durations (with 95% CI) as a function of ROI, style and ethnicity in encoding session.

The reason why the effect of participants culture is limited to Chinese participants viewing Western paintings is that faces are less important in East Asian paintings. East Asian painters tend to structuralise paintings (e.g. floating perspective, panoramic viewpoint, less literal representation of objects) in ways that amplify the meaning of the context and reduced the importance of the human figure paintings. In contrast, Western artists placed human figure in the central part of the painting and use luminance and colour to emphasize this region.

6.2.4 The influence of motif on spectatorship.

Experiment 5.1, reported in Chapter 5, explored whether emphasizing motif category might influence spectatorship of paintings of Venus and did so testing British and Chinese participants. The results showed spectatorship was influenced by efforts to make

the motif explicit. For British participants, making the motif explicit increased focus on the painting. In contrast, for Chinese participants, knowledge of the motif decreased focus on the painting. Additionally, Chinese participants had lower sensitivity than their British counterparts at discriminating target paintings from foils. It is worth noting that emphasizing motif category did not influence sensitivity at discrimination among either Chinese or British viewers.

In Chapter 5, I considered only the data for motif of Venus. However, the effect of participants' cultural background on spectatorship of paintings should be observed regardless of the painting's motif. To explore this hypothesis further, I compared data from studies reported in Chapter 4 and 5. I reanalysed behavioral and eye movements data made to Western paintings and considered all paintings used in Experiement 5.1.

With respect to behavioral data, sensitivity was higher for British than Chinese participants $F(1,109) = 35.67$, $p < 0.001$, $\eta_p^2 = 0.24$). Additionally, sensitivity was higher in study reported in Chapter 5 than 4 ($F(1,109) = 6.18$, $p = 0.014$, $\eta_p^2 = 0.05$). With respect to bias, no main effects or interaction reached significance ($Fs < 1.42$; Figure 6.2).

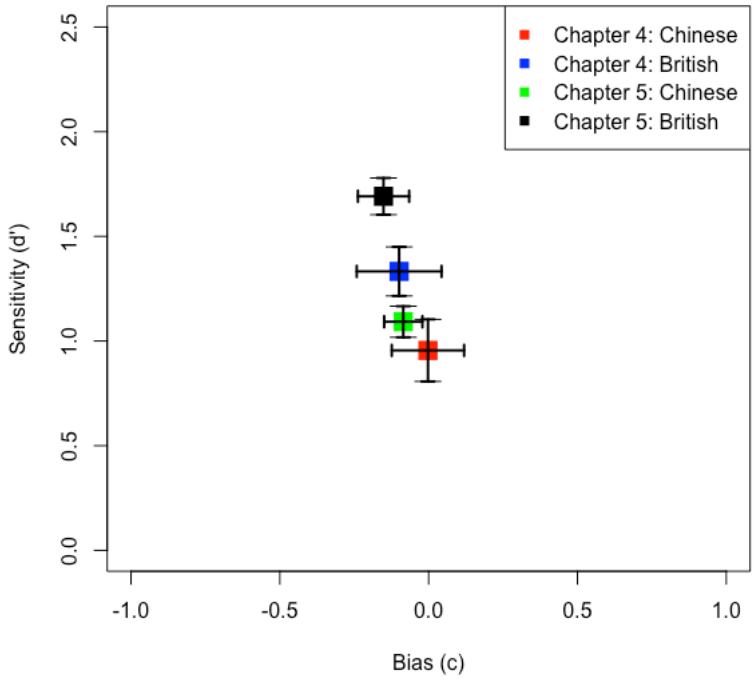


Figure 6.2. Means for sensitivity and bias (*SE*) as a function of Study and Ethnicity.

With respect to eye movements I present only the data for total fixation duration made at encoding session. This analyses shows that Chinese participants looked more to the context of Western paintings than British[24] (Figure 6.3). Taking together, the effect of cultural background on spectatorship of paintings was consistent across studies reported in Chapter 4 and 5. Chinese participants tend to make a greater focus to the context of Western paintings and had poorer memory performance than British viewers.

[24] Data was analysed using LMM for three fixed factors: Ethnicity (2: Chinese versus British), Study (2: Chapter 4 versus Chapter 5), and ROI (2: face versus context). The random structure for log-transformed total fixation duration was (1| Subject) + (1| Stimuli). With respect to total fixation duration participants looked longer to the theme than context ROI (b = 1.71, SE = 0.03, t = 56.89). The two-way interactions between ROI and Ethnicity were significant (b = .16, SE = 0.04, t = 3.77). No other main effects or interactions reached significance (ts < |1.66|).

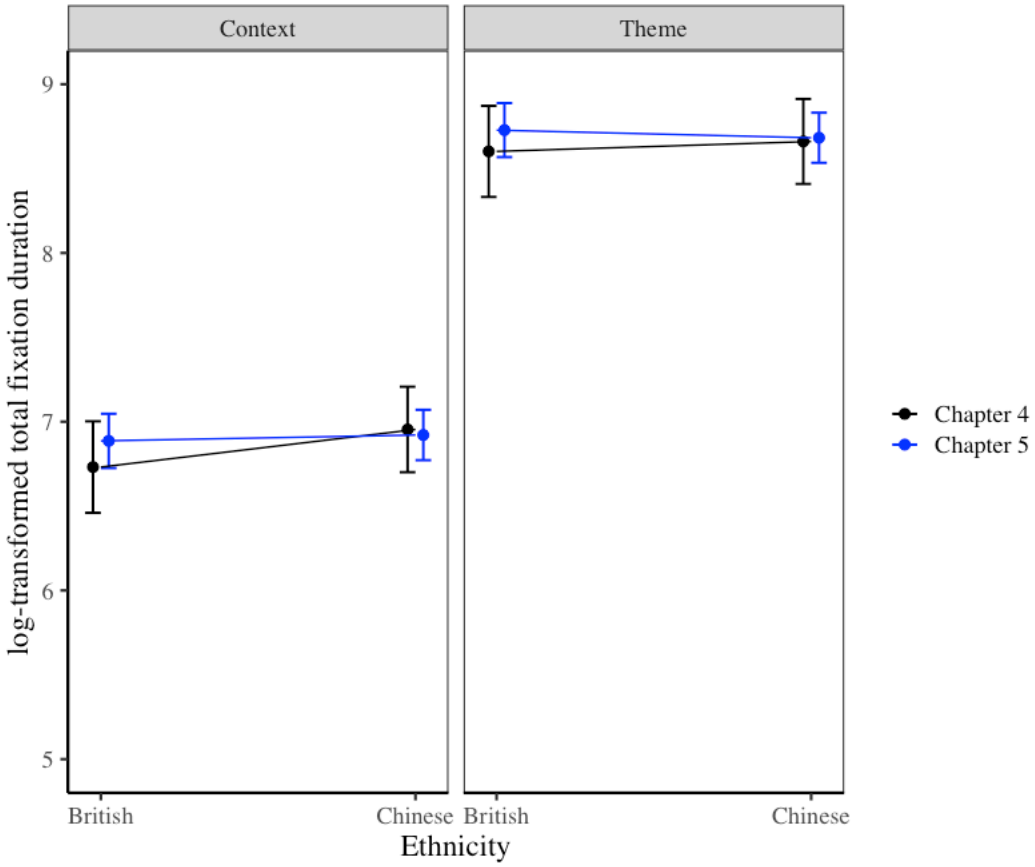


Figure 6.3. Effect estimates from the linear mixed model for log-transformed total fixation durations (with 95% CI) as a function of ROI, Study and Ethnicity in encoding session.

Given the results of Chapter 5, and the reanalysis of data from Experiment 4.1, it seems likely that knowing the motif allowed participants to focus on the information that would best support discrimination. For British participants this is likely to be an increased focus on faces but for Chinese participants it is likely to be an increased focus on the context. To explore this hypothesis, the same type of analyses (as presented in 6.2.3) regarding encoding session was conducted for Experiment 5.1. The results of this reanalysis support this hypothesis in showing that emphasizing the motif allowed British participants looked at faces for longer than Chinese participants (Figure 6.4)[25].

[25] Data was analysed using LMM for three fixed factors: Ethnicity (2: Chinese versus British), Condition (3: random versus blocked versus blocked-named), and ROI (2: face

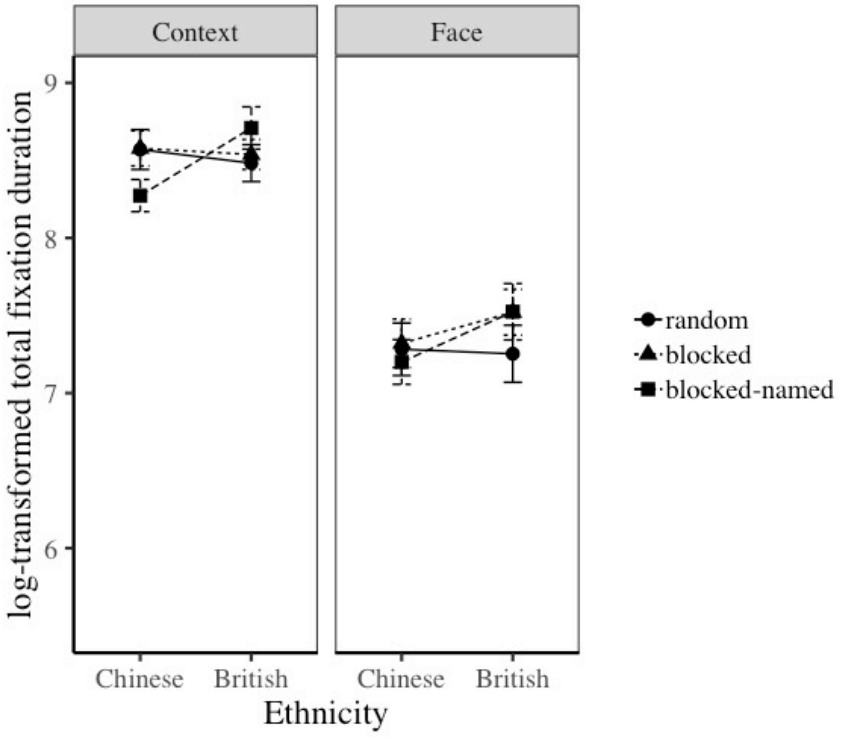


Figure 6.4. Effect estimates from the linear mixed model for log-transformed total fixation durations (with 95% CI) as a function of ROI, condition and ethnicity in encoding session.

In sum, the spectatorship of representational paintings by naïve viewers is dominated by a focus on faces. They attract attention, even in paintings that are not portraits, and focus on them is affected by cultural factors known to influence face perception. Furthermore, this effect of culture is amplified in conditions where the motif is made explicit. Of course, while the importance of faces to spectatorship of representational paintings may not seem surprising from a psychological perspective (see Young, 2018 for a review of face perception), it is more surprising in the context of art theory.

versus context). The random structure for log-transformed total fixation duration was (1| Subject) + (1| Stimuli). With respect to total fixation duration participants looked longer to the context than face ROI (b = -1.31, SE = 0.05, t = - 26.78). The two-way interactions between ROI and condition were significant as was three-way interaction between ROI, Condition and Ethnicity (b = .23, SE = 0.07, t = 3.43; b = -.21, SE = 0.10, t = - 2.13; respectively). No other main effects or interactions reached significance (ts < |1.74|).

6.2.5 The Association of Spectatorship with Cognitive Abilities

In Chapters 3, 4 and 5, we reported that a standardized battery of cognition test was used. Participants completed the Attention Network Test (Fan et al., 2002) and visuospatial and verbal versions of 3-Back Task (Shackman et al., 2006). These data were not reported because of the lack of statistical power needed to investigate the role of individual differences. In Chapter 1, I argued that the current state of knowledge about the role of cognitive abilities in the spectatorship of paintings is severely limited. I argued that if art experts are characterized by better visual memory and high executive control of attention then these two aspects of cognitive abilities matter during the spectatorship of paintings by naïve viewers. Specifically, I hypothesized that eye movements made to the paintings will be facilitated by the ability to execute attention to relevant areas of the paintings and the ability to maintain visual representation of painting in working memory.

To explore this hypothesis further, here I summarise the correlation matrix for (a) total fixation durations made at encoding sessions (b) sensitivity (*d'*) in discrimination targets from foils and (c) cognitive abilities for all one hundred forty-three undergraduate and postgraduate students from University of Southampton, Liverpool Hope University, Bournemouth University, and Tianjin Normal University (40 male; $M = 21.92$ years; $SD = 4.84$; age range: 18-36 years) tested across Experiments 3.1 – 5.1. In Table 6.1 are shown results of the pairwise correlations.

Sensitivity in discriminating targets from foils is associated with verbal working memory and total fixation duration. No other relationships approached significance. A multiple regression model on these data showed that total fixation duration at encoding and the verbal component of working memory capacity predicted sensitivity[26] (Figure 6.5).

[26] A significant regression equation was found, $F(2, 137) = 33.66$, $p < .001$, $R = .57$, $R^2 = .33$ indicated that a considerable amount of variance of sensitivity was explained by predictors. Specifically, total fixation duration and verbal working memory significantly

The sum total of taking these cognitive measures is that sensitivity in discriminating paintings is associated with how much you look when encoding them and your ability to verbally encode what you see. Of course, what impacts on your motivation to spectate is not captured in these data.

With respect to this question, there is evidence suggesting personality may be important. For example, 'openness to experience' (Costa & McCrae, 1992) is positively associated with a preference for art in general as well as a higher appreciation of nonconventional art forms (such as abstract, pop-art, and contemporary art, as opposed to impressionist and traditional art; Chamorro-Premuzic, Burke, Hsu, & Swami, 2010; Feist & Brady, 2004; Furnham & Chamorro-Premuzic, 2004; Furnham & Walker, 2001b, 2001a; McManus & Furnham, 2006). Extraversion was positively correlated with preferences for geometric, colourful, complex, and happy paintings whereas neuroticism was positively correlated with preferences for geometric and sad paintings (Chamorro-Premuzic et al., 2010). Finally, conservative people prefer conventional art forms which are in line with what they consider appropriate (Cleridou & Furnham, 2014; see also Furnham & Avison, 1997).

Together these findings suggest that spectatorship of representational paintings may be moderated more by personality than by cognitive factors. If this is the case, then the question of whether the viewer's personality interacts with the eye movements strategy becomes important to address in future studies.

predicted higher levels of sensitivity (b = .52, SE = .07, p < .001; b = .15, SE = .07, p = .03; respectively).

Table 6.1

Means, standard deviations, and correlations with confidence intervals for sensitivity (d'), total fixation duration and results of the battery of cognition tests.

Variable	*M*	*SD*	1	2	3	4	5	6
1. *d'*	1.20	0.53						
2. E_TFD	8718.68	5686.10	.57**					
			[.45, .67]					
3. ATN: ORIENT	33.70	32.15	.06	.04				
			[-.11, .22]	[-.13, .20]				
4. ATN: ALERT	25.12	31.00	.06	-.08	.11			
			[-.10, .22]	[-.24, .08]	[-.06, .27]			
5. ATN: EXEC	76.90	31.72	.07	.07	-.08	.05		
			[-.10, .23]	[-.10, .23]	[-.24, .08]	[-.12, .21]		
6. 3-BACK: SPATIAL	60.01	16.05	.06	.02	-.15	-.07	.04	
			[-.11, .22]	[-.14, .19]	[-.30, .02]	[-.23, .10]	[-.13, .20]	
7. 3-BACK: VERBAL	63.85	16.68	.26**	.07	-.13	-.02	.04	.73**
			[.10, .40]	[-.09, .23]	[-.29, .03]	[-.18, .15]	[-.13, .20]	[.64, .80]

Note. * indicates $p < .05$. ** indicates $p < .01$. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. E_TFD – total fixation duration made at encoding session; ATN: ORIENT – orienting component of the Attention Network Test; ATN: ALERT – alerting component of the Attention Network Test; ATN: EXEC –executive component of the Attention Network Test; 3-BACK: SPATIAL – visuospatial version of 3 – back task; 3-BACK: VERBAL – verbal version of 3 – back task.

Figure 6.5. Results of the multiple regression model were total fixation duration (E_TFD) and results of the verbal version of 3-Back task (VERBAL) are predictors of *d'* (sensitivity).

6.4 Concluding Remarks

The process of art spectatorship of art has been discussed by artists, art critics, art historians, and psychological theorists (Chatterjee & Vartanian, 2014; Gombrich, 1992, 1995; Leder & Nadal, 2014; Minissale, 2013; Panofsky, 1987; Pelowski et al., 2017). While some empirical works about spectatorship of art date back at the end of 19th century (Fechner, 1876) much of the research literature is more recent. By exploring how the visual information of a painting interacts with spectators, the visual system can become informative (e.g., Cavanagh, 2005; Melcher & Cavanagh, 2011; Sayim & Cavanagh, 2011). The studies presented in this thesis show that knowledge from cognitive psychology can also be of value in extending our understanding of the spectatorship of representational paintings.

I finish by making three observations about how to study spectatorship of representational paintings. First, present studies largely used (G)LMM analysis (Baayen et al., 2008) to analyze data. Using (G)LMM has several advantages in comparison to repeated measures ANOVA when considering spectatorship of representational pictures where tight control of stimuli is difficult to achieve. These advantages include simultaneous random structure for subject and item, heightened statistical power, and suitability for unbalanced designs (for a future discussion see Barr, Levy, Scheepers, & Tily, 2013). I highly recommend future studies of spectatorship of representational paintings use the (G)LMM approach to analyzing data.

Second, it is important to note that participants did not view actual paintings in any of the studies presented in this thesis but instead saw images of the paintings which were presented on the computer screen. Of course, there is a difference between spectatorship of a painting in the laboratory and in the art gallery settings (see Brieber, Nadal, Leder, & Rosenberg, 2014; Chatterjee, 2011; Locher, Smith, & Smith, 1999; Specker, Tinio, & van

Elk, 2017 for the role of place of artwork exhibition in relation to aesthetic process) and there is a need to explore if the spectatorship of paintings in the gallery generalizes from the laboratory to the gallery (e.g., Harland et al., 2014; J. K. Smith & Smith, 2001; L. F. Smith, Smith, & Tinio, 2017). The question, which is worthy of future experimentation, is related to the impact of exposition condition on spectatorship process. There is a great need to extend our understanding of spectatorship process into the investigation of the possible interaction between the viewer's act of looking at the painting and an environment dedicated to its exposition.

Third, the empirical work presented in this thesis explored the act of spectatorship made by naïve viewers, and so the role of art-related expertise needs future investigation. Giving the emerging importance of the face region in spectatorship of representational paintings by naïve viewers, the question to explore in future studies is whether the expertise will be manifested in increased fixations away from faces. I hypothesis that this will be the case especially later in spectatorship when the initial attraction of faces might be suppressed. Additionally, the current literature does not provide sufficient evidence to understand what delineates the transition between naïve stage of spectatorship into more expert stage. Apart from advanced knowledge related training, it might be beneficial for naïve viewers to be informed about strategy of looking at the paintings made by art experts. Exploration of these questions is beyond the scope of the presented empirical work but stating them provides a clear direction for future experiments investigating the spectatorship process.

Appendices

Appendix A: Art Questionnaire (English Version)

Questionnaire	**Code:**	**Age:**	**Gender:**
Art interest			

Thank you very much for taking part in this study.
In our studies, we would like to examine both, individual aesthetic preferences and the process of aesthetic experience. We are aware that aesthetic preferences and assessments are not independent of whether one is interested in art, design, etc., and what prior knowledge the individual participant brings. Therefore, we ask you to complete the following questionnaire.
At the beginning, you will find a series of very different statements, which deal in general with art and your interest in art. Please indicate how strongly you agree with each individual statement.

	Degree of True  **completely agree**								**completely disagree**
A work of art must be beautiful to me to like it.	o	o	o	o	o	o	o	o	o
Works of art always have a meaning, only sometimes you do not understand the meaning.	o	o	o	o	o	o	o	o	o
I enjoyed art lessons at school.	o	o	o	o	o	o	o	o	o
In my free time or for my studies I visit events relating to art or art history.	o	o	o	o	o	o	o	o	o
I could do what many so-called artists produce.	o	o	o	o	o	o	o	o	o
I like talking about art with other people.	o	o	o	o	o	o	o	o	o
I have many friends who are interested in art.	o	o	o	o	o	o	o	o	o
I cannot stand ugly works of art.	o	o	o	o	o	o	o	o	o

I like to read texts from artists or about art in general.	o	o	o	o	o	o	o	o	o
Modern art is often preposterous.	o	o	o	o	o	o	o	o	o
Art should portray things as accurately as possible.	o	o	o	o	o	o	o	o	o
I am interested in art.	o	o	o	o	o	o	o	o	o
Art should be mainly decorative.	o	o	o	o	o	o	o	o	o
I look for new artistic impressions and experiences repeatedly.	o	o	o	o	o	o	o	o	o
It is often the case that in my day-to-day life I spontaneously notice an art object which fascinates me.	o	o	o	o	o	o	o	o	o
I often go to art exhibitions.	o	o	o	o	o	o	o	o	o
I came from a family that is interested in art.	o	o	o	o	o	o	o	o	o
Artists and their works are so diverse that they should be viewed 'with different eyes' over and over again.	o	o	o	o	o	o	o	o	o

- What do you understand by "Modern" in relation to art?

Since the stimuli to be assesse were exclusively portrayals of paintings, we would like to know how knowledgeable you are in the field of art. This is not a test. The information you provide will help us evaluate your ratings in more detail.

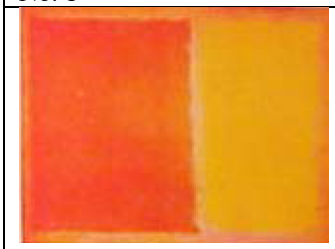
In the table below you will find the names of some artists. Please indicate for each artist whether you know at least their name. As far as you know, please indicate also the artist's nationality and which artistic style is mainly associated with these artists.

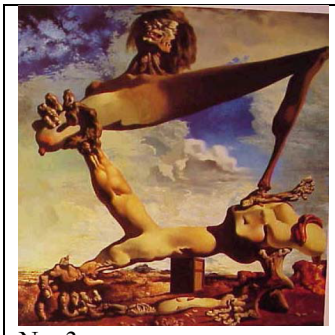
If you are not sure, you may guess.

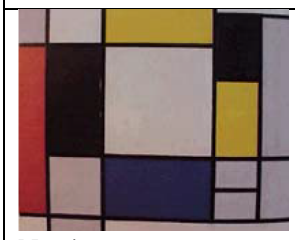
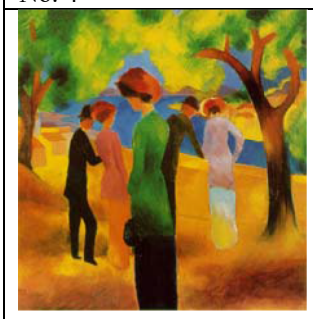
artist's name	know (yes/no)	nationality	artistic style
Henri Matisse			
Joseph Beuys			
Salvador Dali			

Pablo Picasso			
Jackson Pollock			
Piet Mondrian			
Ernst Ludwig Kirchner			
Andy Warhol			
Victor Vasarely			
Anselm Kiefer			

Finally, we will show you a selection of pictures from modern artists. Please indicate again whether you know the pictures. As far as you know please also indicate the painter of the painting. In the last column, please indicate with which artistic style you associate the paintings.

Images	know (yes/no)	painter's name	artistic style
 No. 1			
 No. 2			

 No. 3			

Images	know (yes/no)	painter's name	artistic style
 No. 4			
 No. 5			
 No. 6			

Appendix B: Art Questionnaire (Chinese Version)

问卷	编码	年龄	性别
艺术兴趣			

非常感谢你参与本次实验！
本次实验主要为了考察个人的审美偏好以及审美体验过程。审美偏好与评价与个人对艺术、设计等的兴趣，以及个人参与艺术活动时所获得的先前知识紧密相关。因此，请你完成下面的问卷。
下面将呈现一些观点，包括艺术的一般认识以及你自身对艺术的兴趣程度。请你对每个观点的同意程度，作出评价。

	同意程度  完全同意 完全不同意								
我喜欢的艺术品，必须是非常漂亮的。	o	o	o	o	o	o	o	o	o
艺术品都是具有特定意义的，只是有时候你不明白它们的意义。	o	o	o	o	o	o	o	o	o
我喜欢学校里的艺术课程。	o	o	o	o	o	o	o	o	o
在空闲时间或为了学习，我会参观一些艺术或者艺术史的展览。	o	o	o	o	o	o	o	o	o
所谓的艺术创作，我也会做。	o	o	o	o	o	o	o	o	o
我喜欢和别人谈论艺术。	o	o	o	o	o	o	o	o	o
我有许多朋友都对艺术感兴趣。	o	o	o	o	o	o	o	o	o
我接受不了那些丑陋的艺术作品。	o	o	o	o	o	o	o	o	o
我喜欢阅读那些艺术家写的文章或关于艺术的文章。	o	o	o	o	o	o	o	o	o
现代艺术通常很荒诞。	o	o	o	o	o	o	o	o	o
艺术应该尽可能精确地描绘事物。	o	o	o	o	o	o	o	o	o
我对艺术感兴趣。	o	o	o	o	o	o	o	o	o
艺术主要是用来装饰的。	o	o	o	o	o	o	o	o	o

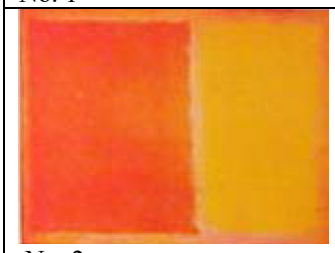
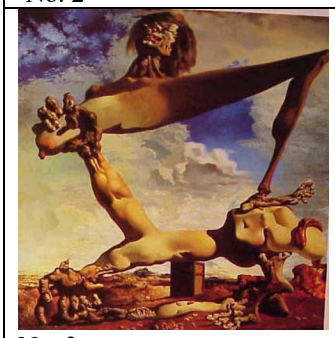
我时常在寻找新的艺术印象和体验。	o	o	o	o	o	o	o	o	o
在日常生活中，我经 常会不由自主地注意到一件令我着迷的艺术品。	o	o	o	o	o	o	o	o	o
我经常去一些艺术展览会。	o	o	o	o	o	o	o	o	o
我出身于一个对艺术很感兴趣的家庭。	o	o	o	o	o	o	o	o	o
艺术和艺术品如此多样，我们应该通过“不同视角”反复欣赏它们。	o	o	o	o	o	o	o	o	o

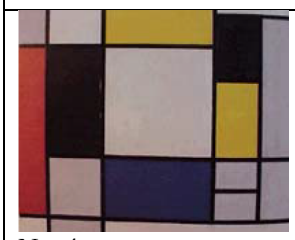
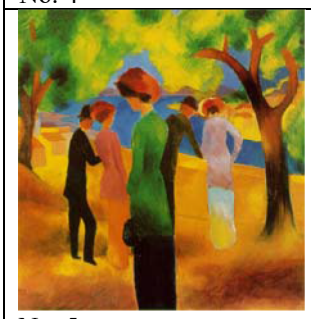
- 你对艺术中关于“现代”的概念是如何理解的？

鉴于要测量的实验材料均为画像，我们很想了解你在艺术领域中的知识储备程度。这不是测验。你提供的信息将有助于我们对你的等级评定结果作出更精细地评估。在下面的表格中，将呈现出一些艺术家的名字。请指出，你对每个艺术家是否了解或至少听过名字。根据你的了解，请同时写出每个艺术家的国籍及他们相应的主要艺术风格。
如果不确定，你可以进行猜测。

画家姓名	认识 (是/否)	国籍	艺术风格
亨利·马蒂斯			
约瑟夫·博伊斯			
萨尔瓦多·达利			
巴勃罗·毕加索			
杰克逊·波洛克			
皮特·蒙德里安			
恩斯特·路德维希·克尔			
安迪·沃霍尔			
维克多·瓦沙雷			
安塞尔姆·基弗			

最后，将呈现给你一些精选的来自现代艺术家的绘画作品。请指出你是否认识这些作品。根据你的了解，请指出创作这些画的画家。请在最后一栏，写出你认为这些画所属的艺术风格。

图片	认识 (是/否)	画家姓名	艺术风格
 No. 1			
 No. 2			
 No. 3			

图片	认识 （是/否）	画家姓名	艺术风格
 No. 4			
 No. 5			
 No. 6			

Appendix C: List of Western paintings used in Chapter 3, 4, and 5 at Encoding and Discrimination session collapsed by authors and motifs.

Author	Title	Year	Motif
	Encoding Session		
Baldung Grien, Hans	*The Three Graces*	c. 1540	1
Canova, Antonio	*The Three Graces Dancing*	c. 1799	1
Cranach, Lucas the Elder	*The Three Graces*	1535	1
Furini, Francesco	*The Three Graces*	c. 1633	1
Rubens, Peter Paul	*The Three Graces*	1639	1
Rafaello Sanzio	*The Three Graces*	1504	1
Rubens, Peter Paul	*Nature Adoring the Three Graces*	c. 1615	1
Botticelli, Sandro	*Primavera*	c. 1482	1
Tintoretto	*Mercury and the Graces*	c. 1576	1
Bronkhorst, Jan Gerritsz	*The Three Graces*	c. 1645	1
Moser, Koloman	*The Three Graces*	1905	1
Carle van Loo	*The Three Graces*	1763	1
Mathews, Arthur Frank	*Song of the Sea (Three Graces)*	c. 1909	1
Dali, Salvador	*Enchanted Beach With Three Fluid Graces*	1938	1
Delaunay, Robert	*La Ville de Paris*	1912	1

Scalbert, Jules	*The Three Graces dancing with Faun*	c. 1877	1
Janco, Marcel	*The Three Women in Malta*	1930	1
Fragonard, Jean_Honore	*The Three Graces*	1756	1
Etty, Wiliam	*Venus and Her Satellites*	1835	1
Picasso, Pablo	*Three woman*	1908	1
Botticelli, Sandro	*Judith Leaving the Tent of Holofernes*	c. 1495	2
Cairo, Francesco del	*Judith with Head of Holofernes*	c. 1645	2
Catena, Vincenzo	*Judith*	1520	2
Elsheimer, Adam	*Judith Beheading Holofernes*	1601	2
Gentileschi, Artemisia	*Judith and Her Maidservant*	c. 1614	2
Allori, Cristofano	*Judith with Head of Holofernes*	1613	2
Giorgione	*Judith*	c.1504	2
Riedel, August	*Judith*	1840	2
Rubens, Peter Paul	*Judith with Head of Holofernes*	c.1616	2
Tintoretto	*Judith and Holofernes*	c.1579	2
Tiziano	*Judith*	c. 1515	2
Klimt, Gustav	*Judith I*	1901	2
Valentin de Boulogne	*Judith*	c. 1626	2
Corot, Jean_Baptiste-Camille	*Judith*	c. 1872	2

Moser, Koloman	*Judith and Holofernes*	1916	2
Mellin, Charles	*Judith with Head of Holofernes*	1630	2
Piazzetta, Giovanni Battista	*Judith and Holofernes*	c. 1745	2
Cranach, Lucas the Elder	*Judith Victorious over Holofernes*	c. 1520	2
Carrachi, Agostino	*Juditt*	c.1590	2
Stuck, Franz	*Judith*	1928	2
Renoir, Pierre-Auguste	*Large Bathers*	c. 1884	3
Seurant, Georges	*Bathers at Asnieres*	c. 1883	3
Bazille, Jean-Frederic	*Bathers (summer Scene)*	1869	3
Vernet, Claude-Joseph	*Landscape with Bathers*	1783	3
Cezanne, Paul	*Bathers Beneath a Bridge*	c. 1895	3
Coubert, Gustave	*The Bathers*	1853	3
Gaugini, Paul	*The Baters*	1897	3
Fragonard, Jean-Honore	*The Baters*	c. 1772	3
Carracci	*Landscape with Bathers*	1616	3
Cezanne, Paul	*The Large Bathers*	c. 1900	3
Kirchner, Ernst Ludwig	*Bathers at Mortizburg*	c. 1909	3
Cezanne, Paul	*Bathers*	c. 1872	3
Cezanne, Paul	*Bathers*	c. 1890	3
Andre Derain	*Bathers*	1907	3
Picasso, Pablo	*Bathers with Toy Boat*	1937	3
Picasso, Pablo	*Bathers*	1918	3

Picasso, Pablo	*Les Demoiselles d'Avignon*	1907	3
Walker, Frederick	*The Bathers*	c. 1866	3
Matisse, Henri	*Joy of Life*	c. 1905	3
Matisse, Henri	*Bathers with turtle*	1908	3
Leighton, Frederic	*Odalisque*	1862	4
Boucher, Francois	*Brown Odalisque*	1745	4
Delacroix, Eugene	*Odalisque*	1857	4
Ingres, Jean-Auguste-Dominique	*The Grand Odalisque*	1814	4
Renoir, Pierre-Auguste	*Odalisque*	1870	4
Matisse, Henri	*Odalisque, Harmony in Red*	c. 1926	4
Tanoux, Adrien Henri	*Odalisque*	1913	4
Schiovoni, Natale	*Odalisque*	1845	4
Matisse, Henri	*Odalisque*	1926	4
Picasso, Pablo	*The Great Odalisque (after Ingres)*	1907	4
Picou, Henri Pierre	*Odalisque*	1858	4
Picasso, Pablo	*Woman of Algier (Version N)*	1955	4
Picasso, Pablo	*Jacqueline in Turkish Dress*	1955	4
Corot, Jean_Baptiste-Camille	*The Roman Odalisque*	1843	4
Fabbi, Fabio	*Girls of the Harem*	c. 1906	4
Delacroix, Eugene	*The Women of Algiers in Their*	1834	4
Jonghe, Gustave Leonard	*A reclining Odalisque*	c. 1870	4
Fortuny, Maria	*The Odalisque*	1861	4

Lefebvre, Jules Joseph	*Odalisque*	1874	4
Bukovac, Vlaho	*Odalisque*	1882	4
Botticelli, Sandro	*The Birth of Venus*	1486	5
Cabanel	*The Birth of Venus*	1683	5
Fauconnet, Guy Pierre	*Venus*	1919	5
Titian	*The Venus of Urbino*	1538	5
Picasso, Pablo	*Nude woman with Necklece*	1968	5
Cranach, Lucas the Elder	*Cupid Complaining to Venus*	1525	5
Sustris, Lambert	*Venus and Love*	1550	5
Matisse, Henri	*Venus*	1952	5
Rosetti, D. G.	*Venus*	c. 1863-	5
Velazques, Diego	*Venus at her Mirror*	1601	5
Gossart, Jan	*Venus*	c. 1521	5
Rubens, Peter Paul	*Venus at a Mirror*	c. 1615	5
Modigliani, Amadeo	*Venus-Maja*	1917	5
Rembrandt van Rijni	*Hendrickje Stoffels as Venus*	1662	5
Albani, Francesco	*Venus Attended by Nymphs and Cupids*	1633	5
Bollandt, Heinrich	*Venus and Amor*	c. 1520	5
Lambert, Sustris	*Venus and Love*	1550	5
Boucher, Francois	*The Triumph of Venus*	1740	5
Ingres, Jean-Auguste-Dominique	*Venus Anadyamene*	c. 1825	5
Dali, Salvador	*Venus Binding Cupids*	1925	5

Discrimination Session

Aachen, Hans von	*The three Graces*	1604	1
Bisson, Eduard	*The Three Graces*	1899	1
Bouvier, Jules Augustus	*The Three Graces*	1975	1
Cranach, Lucas the Elder	*The Three Graces*	1531	1
Delaunay, Robert	*The Three Graces*	1912	1
Frost, William	*The Three Graces*	c. 1854	1
Picasso, Pablo	*The Three Graces*	1908	1
Picasso, Pablo	*The Three dancers*	1925	1
Vernon, Emile	*The Three Graces*	1917	1
Rubens, Peter Paul	*The Three Graces*	1620	1
Botticelli, Sandro	*Primavera*	c. 1482	1
Bronchorst, Jan Gerritsz	*The Three Graces*	c. 1645	1
Dali, Salvador	*Enchanted Beach With Three Fluid Graces*	1938	1
Etty, Wiliam	*Venus and Her Satellites*	1835	1
Furini, Francesco	*The Three Graces*	c. 1633	1
Janco, Marcel	*The Three Women in Malta*	1930	1
Mathews, Arthur Frank	*Song of the Sea (Three Graces)*	c. 1909	1
Picasso, Pablo	*Three woman*	1908	1
Rubens, Peter Paul	*The Three Graces*	c. 1615	1
Tintoretto	*Mercury and the Graces*	c. 1576	1
Botticelli, Sandro	*The return Judith to Bethulia*	1427	2
Carravagio	*Judith Beheadinng Holofernes*	c.1598	2
Cranach, Lucas the Elder	*Judith Victorious*	c.1530	2

Gentileschi, Artemisia	*Judith Beheading Holofernes*	1611	2
Goya, Francisco	*Judith and Holofernes*	1819	2
Klimt, Gustav	*Judith II*	1909	2
Lama, Gulia	*Judith and Holofernes*	1730	2
Vasari, Giorgio	*Judith and Holofernes*	c. 1554	2
Bray, Salomon de	*Judith Delivering the Head of Holofernes*	1636	2
Vermeyen, Jan Cornelisz	*Judith with Head of Holofernes*	c. 1525	2
Botticelli, Sandro	*Judith Leaving the Tent of Holofernes*	c. 1495	2
Cairo, Francesco del	*Judith with Head of Holofernes*	c. 1645	2
Corot, Jean_Baptiste-Camille	*Judith*	c. 1872	2
Giorgione	*Judith*	c.1504	2
Moser, Koloman	*Judith and Holofernes*	1916	2
Mellin, Charles	*Judith with Head of Holofernes*	1630	2
Riedel, August	*Judith*	1840	2
Piazzetta, Giovanni Battista	*Judith and Holofernes*	c. 1745	2
Stuck, Franz	*Judith*	1928	2
Valentin de Boulogne	*Judith*	c. 1626	2
Picasso, Pablo	*Bathers in Forest*	1908	3
Wouwerman, Philips	*Landscape with Bathers*	c.1660	3
Cezanne, Paul	*Bathers*	1892	3

Gaugini, Paul	*Bathers at Tahiti*	1897	3
Kirchner, Ernst Ludwig	*Three Bathers*	1913	3
Peter, Jean Baptiste Joseph	*The Bathers*	c. 1721	3
Preisler, Jan	*Bathers*	1912	3
Renoir, Pierre-Auguste	*The Bathers*	1918	3
Seurat, Georges	*Study for Bathers at Asnieres*	1883	3
Cezanne, Paul	*Bathers*	c. 1900	3
Bazille, Jean-Frederic	*Bathers (Summer Scene)*	1869	3
Carracci	*Landscape with Bathers*	1616	3
Cezanne, Paul	*The Large Bathers*	c. 1900	3
Fragonard, Jean-Honore	*The Bathers*	c. 1772	3
Walker, Frederick	*The Bathers*	c. 1866	3
Gaugini, Paul	*The Bathers*	1897	3
Matisse, Henri	*Joy of Life*	c. 1905	3
Picasso, Pablo	*Bathers with Toy Boat*	1937	3
Picasso, Pablo	*Bathers*	1918	3
Courbet, Gustave	*The Bathers*	1853	3
Boucher, Francois	*Blond Odalisque*	1752	4
Ingres, Jean-Auguste-Dominique	*Odalisque with slave*	1842	4
Matisse, Henri	*Odalisque with a Green Plant and Screen*	1923	4
Matisse, Henri	*Reclining Odalisque*	1926	4
Picasso, Pablo	*Femmes d'Alger*	1955	4

Renoir, Pierre-Auguste	*Parisian Women in Agerian Costume*	1872	4
Tanoux, Adrien Henri	*Odalisque*	1904	4
Weisz, Adolphe	*Odalisque*	1884	4
Gervex, Henri	*Odalisque*	1882	4
Renoir, Auguste	*Reclining Odalisque*	c. 1917	4
Bukovac, Vlaho	*Odalisque*	1882	4
Corot, Jean_Baptiste-Camille	*The Roman Odalisque*	1843	4
Delacroix, Eugene	*The Women of Algiers in Their*	1834	4
Ingres, Jean-Auguste-Dominique	*The Grand Odalisque*	1814	4
Lefebvre, Jules Joseph	*Odalisque*	1874	4
Leighton, Frederic	*Odalisque*	1862	4
Picasso, Pablo	*Jacqueline in Turkish Dress*	1955	4
Picasso, Pablo	*The Great Odalisque (after Ingres)*	1907	4
Picou, Henri Pierre	*Odalisque*	1858	4
Schiovoni, Natale	*Odalisque*	1845	4
Amaury, Duval	*La Naissance de Venus*	1862	5
Bouguereau, A.	*The Birth of Venus*	1879	5
Picasso, Pablo	*Venus et L'Amour*	1957	5
Giorgione	*Sleeping Venus*	c. 1510	5
Titian	*Venus and Music*	1547	5

Rubens, Peter Paul	*Venus Frigda*	1614	5
Girodet de Roucy-Trison, Louis	*Mademoiselle Lange as Venus*	1798	5
Tintoretto	*Venus, Mars and Vulcan*	c. 1551	5
Carracci	*Sleeping Venus*	c. 1602	5
Poussin, Nicholas	*Venus and Satyr*	1626	5
Boucher, Francois	*The Triumph of Venus*	1740	5
Dali, Salvador	*Venus Binding Cupids*	1925	5
Fauconnet, Guy Pierre	*Venus*	1919	5
Gossart, Jan	*Venus*	c. 1521	5
Matisse, Henri	*Venus*	1952	5
Modigliani, Amadeo	*Venus-Maja*	1917	5
Picasso, Pablo	*Nude woman with Necklace*	1968	5
Rembrandt van Rijni	*Hendrickje Stoffels as Venus*	1662	5
Rubens, Peter Paul	*Venus at a Mirror*	c. 1615	5
Sustris, Lambert	*Venus and Love*	1550	5

Note. In fourth column is shown motif categories (1 = *Three Graces*, 2 = *Judith,* 3 = Bathers, 4 = *Odalisque*, 5 = *Venus*).

Appendix D: List of East Asian paintings used in Chapter 4 at Encoding and Discrimination session collapsed by authors and motifs.

Artist	Title	Dynasty	Motif
	Encoding Session		
unknown	*Samantabhadra*	Tang	1
unknown	*Illustration of the Buddhist Scripture*	Wu Dai	1
Guanpeng, Ding	*The solemn image of Bodhisattva*	Qing	1
unknown	*Bodhisattva leads the dead to paradise*	Tang	1
unknown	*The Portrait of Samantabhadra*	Song	1
unknown	*King of the Inferno*	Song	1
unknown	*Water moon kuan-yin*	Song	1
Liying, Jin	*The Portrait of Avalokitesvara*	Qing	1
Daqian, Zhang	*The Portrait of Avalokitesvara*	CHRP	1
Daqian, Zhang	*Avalokitesvara in white dress*	CHRP	1
Daqian, Zhang	*The Portrait of Avalokitesvara*	CHRP	1
Daqian, Zhang	*Water moon kuan-yin*	CHRP	1
unknown	*Thousand-hand Bodhisattva*	Song	1
unknown	*Shakya Muni and Bodhisattva*	Yuan	1
unknown	*Nyoirin Kannon sitting a top island paradise Fudaraku*	Yuan	1
unknown	*The Bodhisattva Avalokitesvara*	Qing	1
Xigui, Hu	*The Portrait of Avalokitesvara*	Qing	1
unknown	*Lotus Kwun Yin*	Ming	1
Guanpeng, Ding	*The Portrait of Avalokitesvara*	Qing	1

unknown	*Bodhisattva Manjusri*	Tang	1
unknown	*Yongzheng Sitting in the Pavilion*	Qing	2
unknown	*Yongzheng Indulged in Pleasures_Reading by the Fire*	Qing	2
unknown	*Yongzheng Indulged in Pleasures_Becoming an Immortal*	Qing	2
unknown	*Yongzheng Indulged in Pleasures_Lama Dress*	Qing	2
unknown	*Yongzheng Indulged in Pleasures_Taoist Costume*	Qing	2
unknown	*Chatting with Taoist*	Qing	2
unknown	*Yongzheng is reading,wearing the Dragon Robe*	Qing	2
unknown	*Yongzheng is writing,wearing casual clothes*	Qing	2
unknown	*Qianlong is writing*	Qing	2
unknown	*Xuande Emperor Hunting in the Wild*	Ming	2
Lang Shining, Shen Yuan, Zhou Kun, Zhou/Guanpeng, Ding	*Qianlong Had Fun in the Snow*	Qing	2
Shining, Lang/Yuan, Shen/Kun, Zhou/Guanpeng, Ding	*Qianlong was carrying an arrow*	Qing	2

Shining, Lang/Yuan, Shen/Kun, Zhou/Guanpeng, Ding	*Qianlong Shot a Wild Geese*	Qing	2
Shining, Lang/Yuan, Shen/Kun, Zhou/Guanpeng, Ding	*Qianlong Shot a Wolf*	Qing	2
unknown	*Qianlong and his wife shot a deer*	Qing	2
unknown	*Qianlong in the prime of life,wearing the Dragon Robe*	Qing	2
unknown	*Yongzheng in the Dragon Robe*	Qing	2
unknown	*Xuande Emperor Indulged in Pleasures_Pitch-pot*	Ming	2
unknown	*Tongzhi Enjoys Pleasured in the Garden*	Qing	2
unknown	*Daoguang Stayed in the Autumn Courtyard Happily*	Qing	2
unknown	*Watching butterflies in the summer*	Qing	2
unknown	*Viewing Bamboo Leaning on the door*	Qing	2
Danxu, Fei	*Twelve girls in Dream of the Red Mansion_Li Wan*	Qing	2
Danxu, Fei	*Twelve girls in Dream of the Red Mansion_Jia Yingchun*	Qing	2
Danxu, Fei	*Twelve girls in Dream of the Red Mansion_Jia Yuanchun*	Qing	2

Danxu, Fei	*Twelve girls in Dream of the Red Mansion_Lin Daiyu*	Qing	2
unknown	*Empress of Filial Piety and Chastity*	Qing	2
Danxu, Fei	*Twelve girls in Dream of the Red Mansion_Miao Yu*	Qing	2
unknown	*Women in the Garden*	Qing	2
Tingbiao, Jin	*A woman is wearing flowers in her hair*	Qing	2
Bingzhen, Jiao	*Picking Rattan to Make Clothes for Parents*	Qing	2
Bingzhen, Jiao	*Dressing Plain Clothes*	Qing	2
Bingzhen, Jiao	*Admonishing the Clan*	Qing	2
Bingzhen, Jiao	*Planting Crops in the Palace*	Qing	2
Bingzhen, Jiao	*Governing the Country Wisely*	Qing	2
Bingzhen, Jiao	*Filial Piety to the Elders*	Qing	2
Bingzhen, Jiao	*Rearing Silkworm in the Palace*	Qing	2
unknown	*Reading and Meditating*	Qing	2
unknown	*Sitting beside the Chrysanthemum*	Qing	2
unknown	*Watching snow on the hearth*	Qing	2
unknown	*Children playing in the courtyard in summer*	Yuan	3
Hanchen, Su	*Children playing in the courtyard in autumn*	Song	4
Hanchen, Su	*Children playing in winter*	Song	4
Kazunobu, Kano	*The Game of Chicken*	Qing	4
Tingbiao, Jin	*Children playing games with grass*	Qing	4
unknown	*Children playing on a platform*	Ming	4
Hanchen, Su	*Children Playing in a Palace Garden*	Northern Song	4

Xuan, Qian	*Children playing beside a palm tree*	Yuan	4
unknown	*Picking herbal medcine*	Qing	4
Hongshou, Chen	*Children praying to Buddha*	Ming	4
unknown	*Playing around the rockery*	Song	4
Hanchen, Su	*Children playing in the courtyard in autumn*	Song	4
unknown	*Children playing in the garden*	Ming	4
Hanchen, Su	*Children romping in the yard*	Song	4
unknown	*Palace Children Playing*	Song	4
Pu, Wang	*Children playing in the garden with their mother*	Qing	4
unknown	*Children playing in autumn scenery*	Yuan	4
Hanchen, Su	*The Knickknack Peddler*	Northern Song	4
unknown	*Naughty Children fighting in the courtyard*	Song	4
unknown	*Children at Play*	Song	4
Xinzhong, Lu	*The Portrait of 16 Rohan*	Song	5
Shengwen, Zhang	*Buddhism Figure Paintings*	Song	5
Shengwen, Zhang	*Buddhism Figure Paintings*	Song	5
Shengwen, Zhang	*Buddhism Figure Paintings*	Song	5
Shengwen, Zhang	*Buddhism Figure Paintings*	Song	5
unknown	*The Portrait of Rohan*	Song	5
Xu, Song	*Rohan Album*	Ming	5
Xiu, Guan	*Kan-akavatsa*	Wu Dai	5
Xu, Song	*Rohan Album*	Ming	5
Yunpeng, Ding	*The Portrait of Rohan*	Ming	5

Yunpeng, Ding	*The Portrait of Rohan*	Ming	5
Yunpeng, Ding	*The Portrait of Rohan*	Ming	5
Tingbiao, Jin	*The Portrait of Rohan*	Qing	5
Nong, Jin	*A Rohan is reading the Buddhist Scripture*	Qing	5
unknown	*The Portrait of Rohan*	Ming	5
Bin, Wu	*The Portrait of Rohan*	Ming	5
Songnian, Liu	*The Portrait of Rohan*	Song	5
Xinzhong, Lu	*The Portrait of 16 Rohan*	Song	5
Xinzhong, Lu	*The Portrait of 16 Rohan*	Song	5
Xinzhong, Lu	*The Portrait of 16 Rohan*	Song	5
	Discrimination Session		
unknown	*Bodhisattva leads the dead to paradise*	Wu Dai	1
unknown	*Illustration of the Buddhist Scripture*	Wu Dai	1
Bin, Wu	*The Portrait of Samantabhadra*	Ming	1
Daqian, Zhang	*Water moon kuan-yin*	CHRP	1
Norifusa	*Bodhisattva-Ragaraja*	Qing	1
unknown	*The Tang-ka*	Yuan	1
unknown	*Water moon kuan-yin*	Wu Dai	1
Yunpeng, Ding	*Five kinds of looks of Guanyin*	Ming	1
Guanpeng, Ding	*The Portrait of Avalokitesvara*	Qing	1
unknown	*The Portrait of Bodhisattva Manjusri*	Ming	1
unknown	*Samantabhadra*	Tang	1
unknown	*Bodhisattva leads the dead to paradise*	Tang	1
Liying, Jin	*The Portrait of Avalokitesvara*	Qing	1
Daqian, Zhang	*Avalokitesvara in white dress*	CHRP	1

Daqian, Zhang	*The Portrait of Avalokitesvara*	CHRP	1
unknown	*Shakya Muni and Bodhisattva*	Yuan	1
unknown	*Nyoirin Kannon sitting a top island paradise Fudaraku*	Yuan	1
unknown	*The Bodhisattva Avalokitesvara*	Qing	1
Xigui, Hu	*The Portrait of Avalokitesvara*	Qing	1
unknown	*Lotus Kwun Yin*	Ming	1
unknown	*Yongzheng Indulged in Pleasures_Shouldering a Cattail Hassock*	Qing	2
Shining, Lang/Yuan, Shen/Kun, Zhou/Guanpeng, Ding	*Qianlong Hunted and Had Picnic*	Qing	2
Shining, Lang/Yuan, Shen/Kun, Zhou/Guanpeng, Ding	*Qianlong Shot a Wild Duck*	Qing	2
Shining, Lang/Yuan, Shen/Kun, Zhou/Guanpeng, Ding	*Qianlong Shot a Bear*	Qing	2
unknown	*Qianlong in his later years,wearing the Dragon Robe*	Qing	2
unknown	*Xuande Emperor Indulged in Pleasures_Shooting*	Ming	2

unknown	*Xuande Emperor Indulged in Pleasures_Football*	Ming	2
unknown	*Xuande Emperor Indulged in Pleasures_Polo*	Ming	2
unknown	*Xuande Emperor Indulged in Pleasures_Chui Wan*	Ming	2
unknown	*Qianlong Appreciated Antiques*	Qing	2
unknown	*Yongzheng Indulged in Pleasures_Reading by the Fire*	Qing	2
unknown	*Yongzheng Indulged in Pleasures_Taoist Costume*	Qing	2
unknown	*Yongzheng is writing,wearing casual clothes*	Qing	2
unknown	*Qianlong is writing*	Qing	2
unknown	*Xuande Emperor Hunting in the Wild*	Ming	2
unknown	*Qianlong and his wife shot a deer*	Qing	2
unknown	*Yongzheng in the Dragon Robe*	Qing	2
unknown	*Xuande Emperor Indulged in Pleasures_Pitch-pot*	Ming	2
unknown	*Tongzhi Enjoys Pleasured in the Garden*	Qing	2
unknown	*Daoguang Stayed in the Autumn Courtyard Happily*	Qing	2
unknown	*Holding a Ruyi in Hand*	Qing	2
Danxu, Fei	*Twelve girls in Dream of the Red Mansion_Xue Baochai*	Qing	2

Danxu, Fei	*Twelve girls in Dream of the Red Mansion_Shi Xiangyun*	Qing	2
Danxu, Fei	*Twelve girls in Dream of the Red Mansion_Jia Tanchun*	Qing	2
unknown	*One of the Imperial Concubine of Qianlong*	Qing	2
Danxu, Fei	*Twelve girls in Dream of the Red Mansion_Jia Xichun*	Qing	2
Danxu, Fei	*Twelve girls in Dream of the Red Mansion_Wang Xifeng*	Qing	2
Danxu, Fei	*Twelve girls in Dream of the Red Mansion_Qin Keqing*	Qing	2
unknown	*Tasting Tea under a Tung Tree*	Qing	2
unknown	*Sewing clothes in candlelight*	Qing	2
unknown	*Viewing Bamboo Leaning on the door*	Qing	2
Danxu, Fei	*Twelve girls in Dream of the Red Mansion_Jia Yuanchun*	Qing	2
unknown	*Empress of Filial Piety and Chastity*	Qing	2
Bingzhen, Jiao	*Picking Rattan to Make Clothes for Parents*	Qing	2
Bingzhen, Jiao	*Admonishing the Clan*	Qing	2
Bingzhen, Jiao	*Governing the Country Wisely*	Qing	2
Bingzhen, Jiao	*Filial Piety to the Elders*	Qing	2
Bingzhen, Jiao	*Rearing Silkworm in the Palace*	Qing	2
unknown	*Reading and Meditating*	Qing	2
unknown	*Watching snow on the hearth*	Qing	2
Hanchen, Su	*Palace children playing in the garden*	Song	3

Hanchen, Su	*Children playing in the courtyard in autumn*	Song	4
Gan, Han	*A boy sage riding on a goat*	Tang	4
Hanchen, Su	*Puppet Play*	Song	4
Tingbiao, Jin	*Children playing on the ice*	Qing	4
Xuan, Qian	*Children playing under the shadow of willow*	Yuan	4
unknown	*Royal children playing in winter*	Yuan	4
Hanchen, Su	*Winter Play*	Northern Song	4
unknown	*Children Cooking Pao-tzu*	Yuan	4
Hanchen, Su	*One Hundred Children in the Long Spring*	Northern Song	4
Hanchen, Su	*Children playing in the courtyard in autumn*	Song	4
Tingbiao, Jin	*Children playing games with grass*	Qing	4
unknown	*Children playing on a platform*	Ming	4
Hanchen, Su	*Children Playing in a Palace Garden*	Northern Song	4
unknown	*Picking herbal medcine*	Qing	4
unknown	*Playing around the rockery*	Song	4
Hanchen, Su	*Children playing in the courtyard in autumn*	Song	4
unknown	*Children playing in the garden*	Ming	4
unknown	*Children playing in autumn scenery*	Yuan	4
unknown	*Naughty Children fighting in the courtyard*	Song	4
Xinzhong, Lu	*The Portrait of 16 Rohan*	Song	5
Xinzhong, Lu	*The Portrait of 16 Rohan*	Song	5

Shengwen, Zhang	*Buddhism Figure Paintings*	Song	5
Xu, Song	*Rohan Album*	Ming	5
Xu, Song	*Rohan Album*	Ming	5
Yunpeng, Ding	*The Portrait of Rohan*	Ming	5
Bin, Wu	*The Portrait of 18 Rohan*	Ming	5
Songnian, Liu	*The Portrait of Rohan*	Song	5
Guandao, Liu	*Protectors Gather for Zen*	Yuan	5
Songnian, Liu	*The Portrait of Rohan*	Song	5
Xinzhong, Lu	*The Portrait of 16 Rohan*	Song	5
Shengwen, Zhang	*Buddhism Figure Paintings*	Song	5
Shengwen, Zhang	*Buddhism Figure Paintings*	Song	5
Shengwen, Zhang	*Buddhism Figure Paintings*	Song	5
Xu, Song	*Rohan Album*	Ming	5
Xu, Song	*Rohan Album*	Ming	5
Yunpeng, Ding	*The Portrait of Rohan*	Ming	5
Nong, Jin	*A Rohan is reading the Buddhist Scripture*	Qing	5
Bin, Wu	*The Portrait of Rohan*	Ming	5
Xinzhong, Lu	*The Portrait of 16 Rohan*	Song	5

Note. In fourth column is shown motif category (1 = *Bodhisattva*, 2 = *Emperor,* 3 = Noble Woman, 4 = *Palace Children*, 5 = *Rohan*).

References

Aristotle (1944). *Politics*. In H. Rackham (Ed. & Trans.), *Aristotle in 23 Volumes* (Vol. 7), London: William Heinemann Ltd.

Arnheim, R. (1971). *Art and visual perception*. Berkeley: CA: Universityof California Press.

Augustin, M. D., Defranceschi, B., Fuchs, H. K., Carbon, C. C., & Hutzler, F. (2011). The neural time course of art perception: An ERP study on the processing of style versus content in art. *Neuropsychologia*, *49*(7), 2071–2081. https://doi.org/10.1016/j.neuropsychologia.2011.03.038

Augustin, M. D., Leder, H., Hutzler, F., & Carbon, C. C. (2008). Style follows content: On the microgenesis of art perception. *Acta Psychologica*, *128*, 127–138. https://doi.org/10.1016/j.actpsy.2007.11.006

Baayen, R. H., Davidson, D. J., & Bates, D. M. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language*, *59*(4), 390–412. https://doi.org/10.1016/j.jml.2007.12.005

Bao, Y., & Pöppel, E. (2012). Anthropological universals and cultural specifics: Conceptual and methodological challenges in cultural neuroscience. *Neuroscience and Biobehavioral Reviews*, *36*(9), 2143–2146. https://doi.org/10.1016/j.neubiorev.2012.06.008

Bao, Y., Yang, T., Lin, X., Fang, Y., Wang, Y., Pöppel, E., & Lei, Q. (2016). Aesthetic preferences for Eastern and Western traditional visual art: Identity matters. *Frontiers in Psychology*, *7*(1596), 1–8. https://doi.org/10.3389/fpsyg.2016.01596

Baron-Cohen, S., Jolliffe, T., Mortimore, C., & Robertson, M. (1997). Another Advanced Test of Theory of Mind: Evidence from Very High Functioning Adults with Autism or Asperger Syndrome. *J. Child Psychol. Psychiat*, *38*(7), 813–822.

Barr, D. J., Levy, R., Scheepers, C., & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language*, *68*(3), 255–278. https://doi.org/10.1016/j.jml.2012.11.001

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2014). Fitting Linear Mixed-Effects Models using lme4. *Journal of Statistical Software*, *67*(1), 1–48. https://doi.org/10.18637/jss.v067.i01

Batki, A., Baron-Cohen, S., Wheelwright, S., Connellan, J., & Ahluwalia, J. (2000). Is there an innate gaze module? Evidence from human neonates. *Infant Behavior and Development*, *23*, 223–229. https://doi.org/10.1016/S0163-6383(01)00037-6

Belke, B., Leder, H., Harsanyi, G., & Carbon, C. C. (2010). When a Picasso is a "Picasso": The entry point in the identification of visual art. *Acta Psychologica*, *133*, 191–202. https://doi.org/10.1016/j.actpsy.2009.11.007

Belke, B., Leder, H., Strobach, T., & Carbon, C. C. (2010). Cognitive Fluency: High-Level Processing Dynamics in Art Appreciation. *Psychology of Aesthetics, Creativity, and the Arts*, *4*(4), 214–222. https://doi.org/10.1037/a0019648

Bentin, S., Allison, T., Puce, A., Perez, E., & McCarthy, G. (1996). Electrophysiological studies of face perception in humans. *Journal of Cognitive Neuroscience*, *8*(6), 551–565. https://doi.org/10.1162/jocn.1996.8.6.551

Belopolsky, A. V., Kramer, A. F., & Godijn, R. (2008). Transfer of information into working memory during attentional capture. *Visual Cognition*, *16*(4), 409-418. https://doi.org/10.1080/13506280701695454

Berns, R. S. (2016). *Color Science and the Visual Arts: A Guide for Conservators, Curators, and the Curious*. Los Angeles: Getty Publications.

Bertamini, M., Latto, R., & Spooner, A. (2003). The venus effect: People's understanding of mirror reflections in paintings. *Perception*, *32*, 593–599.

https://doi.org/10.1068/p3418

Biederman, I. (1987). Recognition-by-Components: A Theory of Human Image Understanding. *Psychological Review*, *94*(2), 115–147. https://doi.org/10.1037/0033-295X.94.2.115

Bilalić, M., Langner, R., Ulrich, R., & Grodd, W. (2011). Many faces of expertise: fusiform face area in chess experts and novices. *Journal of Neuroscience*, *31*(28), 10206-10214. https://doi.org/10.1523/JNEUROSCI.5727-10.2011

Bindemann, M., & Lewis, M. B. (2013). Face detection differs from categorization: Evidence from visual search in natural scenes. *Psychonomic Bulletin and Review*, *20*(6), 1140–1145. https://doi.org/10.3758/s13423-013-0445-9

Birmingham, E., Bischof, W. F., & Kingstone, A. (2009). Saliency does not account for fixations to eyes within social scenes. *Vision Research*, *49*(24), 2992–3000. https://doi.org/10.1016/j.visres.2009.09.014

Blais, C., Jack, R. E., Scheepers, C., Fiset, D., & Caldara, R. (2008). Culture shapes how we look at faces. *PLoS ONE*, *3*(8), 1–8. https://doi.org/10.1371/journal.pone.0003022

Bleckley, M. K., Durso, F. T., Crutchfield, J. M., Engle, R. W., & Khanna, M. M. (2003). Individual differences in working memory capacity predict visual attention allocation. *Psychonomic Bulletin & Review*, *10*(4), 884-888. https://doi.org/10.3758/BF03196548

Boland, J. E., Chua, H. F., & Nisbett, R. E. (2008). How we see it: Culturally different eye movement patterns over visual scenes. In K. Rayner, D. Shen, X. Bai, & G. Yan (Eds.), *Cognitive and cultural influences on eye movements* (pp. 363–378). Tianjin: Tianjin People's Press/Psychology Press.

Bonnar, L., Gosselin, F., & Schyns, P. G. (2002). Understanding Dali's slave market with the disappearing bust of Voltaire: A case study in the scale information driving

perception. *Perception*, *31*(6), 683–691. https://doi.org/10.1068/p3276

Borji, A., & Itti, L. (2014). Defending Yarbus: Eye movements reveal observers' task. *Journal of Vision*, *14*(3), 1–22. https://doi.org/10.1167/14.3.29

Boyarskaya, E., Sebastian, A., Bauermann, T., Hecht, H., & Tüscher, O. (2015). The Mona Lisa effect: Neural correlates of centered and off-centered gaze. *Human Brain Mapping*, *36*(2), 619–632. https://doi.org/10.1002/hbm.22651

Brand, J., & Johnson, A. P. (2014). Attention to local and global levels of hierarchical Navon figures affects rapid scene categorization. *Frontiers in Psychology*, *5*, 1274, 1-19. https://doi.org/10.3389/fpsyg.2014.01274

Brieber, D., Nadal, M., Leder, H., & Rosenberg, R. (2014). Art in time and space: Context modulates the relation between art experience and viewing time. *PLoS ONE*, *9*(6), 1–8. https://doi.org/10.1371/journal.pone.0099019

Brooks, J. L. (2015). Traditional and new principles of perceptual grouping. In J. Wagemans (Ed.), *Oxford Handbook of Perceptual Organisation* (pp. 1–31). Oxford: Oxford University Press.

Bruce, V., & Young, A. (1986). Understanding face recognition. *British Journal of Psychology*, *77*(3), 305–327. https://doi.org/10.1111/j.2044-8295.1986.tb02199.x

Brysbaert, M., & Stevens, M. (2018). Power Analysis and Effect Size in Mixed Effects Models: A Tutorial. *Journal of Cognition*, *1*(1), 1–20. https://doi.org/10.5334/joc.10

Bubić, A., Sušac, A., & Palmović, M. (2017). Observing Individuals Viewing Art. *Empirical Studies of the Arts*, *35*(2), 194–213. https://doi.org/10.1177/0276237416683499

Bukach, C. M., Phillips, W. S., & Gauthier, I. (2010). Limits of generalization between categories and implications for theories of category specificity. *Attention, Perception, & Psychophysics*, *72*(7), 1865-1874. https://doi.org/10.3758/APP.72.7.1865

References

Bylinskii, Z., Recasens, A., Borji, A., Oliva, A., Torralba, A., & Durand, F. (2016). Where should saliency models look next? In Leibe B., Matas J., Sebe N., & Welling M. (Eds.), *Computer Vision – ECCV 2016. ECCV 2016. Lecture Notes in Computer Science* (pp. 809–824). Springer. https://doi.org/10.1007/978-3-319-46454-1_49

Caggiano, D. M., & Parasuraman, R. (2004). The role of memory representation in the vigilance decrement. *Psychonomic Bulletin & Review*, *11*(5), 932-937. https://doi.org/10.3758/BF03196724

Cameron, A. S. (1993). *Chinese Painting Techniques*. Mineola: NY: Dover Publications Courier Corporation.

Carlin, J. D., & Calder, A. J. (2013). The neural basis of eye gaze processing. *Current Opinion in Neurobiology*, *23*(3), 450–455. https://doi.org/10.1016/j.conb.2012.11.014

Carneiro, G., Da Silva, N. P., Del Bue, A., & Costeira, J. P. (2012). Artistic Image Classification: An Analysis on the PRINTART. In Itzgibbon A., Lazebnik S., Perona P., Sato Y., & Schmid C. (Eds.), *Computer Vision – ECCV 2012. ECCV 2012. Lecture Notes in Computer Science* (pp. 143–157). Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-642-33765-9_11

Castelhano, M. S., & Heaven, C. (2010). The relative contribution of scene context and target features to visual search in scenes. *Attention, Perception & Psychophysics*, *72*(5), 1283–1297. https://doi.org/10.3758/APP.72.5.1283

Castelhano, M. S., & Henderson, J. M. (2008). The influence of color on the perception of scene gist. *Journal of Experimental Psychology: Human Perception and Performance*, *34*(3), 660–675. https://doi.org/10.1037/0096-1523.34.3.660

Castelhano, M. S., Mack, M. L., & Henderson, J. M. (2009). Viewing task influences eye movement control during active scene perception. *Journal of Vision*, *9*(3), 1–15. https://doi.org/10.1167/9.3.6

Cavanagh, P. (2005). The artist as neuroscientist. *Nature*, *434*, 301–307.

Cerf, M., Frady, E. P., & Koch, C. (2009). Faces and text attract gaze independent of the task: Experimental data and computer model. *Journal of Vision*, *9*(12), 1–15. https://doi.org/10.1167/9.12.10

Chamberlain, R., McManus, I. C., Riley, H., Rankin, Q., & Brunswick, N. (2013). Local processing enhancements associated with superior observational drawing are due to enhanced perceptual functioning, not weak central coherence. *The Quarterly Journal of Experimental Psychology*, *66*(7), 1448-1466. https://doi.org/10.1080/17470218.2012.750678

Chamberlain, R., & Wagemans, J. (2015). Visual arts training is linked to flexible attention to local and global levels of visual stimuli. *Acta Psychologica*, *161*, 185–197. https://doi.org/10.1016/j.actpsy.2015.08.012

Chamorro-Premuzic, T., Burke, C., Hsu, A., & Swami, V. (2010). Personality Predictors of Artistic Preferences as a Function of the Emotional Valence and Perceived Complexity of Paintings. *Psychology of Aesthetics, Creativity, and the Arts*, *4*(4), 196–204. https://doi.org/10.1037/a0019211

Charman, T., Baron-Cohen, S., Swettenham, J., Baird, G., Cox, A., & Drew, A. (2000). Testing joint attention, imitation, and play as infancy precursors to language and theory of mind. *Cognitive Development*, *15*(4), 481–498. https://doi.org/10.1016/s0885-2014(01)00037-5

Chatterjee, A. (2011). Neuroaesthetics: A coming of age story. *Journal of Cognitive Neuroscience*, *23*(1), 53–62. https://doi.org/10.1162/jocn.2010.21457

Chatterjee, A., & Vartanian, O. (2014). Neuroaesthetics. *Trends in Cognitive Sciences*, *18*(7), 370–375. https://doi.org/10.1016/j.tics.2014.03.003

Chua, H. F., Boland, J. E., & Nisbett, R. E. (2005). Cultural variation in eye movements

during scene perception. *Proceedings of the National Academy of Sciences of the United States of America*, *102*(35), 12629–12633. https://doi.org/10.1073/pnas.0506162102

Clark, T. J. (2008). *The Sight of Death. An Experiment in Art Writing*. New Haven: Yale University Press.

Cleridou, K., & Furnham, A. (2014). Personality correlates of aesthetic preferences for art, architecture, and music. *Empirical Studies of the Arts*, *32*(2), 231–255. https://doi.org/10.2190/EM.32.2.f

Cohen, D. J., & Jones, H. E. (2008). How Shape Constancy Relates to Drawing Accuracy. *Psychology of Aesthetics, Creativity, and the Arts*, *2*(1), 8–19. https://doi.org/10.1037/1931-3896.2.1.8

Coren, S., & Girgus, J. S. (1980). Principles of perceptual organization and spatial distortion: The gestalt illusions. *Journal of Experimental Psychology: Human Perception and Performance*, *6*(3), 404–412. https://doi.org/10.1037/0096-1523.6.3.404

Costa, M., & Corazza, L. (2006). Aesthetic phenomena as supernormal stimuli: The case of eye, lip, and lower-face size and roundness in artistic portraits. *Perception*, *35*(2), 229–246. https://doi.org/10.1068/p3449

Costa, P. T., & McCrae, R. R. (1992). The five-factor model of personality and its relevance to personality disorders. *Journal of Personality Disorders*, *6*(4), 343–359.

Crary, J. (1992). *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century*. Cambridge, Massachusetts: MIT press.

Cupchik, G. C., Vartanian, O., Crawley, A., & Mikulis, D. J. (2009). Viewing artworks: Contributions of cognitive control and perceptual facilitation to aesthetic experience. *Brain and Cognition*, *70*(1), 84–91. https://doi.org/10.1016/j.bandc.2009.01.003

Cutting, J. E. (2003). Gustave Caillebotte, French Impressionism, and mere exposure. *Psychonomic Bulletin & Review*, *10*(2), 319–343. https://doi.org/10.3758/BF03196493

Damisch, H. (1996). *The Judgment of Paris*. Chicago : University of Chicago Press.

Delahaye, H. (1993). Du peu d'effet de la peinture occidentale en Chine aux XVIIe et XVIIIe siecles. In J. Catherine & H. Delahaye (Eds.), *L'Europe en Chine* (pp. 111–135). Paris: De Boccard.

Donnelly, N., Harland, B., Mestry, N., Thompson, N., Trawiński, T., & Liversedge, S. P. (2017). The influence of pupil alignment on spectator address in Manet's portraiture. *Psychology of Aesthetics, Creativity, and the Arts*, *11*(2), 167–178. https://doi.org/10.1037/aca0000096

Dupierrix, E., de Boisferon, A. H., Méary, D., Lee, K., Quinn, P. C., Di Giorgio, E., … Pascalis, O. (2014). Preference for human eyes in human infants. *Journal of Experimental Child Psychology*, *123*, 138–146. https://doi.org/10.1016/j.jecp.2013.12.010

Fan, J., Mccandliss, B. D., Sommer, T., Raz, A., & Posner, M. I. (2002). Testing the Efficiency and Independence of Attentional Networks. *Journal of Cognitive Neuroscience*, *14*(3), 340–347. https://doi.org/10.1162/089892902317361886

Fechner, G. . (1876). *Vorschule der Aesthetik*. Leipzig: Breitkopf & Hartel.

Feist, G. J., & Brady, T. R. (2004). Openness to Experience, Non-Conformity, and the Preference for Abstract Art. *Empirical Studies of the Arts*, *22*(1), 77–89. https://doi.org/10.2190/y7ca-tby6-v7lr-76gk

Fletcher-Watson, S., Findlay, J. M., Leekam, S. R., & Benson, V. (2008). Rapid detection of person information in a naturalistic scene. *Perception*, *37*(4), 571–583. https://doi.org/10.1068/p5705

References

Flevaris, A. V., Bentin, S., & Robertson, L. C. (2011). Attention to hierarchical level influences attentional selection of spatial scale. *Journal of Experimental Psychology: Human Perception and Performance*, *37*(1), 12-22. doi:10.1037/a0019251

Francuz, P., Zaniewski, I., Augustynowicz, P., Kopiś, N., & Jankowski, T. (2018). Eye Movement Correlates of Expertise in Visual Arts. *Frontiers in Human Neuroscience*, *12*(87), 1–13. https://doi.org/10.3389/fnhum.2018.00087

Fried, M. (1980). *Absorption and theatricallity: Painting and beholder in the age of Diderot*. Barkeley, Los Angeles: CA: The University of California Press.

Fried, M. (1996). *Manet's Modernism: Or, The Face of Painting in the 1860s*. Chicago: IL: The University of Chicago Press.

Frischen, A., Bayliss, A. P., & Tipper, S. P. (2007). Gaze Cueing of Attention: Visual Attention, Social Cognition, and Individual Differences. *Psychological Bulletin*, *133*(4), 694–724. https://doi.org/10.1037/0033-2909.133.4.694

Fu, G., Hu, C. S., Wang, Q., Quinn, P. C., & Lee, K. (2012). Adults scan own- and other-race faces differently. *PLoS ONE*, *7*(6), 1–12. https://doi.org/10.1371/journal.pone.0037688

Fuchs, I., Ansorge, U., Redies, C., & Leder, H. (2011). Salience in Paintings: Bottom-Up Influences on Eye Fixations. *Cognitive Computation*, *3*(1), 25–36. https://doi.org/10.1007/s12559-010-9062-3

Fukuda, K., & Vogel, E. K. (2011). Individual differences in recovery time from attentional capture. *Psychological science*, *22*(3), 361-368. https://doi.org/10.1177/0956797611398493

Furnham, A., & Avison, M. (1997). Personality and preference for surreal paintings. *Personality and Individual Differences* , *23*(6), 923–935. https://doi.org/10.1016/S0191-8869(97)00131-1

Furnham, A., & Chamorro-Premuzic, T. (2004). Personality, intelligence, and art. *Personality and Individual Differences*, *36*(3), 705–715. https://doi.org/10.1016/S0191-8869(03)00128-4

Furnham, A., & Walker, J. (2001a). Personality and judgements of abstract, pop art, and representational paintings. *European Journal of Personality*, *15*(1), 57–72. https://doi.org/10.1002/per.340

Furnham, A., & Walker, J. (2001b). The influence of personality traits, previous experience of art, and demographic variables on artistic preference. *Personality and Individual Differences*, *31*(6), 997–1017. https://doi.org/10.1016/S0191-8869(00)00202-6

Gaines, R. (1975). Developmental perception and cognitive styles: from young children to master artists. *Perceptual and Motor Skills*, *40*(3), 983–998. https://doi.org/10.2466/pms.1975.40.3.983

Godijn, R., & Theeuwes, J. (2004). The Relationship Between Inhibition of Return and Saccade Trajectory Deviations. *Journal of Experimental Psychology: Human Perception and Performance*, *30*(3), 538–554. https://doi.org/10.1037/0096-1523.30.3.538

Godwin, H. J., Liversedge, S. P., Kirkby, J. A., Boardman, M., Cornes, K., & Donnelly, N. (2015). The influence of experience upon information-sampling and decision-making behaviour during risk assessment in military personnel. *Visual Cognition*, *23*(4), 415–431. https://doi.org/10.1080/13506285.2015.1030488

Goffen, R. (1999). *Titian's "Venus of Urbino."* Cambridge: Cambridge University Press.

Goldinger, S. D., He, Y., & Papesh, M. H. (2009). Deficits in Cross-Race Face Learning: Insights From Eye Movements and Pupillometry. *Journal of Experimental Psychology: Learning Memory and Cognition*, *35*(5), 1105–1122.

https://doi.org/10.1037/a0016548

Goldstone, R. L., Feng, Y., & Rogosky, B. J. (2005). Connecting concepts to each other and the world. In D. Pecher & R. A. Zwaan (Eds.), *Grounding Cognition: The Role of Perception and Action in Memory, Language and Thinking*. Cambridge: Cambridge University Press.

Gombrich, E. (1992). *Art and Illusion. A study in the psychology of pictorial representation.* London: Phaidon Press Limited.

Gombrich, E. (1995). *The Story about Art*. London: Phaidon Press Limited.

Graham, D. J., & Redies, C. (2010). Statistical regularities in art: Relations with visual coding and perception. *Vision Research*, *50*(16), 1503–1509. https://doi.org/10.1016/j.visres.2010.05.002

Graham, D., Pallett, P. M., Meng, M., & Leder, H. (2014). Representation and Aesthetics of the Human Face in Portraiture. *Art and Perception*, *2*(1–2), 75–98. https://doi.org/10.1163/22134913-00002026

Green, P., & Macleod, C. J. (2016). SIMR: An R package for power analysis of generalized linear mixed models by simulation. *Methods in Ecology and Evolution*, *7*, 493–498. https://doi.org/10.1111/2041-210X.12504

Green, P., MacLeod, C. J., & Alday, P. (2016). Package 'simr.' Retrieved from https://cran.r-project.org/web/packages/simr/simr.pdf

Harkness, J., & Schoua-Glusberg, A. (1998). Questionnaires in translation. In J. Harkness (Ed.), *Cross-cultural survey equivalence* (pp. 87–126). Mannheim: ZUMA-Nachrichten Spezial. Retrieved from www.ssoar.info

Harland, B., Gillett, J., Mann, C. M., Kass, J., Godwin, H. J., Liversedge, S. P., & Donnelly, N. (2014). Modes of Address in Pictorial Art: An Eye Movement Study of Manet's Bar at the Folies-Bergère. *Leonardo*, *47*(3), 241–247.

https://doi.org/10.1162/LEON_a_00676

Harmon, L. D., & Julesz, B. (1973). Masking in Visual Recognition: Effects of Two-Dimensional Filtered Noise. *Science*, *180*(4091), 1194–1197. https://doi.org/10.1126/science.180.4091.1194

Haxby, J. V, Hoffman, E. A., & Gobbini, M. I. (2000). The distributed human neural system for face perception. *Trends in Cognitive Sciences*, *4*(6), 223–233. https://doi.org/10.1016/S1364-6613(00)01482-0

Hayn-Leichsenring, G. U., Kloth, N., Schweinberger, S. R., & Redies, C. (2013). Adaptation effects to attractiveness of face photographs and art portraits are domain-specific. *I-Perception*, *4*(5), 303–316. https://doi.org/10.1068/i0583

Hayward, W. G., Crookes, K., & Rhodes, G. (2013). The other-race effect: Holistic coding differences and beyond. *Visual Cognition*, *21*(9–10), 1224–1247. https://doi.org/10.1080/13506285.2013.824530

Hedden, T., Van Dijk, K. R. A., Shire, E. H., Sperling, R. A., Johnson, K. A., & Buckner, R. L. (2012). Failure to Modulate Attentional Control in Advanced Aging Linked to White Matter Pathology. *Cerebral Cortex*, *22*(5), 1038–1051. https://doi.org/10.1093/cercor/bhr172

Henderson, J. M., Shinkareva, S. V., Wang, J., Luke, S. G., & Olejarczyk, J. (2013). Predicting Cognitive State from Eye Movements. *PLoS ONE*, *8*(5), 1–6. https://doi.org/10.1371/journal.pone.0064937

Henderson, J. M., Weeks Jr., P. A., & Hollingworth, A. (1999). The effects of semantic consistency on eye movements during complex scene viewing. *Journal of Experimental Psychology: Human Perception and Performance*, *25*(1), 210–228. https://doi.org/10.1037/0096-1523.25.1.210

Hogan, W. H. (1975). Time perception and stimulus preference as a function of stimulus

complexity. *Journal of Personality and Social Psychology*, *31*(1), 32–35. Retrieved from https://psycnet.apa.org/fulltext/1975-08641-001.pdf

Hollingworth, A. (2009). Two forms of scene memory guide visual search: Memory for scene context and memory for the binding of target object to scene location. *Visual Cognition*, *17*(1/2), 273–291. https://doi.org/10.1080/13506280802193367

Hristova, E., Georgieva, S., & Grinberg, M. (2011). Top-Down Influences on Eye-Movements during Painting Perception: The Effect of Task and Titles. In A. Esposito, A. M. Esposito, R. Martone, V. C. Müller, & G. Scarpetta (Eds.), *Toward Autonomous, Adaptive, and Context-Aware Multimodal Interfaces. Theoretical and Practical Issues. Lecture Notes in Computer Science* (pp. 104–115). Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-642-18184-9_10

Humphrey, N. K., & McManus, I. C. (1973). Status and the left cheek. *New Scientist*, *59*, 437–439.

Ishai, A., Fairhall, S. L., & Pepperell, R. (2007). Perception, memory and aesthetics of indeterminate art. *Brain Research Bulletin*, *73*(4–6), 319–324. https://doi.org/10.1016/j.brainresbull.2007.04.009

Itti, L., & Koch, C. (2001). Computational modelling of visual attention. *Nature Reviews Neuroscience*, *2*, 194–203. https://doi.org/10.1038/35058500

Itti, L., Koch, C., & Niebur, E. (1998). A model of saliency-based visual attention for rapid scene analysis. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, *20*(11), 1254–1259. https://doi.org/10.1109/34.730558

Iversen, M. (2003). *Alois Riegl: Art History and Theory*. Cambridge, Massachusetts, London: MIT Press LTD.

Jacobsen, T., & Höfel, L. (2003). Descriptive and evaluative judgment processes: Behavioral and electrophysiological indices of processing symmetry and aesthetics.

Cognitive, Affective, & Behavioral Neuroscience, *3*(4), 289–299. https://doi.org/https://doi.org/10.3758/CABN.3.4.289

Jakesch, M., & Leder, H. (2009). Finding meaning in art: Preferred levels of ambiguity in art appreciation. *Quarterly Journal of Experimental Psychology*, *62*(11), 2105–2112. https://doi.org/10.1080/17470210903038974

Ji, L. J., Peng, K., & Nisbett, R. E. (2000). Culture, control, and perception of relationships in the environment. *Journal of Personality and Social Psychology*, *78*(5), 943–955. https://doi.org/10.1037/0022-3514.78.5.943

Johnston, P., Molyneux, R., & Young, A. W. (2015). The N170 observed "in the wild": Robust event-related potentials to faces in cluttered dynamic visual scenes. *Social Cognitive and Affective Neuroscience*, *10*(7), 938–944. https://doi.org/10.1093/scan/nsu136

Kampis, D., Fogd, D., & Kovács, Á. M. (2017). Nonverbal components of Theory of Mind in typical and atypical development. *Infant Behavior and Development*, *48*, 54–62. https://doi.org/10.1016/j.infbeh.2016.11.001

Kapoula, Z., Daunys, G., Herbez, O., & Yang, Q. (2009). Effect of title on eye-movement exploration of cubist paintings by Fernand Léger. *Perception*, *38*(4), 479–491. https://doi.org/10.1068/p6080

Kapoula, Z., & Lestocart, L.-J. (2006). Perception de l'espace et du mouvement dans Study of a Dog (Étude de chien) de Francis Bacon. *Intellectica*, *44*(2), 215–226. https://doi.org/10.3406/intel.2006.1299

Kass, J., Harland, B., & Donnelly, N. (2015). Abstracting the Set: Monet's Cathedrals and Stable Mental Concepts from Serial Pictorial Artworks. *Art and Perception*, *3*(2), 139–150. https://doi.org/10.1163/22134913-00002030

Kass, J., Harland, B., & Donnelly, N. (2018). Warholian repetition and the viewer's

affective response to artworks from his Death and Disaster series. *Leonardo*, *51*(2), 138–142. https://doi.org/10.1162/LEON_a_01191

Kennel, P., Puech, W., & Comby, F. (2017). Visualization framework of digital paintings based on visual saliency for cultural heritage. *Multimedia Tools and Applications*, *76*(1), 561–575. https://doi.org/10.1007/s11042-015-3013-7

Khan, F. S., Beigpour, S., Van De Weijer, J., & Felsberg, M. (2014). Painting-91: A large scale database for computational painting categorization. *Machine Vision and Applications*, *25*(6), 1385–1397. https://doi.org/10.1007/s00138-014-0621-6

Kimchi, R. (1992). Primacy of Wholistic Processing and Global/Local Paradigm: A Critical Review. *Psychological Bulletin*, *112*(1), 24–38.

Kimchi, R., & Palmer, S. E. (1982). Form and texture in hierarchically constructed patterns. *Journal of Experimental Psychology: Human Perception and Performance*, *8*(4), 521–535. https://doi.org/10.1037/0096-1523.8.4.521

Kitayama, S., Duffy, S., Kawamura, T., & Larsen, J. T. (2003). Perceiving and object and its context in different cultures: A Culture Look at New Look. *Psychological Science*, *14*(3), 201–206. https://doi.org/10.1111/1467-9280.02432

Ko, S. G., Lee, T. H., Yoon, H. Y., Kwon, J. H., & Mather, M. (2011). How Does Context Affect Assessments of Facial Emotion? The Role of Culture and Age. *Psychology and Aging*, *26*(1), 48–59. https://doi.org/10.1037/a0020222

Koch, C., & Ullman, S. (1987). Shifts in Selective Visual Attention: Towards the Underlying Neural Circuitry. In Vaina L.M. (Ed.), *Matters of Intelligence. Synthese Library (Studies in Epistemology, Logic, Methodology, and Philosophy of Science)* (pp. 115–141). Dordrecht: Springer.

Koelsch, S., & Siebel, W. A. (2005). Towards a neural basis of music perception. *Trends in Cognitive Sciences*, *9*(12), 578–584. https://doi.org/10.1016/j.tics.2005.10.001

Koide, N., Kubo, T., Nishida, S., Shibata, T., & Ikeda, K. (2015). Art expertise reduces influence of visual salience on fixation in viewing abstract-paintings. *PLoS ONE*, *10*(2), 1–14. https://doi.org/10.1371/journal.pone.0117696

Kolodziej, M., Majkowski, A., Francuz, P., Rak, R., & Augustynowicz, P. (2018). Identifying experts in the field of visual arts using oculomotor signals. *Journal of Eye Movement Research*, *11*(3). https://doi.org/10.16910/jemr.11.3.3

Kristjanson, A. F., Antes, J. R., & Kristjanson, A. K. (1989). Eye Movement Analysis of Artists and Nonartists Viewing Paintings. *Visual Arts Research*, *15*(2), 21–30. Retrieved from https://www.jstor.org/stable/20715702

Kuehni, R. G. (2003). *Color Space and Its Divisions: Color Order from Antiquity to the Present*. New Jersey: John Wiley & Sons, Inc.

Kundel, H. L., Nodine, C. F., Conant, E. F., & Weinstein, S. P. (2007). Holistic Component of Image Perception in Mammogram Interpretation: Gaze-tracking Study. *Radiology*, *242*(2), 397–402. https://doi.org/10.1148/radiol.2422051997

Langton, S. R. H., Law, A. S., Burton, A. M., & Schweinberger, S. R. (2008). Attention capture by faces. *Cognition*, *107*(1), 330–342. https://doi.org/10.1016/j.cognition.2007.07.012

Leder, H. (2001). Determinants of preference: when do we like what we know? *Empirical Studies of the Arts*, *19*(2), 201–211. https://doi.org/10.2190/5TAE-E5CV-XJAL-3885

Leder, H., Belke, B., Oeberst, A., & Augustin, D. (2004). A model of aesthetic appreciation and aesthetic judgments. *British Journal of Psychology*, *95*, 489–508. https://doi.org/10.1348/0007126042369811

Leder, H., & Nadal, M. (2014). Ten years of a model of aesthetic appreciation and aesthetic judgments: The aesthetic episode - Developments and challenges in empirical aesthetics. *British Journal of Psychology*, *105*, 443–464.

https://doi.org/10.1111/bjop.12084

Leong, J. J. H., Nicolaou, M., Emery, R. J., Darzi, A. W., & Yang, G. Z. (2007). Visual search behaviour in skeletal radiographs: a cross-speciality study. *Clinical radiology*, *62*(11), 1069-1077. https://doi.org/10.1016/j.crad.2007.05.008

Livingstone, M. S. (2000). Is it warm? Is it real? Or just low spatial frequency? *Science* , *290*(5495), 1299. https://doi.org/10.1126/science.290.5495.1299b

Locher, P., Gray, S., & Nodine, C. (1996). The structural framework of pictorial balance. *Perception*, *25*(12), 1419–1436. https://doi.org/10.1068/p251419

Locher, P., Krupinski, E. a, Mello-Thoms, C., & Nodine, C. F. (2007). Visual interest in pictorial art during an aesthetic experience. *Spatial Vision*, *21*(1–2), 55–77. https://doi.org/10.1163/156856807782753868

Locher, P., Krupinski, E., & Schaefer, A. (2015). Art and authenticity: Behavioral and eye-movement analyses. *Psychology of Aesthetics, Creativity, and the Arts*, *9*(4), 356–367. https://doi.org/10.1037/aca0000026

Locher, P., & Nodine, C. (1989). The perceptual value of symmetry. *Computers and Mathematics with Applications*, *17*(4–6), 475–484. https://doi.org/10.1016/0898-1221(89)90246-0

Locher, P., Smith, L., & Smith, J. (1999). Original Paintings versus Slide and Computer Reproductions: A Comparison of Viewer Responses. *Empirical Studies of the Arts*, *17*(2), 121–129. https://doi.org/10.2190/r1wn-taf2-376d-efuh

Loftus, G. R., & Norman H. Mackworth. (1978). Cognitive determinants of fixation location during picture viewing. *Journal of Experimental Psychology: Human Perception and Performance*, *4*(4), 565–572. https://doi.org/10.1037/0096-1523.4.4.565

Macmillan, N. A., & Creelman, C. D. (2004). *Detection theory: A user's guide* (2nd ed.).

Mahwah: NJ: Erlbaum.

Macrae, C. N. Lewis, H. L. (2002). Do I know you? Processing orientation and face recognition. *Psychological Science, 13*(2), 194–196. https://doi.org/10.1111/1467-9280.00436

Mallon, B., Redies, C., & Hayn-Leichsenring, G. U. (2014). Beauty in abstract paintings: perceptual contrast and statistical properties. *Frontiers in Human Neuroscience*, *8*(161), 1–14. https://doi.org/10.3389/fnhum.2014.00161

Massaro, D., Savazzi, F., Di Dio, C., Freedberg, D., Gallese, V., Gilli, G., & Marchetti, A. (2012). When art moves the eyes: A behavioral and eye-tracking study. *PLoS ONE*, *7*(5), 1–16. https://doi.org/10.1371/journal.pone.0037285

Masuda, T., Ellsworth, P. C., Mesquita, B., Leu, J., Tanida, S., & Van de Veerdonk, E. (2008). Placing the Face in Context: Cultural Differences in the Perception of Facial Emotion. *Journal of Personality and Social Psychology*, *94*(3), 365–381. https://doi.org/10.1037/0022-3514.94.3.365

Masuda, T., Gonzalez, R., Kwan, L., & Nisbett, R. E. (2008). Culture and aesthetic preference: Comparing the attention to context of East Asians and Americans. *Personality and Social Psychology Bulletin*, *34*(9), 1260–1275. https://doi.org/10.1177/0146167208320555

Masuda, T., & Nisbett, R. E. (2001). Attending holistically vs. analytically: Comparing the context sensibility of Japanese and American. *Journal of Personality and Social Psychology*, *81*(5), 922–934. https://doi.org/10.1037//0022-35I4.81.5.922

Masuda, T., & Nisbett, R. E. (2006). Culture and Change Blindness. *Cognitive Science*, *30*, 381–399. https://doi.org/10.1207/s15516709cog0000_63

Masuda, T., Wang, H., Ito, K., & Senzaki, S. (2012). Culture and cognition: Implications for art, design, and advertisement. In S. Okazaki (Ed.), Handbook of research in

international advertising (pp. 109–132). Cheltenham, England: Edward Elgar.

Matisse, H. (1987). Notes of Painter. In R. Benjamin (Ed.), *Matisse's "Notes of a Painter": Criticism, Theory, and Context, 1891-1908* (pp. 32 – 40). Michigan: Uni Research Press. (Orginal work published 1908)

Maxwell, S. E. (2004). The persistence of underpowered studies in psychological research: causes, consequences, and remedies. *Psychological Methods*, *9*(2), 147 – 163. https://doi.org/10.1037/1082-989X.9.2.147

McManus, I. C., & Furnham, A. (2006). Aesthetic activities and aesthetic attitudes: Influences of education, background and personality on interest and involvement in the arts. *British Journal of Psychology*, *97*(4), 555–587. https://doi.org/10.1348/000712606X101088

Meissner, C. A., & Brigham, J. C. (2001). Thirty Years of Investigating the Own-Race Bias in Memory for Faces: A Meta-Analytic Review. *Psychology, Public Policy, and Law*, *7*(1), 3–35. https://doi.org/10.1037/1076-8971.7.1.3

Melcher, D., & Cavanagh, P. (2011). Pictorial cues in art and in visualperception. In F. Bacci & D. Melcher (Eds.), *Art and the senses* (pp. 359–394). Oxford, UK: Oxford University Press.

Mickley Steinmetz, K. R., Sturkie, C. M., Rochester, N. M., Liu, X., & Gutchess, A. H. (2018). Cross-cultural differences in item and background memory: examining the influence of emotional intensity and scene congruency. *Memory*, *26*(6), 751–758. https://doi.org/10.1080/09658211.2017.1406119

Millar, P. R., Serbun, S. J., Vadalia, A., & Gutchess, A. H. (2013). Cross-cultural differences in memory specificity. *Culture and Brain*, *1*(2–4), 138–157. https://doi.org/10.1007/s40167-013-0011-3

Minissale, G. (2013). *The Psychology of Contemporary Art*. Cambridge: Cambridge

University Press.

Miyamoto, Y., Nisbett, R. E., & Masuda, T. (2006). Culture and the Physical Environment. *Psychological Science*, *17*(2), 113–119. https://doi.org/10.1111/j.1467-9280.2006.01673.x

Nand, K., Masuda, T., Senzaki, S., & Ishii, K. (2014). Examining cultural drifts in artworks through history and development: Cultural comparisons between Japanese and western landscape paintings and drawings. *Frontiers in Psychology*, *5*, 1–12. https://doi.org/10.3389/fpsyg.2014.01041

Navon, D. (1977). Forest before trees: The precedence of global features in visual perception. *Cognitive Psychology*, *9*(3), 353–383. https://doi.org/10.1016/0010-0285(77)90012-3

Navon, D. (1981). The forest revisited: More on global precedence. *Psychological Research*, *43*(1), 1–32. https://doi.org/10.1007/BF00309635

Nightingale, A. W. (2004). *Spectacles of truth in classical Greek philosophy: Theoria in its cultural context*. Cambridge: Cambridge University Press.

Nisbett, R. E., & Masuda, T. (2003). Culture and point of view. *Proceedings of the National Academy of Sciences*, *100*(19), 11163– 11170. https://doi.org/https://doi.org/10.1073/pnas.1934527100

Nodine, C. F., Locher, P., & Krupinski, E. A. (1993). The Role of Formal Art Training on Perception and Aesthetic Judgment of Art Compositions. *Leonardo*, *26*(3), 219–227. https://doi.org/10.2307/1575815

Nuthmann, A., & Henderson, J. M. (2010). Object-based attentional selection in scene viewing. *Journal of Vision*, *10*(8). https://doi.org/10.1167/10.8.20

Oliva, A. (2013). The Art of Hybrid Images: Two for the View of One. *Art & Perception*, *1*(1–2), 65–74. https://doi.org/10.1163/22134913-00002004

Oliva, A., & Torralba, A. (2006). Building the gist of a scene: The role of global image features in recognition. *Progress in Brain Research*, *155*(Part B), 23–36. https://doi.org/10.1016/S0079-6123(06)55002-2

Ostrofsky, J., Kozbelt, A., & Seidel, A. (2012). Perceptual constancies and visual selection as predictors of realistic drawing skill. *Psychology of Aesthetics, Creativity, and the Arts*, *6*(2), 124–136. https://doi.org/10.1037/a0026384

Ostrovsky, Y., Cavanagh, P., & Sinha, P. (2005). Perceiving illumination inconsistencies in scenes. *Perception*, *34*(11), 1301–1314. https://doi.org/10.1068/p5418

Panofsky, E. (1987). *Meaning in Visual Art*. Harmondsworth: Penguin Books.

Panofsky, E., & Heckscher, W. S. (1995). *Three Essays on Style*. (I. Lavin, Ed.). Cambridge, Mass., United States: MIT Press Ltd.

Parkhurst, D., Law, K., & Niebur, E. (2002). Modeling the role of salience in the allocation of overt visual attention. *Vision Research*, *42*(1), 107–123. https://doi.org/10.1016/S0042-6989(01)00250-4

Pelowski, M., Markey, P. S., Forster, M., Gerger, G., & Leder, H. (2017). Move me, astonish me… delight my eyes and brain: The Vienna Integrated Model of top-down and bottom-up processes in Art Perception (VIMAP) and corresponding affective, evaluative, and neurophysiological correlates. *Physics of Life Reviews*, *21*, 80–125. https://doi.org/10.1016/j.plrev.2017.02.003

Perdreau, F., & Cavanagh, P. (2013). The artist's advantage: Better integration of object information across eye movements. *i-Perception*, *4*(6), 380-395. https://doi.org/10.1068/i0574

Perfect, T. J. (2003). Local processing bias impairs lineup performance. *Psychological Reports*, *93*(2), 393-394. https://doi.org/10.2466/pr0.2003.93.2.393

Perfect, T. J., Dennis, I., & Snell, A. (2007). The effects of local and global processing

orientation on eyewitness identification performance. *Memory*, *15*(7), 784-798. https://doi.org/10.1080/09658210701654627

Perfect, T. J., Weston, N. J., Dennis, I., & Snell, A. (2008). Short article: The effects of precedence on Navon-induced processing bias in face recognition. *Quarterly Journal of Experimental Psychology*, *61*(10), 1479-1486. https://doi.org/10.1080/17470210802034678

Pihko, E., Virtanen, A., Saarinen, V.-M., Pannasch, S., Hirvenkari, L., Tossavainen, T., … Hari, R. (2011). Experiencing Art: The Influence of Expertise and Painting Abstraction Level. *Frontiers in Human Neuroscience*, *5*(94), 1–10. https://doi.org/10.3389/fnhum.2011.00094

Pippin, R. B. (2014). *After the beautiful: Hegel and the philosophy of pictorial modernism.* Chicago: IL: University of Chicago Press.

Plato (1969). *Republic.* In P. Shorey (Ed. & Trans.), *Plato in Twelve Volumes* (Vol. 5 & 6), London: William Heinemann Ltd.

Pöppel, E. (2018). East of West, West of East: a matter of global and local identity. *Cognitive Processing*, *19*(1), 115–119. https://doi.org/10.1007/s10339-018-0885-2

Pöppel, E., Avram, M., Bao, Y., Graupmann, V., Gutyrchik, E., Lutz, A., … Zaytseva, Y. (2013). Sensory Processing of Art as a Unique Window into Cognitive Mechanisms: Evidence from Behavioral Experiments and fMRI Studies. *Procedia - Social and Behavioral Sciences*, *86*, 10–17. https://doi.org/10.1016/j.sbspro.2013.08.517

Posner, M. I., & Keele, S. W. (1968). On the genesis of abstract ideas. *Journal of Experimental Psychology*, *77*(3), 353–363. https://doi.org/10.1037/h0025953

Quiroga, R. Q., & Pedreira, C. (2011). How Do We See Art: An Eye-Tracker Study. *Frontiers in Human Neuroscience*, *5*(98), 1–9. https://doi.org/10.3389/fnhum.2011.00098

References

Rayner, Keith. (1998). Eye Movements in Reading and Information Processing: 20 Years of Research. *Psychological Bulletin*, *124*(3), 372–422. https://doi.org/10.1037/0033-2909.124.3.372

Rayner, Keith. (2009). The 35th Sir Frederick Bartlett Lecture: Eye movements and attention in reading, scene perception, and visual search. *Quarterly Journal of Experimental Psychology*, *62*(8), 1457–1506. https://doi.org/10.1080/17470210902816461

Rayner, Keith, Li, X., Williams, C. C., Cave, K. R., & Well, A. D. (2007). Eye movements during information processing tasks: Individual differences and cultural effects. *Vision Research*, *47*(21), 2714–2726. https://doi.org/10.1016/j.visres.2007.05.007

Reber, R., Schwarz, N., & Winkielman, P. (2004). Processing fluency and aesthetic pleasure: Is beauty in the perceiver's processing experience? *Personality and Social Psychology Review*. https://doi.org/10.1207/s15327957pspr0804_3

Reff, T. (1975). Manet's Portrait of Zola. *The Burlington Magazine*, *117*(862), 34–44.

Reingold, E. M., Charness, N., Pomplun, M., & Stampe, D. M. (2001). Visual span in expert chess players: Evidence from eye movements. *Psychological Science*, *12*(1), 48-55. https://doi.org/10.1111/1467-9280.00309

Reynolds, N. (2005, June 21). Art world goes wild for chimpanzee's paintings as Warhol work flops. *The Telegraph*. Retrieved from https://www.telegraph.co.uk/news/1492463/Art-world-goes-wild-for-chimpanzees-paintings-as-Warhol-work-flops.html

Richler, J. J., Tanaka, J. W., Brown, D. D., & Gauthier, I. (2008). Why does selective attention to parts fail in face processing? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *34*(6), 1356 –1368. https://doi.org/10.1037/a0013080

Rosch, E. (1999). Principles of categorization. In E. Margolis & S. Laurence (Eds.), *Concepts:Core Reading* (pp. 189–206). Cambridge: MA: MIT Press.

Rosch, E., Mervis, C. B., Gray, W. D., Johnson, D. M., & Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology*, *8*(3), 382-439. https://doi.org/10.1016/0010-0285(76)90013-X

Rosenholtz, R. (1999). A simple saliency model predicts a number of motion popout phenomena. *Vision Research*, *39*(19), 3157–3163. https://doi.org/10.1016/S0042-6989(99)00077-2

Rothko, Mark *No. 5/No. 22* 1950. (n.d.). Retrieved from https://www.moma.org/collection/works/80566

Rousselet, G. A., Joubert, O. R., & Fabre-Thorpe, M. (2005). How long to get to the "gist" of real-world natural scenes? *Visual Cognition*, *12*(6), 852–877. https://doi.org/10.1080/13506280444000553

Sablatnig, R., Kammerer, P., & Zolda, E. (1998). Hierarchical classification of paintings using face- and brush stroke models. *Proceedings. Fourteenth International Conference on Pattern Recognition*, *1*, 172–174. https://doi.org/10.1109/icpr.1998.711107

Savazzi, F., Massaro, D., Dio, C. Di, Gallese, V., Gilli, G., & Marchetti, A. (2014). Exploring Responses to Art in Adolescence: A Behavioral and Eye-Tracking Study. *PLoS ONE*, *9*(7), 1–12. https://doi.org/10.1371/journal.pone.0102888

Sayim, B., & Cavanagh, P. (2011). The art of transparency. *I-Perception*, *2*(7), 679–696. https://doi.org/10.1068/i0459aap

Schirillo, J. A. (2007). Gender's effect on the hemispheric laterality of Rembrandt's portraits. *Spatial Vision*, *21*(1–2), 19–26. https://doi.org/10.1163/156856808782713753

Schmidt, B. K., Vogel, E. K., Woodman, G. F., & Luck, S. J. (2002). Voluntary and automatic attentional control of visual working memory. *Perception &*

Psychophysics, *64*(5), 754–763. https://doi.org/10.3758/BF03194742

Schulz, K., & Hayn-Leichsenring, G. U. (2017). Face attractiveness versus artistic beauty in art portraits: A behavioral study. *Frontiers in Psychology*, *8*(2254), 1–9. https://doi.org/10.3389/fpsyg.2017.02254

Senju, A., Csibra, G., & Johnson, M. H. (2008). Understanding the referential nature of looking: Infants' preference for object-directed gaze. *Cognition*, *108*(2), 303–319. https://doi.org/10.1016/j.cognition.2008.02.009

Senzaki, S., Masuda, T., & Nand, K. (2014). Holistic Versus Analytic Expressions in Artworks: Cross-Cultural Differences and Similarities in Drawings and Collages by Canadian and Japanese School-Age Children. *Journal of Cross-Cultural Psychology*, *45*(8), 1297–1316. https://doi.org/10.1177/0022022114537704

Shackman, A. J., Sarinopoulos, I., Maxwell, J. S., Pizzagalli, D. A., Lavric, A., & Davidson, R. J. (2006). Anxiety selectively disrupts visuospatial working memory. *Emotion*, *6*(1), 40–61. https://doi.org/10.1037/1528-3542.6.1.40

Shamir, L., Macura, T., Orlov, N., Eckley, D. M., & Goldberg, I. G. (2010). Impressionism, Expressionism, Surrealism: Automated Recognition of Painters and Schools of Art. *ACM Transactions on Applied Perception*, *7*(2), 1–18. https://doi.org/10.1145/1670671.1670672

Shamir, L., & Tarakhovsky, J. A. (2012). Computer analysis of art. *Journal on Computing and Cultural Heritage*, *5*(2), 1–11. https://doi.org/10.1145/2307723.2307726

Shen, Y.-T., & Yi-Luen Do, E. (2009). Fun with Blow Painting! Making leaf collages by blowing at toy windmill. *Proceedings of the Seventh ACM Conference on Creativity and Cognition*, 437–438. https://doi.org/10.1145/1640233.1640340

Sherman, A., Grabowecky, M., & Suzuki, S. (2015). In the working memory of the beholder: Art appreciation is enhanced when visual complexity is compatible with

working memory. *Journal of Experimental Psychology: Human Perception and Performance*, *41*(4), 898–903. https://doi.org/10.1037/a0039314

Smith, J. K., & Smith, L. F. (2001). Spending time on art. *Empirical Studies of the Arts*, *19*(2), 229–236. https://doi.org/https://doi.org/10.2190%2F5MQM-59JH-X21R-JN5J

Smith, L. F., Smith, J. K., & Tinio, P. P. L. (2017). Time spent viewing art and reading labels. *Psychology of Aesthetics, Creativity, and the Arts*, *11*(1), 77–85. https://doi.org/https://doi.org/10.1037/aca0000049

Specker, E., Tinio, P. P. L., & van Elk, M. (2017). Do you see what I see? An investigation of the aesthetic experience in the laboratory and museum. *Psychology of Aesthetics, Creativity, and the Arts*, *11*(3), 265–275. https://doi.org/10.1037/aca0000107

Stanley, J. T., Zhang, X., Fung, H. H., & Isaacowitz, D. M. (2013). Cultural differences in gaze and emotion recognition: Americans contrast more than chinese. *Emotion*, *13*(1), 36–46. https://doi.org/10.1037/a0029209

Sternberg, S. (1969). Memory-scanning: Mental processes revealed by reaction-time experiments. *American Scientist*, *57*(4), 421–457.

Sörqvist, P., & Marsh, J. E. (2015). How concentration shields against distraction. *Current Directions in Psychological Science*, *24*(4), 267-272. https://doi.org/10.1177/0963721415577356

Sullivan, M. (1984). *The Arts of China* (5th ed.). Berkeley: CA: University of California Press.

Tatler, B. W., Brockmole, J. R., & Carpenter, R. H. S. (2017). Latest: A model of saccadic decisions in space and time. *Psychological Review*, *124*(3), 267–300. https://doi.org/10.1037/rev0000054

Team R Core. (2016). *R: A Language and Environment for Statistical Computing*. Vienna: R Foundation for Statistical Computing.

Theeuwes, J., Belopolsky, A., & Olivers, C. N. L. (2009). Interactions between working memory, attention and eye movements. *Acta Psychologica*, *132*(2), 106–114. https://doi.org/10.1016/j.actpsy.2009.01.005

Theeuwes, J., Olivers, C. N., & Chizk, C. L. (2005). Remembering a location makes the eyes curve away. *Psychological Science*, *16*(3), 196-199. https://doi.org/10.1111/j.0956-7976.2005.00803.x

Tinio, P. P. L. (2013). From Artistic Creation to Aesthetic Reception: The Mirror Model of Art. *Psychology of Aesthetics, Creativity, and the Arts*, *7*(3), 265–275. https://doi.org/10.1037/a0030872.supp

Todorović, D. (2006). Geometrical basis of perception of gaze direction. *Vision Research*, *46*(21), 3549–3562. https://doi.org/10.1016/j.visres.2006.04.011

Todorović, D. (2009). The effect of face eccentricity on the perception of gaze direction. *Perception*, *38*(1), 109–132. https://doi.org/10.1068/p5930

Torralba, A., Oliva, A., Castelhano, M. S., & Henderson, J. M. (2006). Contextual guidance of eye movements and attention in real-world scenes: The role of global features in object search. *Psychological Review*, *113*(4), 766–786. https://doi.org/10.1037/0033-295X.113.4.766

Trawinski, T., Mestry, N., Harland, B., Liversedge, S., Godwin, H., & Donnelly, N. (2019). The Spectatorship of Portraits by Naïve Beholders. *Psychology of Aesthetics, Creativity, and the Arts*.

Treisman, A. M. (1977). Focused attention in the perception and retrieval of multidimensional stimuli. *Perception & Psychophysics*, *22*(1), 1–11. https://doi.org/10.3758/BF03206074

Treisman, A. M., & Gelade, G. (1980). A feature-integration theory of attention. *Cognitive Psychology*, *12*(1), 97–136. https://doi.org/10.1097/00075198-199608000-00002

Tröndle, M., Kirchberg, V., & Tschacher, W. (2014). Subtle differences: Men and women and their art reception. *Journal of Aesthetic Education*, *48*(4), 65–93. Retrieved from https://www.jstor.org/stable/pdf/10.5406/jaesteduc.48.4.0065.pdf

Tyler, C. W. (1998). Painters centre one eye in portraits. *Nature*, *392*, 877–878. https://doi.org/10.1038/31833

Ueda, Y., & Komiya, A. (2012). Cultural Adaptation of Visual Attention: Calibration of the Oculomotor Control System in Accordance with Cultural Scenes. *PLoS ONE*, *7*(11), 1–6. https://doi.org/10.1371/journal.pone.0050282

Ullman, S. (1984). Maximizing rigidity: the incremental recovery of 3-D structure from rigid and nonrigid motion. *Perception*, *13*(3), 255–274. https://doi.org/10.1068/p130255

Underwood, G., Templeman, E., Lamming, L., & Foulsham, T. (2008). Is attention necessary for object identification? Evidence from eye movements during the inspection of real-world scenes. *Consciousness and Cognition*, *17*(1), 159–170. https://doi.org/10.1016/j.concog.2006.11.008

Valenza, E., Simion, F., Cassia, V. M., & Umiltà, C. (1996). Face Preference at Birth. *Journal of Experimental Psychology: Human Perception and Performance*, *22*(4), 892–903. https://doi.org/10.1037/0096-1523.22.4.892

Venables, W. N., & Ripley, B. D. (2002). *Modern Applied Statistics with S. Fourth Edition*. New York: Springer.

Villani, D., Morganti, F., Cipresso, P., Ruggi, S., Riva, G., & Gilli, G. (2015). Visual exploration patterns of human figures in action: An eye tracker study with art paintings. *Frontiers in Psychology*, *6*(OCT), 1–10. https://doi.org/10.3389/fpsyg.2015.01636

da Vinci, L. (2010). *The Notebooks of Leonardo da Vinci*. In J. P. Richter (Ed. & Trans.), Madison

Park: Pacific Publishing Studio.

Võ, M. L. H., & Henderson, J. M. (2010). The time course of initial scene processing for eye movement guidance in natural scene search. *Journal of Vision*, *10*(3), 1–13. https://doi.org/10.1167/10.3.14

Vogt, S., & Magnussen, S. (2007). Expertise in pictorial perception: Eye-movement patterns and visual memory in artists and laymen. *Perception*, *36*(1), 91–100. https://doi.org/10.1068/p5262

Wade, N. J. (2012). Artistic Precursors of Gestalt Principles. *Gestalt Theory*, *34*(3–4), 329–348.

Winner, E., & Casey, B. (1992). 10 Cognitive profiles of artists. In G. C. Cupchik & J. László (Eds.), *Emerging visions of the aesthetic process: Psychology, semiology, and philosophy* (pp. 154–170). New York: Cambridge University Press.

Wolfe, J. M., Võ, M. L. H., Evans, K. K., & Greene, M. R. (2011). Visual search in scenes involves selective and nonselective pathways. *Trends in Cognitive Sciences*, *15*(2), 77–84. https://doi.org/10.1016/j.tics.2010.12.001

Wolfflin, H. (1950). *Principles of Art History: The Problem of the Development of Style in Later Art* (6th ed.). New York: Dover Publications, Inc.

Wong, A. C. N., & Gauthier, I. (2007). An analysis of letter expertise in a levels-of-categorization framework. *Visual Cognition*, *15*(7), 854-879. https://doi.org/10.1080/13506280600948350

Wong, B. I., Yin, S., Yang, L., Li, J., & Spaniol, J. (2018). Cultural Differences in Memory for Objects and Backgrounds in Pictures. *Journal of Cross-Cultural Psychology*, *49*(3), 404–417. https://doi.org/10.1177/0022022117748763

Wydawnictwo KUL. (2013). *Imagia: w kierunku neurokognitywnej teorii obrazu* [Imagia: in direction of neurocognitive theory of image]. Lublin, Poland: Francuz, P.

Yago, E., & Ishai, A. (2006). Recognition memory is modulated by visual similarity. *NeuroImage*, *31*(2), 807–817. https://doi.org/10.1016/j.neuroimage.2005.12.014

Yang, L., Li, J., Spaniol, J., Hasher, L., Wilkinson, A. J., Yu, J., & Niu, Y. (2013). Aging, Culture, and Memory for Socially Meaningful Item-Context Associations: An East-West Cross-Cultural Comparison Study. *PLoS ONE*, *8*(4), 1–7. https://doi.org/10.1371/journal.pone.0060703

Yarbus, A. L. (1967). Eye Movements During Perception of Complex Objects. In *Eye Movements and Vision* (pp. 171–211). Boston: Springer. https://doi.org/10.1007/978-1-4899-5379-7_8

Yarkoni, T., & Braver, T.S. (2010). Cognitive neuroscience approaches to individual differences in working memory and executive control: Conceptual and methodological issues. In A. Gruszka, G. Matthews, & B. Szymura (Eds.), Handbook of individual differences in cognition: Attention, memory and executive control. New York: Springer.

Young, A. W. (2018). Faces, people and the brain: The 45th sir frederic bartlett lecture. *Quarterly Journal of Experimental Psychology*, *71*(3), 569–594. https://doi.org/10.1177/1747021817740275

Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology*, *9*(2), 1–27.

Zangemeister, W. H., Sherman, K., & Stark, L. (1995). Evidence for a global scanpath strategy in viewing abstract compared with realistic images. *Neuropsychologia*, *33*(8), 1009–1025. https://doi.org/10.1016/0028-3932(95)00014-T

Zhang, X., Constable, M., Chan, K. L., Yu, J., & Junyan, W. (2018). *Computational Approaches in the Transfer of Aesthetic Values from Paintings to Photographs*. Singapore: Springer Nature.

Zhao, Q., & Koch, C. (2011). Learning a saliency map using fixated locations in natural scenes. *Journal of Vision*, *11*(9), 1–15. https://doi.org/10.1167/11.3.9

Zujovic, J., Gandy, L., Friedman, S., Pardo, B., & Pappas, T. N. (2009). Classifying paintings by artistic genre: An analysis of features & classifiers. In *2009 IEEE International Workshop on Multimedia Signal Processing*. Rio De Janeiro: IEEE. https://doi.org/10.1109/MMSP.2009.5293271