Visceral and Behavioural Responses to Modern Art: Influence of Expertise, Type of Art and Context

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PhD
2016

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A thesis submitted in partial fulfilment of the requirements of the University of Northumbria at Newcastle for the degree of Doctor of Philosophy

Faculty of Health and Life Sciences

June 2016

Abstract

Art is one of life's great joys, whether beautiful, ugly, sublime or shocking. Whilst neuroimaging studies using visual art as stimuli have yielded a wealth of information regarding aesthetic appreciation and beauty, few have considered a wider range of emotions or the effect of expertise and context. In order to address this three studies were conducted. The first studied the time course of visual, cognitive and emotional processes in response to visual art by investigating the event-related potentials (ERPs) elicited whilst viewing and rating the visceral affect of art, in artists and non-artists. The second, behavioural, study questioned the ecological validity of using reproductions of art. Contextual differences in arousal, aesthetic response, viewing time and memory, were explored. The final study aimed to extend the findings of the first two. Continuous EEG was recorded to explore effects of expertise and context on phase synchrony bands during the contemplation of art in a gallery. Behavioural measures and structured interviews were employed to examine the impact of contemplating art on subjective feelings, mood and memory. A number of negative environmental factors adversely affected collection and validity of the continuous EEG data, which was not considered further.

There were three prominent findings. First, looking at art is interesting and rewarding, particularly for experts. It is not dependent on aesthetic preference, although expertise is important regarding the appreciation of abstract art. Second, the response to art is not isolated from the context in which it is experienced, whether the physical context of a gallery vs. laboratory, or original vs. reproduction. Finally, both the prospect of looking at art and contemplation of art, whether original or reproduced, increases calmness and contentedness and decreases alertness, irrespective of expertise. Interest and curiosity are the dominant factors eliciting positive mood and positive emotions. Looking at art is relaxing and is good for you.

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Publications

Excerpts of Chapter 3 have been published in Frontiers in Human Neuroscience:

Else, J., Ellis, J., & Orme, L. (2015). Art expertise modulates the emotional response in modern art, especially abstract: an ERP investigation. *Frontiers in Human Neuroscience, 9*(525).

(IF 2.463)

Acknowledgements

I would firstly like to express my sincere gratitude to my supervisors Professor Jason Ellis and Dr Libby Orme for their help, support, guidance and patience during this PhD journey. You took me on when I was half way through my research, and despite the many hiccups along the way have continued to offer patience and advice, with humour and kindness. Thank you. To Professor Christine Borland, thank you for giving me the opportunity to conduct real world research at BALTIC39. I would also like to thank Dr Jonathon Reay for sticking by me and Paul Agnew for all he has done to keep my PhD running smoothly, despite my best efforts.

Thank you to everyone at The Biscuit Factory and BALTIC39 for giving me the opportunity to access exhibitions, genuine artworks, your clients and your websites. Thank you to all the artists who allowed me to use your work for my research, without you there would be no art. I would also like to thank Mhairi McMullon and Rachel Sharp, without whom I could not have completed my research.

I thank all my friends and colleagues, they have put up with so much, and so little, from me during this time, but particular thanks to Dr Jo Greer. Thank you for being such a great friend, for sharing every last squiggly line, every EEG disaster and triumph, and for all those late night chats.

To all the friends, friends of friends, acquaintances and total strangers who gave up their time and hairstyles to be my participants, thank you.

Finally, to my family, thank you for your patience. Most of all, to Hugh, without your love and cooking I could not have made it. Thank you.

Declaration

I declare that the work contained in this thesis has not been submitted for any other award and that it is all my own work. I also confirm that this work fully acknowledges opinions, ideas and contributions from the work of others.

Any ethical clearance for the research presented in this thesis has been approved. Approval has been sought and granted by the Faculty of Health and Life Sciences Ethics Committee.

I declare that the word count of this Thesis is 75,016

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Signature

Date

Chapter 1: Aesthetics, Affective Pictures and Emotion

1.1 Introduction

The study of visual aesthetics has been an important aspect in the understanding of the psychology of art and of aesthetic processing for over 150 years. Since the 1990's the relatively new discipline of neuroaesthetics, the combination of neuroscience and the study of cognitive and affective aesthetic responses to art, has been shedding light on the neural processes involved in aesthetic experiences and artistic and creative activities. This chapter will briefly consider what art is and what it is for, the aesthetic response and the development of neuroaesthetics.

A number of frameworks or models proposed in an attempt to understand aesthetic appreciation or aesthetic processing are reviewed. The models range from those based on visual neuroscience to a cognitive appraisal theory of aesthetic emotions. Electroencephalography (EEG) and event-related potential (ERP) research into affective pictures and emotion is then reviewed, to provide a background to the research focussed on understanding neural responses to art discussed in Chapter 2.

1.2 Aesthetics, Neuroaesthetics and Art

This section will explore what art is and how the psychological study of aesthetics has engaged cognitive neuroscientists in the search for understanding neural responses to art. Whilst early empirical work focussed almost entirely on aesthetics and beauty we will see that there has recently been a movement towards exploring a wider range of emotional responses to art, particularly modern art, whose aim is not necessarily to evoke emotions associated with beauty in the viewer. A range of models and frameworks of aesthetic processing will be reviewed, including those who propose an interdisciplinary approach.

1.2.1 What is art?

Visual artefacts have been created by the human race for millions of years, yet whether these can be called Art, or even whether there is such a thing as Art, (Gombrich, 1953) continues to be debated. What is certain is that human beings have always created something that can be called Art, they have spent time making images, decorating their bodies, making music, singing and dancing. Yet, many philosophers and artists appear resigned to the impossibility of ever defining 'art' (e.g., Dickie, 1974). Visual art is not simply a process of imitation, a recording of what is going on around us, a notion prevalent from Antiquity to the eighteenth century, from Aristotle to Vasari (1550) and to Kant (1790) and to the present day Scruton (2009).

It is clear that many modern artworks do not imitate or represent anything. In fact art is more likely to be a reinterpretation of what is around us - the subject is more likely to be something that cannot be seen (Greer, 2011), something that expresses or stimulates emotions. In his guide to what art is for, Alain de Botton (2014) explains that art is a vital force for humanity, it has many purposes, from keeping us hopeful and joyous with its beauty, to making us less lonely with its images of humanity, suffering or loneliness, or rebalancing us, making us sad when we are happy, or happy when we are sad, it helps us to appreciate life and what really matters. 'Art' and the 'aesthetic' are often used interchangeably; the appreciation of art can be seen as centring on aesthetic appreciation (Koopman, 2010). Visual aesthetics, widely accepted as the ability to recognise and assign beauty to certain forms, colours or movements, is a defining human trait developed over millions of years, and one which continues to fascinate philosophers (e.g., Scruton, 2009). But aesthetic and art are by no means all embracing. All kinds of artefacts, the wonders of the natural world, design, our environment, are generally not classified as art, yet can be approached from an aesthetic point of view.

1.2.2 Aesthetics and neuroaesthetics

Since Plato and Aristotle philosophers have been interested in aesthetics and beauty, and whether there is some inherent quality of what is beautiful, what is aesthetically pleasing, or, whether beauty is in the eye of the beholder. In 1750 Alexander Baumgarten defined aesthetics as, ‘the art of thinking beautifully’. Whilst it is accepted that the philosophy of aesthetics deals with the nature and expression of beauty, particularly in the fine arts, from a historical perspective aesthetics has been linked to the emotional response evoked by art. The psychological approach is to study psychological responses to beauty and artistic expression.

Whilst the problem of trying to define art continues to confound, the nature of art has attracted the attention of cognitive neuroscientists. In 1999 Zeki proposed that any profound theory of aesthetics would be substantially based on the activity of the brain. Subsequent interest in the neural correlates of the perception of art and aesthetics is reflected in the quantity and variety of relatively recent publications exploring this area, and the range of imaging techniques employed, such as functional magnetic resonance (fMRI), magnetoencephalography (MEG) and electroencephalography (EEG). A growing interest in neuroaesthetics (the combination of neurological research with the study of the cognitive and affective processes involved in aesthetic experiences; Zeki, 1999, 2001, 2002; Chatterjee, 2004a, 2011; Skov & Vartanian, 2009), psychological aesthetics (Maclagan, 2001), neuroarthistory (the neurological study of artists, living and dead; Onions, 2007), the relationship between art and visual neurobiology (Livingstone, 2002), and also artful minds and creativity (Turner, 2006) has spurred a range of studies exploring art and aesthetics.

Neuroaesthetics is an emerging discipline within cognitive neuroscience that studies the neural processes that underlie the aesthetic response (Skov & Vartanian, 2009). It seeks to establish the biological and neurobiological foundations of aesthetic experience related not only to visual art, music, literature and film, but also natural objects and environments, from experimental, neuropsychological, evolutionary and neuroimaging perspectives. Such diversity, whilst encouraging, also means that it is difficult to form clear conclusions or hypotheses in this field. There appears to be a consensus that while neuroaesthetics is the study of responses in the brain to the perception and appreciation of beauty, harmony, and pleasure (Cela-Conde et al., 2004; Cupchik, Vartanian, Crawley & Mikulis, 2009; Leder, Belke, Oeberst & Augustin, 2004), and a secondary conceptual system involving memory (Jacobsen, 2010), the study of the relation between cognitive and neural processes involved in aesthetic appreciation remains highly complex and intricate (Cela-Conde et al., 2011).

1.2.3 Models and frameworks of aesthetic processing

When experiencing art neural systems concerned with visual perception, visual recognition, memory, emotion are involved, as well as other mechanisms related to seeing and reacting to objects. It is generally agreed that the principal purpose of a work of art is to elicit an emotional response in the viewer. In response to research into cognition and aesthetics and the development of neuroaesthetics a number of models and frameworks for aesthetic appreciation or aesthetic processing have recently been proposed. These range from those based on visual neuroscience (Chatterjee, 2004a), to an information processing model (Leder et al., 2004), to a unified theory aiming for a psychological model (Jacobsen, 2006) and a model considering primary mental functions (Shimamura, 2012; Chatterjee & Vartanian, 2014). Finally, an appraisal theory of emotion to understand the aesthetic experience is considered (Silvia, 2009).

Chatterjee (2004a) offers a framework based on visual neuroscience from which to consider visual aesthetics. He proposes that visual aesthetics, like vision, has multiple components, which are processed both hierarchically and in parallel in different parts of the brain (Farah, 2000; Zeki, 1993)(see Figure 1). The visual attributes of art are processed like any other objects; early and intermediate vision extracts simple components, such as colour, luminance, shape, motion, location and composition (Livingston & Hubel, 1988). This engages fronto-parietal attentional circuits that continue to modulate processing within the ventral visual stream. This may contribute to a more vivid experience of the stimuli, both of its attributes, such as colour or form, as well as content, such as landscapes or faces. So, a feed forward mechanism is established, the features of the stimuli engage attention, and attention further enhances the processing of the stimuli's qualities. Any vividly experienced object, such as an emotional face, is probably processed in this way, as well as aesthetic objects. It is the emotional response that distinguishes between aesthetic objects and others.

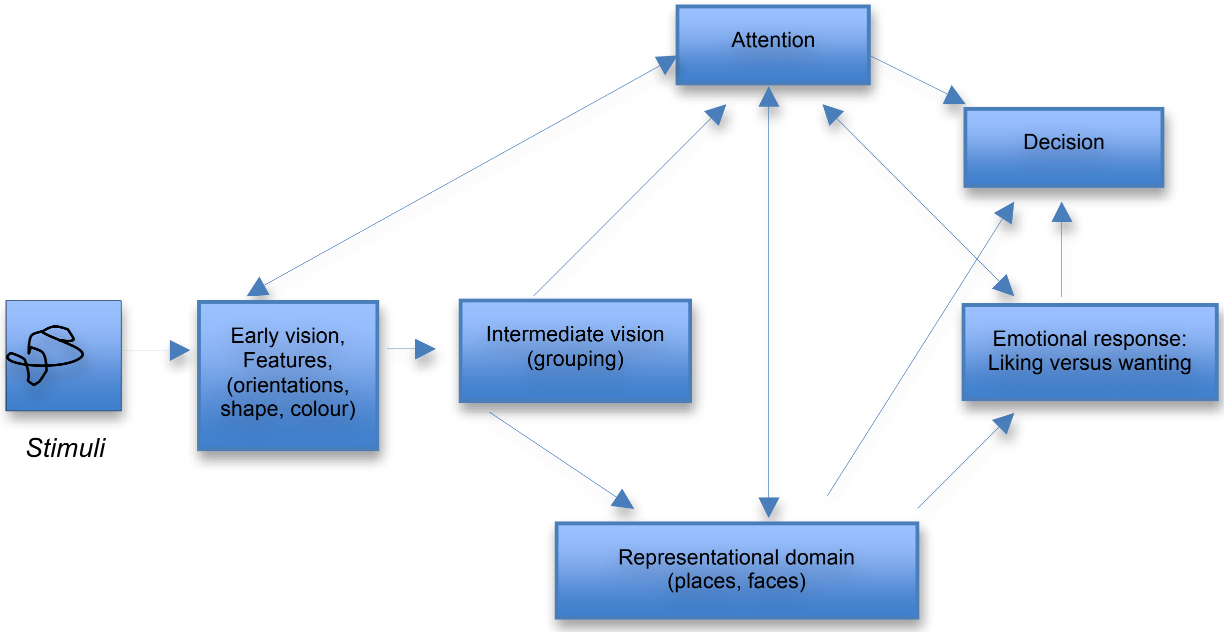


Figure 1. A general framework for the neural underpinnings of visual aesthetics guided by visual neuroscience (based on Chatterjee, 2004a).

Chatterjee (2004a) suggests that these early and intermediate processes are almost certainly universal, presumably 'hardwired' into the brain. However, the subsequent emotional response, essential to the aesthetic experience, involves wildly distributed circuits. Investigations of the neural bases of emotions has identified that the dopaminergic circuits including the ventral striatum and the nucleus accumbens appear to mediate the desire for rewards. He states that the long held belief is that the aesthetic experience involves disinterested interest, an aesthetic object can be liked without being wanted, but the neural mediation of such an experience is not yet known. He proposes that the later visual processes involved in aesthetic judgement recruit these areas associated with liking or wanting.

Leder et al., (2004) were interested in the cognitive processing of art and how it produces affective, often positive and self-rewarding aesthetic experiences and proposed an information-processing model of aesthetic processing that differentiates between aesthetic emotion and aesthetic judgement. The model involves five stages each concerned with different cognitive analyses: perception → implicit memory→ explicit classification → cognitive mastering → evaluation, with information flowing from one process to the next, see Figure 2 below.

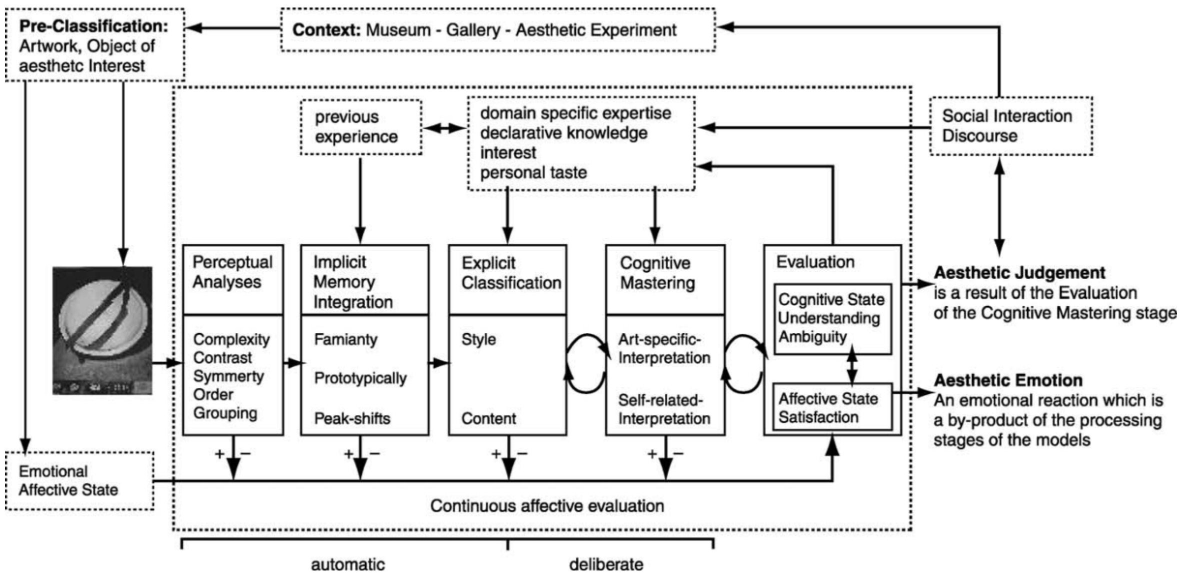


Figure 2. An information-processing model of aesthetic experience (adapted from Leder, Belke, Oeberst and Augustin (2004).

They propose that exposure, to modern art in particular, provides a challenge to the perceiver that requires stages of processing to result in an aesthetic emotion. The fact that art has such a prominent position in human culture suggests that the cognitive experience is more than simply an interesting perceptual process. They also point out that the context in which an aesthetic experience takes place can influence the affective reaction (Leder, Carbon & Ripsas, 2006; Kirk, Skov, Christensen & Nygaard, 2009b). If art is perceived in a museum, gallery, or exhibition, or if it is labelled as art, then it is contextually perceived as a work of art, which encourages aesthetic processing.

Leder et al., (2004) go on to explain that exposure to art presents the viewer with challenging situations requiring the viewer to successfully classify, understand and cognitively master the work, and that this is what constitutes the aesthetic experience.

These experiences are accompanied by continuously upgrading affective states that are appraised, resulting in an (aesthetic) emotion. Successful cognitive mastering of a work of art results in motivation to seek further exposure to art, which increases interest, and thus the acquisition of expertise. It is unlikely that the flow of information only moves from the bottom up, from posterior to anterior parts of the brain, it is more likely that information flows back and forth between the various mechanisms suggested by Leder et al.'s (2004) model. Although Leder et al., (2004) describe the different components of the model from left to right, they also comment that the model does not depict a strict serial flow of information, but rather a relative hierarchy of processing stages, with processing potentially going back to previous stages. They also suggest that the stimuli are analyzed within each processing unit simultaneously.

Skov (2009) comments that although probably true that all these stages will be engaged by any work of art, different works will differ in how they stimulate different parts of the system. There are so many different styles, so many variables in visual art; for instance portraits will involve face processing, landscapes may involve more visuospatial analysis, whilst abstract art may concentrate more on geometric shapes or colour, that the impact of the five stage model on individual art experience will vary. Skov (2009) further states that it remains to be seen exactly how perceptual analysis, memory, object recognition and prefrontal processes interact, functionally and temporally, during the mental representation of art.

Present-day psychology of aesthetics is characterized by an assortment of empirical discoveries. Many factors influencing aesthetic experience have been identified, such as symmetry, complexity or simplicity, novelty or familiarity, proportion or composition, semantic content or mere exposure, as well as the viewers' emotional state and level of expertise (Jacobsen, 2006). As aesthetic experiences and behaviour are influenced by a complex network of stimulus-person and situation-related influences Jacobsen (2010) posits that aesthetic processing needs to be considered from multiple perspectives. Any attempt to understand the cognitive processing underlying human aesthetics needs to be approached from these multiple perspectives and at several different levels of analysis. He (Jacobsen, 2006) proposes a framework that adopts seven, not mutually exclusive, vantage points, in an attempt to provide a unified theory of aesthetic processing, see Figure 3 below.

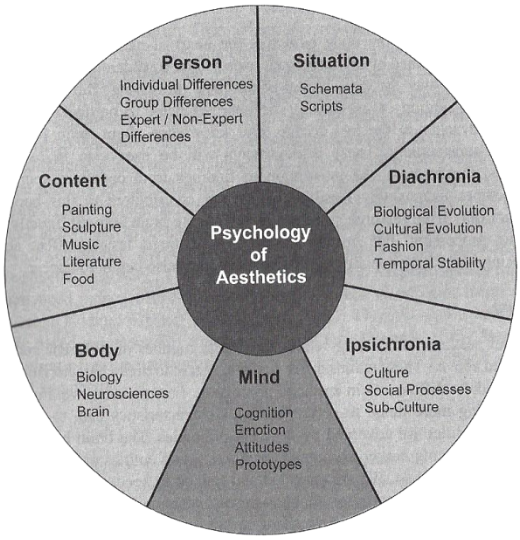


Figure 3. An illustration of a framework for the Psychology of Aesthetics (adapted from Jacobsen, 2006).

Each vantage point can have different levels of analysis, covering a broad range of partly inter-related topics. The seven perspective pillars are: mind, body (these two are at the heart of neuroaesthetics), content, person, situation, diachronia and ipsichronia. Diachronia is the perspective that considers change over time; ipsichronia focuses on comparisons within a period of time, i.e. comparisons between cultures, sub-cultures or social systems. Jacobsen's (2006) goal is a unified theory of the mental processing of aesthetics that describes the whole network of stimulus, personality and situation related factors, resulting in an inherently complex and finely tuned theoretical structure. Nevertheless, this model could apply to virtually any experience, aesthetic or not.

It is clear that aesthetic science is moving towards a more multidisciplinary approach to the way that artworks are perceived, interpreted and felt. Shimamura (2012) proposes that the experience of the observer of an artwork is best understood by considering the ways in which an artwork influences three primary mental functions: sensation, knowledge and emotion. All three contribute to aesthetic experiences, and although one or two of these components may be emphasized, the fullest aesthetic experience is one that heightens all three components. Chatterjee and Vartanian (2014) expand on this with their aesthetic triad (Figure 4, below). Aesthetic experiences emerge from the interaction between sensory-motor, emotion-valuation, and meaning-knowledge circuitry.

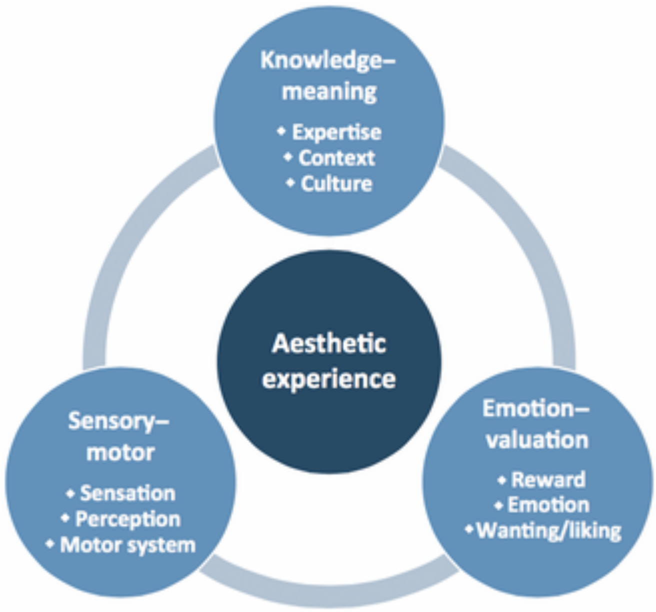


Figure 4. The aesthetic triad: neural systems contributing to emergent aesthetic experience, (Chatterjee and Vartanian 2014, Trends in Cognitive Science).

The mechanisms by which these systems influence each other in aesthetic experiences likely mimic those in non-aesthetic experiences. However, the context in which objects are encountered (e.g. as artworks) and appraisals that focus on objects (e.g. as artworks) distinguish aesthetic experiences from others. This integrated view builds on the earlier sequential and distinct information processing models, which isolated and analyzed a different component of the aesthetic object (Chatterjee, 2004a; Leder at al., 2004). Whilst these distinct components proved useful for laying the foundations of neuroaesthetics by mapping various aspects of information-processing stages onto specific neural structures it is clear that an interaction between areas of research, such as neuroscience and emotion, provides exciting opportunities. However, despite the clarity of this model, it could arguably be applied to virtually any kind of experience. Substitute the word ‘Sport’ for ‘Aesthetic’, for example, and the model would apply to ‘Sport Experience’. Unfortunately, this raises the spectre of the philosophy of aesthetics. What do we mean by the aesthetic experience? Is it confined to art? Football, after all, is known as ‘the beautiful game’.

Expanding on a cognitive appraisal theory of emotion Silvia (2009) considers emotions not normally considered in the study of aesthetic emotions in response to art: knowledge emotions (interest, confusion, surprise), hostile emotions (anger, disgust, contempt) and self-conscious emotions (pride, shame, embarrassment). He expresses surprise that modern research on experimental aesthetics continues to take inspiration from Berlyne’s (1974) seminal ideas about how collative variables (stimulus factors such as complexity, novelty, uncertainty, conflict and ambiguity which are compared and contrasted) affect arousal, interest and preference. He proposes that the psychological study of emotion has much to offer the study of aesthetics, particularly the recognition that emotions are not merely states of high arousal. Appraisal theories of emotion centre on the assumption that it is the evaluation of events, not the events themselves that are the cause of emotional experience (Roseman & Smith, 2001, as cited in Silvia, 2005a). Silvia (2005a, 2005b, 2009) and Silvia and Brown (2007) describe how the major theories of aesthetic emotions easily explain positive emotions but struggle to explain negative emotions, or to differentiate between neutral and negative feelings.

There is some disagreement (Dissanayake, 2007) regarding whether feelings such as anger and pride, surprise and disgust, can be considered aesthetic feelings, but they are feelings that are experienced in response to art. Figure 5 depicts a two-dimensional appraisal space for the knowledge emotions, confusion surprise and interest.

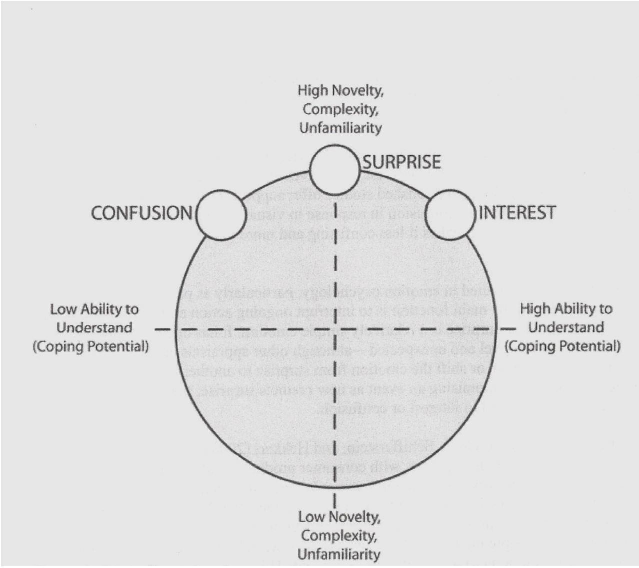


Figure 5. A two-dimensional appraisal space for interest, confusion and surprise (adapted from Silvia, 2009).

Sylvia (2009) argues that the knowledge emotions are made up of emotions associated with thinking and comprehending, with interest, confusion and surprise the most widely studied emotions in this family. Interest involves two appraisals: appraising stimuli as new, complex and unfamiliar, and as comprehensible. It is different to pleasure. Confusion is a metacognitive signal: it informs the viewer that they do not comprehend and thus more effort, withdrawal or avoidance is needed. Confusion is a major emotion in people faced with artworks they do not understand, and fits within interest's appraisal space. Both confusion and interest involve appraising something as new and complex. Surprise has one core appraisal, appraising something as novel and unexpected. Its main function is to interrupt and orient people to something significant. Figure 5 (above) shows that appraising an event, stimulus or artwork as new predicts surprise that can lead to interest or confusion. Perhaps theories such as this should be included in future models and frameworks attempting to explain aesthetic processing. The judgement or appraisal of art involves more than experiencing beauty, or not, it involves a vast range of sometimes conflicting emotions.

1.2.4 Summary

The models and frameworks discussed in this section provide a foundation for a multi-disciplinary approach to the study of aesthetic pleasure. It is clear that whilst viewing and appreciating art can be based on visual neuroscience and emotional processes involved in liking or wanting (Chatterjee, 2004a) it is more than simply an interesting perceptual process. There are at least two types of aesthetic experience, aesthetic emotion and aesthetic judgement, and whilst both of these outputs are influenced by experience and knowledge (Leder et al., 2004), it must not be ignored that sensation also contributes (Shimamura, 2012). It is clear from these models that expertise produces an often positive and self-rewarding aesthetic experience. Exposure to art presents the viewer with perceptual and cognitive challenges, which when mastered results in the desire for more exposure to art and increased interest, resulting in an affective reaction (Leder et al., 2004). The range of aesthetic feelings or pleasure is not limited to liking or preference, but may include emotions such as shame or embarrassment, disgust or fear, anger or confusion, particularly in response to modern and contemporary art. The context in which art is experienced also differentiates the aesthetic experience from perceptual experiences. Whilst early visual processing is hard-wired (Chatterjee, 2004a) contextual factors, such as the physical environment and the status of the objects perceived as 'artworks' may influence the aesthetic experience. Thus, expertise and context both appear to be influential on the perceptual and affective responses to art, particularly modern art.

1.3 EEG, ERPs and emotion

In this section we briefly look at the background to electroencephalography (EEG), the technique and its uses in empirical research. Two separate methods of analysis are explored, continuous EEG and Event Related Potentials (ERPs). We then review ERP studies that have explored the emotional impact of affective pictures on neural responses, in order to identify key visual ERP components associated with emotional affect.

1.3.1 Electroencephalography (EEG)

For more than half a century EEG has been by far the most widely used experimental technique to investigate the relationship between cognitive processes, such as perception, memory, attention, language and emotion, and brain activity (although fMRI is proving increasingly popular). In 1929 Hans Berger reported that placing an electrode on the scalp, amplifying the signal, and plotting the changes in voltage over time could measure the electrical activity of the human brain. However, it was not until 1935 that the electroencephalogram (EEG) was accepted as a real phenomenon rather than as some sort of artefact (Luck, 2005). Since this time EEG has proved to be useful in both clinical and experimental applications. Berger posited that brain activity changes in a consistent and recognizable way when the general status of the subject changes, as from relaxation to alertness. Some years later the concept of 'human brain waves' was verified and regular oscillations around 10 to 12 Hz identified as the 'alpha rhythm' (Adrian & Matthews, 1934, as cited by Teplan, 2002).

Although EEG has low spatial resolution (it is excellent at recording current originating in the cortex rather the depth of the brain, particularly in the gyri of the brain rather than the sulci), it provides virtually no anatomical information, but it does have high temporal resolution (events in the brain can be recorded with millisecond accuracy), so is a valuable technique for evaluating brain activity underlying different brain functions. The physiological basis of the EEG signal originates during synaptic excitations of the dendrites of many pyramidal neurons in the cerebral cortex, rather than the axonal currents associated with the action potential. The basic requirements needed for an electrical signal to be detected are that large populations of neurons must be activated in synchrony, and they must be aligned in parallel orientation so that they summate to yield a dipolar field (a field with positive and negative charges between which current flows) rather than cancel out (Coles & Rugg, 1995). Neurons are arranged in this way in the outer cortical layers, which represents 75% of neurons in the cerebral cortex (Braitenburg, 1977), but not necessarily in other areas of the brain, which can result in activity in these areas being invisible to the EEG. Between the electrode and the neuronal layers are the skin, skull and many other layers. To enable the weak electrical signals to be detected by the electrodes massive amplification of the voltage is required (typically 1,000 to 100,000 times).

EEG has a number of other limitations, besides poor spatial resolution. Artefacts, both biological, such as eye blinks, eye movement, jaw tension, increased alpha, or environmental, such as external noise or electrical noise in the environment, may contaminate the EEG, and can affect levels of impedance. This can be addressed initially by identifying and removing trials with artefacts, or by subtracting an estimate of the artefactual activity from the EEG (Luck, 2005). The time required to connect a participant to EEG can be much greater than that required for other psychophysiological assessments such as fMRI or MEG. The time requirement depends on the number of electrodes, the specific equipment used (e.g. electrodes attached directly to the head, or elastic headcap and pin type electrodes), and the experience of the researcher. Finally, the signal-to-noise ratio is poor. To ensure that random noise is reduced a large number of trials must be recorded to enable the signal to be averaged. The signal is assumed to be unaffected by the averaging process, whereas the noise is assumed to be reduced (Luck, 2005). To allow for this relatively large numbers of participants are required, large numbers of trials and sophisticated data analysis are needed to ensure useful information.

The greatest advantage of EEG is data capture speed. Complex patterns of neural activity occurring milliseconds after a stimulus has been administered can be recorded. But there are a number of other benefits. It is relatively inexpensive; the hardware costs are significantly lower than for MRI or MEG, and the cost of consumables is comparatively small. It is also flexible and mobile; it does not need a magnetically shielded room, or highly skilled operators. Operators who have had relatively little training and experience can use it both in the lab and outside. It is relatively tolerant of subject movement, compared to other techniques. It is silent and it is not claustrophobic.

There are two different applications utilising using the same technology and principles, event related potentials (ERPs) and oscillatory EEG. Oscillatory EEG is related to the event-related fluctuations in rhythmic EEG activity, which may provide a view on the dynamics of the coupling and uncoupling of functional networks involved in cognitive processing (Bastiaansen, Mazaheri & Jensen, 2012). ERPs are fluctuations in voltage in the raw EEG that are time-locked to an event, such as a stimulus onset or the execution of a response. They can follow or precede this event.

1.3.2 Phase- synchrony analysis of EEG.

EEG recordings provide a continuous measure of brain activity, and can be used to record the changes in brain activity that occurs during different functional states. Neural synchronization (or neural synchrony) appears to be a basic mechanism in which neurons synchronize or 'phase lock' their (oscillatory) firing activity within a restricted frequency band, for neuronal information processing both within a brain area and for communication between different brain areas (Bhattacharya & Petsche, 2002, Trujullo, Peterson, Kasziak & Allen, 2005). The synchronous oscillations have traditionally been organised into standard spectral frequency bands, ranging from slow to fast-wave oscillations (Saggar et al., 2012).

One reason for the interest in this type of EEG is to explore not just the binding of sensory attributes, but the overall integration of all dimensions of a cognitive act, including visual perception and imagery (Bhattacharya & Petsche, 2002), associative memory, emotional tone (Damasio, 1990), contemplation, meditation and attention (Saggar et al., 2012). This continuous EEG recording technique allows exploration of the mechanisms of attention and contemplation during visual and cognitive processing, and also visual processes involved in memory and imagination, without goal directed cognitive processing.

Table 1 below describes 5 major EEG frequency bands (Barry et al., 2007), where the activity is normally located, and the function it is considered to reflect in normal adults.

Table 1. The 5 major EEG frequency bands, location and function reflected in normal adults.

Band	**Frequency (Hz)**	**Location**	**Function**
Delta	1.5-3.5 Hz	Frontal	Slow-wave sleep, continuous attention
Theta	4-7.5 Hz	No clear location	Drowsiness, idling, associated with inhibition, frustration
Alpha	8-13 Hz	Posterior and occipital, both sides	Relaxed/reflecting Attention Awake, eyes closed Inhibition control
Beta	13.5-25 Hz	Symmetrical frontal distribution	Awake and alert, concentrating, anxious
Gamma	20-60 Hz	Middle, related to somatosensory and motor cortex	Cross modal sensory processing Short term memory matching of recognized objects, sounds, tactile sensations

1.3.3 Event Related Potentials (ERPs)

Event related potentials (ERPs) allow precise measurement (millisecond timing) of different perceptual and affective processes, including encoding, recognition and attentional processing during specific cognitive events. They have been used for decades to study perception, cognition, emotion, neurological and psychiatric disorders, over the lifespan. The averaged ERP consists of a prestimulus, not condition specific, baseline and a time-span covering the presentation of the stimulus, or the execution of a physical response, and an allocated response time. The ERP waveform contains multiple components during this time-span, each of which reflects a specific neurological process. The excellent temporal resolution provides a unique window into neural processes as they happen, millisecond by millisecond. The processing before, during and after the execution of behavioural responses can be recorded, providing additional insights that cannot be gained with behavioural measures alone.

ERP components have been defined as ‘a scalp-recorded voltage change that reflects a specific neural or psychological process (Kappenham & Luck, 2012). ERP components usually only become visible when multiple EEG time-locked epochs are combined together to form an average ERP waveform. This averaging process filters out all the brain activity that is not related to the appearance of stimulus, leaving an ERP waveform isolating the electrophysical activity related to the stimulus, see Figure 6.

The averaged waveform appears as a series of positive and negative voltage deflections, which are called peaks, waves or components, and which vary in polarity (positive or negative), amplitude (size of the component relative to the baseline) and latency (the precise duration of the component). This is almost instantaneous, because electrical potentials travel close to the speed of light through the brain, meninges, skull and scalp. Thus, ERPs provide a direct and instantaneous measure of cortical activity. However, it must be remembered that not all neural structures are reflected in the EEG, but they may modulate it (i.e. subcortical structures).

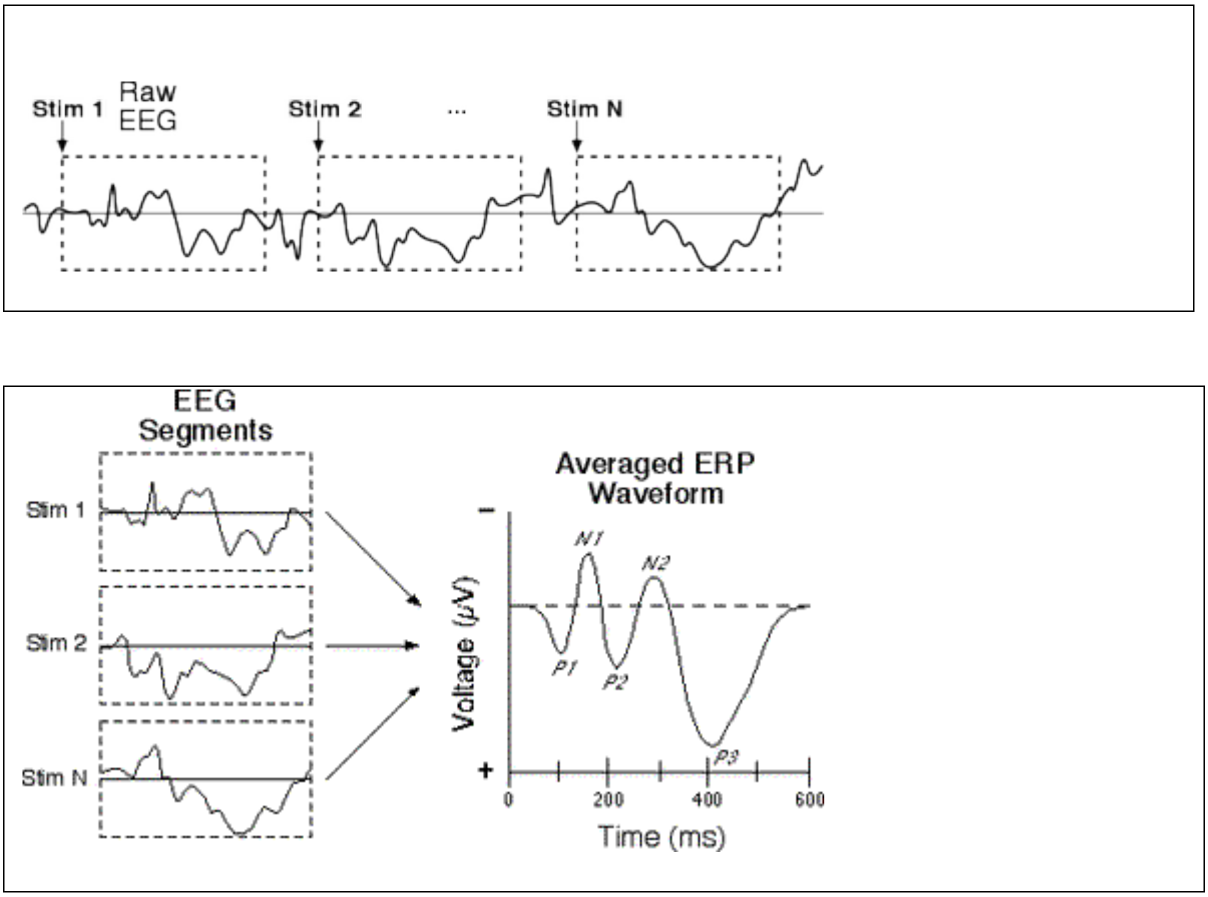


Figure 6. Example of raw EEG with the stimulus occurrence time-locked (Stimulus 1 and 2 are target stimuli, whilst Stimulus N is neutral). These EEG segments are then averaged together leaving an ERP waveform isolating the electrophysiological activity related to each stimulus. The individual components can then be identified, adapted from Luck, 2014. The stimuli are normally visual or auditory.

These peaks or components are usually labelled according to their polarity, their position within the waveform, and their precise latency, i.e. N100/P100 (negative/positive component at 100ms). They can also be labelled in order of appearance, i.e. N1/P1 (first negativity/positivity). ERP components are also categorized as exogenous or endogenous. *Exogenous* components are dependent on external rather than internal factors (e.g. frequency, luminance, colour, loudness) and index early sensory responses, whereas *endogenous* components are dependent on internal, psychological factors (e.g. task, relevance, probability of occurrence). ERPs are very useful for determining which stage or stages of processing are influenced by a specific experimental manipulation; they give a continuous measure of processing between a stimulus and a response. They also provide a measure of the processing of stimuli, even when no behavioural response is required. However, the functional significance of an ERP component is not always clear, and virtually never as clear as the functional significance of the behavioural response, thus standardized behavioural measures are often employed in conjunction with EEG. ERPs also need a large number of trials to ensure an accurate response is captured. Often 50, 100 or even 1000 trials per subject, in each condition, may be required. This can be a major limitation in the design of ERP experiments.

Despite these limitations, many of the waveform's peaks have been linked to specific cognitive mechanisms. Because of the very fine temporal resolution ERPs have become a crucial tool in understanding cognitive processing as temporal information is fundamental to understanding how something works (Luck, 2005).

To summarise: whilst EEG measures the phase synchrony in 5 standard frequency bands (delta, theta, alpha, beta and gamma) during spontaneous and prolonged visual perception, the ERP technique allows precise millisecond measurement of responses to specific visual events. Thus, the ERP technique can be utilised to explore the time course of early sensory and affective responses, visual processes and attention in response to visual art, whereas continuous EEG can be utilised to explore brain oscillations and synchronisation during visual processing whilst contemplation and imagining visual art.

1.3.4 Affective pictures, emotion and ERP components

Because of their excellent temporal resolution ERP techniques provide opportunities to explore the time course of affective responses. ERP affect assessment has a comparatively long history – since the 1960's – thus a wide range of experimental protocols, stimulus characteristics and task procedures have been employed. Here, the focus is on conclusions drawn from studies that have used affective pictures, particularly those that have employed stimuli from the International Affective Picture System (IAPS). The International Affective Picture System was constructed to provide a set of normative emotional stimuli for experimental investigations of emotion and attention. The IAPS consists of a large set of standardized, emotionally evocative, and internationally accessible, colour photographs whose contents cover a wide range of semantic categories (Lang, Bradley & Cuthbert, 1997). The images have been rated regarding the arousal they stimulate (low-to-high) and valence (unpleasant-to-pleasant). The use of these images allows ERP researchers to have better experimental control, to facilitate the comparison of results and to allow replication of experimental techniques. There is no such standardized set of artworks, nor is there ever likely to be one. A major goal of studies utilising IAPS has been to characterize ERP component modulations related to affective valence and arousal (Olofsson, Nordin, Sequeira & Polich, 2008). Generally, ERPs from affective stimuli are sensitive to both positively and negatively valenced stimuli compared to neutral stimuli, with amplitude modulations in early and late components (Cuthbert et al., 2000; Deplanque et al., 2006; Keil et al., 2002; Schupp et al., 2006; Schupp, Junghöfer, Weike & Hamm, 2004). These effects have been reported both in anticipation of (Polich, 2007a), as well as following the presentation of emotional stimuli (Hajcak & Olvet, 2008), and in passive viewing as well as active response tasks (Cuthbert et al., 2000).

In a comprehensive review of findings from 40 years of ERP studies using affective pictures to elicit emotional processing Olofsson et al., (2008) conclude that more affective content gathers more attention than neutral content, with unpleasant stimuli producing stronger emotional effects than pleasant or neutral. There are differences in the temporal courses of ERP valence and arousal effects, with valence effects appearing relatively early (100-250ms), whilst arousal influences later (200-1000ms) components (Olofsson & Polich, 2007). This suggests that the stimulus' valence activates selective attention, whilst arousal is produced by the motivational qualities of the stimulus, involving attentional resources that contribute to memory encoding (Codispoti, Ferrari & Bradley, 2007; Dolcos & Cabeza, 2002; Schupp et al., 2000). It has also been suggested, however, (Rozenkrants & Polich, 2008) that valence minimally affects ERP amplitude, whilst arousal level is the primary determinant.

Early visual components; P1, N1, P2, N2 and EPN

Early visual ERP components that appear to be sensitive to emotional content include the P1, N1, and P2, which peak between 100 and 200ms following stimulus onset (Carretié, Mercado, Tapia & Hinojosa, 2001; Foti, Hajcak & Dien, 2009; Keil et al., 2002). The P1 and N1 components index early sensory processing in the extrastriate visual cortex. An early ERP latency suggests that emotional images (e.g., IAPS) appear to impact the magnitude of the P1, with unpleasant pictures eliciting larger components than pleasant, both at occipital (Carretié et al., 2004; Delplanque et al., 2004), and frontal sites (Carretié et al., 2007). This suggests that unpleasant pictures have privileged access to attention early in the information-processing stream (Carretié, Mercado, Tapia & Hinojosa, 2001; Delplanque, Lavoie, Hot, Silvert and Sequeria, 2004; Codispoti, Ferrari and Bradley, 2007), and that there is a negativity bias in attention allocation (Smith, Cacioppo, Larsen & Chartrand, 2003). Early encoding of high valence images appears to be associated with a posterior negativity, suggesting initial activation in the visual cortex (Schupp et al, 2003a). On the other hand, Pastor, Bradley, Löw, Versace, Moltó, & Lang, (2008) found that pleasant pictures evoked an early ERP component over occipital and fronto-central sensors. Thus, both an enhanced P1 (Delplanque et al., 2004; Smith et al., 2003), and a reduced P1 in response to emotional images have been reported (Rigoulot et al., 2008). The N1 appears to be sensitive to the emotional content of stimuli being larger for both pleasant and unpleasant images relative to neutral images (Carretié et al., 2007; Foti et al., 2009; Keil et al., 2002; Weinberg & Hajcak, 2010). A later N1 (176ms) component has been identified as being resistant to habituation for high-arousing unpleasant pictures compared to other stimulus categories (Carretie, Hinojosa & Mercado, 2003), though later studies have not supported this effect (Codispoti, Ferrari & Bradley, 2007; Olofsson & Polich, 2007).

Early ERPs also appear to be influenced by the perceptual features of a picture such as composition, colour and spatial frequency. Bradley, Hamby, Löw and Lang (2007) found that picture composition affected ERPs at around 150ms, with simple figure-ground compositions eliciting less positivity over posterior sensors and less negativity over frontal sensors than more complex scenes. Modulation of the P1 in response to emotional stimuli appears to be more reliable in response to faces rather than the more complex IAPS images, and during categorisation rather than passive viewing (Hajcak, Weinberg, McNamara & Foti, 2012). It has also been found that even very brief presentation of affective pictures (120ms) is sufficient for perceptual processing (Schupp et al., 2004). The oddball paradigm is often used in ERP research. Presentations of sequences of often repeated stimuli are interrupted by infrequent target stimuli to which the subject is asked to respond in some way. The data of interest is that in response to the infrequent target stimuli. Studies employing oddball or categorization tasks have reported a larger P1 for emotional stimuli (Carretié et al., 2004; Delplanque et al., 2004), whilst those involving a passive viewing paradigm have not found an effect on the P1 (Weinberg & Hajcak, 2010). These differences may be due to variation in stimuli or to task differences.

It has been suggested that the P2, peaking approximately 180ms after stimulus onset (Carretié et al., 2004), indexes post perceptual attention (Hajcak et al., 2012). In non-affective research the magnitude of the P2 is enhanced for target stimuli (Luck & Hillyard, 1994), and whilst little is known about the P2, it has shown greater amplitudes in response to emotional stimuli (negative and positive) than neutral stimuli (Carretié et al., 2004) and in response to affective pictures (Carretié, Mercado et al., 2001; Carretié, Hinojosa et al., 2004; Delplanque et al., 2004; Olofsson & Polich, 2007), at anterior and central sites (Carretié, Mercado et al., 2001; Carretié, Hinojosa et al., 2004; Luck & Hillyard, 1994). Processing within the 200-300ms latency indicates early stimulus discrimination and is linked to ‘natural selective attention’ (Dolcos and Cabeza, 2002; Schupp et al., 2000, 2007; Schupp, Markus, Weike & Hamm, 2003a), and also of recognition memory (Van Strien, Langeslay, Strekalova, Gootjes & Franken, 2009).

In this time range (200-300ms) two ERP components overlap, the N2 which manifests itself as a central negativity (Carretié et al., 2004), peaking at 250ms after stimuli presentation, and which appears to index selective attention to specific stimulus features (e.g., colour, shape and form; Codispoti, Ferrari, Junghöfer & Schupp, 2006), and the 'early posterior negativity' (EPN) which has been reported at 200-300ms for arousing compared to neutral stimuli (Dolcos & Cabeza, 2002; Schupp et al., 2003a,b, 2004). Emotional stimuli have been shown to influence the magnitude of the N2, although it is not clear whether this effect is equal for both pleasant and unpleasant stimuli (e.g. Carretié et al., 2004), and the EPN has been associated with increased visual processing of emotional stimuli compared to neutral, presenting as a reduction in positivity for emotional compared to neutral stimuli, (Foti et al., 2009; Schupp et al., 2003a, b; Weinberg & Hajcak, 2010).

P3 and Late Positive Potential (LPP)

P3: In studies dating back over 50 years, emotional compared to neutral images elicit an increased positivity 300-500ms after stimuli presentation (e.g., Lifshitz, 1966, as cited in Hajcak et al., 2012). The late part of the affective ERP (>300ms) is dominated by the P3 wave and the subsequent positive slow wave. The distinguishing feature of P3 wave is its sensitivity to target probability (Luck, 2005): only occurring if the subject is actively engaged in the task of detecting the stimuli; these potentials are often elicited with affective pictures using a variant of the oddball paradigm. This component appears to be sensitive to motivational significance (Hajcak et al., 2012), task relevance, and arousal level (Duncan-Johnson & Donchin, 1977; Polich, 2007a). Whilst there is no universally accepted theory of the P3 wave, the most common view (initially proposed by Donchin, 1981, as cited by Luck & Kappenman, 2012), is that it reflects working memory updating (e.g., Vogel et al., 1998, as cited by Luck & Kappenman, 2012).

There is evidence that the amplitude of the P3 can be influenced by the amount of attention allocated to a stimulus. This is particularly evident in dual-task experiments, which suggest that the P3 amplitude is reduced when subjects are required to vary their attention between tasks (e.g. Mangun & Hillyard, 1990), supporting the hypothesis that the amount of resources available to process the stimulus affects the amplitude of the P3 wave. It is also interesting to note that Cano et al., (2009) found that the P3 amplitude is sensitive to affective picture valence in the absence of differences in stimulus arousal, and that the colour of the stimulus contributes to ERP valence effects. They found that the P3 amplitude was larger for normal colour pictures over frontal areas for positive compared to negative or neutral, but not for black/white or scrambled images.

The P3a and P3b are subcomponents of the P3 which may indicate attentional and initial memory storage events (Delplanque, Silvert, Hot & Sequeira, 2005). The P3a originates from stimulus driven frontal attention mechanisms during task processing, whilst the P3b originates from temporal parietal activity which is associated with attention and subsequent memory (Polich, 2007b). Whilst the P3a appears sensitive to picture valence rather than arousal, to unpleasant pictures as compared to pleasant and neutral pictures (Cano, Class & Polich, 2009), interpreted as a negativity bias related to attentional processing (Hajcak & Olvet, 2008; Delplanque et al., 2006), only the P3b appears sensitive to both arousal and valence, suggesting that arousal **and** valence influence target processing. Higher amplitudes of the P3b components at several posterior sites for both types of emotional pictures (Delplanque et al., 2006) and an enhanced positive slow wave seen over posterior sites suggests perceptual sensitivity to the motivational relevance of the picture (Carretié, Hinojosa & Albert, 2006; Codispoti, Ferrari & Bradley, 2007; Sabatinelli, Lang, Keil & Bradley, 2007; Schupp et al, 2003b, 2007).

LPP (Late Positive Potential): A long lasting increased ERP positivity in response to affective pictures has often been observed (Cuthbert et al., 2000; Foti et al., 2009; Hajcak, Dunning & Foti, 2007; Keil et al., 2002; Mini, Palomba, Angrilli & Bravi, 1996; Moser, Hajcak, Bukay & Simmons, 2006; Schupp et al., 2000; Weinberg & Hajcak, 2010). The 'late positive potential' (LPP), a midline centroparietal ERP, in the 300-1500ms range after stimulus onset (Hajcak et al, 2012), has been reported as being larger following the presentation of both pleasant and unpleasant compared to neutral pictures (Cuthbert et al., 2000; Hajcak, Dunning & Foti, 2007; Hajcak & Olvet, 2008; Schupp et al., 2000, 2003b, 2004) and has been found to demonstrate increased positivity to pictures reported to have greater affective arousal (e.g. erotic or violent content) (Bradley et al., 2007; Cuthbert et al., 2000; Keil et al., 2002; Schupp et al., 2003b, 2007; Pastor et al., 2008), suggesting selective processing of and increased attention to emotional stimuli (Hajcak et al., 2009). This is supported by Lang & Bradley (2010) in a review of studies of emotional processing, which have focussed on motivational circuits in the brain that developed in early evolutionary history. They found that the LPP increases in amplitude in the occipital and parietal brain regions, in response to both pleasant and unpleasant pictures rated as more arousing, suggesting that perceptual processing indicates the intensity of the reason to act, but not how to act, to ensure survival.

A positive effect between the magnitude of the LPP and subjective arousal ratings of emotional stimuli has also been reported (Cuthbert et al., 2000; Schupp et al., 2004, Weinberg & Hajcak, 2010). Ferrari, Codispoti, Cardinale & Bradley (2008) suggest that the LPP reflects the operation of attentional neural circuits that are utilized by both top-down and bottom-up processes and that previous knowledge and expectations may influence the magnitude of the component. This effect is related to the evaluation of the stimuli. When categorising pictures along a non-affective dimension, such as their size, or suppressing emotional responses, ERP positivity for arousing (pleasant/unpleasant) pictures decreased, compared to when participants performed an affective evaluation task (Hajcak, Moser & Simmons, 2006; Moser et al., 2006).

This widely found long lasting ERP positivity to affective pictures suggests that it is associated with memory formation (Cuthbert et al., 2000; Delplanque et al., 2005; Keil et al., 2002; Olofsson & Polich, 2007; Schupp et al., 2000). Dolcos and Cabeza (2002) found that the subsequent memory effects at centro-parietal areas was larger for arousing pictures than for neutral pictures, indicating that emotional information has enhanced access to processing resources, which may result in better memory formation. This has been supported more recently by Tapia, Carretié, Sierra and Mercado, (2008) whose results suggest that implicit memory is biased by valence.

1.3.5 Summary

Both valence and arousal influence ERP amplitudes at several processing stages. Valence effects have most commonly been found at short latencies (100-300ms), they appear to be connected to rapid selection processes, part of the 'negativity bias' framework, however, ERP valence effects are not as consistently found as arousal effects. The positive going waveform from about 200ms until stimulus offset elicited by arousal is consistently obtained, but varies with task relevance. In middle range latencies it has been linked to automatic attention, at longer latencies it has been linked to subsequent memory.

1.4 Overall Summary

The study of aesthetics has historically been linked to emotional responses to art, and particularly to beauty. Neuroaesthetics is an emerging discipline exploring responses in the brain to the perception and appreciation of beauty, harmony and pleasure. A number of frameworks and models have been proposed to link perceptual processes with the cognitive and emotional processes involved in aesthetic appreciation. A multi-discipline approach is considered as it becomes clear how complicated not only the aesthetic process is, but also a broader picture of art appreciation, whether it is beautiful and pleasing, or disgusting and surprising.

Event related potential (ERP) research has provided us with considerable knowledge regarding the time course of the brains responses to affective pictures. It is evident that emotional (unpleasant and pleasant) stimuli impact on early visual processing compared to neutral stimuli and that ERPs are more consistent in response to arousal than to valence, particularly at middle and late latencies.

Whilst these findings regarding the brains responses to affective pictures continue to provide us with knowledge little is known regarding how we respond emotionally to works of art. These findings have been based on a normative set of stimuli, collected for the purposes of exploring arousal and valence responses to affective pictures. Clearly there is no such pool of stimuli available for the study of aesthetics or visual art.

Chapter 2: Art and the brain

2.1 Overview

Despite its limitations neuroscience is beginning to tease apart the relationship between responses to art and/or aesthetic stimuli and cognitive function (e.g. knowledge, experience, emotion and perception). This research has identified several brain regions and event-related potential (ERP) components whose activation correlates with aesthetic experiences. This chapter will review those studies that have a) used images of visual art as stimuli to explore a range of perceptual and affective processes, aesthetics and the judgement of beauty, and expertise, b) those that have used stimuli other than visual art to explore the neural processing of beauty and aesthetics, and c) those that have used images of visual art to explore the impact of **art** on neural processes.

The role of art as stimuli will be briefly considered, particularly that of modern art, and how the lack of traditional aesthetic content affects the study of art and the brain. Finally, the research questions will be outlined.

2.2 The judgement of beauty, and art.

A number of studies have explored the neural correlates of aesthetic judgement and symmetry using stimuli other than visual art. Appendix 1a summarizes these studies in chronological order and lists the methodology, demographic information, the type of stimulus and the basis for the selection of the stimulus, and the primary affect results. Jacobsen (2010) states that the first ERP data reflecting human aesthetic judgement were presented in 2000 (Jacobsen & Höfel, 2001) and that a number of ERP studies over the following decade focussed on symmetry and complexity as two key measures of aesthetic judgement, and spontaneous and intentional processes involved in aesthetic processing (see Jacobsen, 2010 for a review). These studies used a range of novel, monochrome, geometric stimuli, created specifically for the study of evaluative aesthetic judgement, see Figure 7 below.

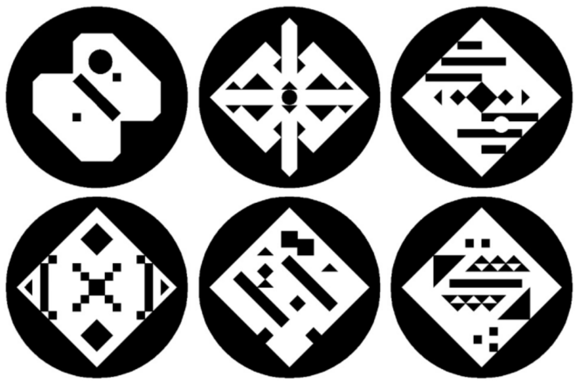


Figure 7. Examples of novel, formal, monochrome, graphic, geometric stimuli, created specifically for the study of evaluative aesthetic judgment (from Höfel & Jacobsen 2007a).

Despite differing results from a number of studies the authors (see Jacobsen, 2010) conclude that the appreciation of beauty is not a spontaneous process but a task induced intentional process that requires attention. This is reflected in an 'early' frontocentral phasic negativity (300-400ms) elicited when judging the stimuli (see Figure 7 above) as not-beautiful but not when judging them as beautiful, and a negative going waveform at parietal and occipital sites after 250ms (Jacobsen & Höfel, 2001, 2003). Kutas and Federmeier (2009) describe a negative-going potential that peaks around 400 ms post-stimulus onset, and is observed between about 250 and 550 ms post stimulus, as the N400. The N400 is typically seen in response to a wide array of meaningful or potentially meaningful stimuli, including visual and auditory words, pictures, environmental sounds, and gestures and appear to be affected by attentional allocation.

Tommaso et al., (2008) suggest that the categorization of the aesthetic qualities of coloured, complex geometric patterns recruits attentional resources. They found that the P3b amplitude, traditionally associated with attentional and working memory operations during cognitive task performance (Polich, 2007a), increased during the categorization of the aesthetic qualities of complex geometric patterns when compared to judging the aesthetic qualities of pictures of art. These results also appear to suggest judgement of

these patterns requires additional attentional resources. Whilst being recognised as having limited scope regarding aesthetic judgement (Jacobsen, 2004), aesthetic judgement of graphic patterns suggests that not only are attentional resources recruited but also the reward systems of the brain (OFC and NAcc) are engaged. fMRi studies (Jacobsen, Schubotz, Höfel & v. Cramm., 2005; Kirk et al., 2009a) have found activation in the orbitofrontal cortex OFC and left nucleus accumbens (NAcc), areas associated with the processing of reward and pleasure.
It must be acknowledged that there are a host of other aspects not found in novel, geometric, monochrome patterns that may affect the aesthetic response. These include form, colour and movement (Cela-Conde et al., 2004), meaning (Cupchik et al., 2009), novelty and interestingness (e.g. Berlyne, 1974), proportion (Di Dio, Macaluso & Rizzolatti, 2007), opposing colours, luminance (Livingstone, 2002; Zeki, 1999) and expertise and experience (Leder et al., 2004). However, it is beyond the scope of this thesis to discuss all of these.

There have been relatively few studies that have explored aesthetics using images of visual art as stimuli. The results of these few studies appear to have little in common, yet provide evidence that affective processes a) play an important role in aesthetic preference, b) integrate with cognitive processes to reach decisions about beauty (Nadal, Munar, Capó, Rossello & Cela-Conde, 2008), and c) support the notion that rating beauty captures the aesthetic experience meaningfully. Appendix 1b summarizes these studies in chronological order and lists the methodology, demographic information, the type of stimulus and the basis for the selection of the stimulus, and the primary affect results. Appendix 1c summarizes brain imaging studies using visual art as stimuli to explore expertise, visual perception, style and content processing, object recognition, recognition memory and reward circuitry. The stimuli in a number of these studies (Appendix 1c) may have been manipulated to fulfil the aims of the research, thus ensuring that they will not be perceived as the artist originally intended, or even as art. The stimuli employed to explore emotional responses to **art** (Appendix 1b) rather than aesthetic preference, proportion or perception, are less likely to have been manipulated or altered from the original, and so are more likely to reflect the true impact of visual art on neural processes. Early studies using visual art as stimuli had previously reported both quantitative changes in the activation of visual cortex and qualitatively distinct networks of brain areas in frontal and limbic areas in response to positive, negative and neutral aesthetic preference to visual art images (Hansen, Brammer & Calvert, 2000). Further exploration of aesthetic preference found that activity was greater in the orbitofrontal cortex for stimuli classified as beautiful and in the motor cortex for those classified as ugly (Kawabata & Zeki, 2004). That activity in the dorsolateral prefrontal cortex was significant in response to stimuli judged as beautiful, compared to non-beautiful, between 400 and 1000ms after stimuli presentation (Cela-Conde et al., 2004). Moreover, different activity in the right caudate nucleus, bilateral occipital gyri, left cingulate sulcus and bilateral fusiform gyrus, in response to increasing or decreasing preference of original, altered or filtered paintings, suggests that these areas are linked to the evaluation of reward based stimuli that vary in emotional valence (Vartanian & Goel 2004a,b). Studies using visual art as stimuli have found a range of neural responses in response to judgements of preference and beauty, but it seems clear that looking at visual art activates the reward-related regions in the brain (Kirk et al., 2009b; Lacey et al., 2011), specifically the left VS (Kirk et al., 2009b), the medial OFC bilaterally (Ishizu & Zeki, 2011; Kawabata & Zeki, 2004; Kirk, 2008; Kirk et al., 2009a, 2009b), and the right amygdala (Di Dio et al., 2007), whereas motor areas are associated with the judgement of ugliness.

Activity in the mOFC during the experience of both artistic and musical beauty has been reported (Ishizu & Zeki, 2011; Kawabata & Zeki, 2004). In a study which used paintings to ask whether there are brain areas that are consistently active when subjects perceive beauty, and, conversely, when they perceive ugliness, Kawabata and Zeki (2004) report activation in the medial OFC bilaterally in response to those paintings classified as beautiful compared to those judged as ugly. The judgement of a painting as beautiful, or not, correlates with specific brain structures associated with specific feelings and emotional states, principally the OFC, known to be engaged during the perception of rewarding stimuli (Bechara, Damasio & Damasio, 2000; Rolls, 2004; Kringelbach & Rolls, 2004), aesthetic judgement (Kirk et al., 2009a), aesthetic beauty and art (Di Dio et al., 2007; Fairhall & Ishai, 2008; Kirk et al., 2009b). However, they did not find separate structures engaged when the stimuli were perceived as beautiful or ugly. Instead, a change in the relative activity of the OFC was found, which correlated with the aesthetic judgement. Beautiful stimuli produced the greatest activity, whilst in the motor cortex ugly stimuli produced the greatest activity. The anterior cingulate and left parietal cortex were both prominent in the contrast of beautiful versus neutral stimuli. The anterior cingulate has been associated with emotion, the activation in this case suggests a connection between emotion and aesthetic judgement. Whilst the parietal cortex is associated with spatial attention, and was activated only in the comparison beautiful versus neutral, this may provide evidence for greater load on the attentional system.

Tommaso et al., (2008) observed an increase in the amplitude of the N2 ERP component during the categorization of neutral rather than beautiful pictures of art. The N2 has been previously associated with an increase in selective attention, and also a response to emotional stimuli (Olofsson & Polich, 2007), although it is not clear whether this effect is equal to both pleasant and unpleasant stimuli (Carretié et al., 2004). This suggests that neutral pictures recruited more attentional resources than beautiful; however, a further simple target/recognition task of the same stimuli resulted in an increase in the P3 amplitude in response to stimuli previously rated as beautiful, suggesting that simply looking at beauty increases arousal. Most interestingly, the experience of art itself, relative to non-art images, has been reported to activate the VS, OFC, and hypothalamus, independent of aesthetic preference (Lacey et al., 2011).

Activation of the OFC has also been found to be moderated by context and by the expertise of the subject (Kirk et. al., 2009a, b). When an artwork is labelled as art (Kirk et. al., 2009b), rather than presented as an interesting image, the aesthetic ratings can be significantly affected, and correlated with activity in the mOFC and PFC. When experts (architects) were asked to make aesthetic judgements the mOFC was recruited differently to non-experts, even in the absence of behavioural differences (Kirk et. al., 2009a). This suggests, as one possibility, the response in this area may be due to expectations about the likely hedonic value of the stimuli (Di Dio,, Canessa, Cappa & Rizzolatti, 2011;

Hagtvedt & Patrick, 2008). However, Lacey et al., (2011) propose that the appeal of visual art is based on artistic status alone, independent of its hedonic value, and that whilst anticipation of intense pleasure has been shown to involve the caudate, the nucleus accumbens has been involved during the experience of peak emotional response (Salimpoor et al., 2011). So, not only does looking at *beautiful* art appear to activate the reward circuitry of the brain, so too does simply *looking at* or even the *expectation* of viewing the art itself, with expertise moderating the response.

Noguchi and Murota (2013) also report neural activity in parietal regions in an investigation into how context affects the appraisal of artworks. The P2 component was larger in response to the genuine condition than in the fake, and to the visual factor (proportion), of pictures of Classical sculptures. It also correlated with the aesthetic rating. This rapid (200-300ms) integration of contextual and visual factors is consistent with the view of Di Dio and Gallese (2009) who define the aesthetic experience as being able to 'perceive-feel-sense' an artwork, rather than as a result of deep contemplation, and is consistent with previous studies showing an involvement of the parietal cortex in the processing of artworks (Cela-Conde et al., 2009; Cupchik et al., 2009; Di Dio et al., 2007; Jacobsen, 2006). It may also reflect strategies associated with visual attention and spatial exploration strategies (Cela-Conde et al., 2009). This is consistent with ERP research with affective pictures (Carretié et al., 2001, 2004; Delplanque et al., 2004; Hajcak et al., 2012; Olofsson & Polich, 2007) which suggests that processing within the 200-300ms latency indicates early stimulus discrimination, is linked to 'natural selective attention' (Dolcos and Cabeza, 2002; Schupp et al., 2000, 2003a, 2007), and also of recognition memory (Van Strien et al., 2009).

Whilst we can draw some conclusions regarding neural processes involved in the aesthetic experience, key questions remain, such as the tension between subjectivity and universality. Some argue that aesthetic evaluation relies on universal principles (Atalay, 2007), others acknowledge that it can be highly subjective, whilst others argue that aesthetic judgements are multi-faceted and multi-dimensional (Huang, Bridge, Kemp & Parker, 2011). It is recognised that there is agreement regarding the aesthetic value of certain objects, scenes or colours, but that this is subject to cultural norms, fashion, education and exposure (e.g., Arnheim, 1974; Vessel, Star & Rubin, 2012). Thus, key questions remain regarding how appropriate it is to use aesthetic judgement, or the judgement of beauty, to study the relation between cognitive and neural responses involved in the aesthetic experience.

To summarize, aesthetic judgement of visual art appears to differentially recruit the areas of the brain associated with reward and attention. Different activation has been observed in response to positive, negative and neutral judgements of beauty, however, beautiful judgements, simply looking at art or even expecting to look at art increases the activity of the VS, mPFC, OFC and amygdala. Aesthetic judgement also appears to reflect visual attention and increase arousal. These processes are affected by the context in which the artwork is experienced. Additionally, the use of aesthetic judgement, or the judgement of beauty remains a thorny topic; there are many influences on and little agreement regarding what is beautiful or what is aesthetically pleasing.

2.3 Perception of art

The brain is continually trying to organise the data it receives, searching for objects, even when they are not there, e.g. seeing faces in the branches of trees, images of Christ on naan bread, or galloping horses in cloud formations. So, what is specific about the perception of art, what differentiates it from the perception of objects, scenes or faces? Is experiencing visual art a cognitive or emotional process or a combination of the two? Behavioural and electrophysiological studies have suggested that object recognition is a rapid process, achieved within a few hundred milliseconds, and that even complex images can be processed in parallel without the need for sequential focal attention (Rousselet, Fabre-Thorpe & Thorpe, 2002). But the process of viewing artworks also involves artistic style. It has been proposed that both style and content are central variables in the processing of representational art (Leder et al., 2004), with the content being of central importance regarding classification and appreciation (Augustin & Leder, 2006). Style is also considered a key aspect that differentiates art perception from other forms of perception (Leder et al., 2004). Augustin, Leder, Hutzler & Carbon (2008) suggest that information acquired during early perceptual processing influences later processing, and that the content-related information in artwork is processed prior to the style of the art. An ERP study (Augustin, DeFranchesi, Fuchs, Carbon & Hutzler, 2011) used an adapted go/no go paradigm to examine the neural time course of two processes, the processing of style and content in art. Employing pictures that systematically varied in style and content (although the artistic style varied, the content was similar, trees, flowers, house, man) they found that the onset of the N200 effect (indexing selective attention) was slightly later in response to the processing of style (224ms), compared to the effect of content (183ms), and suggest that 224ms may be sufficient for people to successfully classify artistic style. These results support the finding that style follows content in the processing of art (Augustin et al., 2008), probably reflecting the optimization of the visual system for object and scene perception rather than the perception of style.

Visual ambiguities are important for art (Gregory, 1998). Our ability to see objects from only a few sketchy lines, to be able to makes assumptions about what is being represented, is crucial. Visual indeterminacy occurs when we view an image, apparently vivid and detailed, but we are unable to recognise the familiar objects suggested, the formal aspects of perception (colour, form and motion) become disassociated from the semantic aspects (association, meaning, memory) (Ishai, Fairhall & Pepperell, 2007). Indeterminate art is neither representational (e.g., a portrait or a landscape) nor abstract (e.g., a Mondrian or Jackson Pollock), it strongly implies natural forms, but resists easy or immediate identification. Ishai et al., (2007) found that in almost a quarter of all cases (24%) participants' reported seeing recognizable images in indeterminate paintings. However, they were significantly slower when perceiving indeterminate images compared to representational paintings, which suggests that they took longer in an attempt to resolve the indeterminacy, performing a visual search, trying to match the ambiguous forms with familiar objects stored in memory.

Recognition memory has been shown to be mediated by a distributed cortical network, where activation can be altered by: a) the visual similarity between familiar and novel pictures (Yago & Ishai, 2006), b) the level of object resolution associated with visual imagery (Fairhall & Ishai, 2008; Cupchik et al., 2009, Wiesmann & Ishai, 2010), or c) the contextual setting of objects (Kirk, 2008). Representational paintings have been found to stimulate brain areas associated with the identification of meaningful objects and the imposition of situational models on pictorial scenes (Cupchik et al., 2009; Yago & Ishai, 2006; Lengger, Fischmeister, Leder & Bauer, 2007; Fairhall & Ishai, 2008), they have been found to stimulate stronger activation than indeterminate and abstract paintings in higher-tier visual areas, and stronger activation than indeterminate in the in the temporoparietal junction, whilst perception of scrambled versions of original paintings has been associated with imagery-related activation in the precuneus and prefrontal cortex (Lengger et al., 2007; Fairhall & Ishai, 2008).

When objects in pictures are viewed in unaccustomed, abnormal settings (such as a cow in a room, or a vase in a landscape) prefrontal areas are significantly more engaged than when objects are viewed in normal contextual settings (Kirk, 2008). These findings suggest that recognition memory matches objects based on their visual similarity to familiar ones (Yago & Ishai, 2006; Kirk, 2008). That when perceiving artworks familiar content is mediated by object recognition, memory recall and mental imagery (Fairhall & Ishai, 2008), and there is increased attentional demand caused by violations of contextual expectations, such as objects in abnormal settings (Kirk, 2008), or the lack of discernible elements in abstract art (Lengger et al., 2007).

So, although object recognition is a rapid process, and whilst the content of artworks is processed faster than the style, viewing artworks requires greater attentional resources, even when viewing representational paintings, suggesting that both cognitive and emotional processes are engaged.

2.4 Preference

With regard to aesthetic preference Tommaso et al., (2008), found that artistic and geometric images classified as beautiful by some participants were classified as ugly by others and vice versa, demonstrating individual variability. That said, others have found generic preferences for symmetry and regularity. Symmetric patterns as opposed to asymmetric (Höfel & Jacobsen, 2007b; Jacobsen & Höfel 2003; Jacobsen et al., 2006) and unmodified classical images as opposed to modified (by having had their proportions changed, Di Dio et al., 2007) and real-body images (Di Dio et al., 2011) have been reported as preferred.

Aesthetic preference, as measured through affect ratings, for different types of art have found little difference between abstract, indeterminate and representational art Ishai et al., 2007). However, the judgement latencies, the length of time taken to make the judgement, for indeterminate paintings were significantly longer than for the other two categories of art. The longer it takes to decide whether a painting contains familiar objects, the more likely this painting is to be subsequently rated as aesthetically affective (Ishai et al., 2007). Moreover, the longer a painting is viewed, the more it is liked (Vartanian & Goel, 2004a). This suggests that the aesthetic affect of paintings is not only independent of semantic meaning, but also independent of the presence or absence of any meaningful content, (Ishai et al., 2007). However, both Vartanian and Goel (2004a) and Di Dio and Gallese (2009) found that representational paintings were preferred more than abstract paintings, which suggests the opposite, that visual preferences are typically driven by the semantic content of the stimuli, and that shared semantic interpretations then lead to shared preferences (Vessel & Rubin, 2010). When no clear semantic content is present in the images, (novel abstract, visually diverse images) visual preferences emerge as highly individual, and when semantic associations are increased (by using real-world scenes), the effect is not to universally increase preference, but instead to increase the degree to which different observers agree in which images are liked or disliked (Vessel & Rubin, 2010).

Solso (2003) describes how there are two aspects to viewing art: hard-wired perception (the synchronicity of eye and brain), and directed perception, (incorporating personal history and knowledge). Both perception and cognition, evolved principally to survive, allow us to interpret art through individual and collective prisms. Whilst neurological processes in humans may be approximately the same in that we may perceive physical images collectively, our personal history and individual experiences affect our visceral responses. Whilst observers may have strong aesthetic reactions to very different sets of images, and are moved by particular images for very different reasons, the ability to be aesthetically moved appears to be universal.

To conclude, there is generally very low agreement regarding aesthetic reaction for visual art, compared to other types of stimuli (e.g., Vessel & Rubin, 2010). We suggest that there may be a number of reasons for this. There is an almost infinite catalogue of artworks, created over thousands of years, involving schools of art, movements, fashions, cultural differences, historical influences, traditions, and so on, from which images have been selected. The nature of art and its immense variety makes it impossible to have a normed set of stimuli, such as the International Affective Picture System (IAPS) from which to select images to include in studies.

2.5 The role of expertise

The appreciation of art is an innate behaviour that is refined by formal training like any other skill. Differences between art experts and non-experts in various aspects of aesthetic preference and judgements (e.g., Furnham & Walker, 2001; Hekkert & van Wieringen, 1996; Smith & Melara, 1990), in methods of processing complexity (Reber, Schwarz & Winkielman, 2004), how they view and perceive pictures (Vogt & Magnussen, 2007) and type of art and emotional appraisal (Silvia, 2006) have been identified. Therefore, a relevant question to consider is, does formal art training impact on the various, complex cognitive, evaluative and affective processes involved in the contemplation of art?

Pang et al., (2012) suggest that contemplating paintings may be simpler for art experts, who, owing to greater efficiency in solving tasks in their particular domain, may rely on more well-mastered and effortless cognitive and perceptual processes. In an ERP study investigating the neural correlates of art expertise Pang et al., (2012) demonstrated that art expertise is associated with reduced ‘higher order’ event-related potential amplitudes (P3b and LPC) under the free viewing of visual art and non-artistic visual stimuli, which can be considered to reflect increased neural efficiency due to extensive practice in the contemplation of art. As such, Pang and colleagues suggest that these findings support the notion that the appreciation of visual art relies on cognitive and neural processes similar to those involved in processing other visual stimuli, and that this contradicts the popular belief that because 'art is special' there should be 'some special brain process' associated with art or aesthetics (Pang et al., 2012).

Structural brain differences have been found between artists and non-artists (Solso, 2001; Chamberlain et al., 2014). This of course, may be due to training, or conversely, the fact that they are artists may be because of the brain differences. However, Karkare, Saha & Bhattacharya (2009) suggest that artistic training is associated with enhancement of brain structures pertaining to visual imagery and in certain aspects of brain activity while performing art-related tasks, such as representational drawing. Bhattacharya and Petsche (2002) found higher EEG phase synchronisation (which may indicate direct communication between different regions of the brain), particularly in the delta and gamma bands in the right hemisphere and in the posterior brain regions, in artists, compared to non-artists, when they were asked to imagine a painting after viewing it. Similar results were reported when artists and non-artists were asked to mentally compose drawings of their own choice (Bhattacharya & Petsche, 2005).

These results are in accordance with the findings of Volke, Dettmar, Richter, Rudolf and Buhss, (2002) in an EEG study exploring chess problems, which revealed that experts as compared to non-experts, exhibited higher EEG synchronisation in general, including higher delta band synchrony in the posterior cortical regions, as well as stronger right hemispheric dominance. Kirk et al., (2009b) also found differences between experts and non-experts during an aesthetic judgement task. They show that brain areas associated with perceptual processing, memory and reward processing are recruited differentially during aesthetic judgement in experts and non-experts, demonstrating that expertise not only modulates cognitive processing, but also the response in reward related brain areas. Interestingly, Silvia (2006) found that whilst art experts find art more interesting and understandable, particularly complex or abstract art, people high and low in art training make the same emotional appraisals of art.

To summarise, whilst art expertise has been associated with structural brain differences, higher phase synchronisation and greater efficiency in cognitive and perceptual processes during art related tasks, it is unclear whether these differences are only evident during these tasks, or are due to enhanced visual processes generally.

2.6 Visual art as stimuli

This section critically reviews the selection and modification procedures employed in the wide range of studies, previously discussed, utilizing visual artworks as stimuli to examine emotional and psychophysiological responses to art. There are number of issues to consider: studies exploring perceptual processes, aesthetic judgement and beauty, for example, have not necessarily honoured the integrity of the original, whereas those exploring the cognitive and emotional affect of art on the brain have been less likely to make any modifications. The selection and source of the images is also discussed. Different styles, periods and mediums of art have been employed. Stimuli have been described simply as famous paintings (Tommaso et al., 2008), as landscape, portrait (Kawabata & Zeki, 2004), and still life's (Ishizu & Zeki, 2011), as 'a range of artistic styles' (Hansen et al., 2000), 'unfamiliar paintings by artists from different schools' (Cela-Conde et al., 2009) or, very different styles of art, selected from a book for guidance (Cela-Conde et al., 2004). Images have been selected from a wide variety of online sources (Kirk et al., 2009b; Vartanian & Goel, 2004a,b), art books and catalogues (Augustin et al., 2011; Cela-Conde et al., 2004, 2009; Lengger et al., 2007). They have been homogenised with regard to size (Kirk et al., 2009b; Vartanian & Goel, 2004a), colour spectrum (Vartanian & Goel, 2004a, Wiesmann & Ishai, 2010), luminosity and light reflection (Wiesmann & Ishai, 2010), or with regard to all of these (Cela-Conde et al., 2004, 2009; Hansen et al., 2000). The content (Vartanian & Goel, 2004a, Augustin et al., 2011) or proportions have been changed (Di Dio et al., 2007, 2011: Noguchi & Moruta, 2013). The resulting images may differ considerably from the original artwork.

Studies which have used visual art as stimuli to explore the effect of art itself on aesthetic preference (Cupchik et al., 2009; Vessel et al., 2012), on perception and mental imagery (Bhattacharya & Petsche, 2002; Karkare et al., 2009), the effect of context on aesthetic judgement (Kirk et al., 2009b), and to explore the brains responses to the artistic status of the images (Lacey et al., 2011), and expertise (Pang et al., 2012) have acknowledged that the status of the stimuli as artworks is imperative, and that the viewer must engage the stimuli as a work of art (Cupchik et al., 2009). Thus, any modifications to the artworks have been minimal, for example the size may have been reduced in order to be able to project the image appropriately. It is acknowledged that original paintings contain all the visual elements that contribute to their aesthetic value and that the processing of stimuli in which the original compositional structure is changed differs from the processing of paintings with 'intact' compositional structure (Pang et al., 2012).

The historical periods the stimuli have been selected for studies ranges from ancient Greek classical art (Di Dio et al., 2007, 2011; Noguchi & Moruta, 2013) to the present day (Fairhall & Ishai, 2008). Schools of art have included Impressionist, Post Impressionist, Renaissance, abstract expressionist, cubist (e.g., Cela-Conde et al., 2004a,b; Di Dio et al., 2007, 2011; Wiesmann & Ishai, 2010), and they have come from a variety of cultural traditions (e.g., European, Western, American, Chinese, Egyptian, Greek, Roman, Indian, Japanese). Representational art, still lives, landscapes and portraits, abstract art and indeterminate art have all been employed. The reasons for this include an attempt to provide a variety of artistic styles to increase choice (e.g., Cela-Conde et al., 2004a,b; Kawabata & Zeki, 2004; Hansen et al., 2000), to control the context ('this is art') that the art was perceived in (Kirk et al., 2009a), to explore the effect of evaluation of semantic content on aesthetic preference (e.g., Vartanian & Goel, 2004a,b), or the impact of object identification on the aesthetic process (Ishai et al., 2007).

There are few studies where researchers have collaborated with art experts in order to identify appropriate stimuli (Fairhall & Ishai, 2008; Lacey et al., 2011; Pang et al., 2012), and they do appear to have a more focused research question regarding the choice of art as stimuli. Fairhall & Ishai (2008) studied the perceptual dilemma in which apparently detailed and vivid images resist identification, using indeterminate paintings by Robert Pepperell, and 2 other classes of paintings, representational and abstract by various artists. Lacey et al., (2011) used images of art selected by an art historian that were chosen as easily recognisable as works of art. Although Pang et al., (2012) do not appear to have collaborated with an art expert regarding their choice of stimuli, they do present a clear rationale for their choice of 50 representational Western professional paintings; original paintings which contain recognisable compositional elements and structure which contribute to their aesthetic value.

A fundamental problem with any research into this area is always going to be the art: the selection, the reproduction and the context may have the potential to affect outcomes. When presenting images of art, be it in a scanner, on a computer screen, or a projection, it is always a reproduction of that piece of work. The scale, the texture, the colours, the luminosity, the whole experience of that work of art is never going to be reproduced. Experiencing the art of Marc Rothko in TATE Modern, the huge, almost floating canvases (see Figure 8), cannot be compared to looking at a reproduction, whether as a postcard, a poster, in a book, or on a computer screen in a lab.

Clearly, it is rarely possible to use original artworks in the study of neural responses to art, so compromises have to be made. Nevertheless, if the purpose of the research is to explore neural responses to art, rather than to perceptual or aesthetic processes, then it is imperative the integrity of the artwork is retained as much as possible. The choice of and source of the artworks should be carefully considered.

Figure 8. Marc Rothko, Untitled, c 1951-52, oil possibly mixed with egg and resins on canvas, 1890 x 1008mm.

2.7 Modern art, aesthetics and beauty

Virtually all the research discussed above exploring aesthetic judgement, aesthetic processing, beauty or neuroaesthetics appears to follow the traditional view, accepted from Plato until Kant and beyond, that beauty be considered the paradigmatic aesthetic quality. Kieran (1997) describes how when we look at that which is beautiful a certain kind of pleasure is experienced, and that it is the contemplation of this beauty that gives rise to the pleasure. There appears to be a common, accepted view that there is a standard of beauty, of what is aesthetically pleasing and what is ugly.

But art has always shocked. It has represented, reproduced, and recreated the violence and horrors of war, the cruelty of man, madness, and grief. It has been obscene, gruesome, hair-raising, disgusting. From Goya's *Disaster of War* suite of engravings to the Chapman brothers remaking of them in Airfix form artists have created a monstrous, horrible, repulsive world. Not only do many artworks involve repulsive emotions, but they may also use disgusting materials. Chris Ofili is famous for painting intrinsically beautiful pictures, with the addition of elephant dung (see Figure 9, *The Holy Virgin Mary*, 1996, below). Andreas Serrano's *Piss Christ* (1987) has a beautiful, golden, luminous light, created by the artists' urine. It has been proposed that the appeal of such works lies not only in the aesthetic value but also in the grotesquery of the image itself (Kieran, 1997). Some may find beauty in these works, others will not.

Whilst aesthetics was the dominant movement in art *until* the twentieth century, modern art *of* the twentieth century has changed both what we think of as art and how we think about art. Picasso started the move away from aesthetics early in the twentieth century, and it has been argued that all various 'isms' of Modern art seem to be departures from the norm of beauty (Collings, 1999). Beauty and loveliness do not appear to be high on the agenda of modern art, in fact 'anti-loveliness' seems to be more the norm. In recent years using words like 'quality' or 'beauty' about art can be interpreted as amateurish enthusiasm rather than knowledgeable connoisseurship (Meecham & Sheldon, 2005). Modern art can be intimidating, challenging, shocking, and impenetrable, it can be jokey and ironical, sometimes rubbish, and sometimes an amazing work of genius. Whilst beauty and loveliness have not disappeared altogether from Modern art, beauty remains respectable (Collings, 1999), the tension between beauty and ugliness, seen in Chris Offili's *The Holy Virgin Mary* (1996), Figure 9 below, or the blandness of Alex Katz's *Winter Branch* (1993), Figure 10 below, is acknowledged, but it is no longer central to the appreciation of art.

Figure 9. Chris Offili, *The Holy Virgin Mary,* 1996, paper collage, oil paint, glitter, polyester resin, map pins and elephant dung on linen.

Figure 10. Alex Katz*, Winter Branch*, 1993, oil paint on hardboard

The focus in this thesis is on Twentieth Century art to investigate emotional and cognitive responses to visual art. Twentieth century art is the period that embraced change and controversy. This was the period which saw art move rapidly from the beautiful ‘biscuit tin’ portraits of Renoir, to Damien Hirsts’ sharks in formaldehyde, from the landscapes of Cezanne to Howard Hodgkin’s’ abstracts. It is beyond the ambition of this thesis to discuss the development of modern art, nevertheless, this was the period that art moved away from aesthetics and realism towards innovation and experimentation with form, abstraction, materials, techniques and processes (Tate, 2016b). It is an excellent period of art to concentrate on to study emotional affect and cognitive responses to art. Without manipulation there are totally abstract images, representational pictures and also art whose content is indeterminate, not quite recognisable. It also provides the opportunity to explore the impact of all these different styles of art. Does abstract art have the same emotional affect as representational? Do experts respond differently to non-experts? Are we honest when we describe the effect art has on us, or is there sometimes a bit of a ‘kings suit of new clothes’ about our responses? As Shimamura (2012) explains, rather than considering the ‘one and only’ aesthetic experience as that overwhelming feeling of beauty there are different kinds of aesthetic experiences which may be more focussed on conceptual and perceptual features. To focus simply on aesthetic responses to art is to limit receptiveness to the power of art. To focus simply on aesthetic judgement of art or on the judgement of beauty is to underestimate the brains' responses to art.

2.8 Overall Summary and aims

The ability to be moved by art appears to be universal. Whilst neurological processes in humans may be approximately the same, we may perceive physical images collectively, it is clear that personal history, individual experiences, cultural and historical changes, fashion, exposure, expectation, context, and even short term perceptual contrast effects affect our aesthetic preferences and visceral responses (our deep feelings, emotional reactions, rather than reason or thought) to art. Despite this there is an emerging picture of brain networks and neural responses which suggest that simply looking at art, or even the expectation of looking at art, activates the reward circuitry of the brain, and that looking at art recruits greater attentional resources than some other visual stimuli. Different types of art and levels of knowledge and expertise have also been shown to affect a widely distributed neural network, including perceptual processes but also emotional and cognitive processes. This picture suggests that looking at and experiencing art involves more than an aesthetic response. Subsequently, not only may Baumgarten's definition of aesthetics inadequate, but the term itself may now be seen as outdated and irrelevant by contemporary artists, art critics and philosophers (Gopnik, 2012; Kelly, 2012). They argue that the focus of neuroaesthetics is too narrow and that we should seek to understand art more broadly (Brown & Dissanayake, 2009; Kelly, 2012).

The present thesis aims to:

- Investigate the effect of modern visual art on visceral and cognitive processes, with the focus on the impact of expertise.
- Initially explore the time course of the visual, visceral, cognitive and emotional responses to modern visual art, including representational, abstract and indeterminate art, in art-experts and non-experts. This will be done using the ERP

technique as it allows precise measurement (millisecond timing) of these processes.

- Examine the impact of context and expertise on the visceral affect, aesthetic response and memory for contemporary art. Contemporary art will be viewed in art galleries, both as original art and as reproductions. This will be done to establish the ecological validity of studying the effect of art on neurocognitive processes using reproductions of art in a laboratory.

Explore the effects of contemplating and imagining art on subjective feelings, mood, and neural mechanisms. This will be done by employing behavioural measures before and after looking at art. Continuous EEG will be recorded during the contemplation of original and reproductions of art and during the imagining of a memorable artwork to explore functional and topographical differences between groups (experts and non-experts) and between contexts (original and reproduced) during the perception and imagery of art.

Chapter 3: Visceral, visual and cognitive processes in response to twentieth century visual art in artists and non-artists. Experiment 1: a Pilot study and an EEG/ERP Study

3.1 Introduction

Art can arouse emotions in many different ways. Great art is as famous for its provocative or shocking content as it is for its beauty and elegance (e.g. Goya's 'Saturn Devouring his Son's', Picasso's 'Guernica', or Duchamp's 'Fountain'). If art is about eliciting an emotional response (Solso, 2003), for making you want to go 'AAAAAARRRGGGHHHH, ha, ha, ha, ha!' (Januszczak, 2008) it is not *necessarily* about beauty but also about shock, disgust and even disinterest. The first pilot study of this thesis aims to identify a range of stimuli with which to explore emotions experienced in response to modern art. These stimuli will then be used to investigate differences in the neurocognitive mechanisms involved in the affective response to three different categories of art; abstract, representational and indeterminate, using a traditional oddball paradigm, and event-related potentials (ERPs). As discussed in Chapter 1 the ERP technique provides a methodology that can directly measure the neural events in response to visual art with high temporal precision; ERPs reflect ongoing brain activity with no delay (Luck, 2012). They can also 'covertly' assess cognitive responses when overt behavioural responses cannot be reliably obtained, or to record disassociations between ERP activity and behavioural responses (Luck, 2012). The oddball paradigm (which is similar to a continuous performance task) is often used in the investigation of ERP components. In this paradigm two classes of stimuli are used, a frequently occurring standard non-target stimulus and an infrequently occurring target 'oddball 'stimulus. The frequency of the stimuli, for example, may be 80% repetitive non-target stimuli, 20% infrequent target stimuli, each presented briefly (e.g., 100-200ms), with the interval in between the onset of each stimulus normally 1000-2000ms. Typically, participants make some sort of manual response to or count the oddball stimuli. When visual stimuli are presented the initial ERP response begins about 50ms post stimuli (Luck, 2012).

ERP studies of emotion, typically using affective pictures as stimuli (see Chapter 1), have identified the 5 components sensitive to emotional content and the time course of emotional processing of the stimuli as P1, N1/N170, P2, N2 and P3 (Hajcak et al., 2012). Often the focus of research has been two emotional components, first the *early posterior negativity* (EPN), a negative potential over the visual cortex in the N2 latency range, and secondly, the *late positive potential* (LPP), a positive potential that usually has the same onset time and scalp distribution as the P3 component, but which may extend over many hundreds of milliseconds (Luck, 2012). Subsequently, the ERP components of interest in this study are the exogenous P1, N1, P2, N2, and the endogenous P3 and LPP. As previously described in Chapter 1, exogenous components are those that are unavoidably triggered by exposure to the stimulus, but which may be modulated by top-down processes, whereas endogenous components reflect neural processes that are entirely task dependent (Luck, 2012). The reasons why these components are of interest in this study are explained below.

P1 component: The P1 is the first positive ERP component and peaks approximately 100ms after stimulus exposure, is influenced by attention and arousal (Hillyard, Vogel & Luck, 1998; Vogel & Luck, 2000) and is sensitive to a number of early visual perception inputs including luminance and contrast (Bradley et al., 2007).

N1/N170 component: The visual N1 is indexed to the allocation of attentional resources, which influence the selection and discrimination of perceptual features such as colour, luminance or motion (Anllo-Vento & Hillyard, 2006; Vogel & Luck, 2000). The N170 is a robust and frequently reported component associated with face processing and recognition research (Rossion & Jacques, 2008), it is also consistent with expertise. An enhanced N170 has been reported in response to dogs, in dog experts, birds, in bird experts, and fingerprints, in fingerprint experts (Busey & Vanderkolk, 2005; Tanaka & Curran, 2001), and perhaps to art, in art experts.

P2 component: Although little is known about the positive going P2 component it is associated with higher level perceptual and attentional processing of visual stimuli (Hajcak et al., 2012; Luck & Hillyard, 1994), and has shown greater amplitudes in response to emotional stimuli and affective pictures, than to neutral (Carretié et al., 2001, 2004; Delplanque et al., 2004; Olofsson & Polich, 2007).

N2/EPN component: The N2 appears to index selective attention to specific stimulus features such as colour, shape and form (Codispoti et al., 2006), and to reflect the actual process of categorizing the stimulus (Luck, 2012). It has previously been explored with regard to the processing of style and content in visual art (Augustin et al., 2011), with the onset of the potential appearing to be slightly later in response to style than to content. Tommaso et al., (2008) report increased amplitude of the N2 in response to neutral rather than to beautiful pictures attributing this effect to the difficulty of discriminating neutral pictures from beautiful. Although it is not clear whether an enhanced early posterior negativity (EPN) is equal for both pleasant and unpleasant stimuli (e.g. Carretié et al., 2004), Luck (2012) reports that it is enhanced for those with a positive valence.

P3 or P300 component: The P3 component is the most common of the endogenous components and has been reported to be sensitive to beauty and aesthetic discrimination of artworks, attributed to increased attention (Tommaso et al., 2008). It is most often observed in the oddball paradigm, with the oddball stimuli eliciting a much larger P3 than standard stimuli. The P3a is associated with executive function and orientation of attention to task *irrelevant* stimuli whereas the P3b is sensitive to task *relevant* probability. The P3b is thought to reflect working memory updating (e.g., Vogel et al., 1998 as cited by Luck & Kappenman, 2012) and the formation of memory representations (Polich, 2007a.

Late Positive Potential (LPP): The late positive potential (LPP) is an emotion-related positive component that typically has the same onset time and scalp distribution as the P3 wave, but it may extend for hundreds of milliseconds and may become more centrally distributed over time. The amplitude of the LPP has been correlated with subjective arousal ratings for stimuli, suggesting that it mirrors subjective emotional experience arousal (Duncan-Johnson & Donchin, 1977; Polich, 2007a), and attention (Hajcak et al., 2012).

Emotional responses to art clearly are not confined to those associated with beauty and loveliness, but also those associated with ugliness or disgust, anger or contempt. Yet previous research with regard to visual art has tended to focus on the neural responses to beauty (e.g. Di Dio et al., 2007; Kawabati & Zeki, 2004; Tomasso et al., 2008), rather than unusual emotions such as confusion or contempt, or surprise or embarrassment (Silvia, 2009). Imaging research has employed variations in aesthetic judgement to isolate neural reactions to aesthetic responses, rather than reactions to particular features of an artwork (e.g., Kawabata & Zeki, 2004; Salimpoor et al., 2011). Most studies have used stimuli that generated wide agreement regarding their beauty, or lack of it (e.g., Kawabata & Zeki, 2004; Tomasso et al., 2008), few have explored variation in the degree of arousal rather than response to beauty and preference (e.g., Vessel at al., 2012) leaving little room for individual aspects of subjective aesthetic experience. Rather than considering the aesthetic experience as that overwhelming feeling of beauty, different kinds of aesthetic experiences may be more focussed on conceptual and perceptual features (Shimamura, 2012), or on emotional responses, both positive and negative (Silvia, 2009). To focus simply on aesthetic responses to art is to limit receptiveness to the power of art. To focus simply on aesthetic judgement of art or on the judgement of beauty is to underestimate the effect of the raw visceral response on the neurological responses to art. In light of this it is the aim of the first EEG study of this thesis to focus on the visceral and emotional responses during the perception of visual art, rather than aesthetics, or simply the judgement of beauty.

Models of aesthetic processing proposed by Chatterjee (2004a) and Leder et al., (2004) posit that the emotional response to art is what distinguishes the aesthetic response from responses to other visual stimuli, and that it involves not only perception but memory, cognitive mastering (measured by the amount of expertise), evaluation and knowledge. Chatterjee (2004a) suggests that the early and intermediate processes are ‘hardwired’ into the brain and are probably universal and that the subsequent emotional response involves widely distributed neural circuitry. The models of Leder et al., (2004), of Chatterjee and Vartanian (2014) and of Silvia (2009) all appear to suggest that it is the evaluation of the stimuli, the interest and attention given to it, which provokes the emotional response. Whereas Leder et al (2004) and Chatterjee (2004a) associate this response with liking and wanting, or pleasure, Silvia's model (2009) acknowledges that modern art may also cause confusion, which may require more attention or effort to determine whether avoidance or withdrawal is required.

Despite extensive research into the neural correlates of the effect of expertise in the music and auditory domain (e.g. Bhattacharya & Petsche, 2005; Koelsch, Schmidt & Kansok, 2000; Mikutta, Maissen, Altorfer, Strik & Koenig, 2014; Tervaniem et al., 2009; Williamson & Egner, 2004), there has been relatively little research into the effect of expertise on visual perception of art. The limited research that does exist has revealed differences in brain activity, specifically in the reward related areas, whilst performing art-related tasks (Bhattacharya & Petsche, 2002; Solso, 2001), whilst making aesthetic judgements (Kirk et al., 2009b), and during the contemplation of art (Pang et al., 2012). A relevant question to consider, therefore, is whether formal art training impacts on the various, complex cognitive, evaluative and affective processes involved in the contemplation of art. Whilst previous ERP research suggests that artists should demonstrate an enhanced P3 in response to arousing artworks due to their increased attention to and memory for art, Pang et al., (2012) propose the opposite, expertise reduces the response due to increased neural efficiency. As such, it will be interesting to explore the effect of expertise on visceral responses to modern art.

As previously discussed (in Chapter 2) the twentieth century was a period of radical change in art. Art moved away from aesthetics and realism and embraced impressionism, fauvism, cubism, abstraction, expressionism, abstract expressionism, minimalism, photo-realism, and many other 'isms'. Art did not abandon beauty altogether but moved towards an opinion that beauty was no longer the norm, that blandness, horror, revulsion were equally acceptable. It is a period of art that embraced controversy, changed how we think about art, and what we think of as art. Twentieth century art provides artworks ranging from biscuit tin sweetness to stomach churning revulsion with which to explore visual, emotional and cognitive responses to art. Twentieth century art was and remains controversial, responses to this period of art are not simply about beauty and loveliness, but must include negative emotions such as confusion or disgust. It also provides us with a great range of stimuli with which to study perceptual, emotional and cognitive processes in response to art. Without any manipulation there are totally abstract images, recognisably representational and also art whose content is indeterminate, not quite recognisable

Ishai et al., (2007) classified art into three categories, Representational Art (RA), Indeterminate Art (IA) and Abstract Art (AA) and tested whether viewers perceived recognizable objects in these three types of art, in order to assess to what extent judgement of affect depended on the recognition of content in the paintings. Indeterminate art, in which objects are ephemeral, invokes a perceptual conundrum, the viewer apparently sees detailed and vivid images, but they remain unrecognised. They evoke an unusual state of awareness; formal aspects of perception (colour, shape, motion) become dissociated from the semantic aspects. Representational or figurative art, on the other hand, represents reality in a straightforward way, it retains strong references to the real world, yet artists seek to provide the viewer with more than a view into reality, they intend to evoke subjective reactions to the stylistic and structural properties of their work. In contrast, abstract art depicts neither natural forms nor objects, but uses line, colour and shape to evoke emotional and aesthetic responses.

Ishai et al., (2007) propose that indeterminate artworks, a category of art that is neither representational nor abstract, comprise a rich set of stimuli with which the neural correlates of visual perception can be investigated. Using representational art as stimuli to explore the emotional affect of visual art may mean that it is difficult to differentiate between emotions evoked by the subject matter, the content of the painting (i.e. faces, birds, dogs or even fingerprints), or whether it is because of how the content has been interpreted by the artist, or the viewer. Earlier studies have removed objects from representational artworks (Augustin et al., 2011; Vartanian & Goel, 2004a), but this obviously changes the whole meaning, the intention of the work. As such, comparing the emotional affect of representational art directly with abstract art, art that has no recognisable subject matter, creates difficulties in interpretation. The effect reported may be as a result of object perception, rather than the affect of the art. Whilst perception and memory for visual art depends on semantic aspects, affect depends on formal visual features, regardless of the nature of the paintings or their colour (Ishai et al., 2007). By comparing the responses to these 3 different types of art we hope to be able to differentiate those responses influenced by semantic content as opposed to other visual features of the artworks, with differences in ERP amplitude being most extreme between RA and AA in the non-expert group.

The findings of a number of behavioural studies investigating preference for different styles and schools of art (see Chapter 2) reveal that there is little consensus. Whilst representational paintings have been found to be preferred to abstract (Di Dio & Gallese, 2009; Vartanian & Goel, 2004; Wypijewski, 1997), suggesting that semantic content drives preference, when art has been created specifically to please the greatest number of people, in response to their aesthetic taste and preference, the results are not always pleasing. *America's Most Wanted* and *America's Least Wanted* paintings, created in 1990's by Komar and Melamid, demonstrate that what people say they prefer may not be what they do actually prefer. When they created artworks in response to preference questionnaires, the resulting pictures were not universally liked, or disliked, but were seen as a satirical comment on society that had, perhaps, too much faith in numbers. See Figures 11 and 12 below.

Although little difference in aesthetic preference between abstract, indeterminate and representational art has been reported, the longer a painting is looked at the more likely it is subsequently rated as aesthetically affective (Ishai et al., 2007) and the more it is liked (Vartanian & Goel, 2004). The findings of a number of behavioural studies investigating preference for different styles and schools of art (see Chapter 2) also reveal little consensus. Nevertheless, whilst preference appears to be highly individual, and independent of the presence or absence of any meaningful content (Vessel & Rubin, 2010), the ability to be moved by art appears to be a universal trait (Solso, 2003).

Figure 11. *America's Most Wanted Painting*, Komar & Melamid, 1990's

Figure 12. *America's least Wanted Painting*, Komar & Melamid, 1990's

The objective of the first empirical EEG study of this thesis is to identify the neurocognitive mechanisms involved in the early perceptual and affective responses to twentieth century art in artists and non-artists.

Subsequently, this experiment was conducted with four aims in mind.

- To examine how the affective response to visual art impacts on emotion/arousal and behavioural measures of cognitive performance, in both artists and non-artists, using EEG.
- To examine the moderating effects of category of art (abstract, representational, indeterminate) on the above mentioned measurements.
- To examine both endogenous and exogenous ERP components elicited by an oddball paradigm to investigate the perceptual and emotion/arousal affect of twentieth century art.
- To examine the moderating effects of expertise on the above mentioned points.

It was decided to investigate both endogenous (early, dependent on external factors) and exogenous (later, dependent on internal psychological factors) perceptual and emotional responses to twentieth century art, in experts (artists) and non-experts (non-artists), employing EEG. The ERP components, P1, N1, P2, N2, P3 and LPP were the components of interest, elicited in response to the three different categories of modern twentieth century art, AA, RA, and IA.

It was expected that:

- Expertise would influence the rating of affect of the different categories of art; artists would more frequently rate all artworks as having high affect than non-artists, but particularly in response to abstract art.
- Both groups would demonstrate greater ERP amplitude in response to representational and indeterminate art than to abstract due to the actual or perceived semantic content.

- In contrast to Pang et al., (2012) in response to all three categories of art the artists would show larger ERP magnitude than the non-artists, with a more pronounced difference between the groups in response to abstract art, due to their increased interest and expertise.
- The artists would show greater magnitude in the early ERP components than the non-artists at occipito-parietal sites (P1 and P2), and at frontal sites (N1 and N2), in response to all 3 stimuli, indexing increased attentional resources, with a larger P3 and LPP at centro-parietal sites, indexing greater emotional arousal.
- Further, these processes would be most pronounced in response to representational art due to its recognisable compositional elements and structure, with the differences between the two groups (artists and non-artists) being most extreme in response to abstract art.

3.2 Pilot Study

3.2.1 Introduction

A pilot study was conducted to identify appropriate stimuli for the ERP experiment. In order to explore the endogenous and exogenous, visual, emotional and cognitive processes in response to modern art a range of representational, abstract and indeterminate artworks from twentieth century art were required.

The speed with which subjects would identify the class of painting was also of particular interest. Different response times can be seen as an indication that the artworks are categorised correctly. When compared with representational paintings subjects take longer to recognize familiar objects in indeterminate and abstract art works (Ishai et al., 2007; Fairhall & Ishai, 2008). This suggests an automatic recognition of objects when they are explicitly depicted, but more effortful cognitive processes when they are not. We hypothesized that subjects would rapidly identify that there was no recognisable content in AA, but would take longer to recognize content and differences between RA and IA.

It was important for the purposes of the ERP experiment that we chose stimuli that were a) recognised as fine art, b) were the work of internationally recognised artists, c) were from the twentieth century (modern and contemporary art), d) the images selected were high quality reproductions, and finally, e) no manipulation or modification, other than size was required.

3.2.2 Method

Participants

43 participants (35 female, 81.4%) with ages ranging from 18-65 years (mean 25.26, SD 10.59) took part in the pilot. 23 were from a convenience sample, 20 were psychology undergraduates who participated for course credits. 6 participants reported further education or expertise in art or design, 6 had visited an art gallery more than 4 times in the previous 12 months, whilst 37 had not visited an art gallery at all in the last 12 months. All reported that they had normal or corrected -to -normal vision. Written informed

consent was obtained from all volunteers after explanation of the projects rationale. Ethical approval was obtained from the School of Life Sciences Ethics committee at Northumbria University.

Stimuli

The artworks selected as stimuli were all by artists from 'The Times Top 200 Artists of the Twentieth Century to Now', a poll run in conjunction with the Saatchi Gallery to discover who the was considered the greatest artists working since 1900, published online in June 2009 (www.thetimes.co.uk/tto/arts/visualarts/article2423361.ece.). 800 artists were originally suggested and over 1 million readers (of The Times) and visitors (to the Saatchi Gallery) nominated their favourite artist from that list, resulting in a final list of 200 of the most influential painters, sculptors, photographers, video and installation artists of the period. Artists from this poll were used in an attempt to both eliminate the effect of personal bias and to ensure a wide a range of artists, styles, schools of art, subject matter and medium. Consequently, 33 of the artists on the list were not included for two main reasons; i) they are sculptors, ii) there is no work accessible in national collections. The artworks chosen are by the remaining 167 internationally recognised twentieth century artists on the list, whose styles range from representational portraits of Lucien Freud, to abstract expressionism of Jackson Pollock or the strange world of Francis Bacon (see Figure 13). To attempt to avoid potentially offending or upsetting any participants' images that depicted *extreme* violence or horror or which contained *strong* religious or sexually explicit imagery were also avoided. All works selected were 2-dimensional images to ensure accurate reproduction on the computer screen. Paintings, drawings, mixed media and photographs, portraits, animals, landscapes, abstract shapes and forms were all included.

High quality jpeg files of the pictures were downloaded from the online collections of the National Galleries of England and Scotland, Museum of Modern Art (MoMA), Tate, or by kind permission of the artist (David Hockney, Inc.). This ensured that not only the highest quality possible of images of the artworks was obtained, but also that they were acknowledged as representative of the artist and worthy of belonging in a national collection.

In order to be able to reproduce the artworks on a computer screen the pictures were resized to fit within a 730x730 pixel format, with a resolution of 96 dpi (dots per inch). Whilst this resulted in changes to the scale of the images (the scale of the originals ranged from 303 x 378 mm, to 3136 x 2254 mm), this was the only adjustment made in an effort to retain the integrity of the image. No changes were made to the original colour or luminance. Graphic manipulation of the stimuli was done using Paint.NET v3.5.8. All stimuli were presented in the centre of the screen on a white background.

466 artworks were selected. Of these 450 were used as task stimuli with the aim of identifying 300 to be used in the experiment, 7 were used as examples and 9 were used as practice stimuli. The complete catalogue of stimuli, examples and practice stimuli is listed in Appendix 2a, b and c.

Each target stimuli was followed by a rating screen, with a scale of 1 to 9, with 1= Definitely Representational, 5= Definitely Indeterminate and 9= Definitely Abstract.

Materials and Apparatus

Demographics: A short questionnaire to gather demographic information regarding age, gender, education and art education, any visual impairment and average annual number of visits to art galleries (Appendix 3).

Familiarisation and task: The task was conducted in 6 blocks. The first was a 9-trial familiarisation block using artworks not presented during the main task (see Appendix 2c). Each picture was presented for 3000ms, displayed on a black screen. A rating screen presented for up to 3000ms immediately followed each picture. The rating screen disappeared as soon as the participant responded. Only when the participant had rated the previous picture was the next picture presented. Each experimental block contained 90 art stimuli and 90 rating screens. All stimuli were presented randomly and each block presented randomly to each participant.

Testing took place in a quiet room at a variety of locations. The task was presented on an Acer Travelmate 2700 computer, with a 15.4 in. screen. It was programmed using Visual Basic v6.

Procedure

After written consent was obtained a short demographic questionnaire was completed. Participants were seated on a comfortable chair with the laptop computer on a table at a comfortable distance from them. The task was completed with no breaks. They were told that the study was about 3 categories of visual art; representational, abstract, and indeterminate. They were then given a definition of each of these categories and 3 example pictures for each definition (Appendix 2b). The definitions were:

> *Representational art:* 'represents reality in a straightforward way, retains strong references to the real world' (TATE, 2010).
> *Abstract art:* 'simplified forms, not related to anything' (TATE, 2010).
> *Indeterminate art*: 'highly suggestive of forms but not exactly descriptive of them' (Fairhall and Ishai, 2008).

They were then told that they were going to see a lot of pictures of art, each one of which they were required to make their own judgement regarding which category they thought they belonged in, using a visual analogue scale of 1-9. Immediately after each picture presentation the rating scale appeared with 1= Definitely Representational, 5= Definitely Indeterminate and 9= Definitely Abstract. They were asked to use all the numbers on the scale and if they were unsure which category the artwork belonged to they should choose a number in between two categories. They were instructed to try to make their decision as quickly as possible, but it was not a reaction time test.

On completion of the task participants were thanked and given the opportunity to ask any questions. Finally, they were given a debrief sheet. Total time of the experiment was about 1 hour.

 Mark Rothko, *Light Red over Black*, 1957, oil on canvas, TATE	 August Renoir, *Peaches and Almonds*, 1901, oil on canvas, TATE	 Henry Moore, *Tube Shelter Perspective: The Liverpool Street Extension*, 1941, gouache and ink, TATE
 Jackson Pollock, *Yellow Islands*, 1952, oil on canvas, TATE	 Edward Hopper, *Gas*, 1940, oil on canvas, MoMA	 Francis Bacon, *Study of a Dog*, 1952, oil on canvas, TATE
 Anish Kapoor, *Untitled*, 1987, gouache on paper, TATE	 Lucien Freud, *Francis Bacon*, 1952, oil on canvas, TATE	 Peter Doig, *Ski Jacket*, 1994, oil on canvas, TATE

Figure 13. Examples of artworks by 9 different artists selected from 'The Times Top 200 Artists of the Twentieth Century to Now', and the online collections from which the reproductions were selected.

3.2.3 Results

The mean rating for each picture was calculated. The 100 pictures with the lowest rating (range 1.02 - 2.88) were categorised as Representational Art (RA), the 100 with the highest rating (range 7.91 – 8.84) were categorised as Abstract Art (AA), whilst the 100 pictures rated in the middle of the scale (range 4.49 – 6.56) were categorised as Indeterminate Art (IA). The remaining 150 pictures were excluded from further analysis.

Table 2 (below), shows the mean rating of the category of art score (and SD) and the response latency (and SD) for the 100 pictures selected for each of the 3 categories of art (AA, RA and IA). This data tells us that the mean rating for art categorised as abstract was 8.4, for representational art the mean rating was 2.11 and the mean rating was 5.5 for indeterminate art. The response latency was faster during the categorisation of abstract art (990ms) and longest for indeterminate (1360ms), with the decision regarding representational art taking 1080ms.

Table 2. Ratings of category of art and response times (Mean and SD) of the 100 pictures selected for each of the 3 categories of art, Abstract Art (AA), Representational Art (RA) and Indeterminate Art (IA).

	Rating	**Response Latency (ms)**
Abstract Art (AA)	8.4 (0.25)	990 (0.23)
Representational Art (RA)	2.11 (0.55)	1080 (0.22)
Indeterminate Art (IA)	5.5 (0.6)	1360 (0.21)

Initial analyses of covariance were carried out on the data to investigate the moderating effects of age, gender, years of art education, and number of gallery visits. However, as none were significant ($p > .05$) they are not discussed further. Post hoc analyses were conducted using the Bonferroni procedure with a significance level of $p < .05$ unless otherwise stated. Where the data failed the sphericity test ($p < .05$) the Greenhouse-Geisser test was substituted.

A One Way Within Subjects ANOVA was carried out to compare the effect of the category of art (AA, RA, IA) on the mean response latency. This analysis revealed that the category of art had a significant effect on the mean response latency, ($F(2,41) = 38.53$, $p<.001$, $\eta^2p= .65$). Pairwise comparisons using the Bonferroni procedure, revealed overall significant differences in the mean response latency between all categories of art. The time taken to categorise AA was significantly faster than that taken to categorise RA or IA, and the time taken to categorise IA was significantly longer than for RA (AA<RA, $p<.001$; AA<IA, $p<.001$; RA<IA, $p<.001$).

3.2.4 Discussion

This pilot study was conducted to identify a range of stimuli for the first EEG/ERP experiment. The aim was to select 300 images of modern artworks from national and international collections, by artists recognised as some of the Top 200 Artists of the twentieth century, which could be categorised as Representational, Indeterminate or Abstract. To support the mean categorisation rating of the artworks the mean response latency was also of interest, with the latency for art categorised as abstract expected to be shortest, and that for indeterminate art the longest.

The result is a set of two-dimensional artworks of various media and subject matter, which have been categorised as Representational, Indeterminate or Abstract, with 100 images in each category. That these stimuli sets represent the different categories of art is supported by the time taken to identify the appropriate category. There were significant differences in the time taken between all three categories of art. Artworks categorised as IA had significantly longer response latency than both RA and AA, supporting previous findings. Ishai et al., (2007) suggest that the increased time taken to recognise familiar objects, whether ambiguous or suggestive or when easily recognised, indicates more effortful cognitive processes are employed, whilst Augustin et al., (2011) found that the content of the art was processed faster than the style. In this case the processing of AA was faster than for either RA or IA because the lack of recognisable objects or content was swiftly perceived, whereas the processing of RA was faster than IA because familiar objects and content were more easily recognised than in IA, which required more cognitive processing than either of the other two types of art, due to the indeterminancy of the images.

3.3 EEG/ERP Study

3.3.1 Method

Design

A mixed model design, 2x3x3 factor, target/standard/novel oddball task was used. The between subject factor was group (artists and non-artists). The within-subjects factors were stimulus type (3 levels, target/standard/novel) and category of art (3 categories, AA/RA/IA). Measurements of rating of affect and reaction time taken by the participant to make an affect rating were taken. Measurement of reaction time was measured in milliseconds (ms) from stimulus onset to button press response. The mean frequency of pictures rated for low and high affect judgements was calculated separately. Low affect was categorised as those with a rating of 1-3, whilst high affect was categorised as having a rating of 5-7. Those with a rating of 4 were excluded from further analysis.

For data reduction purposes and to address the research questions (to identify the neurocognitive mechanisms involved in the early perceptual and affective responses to three categories of twentieth century art in artists and non-artists) outlined above (section 3.1), the primary focus was the search for main and interaction effects for the factors of group and stimulus type.

Participants

A total of thirty-six participants took part in the study. Nineteen were non-artists (5 males). Seventeen were artists (5 males). Artists were classified as such if they identified themselves as a visual artist, had more than 3 years higher education in Fine Art, and were working in the visual art domain at the time of the study, e.g. as an artist, art historian, curator, advisor. Any potential participants who identified themselves as visual artists, but did not meet the other criteria were excluded from taking any further part in the study. Similarly, those who met the criteria for an artist, but did not identify themselves as such were also excluded. Artists reported visiting art galleries more than 6 times per annum, whereas non-artists reported fewer than 3 visits per annum. All were recruited from the Universities of Northumbria and Newcastle staff and undergraduate or graduate populations. Artists were also recruited from artist networks. All were right handed, fluent English speakers and reported normal or corrected to normal vision and no history of neurological damage. All were fluent English speakers. All participants gave informed written consent. Ethical approval was obtained from the School of Life Sciences Ethics committee at Northumbria University. Participants were paid (£10) or were given course credits for their participation. Further participant information is given in Table 5.

Stimuli

The target stimuli were 300 pictures of visual art representing three classes of art (see Figure 14 below), Abstract Art (AA, n.100), Representational Art (RA, n.100), and Indeterminate Art (IA, n. 100). Stimuli were selected on the basis of a previous pilot study (see above). The pictures were resized to fit within a 730x730 pixel format, with a resolution of 96 dpi (dots per inch), without changing the original proportions. The non-target frequent (FSS) stimulus (n. 1800) was a green square and the non-target rare (RSS) stimulus (n. 300) was a red circle. The size of both non-target stimuli was 397 x 397 mm, 150 x 150 pixels. Each stimulus was preceded by a black centred fixation cross. All stimuli were presented in the centre of the screen on a white background. Each target stimuli was followed by an affect rating screen, with a scale of 1 to 7, with 1= no affect at all and 7= lots of affect.

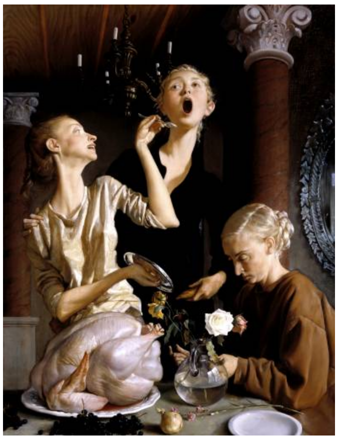
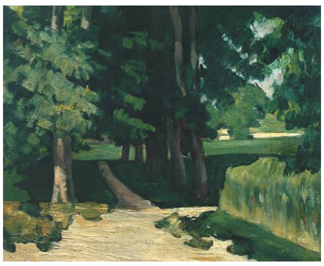
Abstract Art	Representational Art	Indeterminate Art
		
		
		

Figure 14. Examples of the three categories of art; Abstract Art (AA), Representational Art (RA) and Indeterminate Art (IA).

Materials

National Adult Reading Test (NART): This is a brief vocabulary test usually used as a measure of premorbid intellectual ability, but which also provides a valid estimate of WAIS IQ (Weschler Adult Intelligence Scale ; Crawford, Parker, Stewart, Besson & De Lacey, 1989). Participants read 50 short words with irregular pronunciation out loud and were given a point for each word pronounced correctly, according to Collins English Dictionary conventions (Coltheart, Patterson & Marshall, 1987).

Toronto Alexithymia Scale (TAS-20): This is a widely used 20-item, self-report instrument, with a 5-point Likert rating format. It is often used as a measure of alexithymia, or emotional intelligence (Parker, Taylor & Bagby, 2001). The TAS- 20 consists of three factors: difficulty identifying feelings (Factor 1), difficulty describing feelings (Factor 2), and externally-oriented thinking (Factor 3) (Parker, Taylor & Bagby, 2001).

These instruments were administered to indicate general and emotional intelligence levels (Appendices 4 and 5, respectively).

Familiarisation and oddball task: The task was conducted in 5 blocks. The first was a 9 trial familiarisation block, followed by 4 experimental oddball blocks. See Figure 15 below for a reproduction of the experimental paradigm. After each block there was an opportunity for a break. Each experimental block contained 75 art stimuli, 75 rating screens, 75 rare simple stimuli; red circles (RSS), and 450 frequent simple stimuli; green squares (FSS). All stimuli were presented randomly, and each block was presented randomly to each participant. Before each stimulus a fixation cross appeared for 500ms; the non-target frequent stimuli (green square) were presented for 500ms, the non-target rare stimuli (red circle) were presented for 750ms and the target stimuli (art) were presented for between 1200 -1500ms. A rating screen presented for up to 3000ms followed each target stimulus. The rating screen disappeared as soon as the participant responded. The choice of presentation time of the target stimuli, the art, of between 1200 and 1500ms, and 3000ms for the response screen, was based on the mean response times for classification of categories of art in the Pilot Study (990-1360ms). The probability of the target/rare stimuli to the frequent stimuli was 12.5% :- 75% (see Tommaso et al., 2008 for a similar approach). Each stimulus was preceded by a black centred fixation cross. Each target stimuli was followed by an affect rating screen, with a scale of 1 to 7, with 1= no affect and 7= lots of affect.

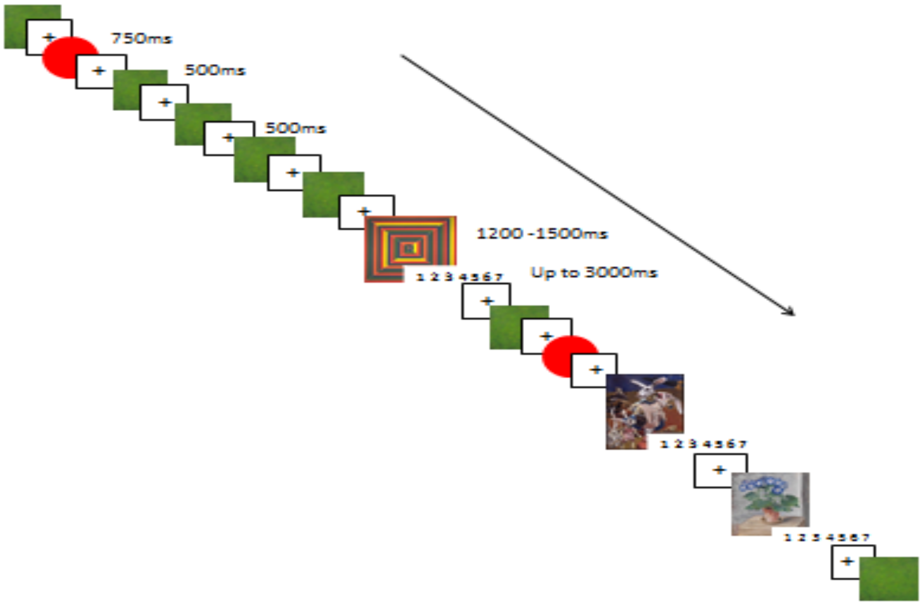


Figure 15. A reproduction of the experimental paradigm, showing the succession of target (1200-1500 ms), frequent (500ms) and rare (750ms) non-target stimuli, and fixation cross (500ms). After each target stimuli the rating screen appeared for up to 3000ms, during which time participants had to give the target stimuli a visceral affective rating (from 1 to 7).

Apparatus

Testing took place in the EEG lab at Northumbria University. The oddball task was presented using E-Prime™ presentation software (E-Prime 2.0, Psychology Software Tools) on a Windows desktop PC, 17 1/2-inch colour monitor. EEG was recorded using the ActiView acquisition programme and the Biosemi Active Two, multi channel, high-resolution measurement system (Biosemi, Amsterdam, Netherlands). BDF file-format conversion to Neuroscan CNT file-format was converted using Polyrex (Kayser, 2003). ERP averaging was carried out off-line using Neuroscan SCAN 4.3 software (Compumedics, El Paso, TX).

EEG/ERP recording and data reduction

EEGs were recorded from 32 electrodes mounted on an elastic electrode cap (Biosemi, Amsterdam, Netherlands) based on the extended international 10-20 system (Jasper, 1958). The montage included 4 midline sites (Fz, Cz, Pz, Oz), 14 sites over the left hemisphere (FP1, AF3, F3, F7, FC1, FC5, C3, T7, CP1, CP5, P3, P7, PO3, O1), and 14 sites over the right hemisphere (FP2, AF4, F4, F8, FC2, FC6, C4, T8, CP2, CP6, P4, P8, PO4, O2), see Figure 16 below. All EEG recordings were referenced to linked mastoid processes, reference electrodes were placed on the left and right mastoid. To assess eye blink movement, electrodes were placed above and below the right eye to record the vertical electrooculogram (EOG). All signals were digitized at a rate of 2048 Hz, with a recording epoch of -200 ms to 1400ms and bandpass filtered between 0.5 and 30 Hz for offline analysis. Automatic eye blink correction, artifact rejection (values outside the range of −75 μV to +75 μV), and ERP averaging was carried out off-line. Target trials with no behavioural response in the interval of 100 – 1500 ms were excluded.

Prior to data analysis, the data from 6 participants (4 non-artists, 2 artists, all female) were discarded due to technical difficulties during data acquisition. Data from 4 participants (2 non-artists, 1 male, 2 female artists) were discarded because of excessive artefacts found in the EEG data. Therefore the total number of participants included in each of the grand averages for encoding was 13 artists (5 males) and 13 non artists (4 males). After eye-blink correction and removal of trials with artefacts, the remaining trials were used in the analysis of each group's responses to the stimuli. A category for individual participants was rejected for averaging if the number of artefact free trials was less than 16 per stimuli. ERP waveforms were created through averaging EEG data for each of the 5 stimuli, non-target frequent stimuli (FSS), non-target rare stimuli (RSS), abstract art (AA), representational art (RA) and indeterminate art (IA), for each group. See Table 3 for the total (*and mean*) number of artefact free accepted trials analysed for each group; artists and non-artists, and for each stimuli; FSS, RSS, AA, RA and IA. Within target stimulus type, the number of accepted trials *(and mean)* was further subdivided according to level of affect.

Table 3. Total (*and mean*) number of artefact free accepted trials analysed for each group; Artists (A) and Non-Artists (NA) and for each stimuli; Frequent Standard Stimuli (FSS), Rare Standard Stimuli (RSS), Abstract Art (AA), Representational Art (RA) and Indeterminate Art (IA). Within stimulus type, the number of accepted trials *(and mean)* is then further subdivided according to level of affect; low or high affect.

Stimuli	Frequent Standard Stimuli (FSS)	Rare Standard Stimuli (RSS)	Abstract Art (AA)	Representational Art (RA)	Indeterminate Art (IA)
Artists (A)	23309 *(1793)*	3821 *(294)*	1249 *(96)*	1285 *(99)*	1257 *(97)*
Non-Artists (NA)	24930 *(1918)*	4164 *(320)*	1407 *(108)*	1411 *(109)*	1390 *(107)*

Stimuli	Abstract Art (AA)		Representational Art (RA)		Indeterminate Art (AA)	
Level of Affect	*Low Affect*	*High Affect*	*Low Affect*	*High Affect*	*Low Affect*	*High Affect*
Artists (A)	491 *(38)*	513 *(39)*	508 *(39)*	542 *(42)*	411 *(32)*	617 *(47)*
Non-Artists (NA)	775 *(60)*	419 *(32)*	430 *(33)*	667 *(51)*	407 *(31)*	657 *(51)*

ERP analyses were conducted on mean amplitude and latency values for specific sets of electrodes within specific time windows. These narrow time windows were selected by visual inspection of the grand average ERPs in each group and by predefinition from previous studies in the literature on visually evoked ERPS (see Luck, 2005, pg. 34, for a summary of ERP components, and Olofsson et al., 2008 for a review of ERP components elicited in response to affective pictures). Mean amplitude was defined as the average deflection occurring within the selected interval and the mean latency was defined as the time point at which the deflection reached its maximum amplitude. See Table 4 for the time windows selected for the non-target frequent and rare standard stimuli (FSS and RSS) and for the target stimuli (AA, RA, IA). The rationale was that the ERP components elicited in response to passive, non-target FSS and RSS will provide a *baseline* comparison for our investigation of unconscious and conscious components evoked in response to active, target art stimuli (Bennington & Polich, 1999; Huettel & McCarthy, 2004). The oddball procedure was used to minimise habituation effects, to ensure any differences in ERP amplitude and latency were due to differences in target stimuli qualities. To allow for the analysis of both hemisphere and region, 12 electrodes were selected for analysis; F3, Fz, F4, C3, Cz, C4, P3, Pz, P4, O1, Oz and O2, see Figure 16 for a headmap of the selected electrodes.

Table 4. Time windows (in milliseconds) selected for ERP components P1, N1, P2, N2, P3 and LPP in response to non-target frequent and rare stimuli (FSS, RSS), and to target stimuli, abstract, representational and indeterminate art (AA, RA, IA).

Stimuli	P1	N1	P2	N2	P3	LPP
FSS, RSS	100-140ms	130-150ms	150-220ms	150-250ms	250-500ms	
AA, RA, IA	100-180ms	170-220ms	190-330ms	275-350ms	340-590ms	500-1000ms

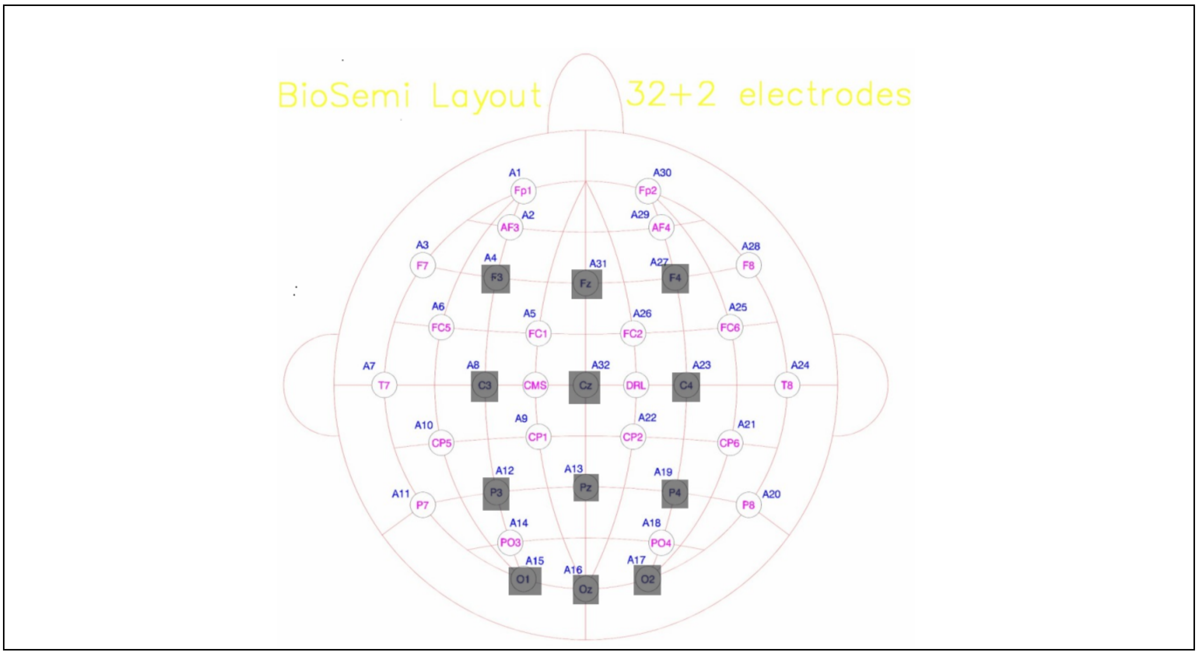


Figure 16. Biosemi cap layout for 32+2 electrodes, with electrodes selected for analysis, F3, Fz, F4, C3, Cz, C4, P3, Pz, P4, O1, Oz and O2 highlighted

Procedure

After written consent was obtained a short questionnaire (Appendix 3) gathering information regarding demographics, handedness, any problems with vision, previous brain injuries, years of further education, years of art education and average number of visits to art galleries per annum, was completed. The NART (Appendix 4) and TAS-20

(Appendix 5) were then administered to identify any differences in general IQ and emotional intelligence between the groups. The electrode cap was fitted following the extended international 10-20 system (Klem, Luders, Jaspers & Elger, 1999). Participants were seated in a comfortable chair in front of the monitor at a distance of 90 cm, with the keyboard directly in front of them. The experimenter then briefed the participant regarding the experiment protocol. Participants were requested to move as little as possible and to try not to chew or blink during the experiment blocks. They were told that they were going to see 3 stimulus on the screen: green squares, red circles and pictures of art. Before each of these stimuli they would see a blank screen with a + in the middle. They were asked to focus on the + in preparation for the next stimuli. After each picture of art there would be a rating screen asking them to rate the picture just seen regarding how much it 'affected' them, on a scale of 1 to 7, with 1 = not at all and 7 = a lot. They were instructed to rate their level of affect regarding how much the picture moved them, either positively or negatively, how much 'WOW' it had. 'Affect' was described as their immediate, visceral, emotional, intuitive response, to the picture, **not** necessarily how beautiful, good, pretty, ugly, colourful, shocking or famous they thought it was. Participants were instructed to use the numbers at the top of the keyboard and to make their decision regarding the level of affect of the picture as quickly as possible.

On completion of the experiment the electrode cap removed and the participant was debriefed. Total EEG recording time was approximately 80 minutes, with 4 self-paced rest periods. The total time in the lab for participants was about 2 hours.

Analysis

For analysis the mean rating of the level of affect for each category of art, abstract art (AA), representational art (RA) and indeterminate art (IA), and the mean response time for the rating of the level of affect for each category of art, for the two groups, non-artists and artists was calculated in a 2 (Group: NA, A) x 3 (Category of art: AA, RA, IA) analysis of variance (ANOVA).

Prior to the analysis of the specific ERP components t –tests were conducted to ensure that the number of trials missed by participants (i.e. when they did not respond, or when the data was rejected due to artefacts) was not significantly different between the groups for each category of art.

Initial ERP analysis was conducted on the ERP components evoked in response to the non-target frequent and rare stimuli. The mean amplitude and latency of each ERP component was analysed in a 2 (Group: NA, A) x 2 (Stimuli: FSS, RSS) x 3 (Hemisphere: Left, Mid line, Right) x 4 (Location: Frontal, Central, Parietal, Occipital) analysis of variance (ANOVA).

For the target art stimuli, the mean amplitude and latency of each ERP component was analysed in a 2 (Group: NA, A) x 3 (Stimuli: AA, RA, IA) x 3 (Hemisphere: Left, Mid line, Right) x 4 (Location: Frontal, Central, Parietal, Occipital) analysis of variance (ANOVA). Initial analyses of covariance were carried out on the data to investigate the moderating effects of age, years of education, and vocabulary ability. Post hoc analyses were Bonferroni corrected to adjust for multiple comparisons, with a significance level of $p < .05$ unless otherwise stated. In instances where the data failed the sphericity test ($p < .05$) the Greenhouse-Geisser test was substituted.

3.3.2 Results

Descriptive Statistics

Table 5shows the participant characteristics for the artist and non-artist groups. Artists were slightly older than non-artists ($t(34) = 2.7$, $p < .05$). On average artists had more years of education than non-artists ($t(34) = 2.94$, $p < .01$) and, unsurprisingly, had more years of higher art education ($t(34) = 16.45$, $p < .001$). Artists also scored higher on the National Adult Reading Test ($t(34) = 2.04$, $p <.05$). There were no significant differences between the two groups regarding the Toronto Alexithymia Scale (TAS-20) ($t(34) = .15$, $p =.88$).

Table 5. Mean (and *SD*) participant characteristics, showing gender, age, years of further education, years of further art education, and National Adult Reading Test and Toronto Alexythimia Scale scores.

	Artists (A) No.17	**Non-Artists (NA) No.19**	t	p
Gender F:M	12:5	14:5		
Age (yrs)	26.6. *(5)*	22.1 *(3.1)*	t(34) = 2.7	p<.05
Education (yrs)	19.1 *(2.5)*	16.6 *(2.4)*	t(34) = 2.94	p<.01
Art education (yrs)	5.6 *(1.4)*	0.1 *(0.7)*	t(34) = 16.45	p<.001
NART	35.8 *(5.3)*	31 *(6.8)*	t(34) = 2.04	p<.05
TAS-20	46.6 *(11.3)*	47.2 (*14.4)*	t(34) = .15	p= .88

Analysis of Rating of Level of Affect and Response Times for each Category of Art.

In order to examine how the affective response to modern visual impacts on the behavioural ratings of affect and response latency for each category of art, abstract art (AA), representational art (RA) and indeterminate art (IA), the first set of analyses was carried out on the mean rating of the level of affect and the mean response latency (ms) for the rating of the level of affect for each category of art, AA, RA, and IA, for the two groups, non-artists and artists (Table 6).

An ANOVA revealed that the category of art had a significant effect on the rating of the mean level of affect, ($F(1.47, 49.95) = 14.49$, $p < .001$, $\eta^2p = .3$). The interaction between the category of art and group indicated that the rating of affect was different between non-artists and artists, ($F(1.47, 49.95) = 5.69$, $p < .05$ $\eta^2p = .14$), with differences evident in response to both AA and RA. Non-artists rated AA as having a lower mean level of affect and RA as having a higher mean level of affect than artists.

Table 6. Mean (and SD) rating of the level of affect and mean response latency (in ms) for rating the level of affect, for 3 categories of art, Abstract Art (AA) Representational Art (RA),Indeterminate Art (IA) and 2 groups Non-Artist (NA) and Artist (A).

	Mean rating of level of affect	**Mean response latency (ms)**
Artists (A)		
Abstract Art (AA)	3.97 *(0.68)*	1128 *(373)*
Representational Art (RA)	4.08 *(0.64)*	1160 *(380)*
Indeterminate Art (IA)	4.35 *(0.76)*	1161 *(381)*
Non-artists (NA)		
Abstract Art (AA)	3.32 *(1.11)*	931 *(329)*
Representational Art (RA)	4.34 *(0.85)*	1056 *(344)*
Indeterminate Art (IA)	4.37 *(0.97)*	1019 *(358)*

.

In order to investigate the interaction, an analysis of simple main effects revealed a significant effect of non-artists, ($F(1.19, 21.34) = 13.32$, $p < .01$, $\eta^2p = .43$) on the mean rating of level of affect. Pairwise comparisons, using the Bonferroni procedure, revealed that there were overall significant differences in the mean rating of the level of affect between AA and both RA and IA (both $p < .01$), but that there were no significant differences in the mean rating of affect between RA and IA. The non-artists rated abstract art as having a significantly lower mean level of affect than either RA or IA.
There was also a significant effect for artists on the mean rating of the level of affect, ($F (1.82, 29.07) = 3.73$, $p < .05$, $\eta^2p = .19$). However, this difference was not reliable as the pairwise comparisons revealed that there were no significant differences in the mean rating of level of affect between the different categories of art in artists. This confirms the pattern seen in Figure 17 showing the interaction with regard to IA.

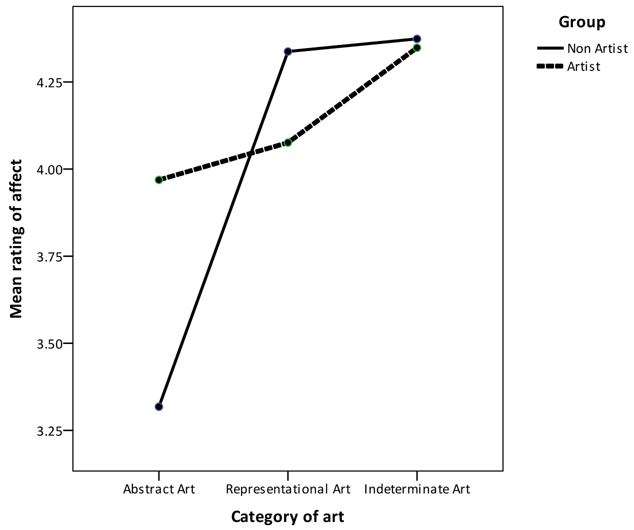


Figure 17. Mean rating of level of affect of 3 categories of art; Abstract Art (AA), Representational Art (RA), Indeterminate Art (IA) and 2 groups; Non-Artist (NA) and Artist (A).

This analysis, however, simply explored the *mean* rating of affect. Of more interest regarding the question of how the affective response to the different categories of modern art impacts on behavioural responses were the extremes of rating of affect, whether the artworks were rated as having a lot of emotional affect, or very little.

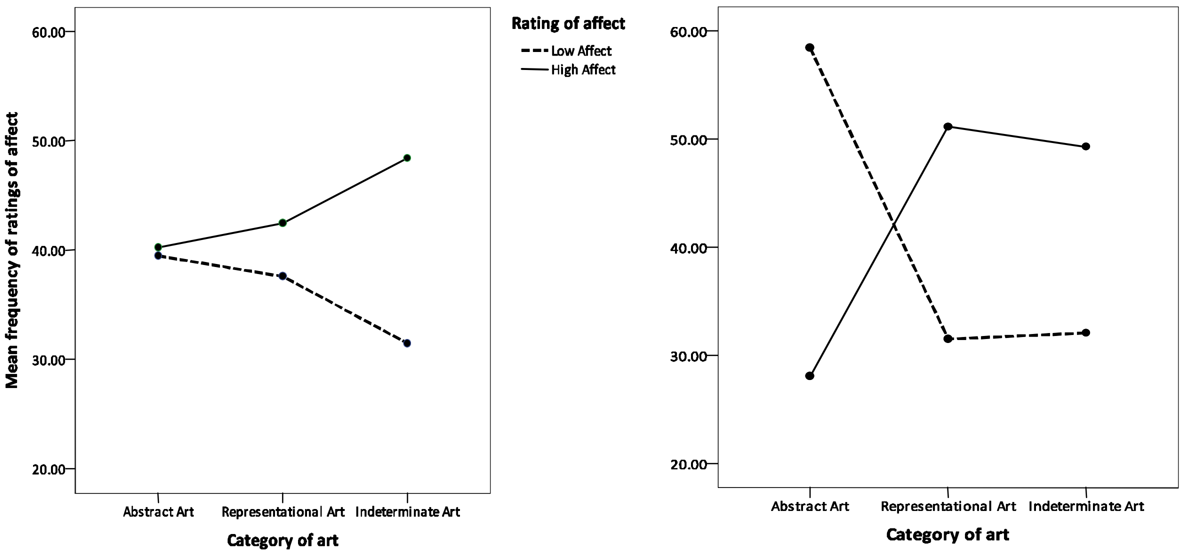
In order to compare these different extremes of affect between each category of art and between the two groups the mean frequency of pictures rated for low and high affect judgements was calculated separately. Low affect was categorised as those with a rating of 1-3, whilst high affect was categorised as having a rating of 5-7. The mean frequency of ratings of low affect and high affect for the different categories of art are shown in Table 7.

Table 7. Mean frequency of ratings (and SD) of low affect and high affect for 3 categories of art (AA, RA, IA) and 2 groups, Non-Artist (NA) and Artist (A).

	Low Affect	**High Affect**
Artists (A)		
Abstract Art (AA)	39.47 *(19.76)*	40.24 *(14.92)*
Representational Art (RA)	37.59 *(15.26)*	42.47 *(16.54)*
Indeterminate Art (IA)	31.47 *(14.41)*	48.41 *(19.7)*
Non-artists(NA)		
Abstract Art (AA)	58.47 *(24.89)*	28.11 *(22.62)*
Representational Art (RA)	31.53 *(20.93)*	51.16 *(21.66)*
Indeterminate Art (IA)	32.11 *(21.54)*	49.35 *(24.31)*

The mean frequency of pictures rated as having either low or high affect was analysed in a 2 (Group; NA, A) x 3 (Category of art: AA, RA, IA) x 2 (Level of affect; LA, HA) analysis of variance. There was a significant interaction between the category of art and the frequency of rating of level of affect, ($F(2, 68) = 14.61$, $p < .001$, $\eta^2p = .3$).

These interactions are displayed in Figure 18.

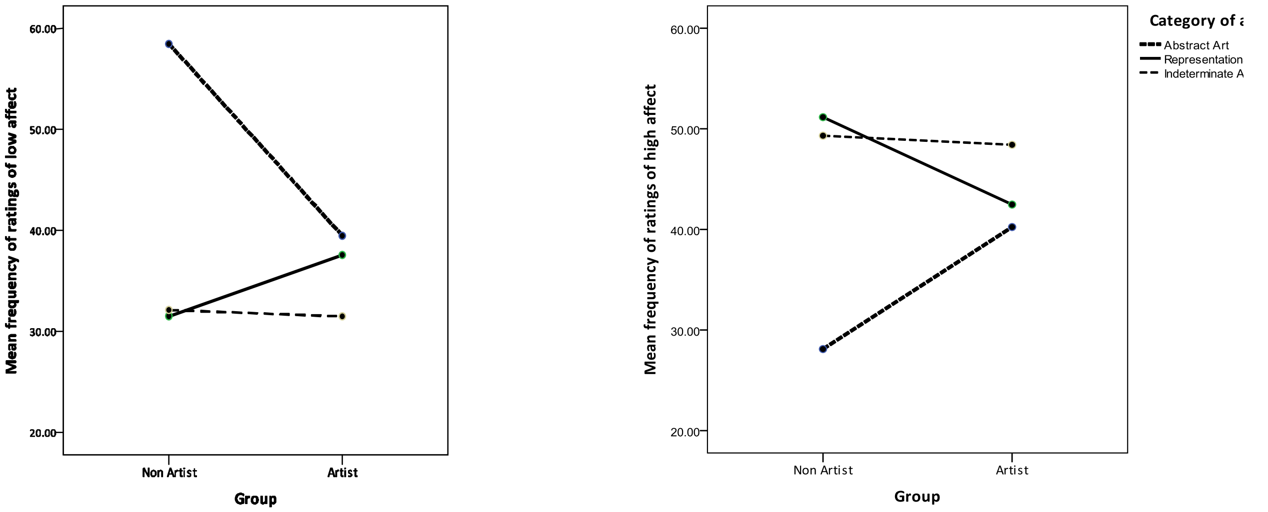


(a) Artist (b) Non-Artist

Figure 18. Mean frequency of ratings of low and high affect for 3 types of art, Abstract Art (AA), Representational Art (RA), Indeterminate Art (IA) and 2 groups; (a) Artist (A) and (b) Non-Artist (NA).

Pairwise comparisons, using the Bonferroni procedure, revealed that in the non-artist group there were significant differences in the frequency of rating the pictures as having either low or high affect. More AA was rated as having low than high affect ($p < .05$). Although more RA and IA pictures were rated as having high than low affect, only the differences with regard to RA were near to significant ($p = .054$).

Artists showed a very different pattern. The frequency of rating was significantly different only for IA ($p < .05$), with more IA rated as having high than low affect. The frequency of rating for AA showed almost no difference between high or low affect. There was also a significant interaction between the frequency of rating of level of affect, the category of art, and the group, (F (2, 68) = 6.81, $p < .01$, $\eta^2 p = .17$), as seen in Fig. 19 (a) and (b) below.



(a) Low Affect

(b) High Affect

Figure 19. Mean frequency of ratings of (a) low affect (and (b) high affect by 2 groups; Non-Artist (NA) and Artist (A) and, for 3 types of art, Abstract Art (AA), Representational Art (RA), Indeterminate Art (IA)

As is evident in Figure 19 (a) independent t tests revealed that non-artists significantly more frequently rated AA as having low affect than artists, ($t(34) = 2.52$; $p < .05$), and there were no significant differences between the two groups in the frequency of ratings of low affect for either RA or IA.

With regard to the frequency of rating of high affect, Figure 20 (b), the opposite pattern can be observed. Artists more frequently rated AA as having high affect than non-artist and less frequently rated RA as having a high affect, with virtually no difference at all between the two groups regarding the frequency of rating IA as having high affect. However, none of the differences in the frequency of rating of high affect were significant between the two groups.

In order to examine how the affective response impacted on the time taken to respond to the affect of the different categories of art analysis was then conducted on the response latency. The response latency was analysed in a 2 (Group: NA, A) x 3 (Category of art: AA, RA, IA) analysis of variance. This analysis revealed that there was a significant main effect of the category of art on the time taken to respond, ($F(1.56, 53.08) = 18.61$, $p < .001$, $\eta^2p = .35$) and that there was a significant interaction between the category of art and the two groups, ($F(1.56, 53.08) = 6.10$, p = < .01, $\eta^2p = .15$), which can be clearly seen in Figure 20.

Pairwise comparisons found that the response times were significantly different between AA and both RA and IA ($p < .001$) but not between RA and IA. Exploring the interaction, further analysis of simple main effects found that the differences in the response times to the different categories of art were significant only in non-artist's, ($F(1.37, 24.68) = 24.42$, $p < .001$, $\eta^2p = .58$), representing a large effect. The Bonferroni procedure found that the response times differed significantly between all 3 categories of art in this group (see Figure 20). Thus, non-artists were significantly faster in rating the level of emotional affect of AA than either RA or IA, whereas there was no difference in the time taken to respond to any of the categories of art by the artists.

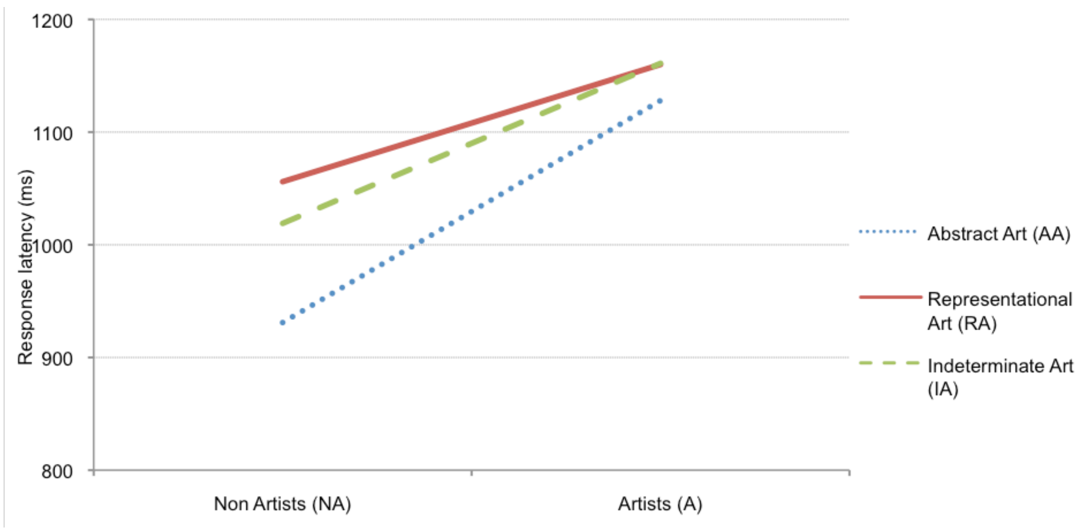


Figure 20. Mean response latency (ms) to rate the level of affect of 3 categories of art; Abstract Art (AA), Representational Art (RA), Indeterminate Art (IA) and 2 groups; Non-Artist (NA) and Artist (A)

ERP analysis

An initial analysis was conducted to ensure that the number of trials missed by participants (i.e. when they did not respond, or when the data was rejected due to artefacts) was not significantly different between the groups for each category of art. No significant differences between the groups for any of the categories of art were found; AA, $t(34) = 1.92$, $p > .05$, IA, $t(34) = 1.43$, $p > .05$, RA, $t(34) = .63$, $p > .05$.
The total number of accepted artefact free trials analyzed for each group, each stimulus and high and low affect ratings in response to each category of art an be seen in Table 4 above.

Analysis of non-target frequent and rare standard stimuli (FSS and RSS)

The first sets of analyses were carried out to investigate exogenous and endogenous ERP components elicited in response to non-target frequent and rare standard stimuli (FSS and RSS). The components of interest were selected on the basis of previous research (see Oloffson et al., 2008 for review) and visual inspection of the grand average ERPs. See Figures 23 and 24 below which show the grand average ERP waveforms for the non-target frequent, FSS, and rare standard, RSS, stimuli plotted on selected electrodes for analysis. The mean amplitude and latency of each ERP component was analysed in a 2 (Group: NA, A) x 2 (Stimuli: FSS, RSS) x 3 (Hemisphere: Left, Mid line, Right) x 4 (Location: Frontal, Central, Parietal, Occipital) analysis of variance (ANOVA). For completeness Table 8 below outlines all significant main effects and interactions.
In instances where the data failed the Mauchly's W sphericity test ($p < .05$) the Greenhouse-Geisser correction was applied. Pairwise comparisons were conducted using the Bonferroni procedure. For data reduction purposes and to address the research questions outlined above, the primary focus was the *search* for main and interaction effects for the factors of group and stimulus type.

Table 8. Showing the significant main effects of a 2 (Group: NA, A) x 2 (Stimuli: FSS, RSS) x 3 (Hemisphere: L, M, R) x 4 (Location: F, P, C, O) analysis of variance (ANOVA) to interpret EEG responses to simple stimuli. In instances where the data failed the Mauchly's W sphericity test ($p < .05$) the Greenhouse-Geisser test was substituted. All pairwise comparisons were Bonferroni adjusted, the mean difference was significant to .05 level. *(blue italics = nearly significant, would be significant if Greenhouse-Geisser test not applied)*

Interaction	P1 amplitude	P1 latency	N1 amplitude	N1 latency	P2 amplitude	P2 latency	N2 amplitude	N2 latency	P3 amplitude	P3 latency
Stimuli		*F* (1, 29) = 18.14, p < .001, η^2p = .39	*F* (1,29) = 26.73, p < .001, η^2p = .48			*F* (1,29) = 5.76, p < .05, η^2p = .17	*F* (1,29) = 33.19, p < .001, η^2p = .53			
Stimuli x Group										
Hemisphere			*F* (2, 58) = 8.61, p < .005, η^2p = .23	*F* (1.47, 42.59) = 14.06, p < .001, η^2p = .33		*F* (1.72, 49.81) = 10.34, p < .001, η^2p = .26	*F* (2,58) = 6.33, p < .005, η^2p = .18	*F* (1.22, 35.32) = 6.86, p < .01, η^2p = .19		*F* (1.36, 39.32) = 6.18, p < .05, η^2p = .18
Hemisphere x Group										
Location		*F* (1.77, 51.18) = 3.70, p < .05, η^2p = .11	*F* (2.12, 61.41) = 13.24, p< .001, η^2p = .31	*F*(2.10, 60.96) = 5.00, p < .01, η^2p = .15	*F* (1.59, 46.23) = 38.60, p < .001, η^2p = .57		*F* (1.78, 51.60) = 28.86, p < .001, η^2p = .50	*F* (1.72, 49.79) = 3.84, p < .05, η^2p = .12	*F* (2.04, 59.12) = 21.34, p < .001, η^2p = .42	*F* (2.53, 73.36) = 5.18, p < .005, η^2p = .15
Location x Group			*F* (2.12, 61.41) = 4.31, p < .05, η^2p = .13		*F* (1.59, 46.23) = 5.55, p < .05, η^2p = .16		*F* (1.78, 51.60) = 3.88, p , .05, η^2p = .12		*F* (2.04, 59.12) = 11.21, p < .001, η^2p = .28	
Stimuli x Hemisphere	*F* (2, 58) = 9.2, p <.001, η^2p = .24		*F* (1.88, 54.37) = 23.94, p < .001, η^2p = .45		*F* (2, 58) = 6.10, p < .005, η^2p = .17		*F* (1.6, 46.39) = 5.19, p < .05, η^2p = .15			
Stimuli x Hemisphere x Group										
Stimuli x Location	*F* (2.02, 58.62) = 6.15, p < .005, η^2p = .18	*F* (2.01, 58.30) = 9.55, p < .001, η^2p = .25	*F* (1.77, 51.41) = 46.27, p < .001, η^2p = .62	*F* (2.34, 67.92) = 10.65, p < .001, η^2p = .27	*F* (1.78, 51. 70) = 48.84, p < .001, η^2p = .63	*F(2.10, 60.82) = 2.9, p = .06,* η^2p *= .09*	*F* (1.88, 54.58) = 42.91, p < .001, η^2p = .60	*F* (1.61, 46.63) = 6.65, p < .01, η^2p = .19		

Stimuli x Location x Group										
Hemisphere x Location	*F* (2.63, 76.12) = 3.04, p < .05, η^2p = .10	*F* (2.96, 85.85) = 3.58, p < .05, η^2p = .11	*F* (4.25, 123.22) = 3.68, P < .01, η^2p = .11		*F* (3.55, 102.79) = 6.79, p < .001, η^2p = .19	*F (3.26, 94.59) = 2.25, p = .08, η^2p = .07*	*F* (3.69, 107.08), = 3.05, p < .05, η^2p = .10	*F* (2.99, 86.80) = 4.34, p < .01, η^2p = .13	*F* (3.78, 109.52) = 3.95, p , .01, η^2p = .12	*F* (2.97, 86.23) = 3.48, p < .05, η^2p = .11
Hemisphere x Location x Group		*F* (2.96, 85.85) = 3.25, p < .05, η^2p = .10		*F* (2.69, 77.83) = 2.77, p < .05, η^2p = .09		*F (3.26, 94.59) = 2.53, p = .06, η^2p = .08*	*F* (3.69, 107.08) = 3.14, p < .001, η^2p = .18	*F* (2.99, 86.80) = 2.86, p < .05, η^2p = .09		*F* (2.97, 86.23) = 3.4, p < .05, η^2p = .11
Stimuli x Hemisphere x Location	*F* (3.11, 90.31) = 3.95, P < .05, η^2p = .39		*F* (4.16, 120.63) = 5.52, p < .001, η^2p = .16		*F* (3.87, 112.29) = 11.79, p < .001, η^2p=.29		*F* (6, 174) = 6.43, p < .001, η^2p=.18			
Stimuli x Hemisphere x Location x Group										
Pairwise Comparisons										
Group										
Stimuli			RSS >FSS, p <.001			FSS>RSS, p<.05	FSS <RSS, p<.001			
Stimuli			RSS >FSS, p <.001			FSS>RSS, p<.05	FSS <RSS, p<.001			
Hemisphere			M>L, p<.01 M>R, p<.005	M>R, p<.001 M>L, p<.05 R>L p<.05		L<M, p<.005 L<R, p<.05	L<M, p<.005	L<R, p<.01 M<R, p<.05		L<M, p<.05 L<R, p<.05
Location		F>P, p < .001	F>P, p<.005 F>O, p<.005	C>P, p<.05 C>O, p<.05	F<P, p<.001 F<O, p<.001		F>P, p<.05 F>O, p<.001	P>F, p< .01	F<C, p<.05 F<P, p<.001 F<O, p<.01	C>O, p<.05

P1 Amplitude and Latency (100-140ms)

The analysis on the mean amplitude of the P1 component revealed no significant main effects of either group or stimuli. However, there was an interaction between stimuli and hemisphere, ($F(2, 58) = 9.2$, $p < .001$, $\eta^2p = .24$) and stimuli and location ($F(2.02, 58.62) = 6.15$, $p < .005$, $\eta^2p = .18$), with the rare standard stimuli (RSS) demonstrating larger amplitude in the right hemisphere and at occipital sites than the frequent standard stimuli (FSS). There was a significant interaction between stimuli, hemisphere and location, ($F(3.11, 90.31) = 3.95$, $p < .05$, $\eta^2p = .39$). At occipital sites the mean amplitude was largest for the RSS in all 3 hemispheres (L, M, R), whilst the mean amplitude was the smallest at frontal sites in all 3 hemispheres (see Grand average ERP topographic map, Figure 23).

Analysis on the latency of the P1 component revealed a main effect of stimuli ($F(1, 29) = 18.14$, $p < .001$, $\eta^2p = .39$), the latency was longer for the FSS than for the RSS, but there was no main effect of group. There was a significant interaction between stimuli and location ($F(2.01, 58.30) = 9.55$, $p< .001$, $\eta^2p = .25$), with a significantly longer latency at parietal than at frontal electrodes (P<F, P <.001). There was also a significant interaction between the groups, hemisphere and location ($F(2.96, 85.85) = 3.25$, $p < .05$, $\eta^2p = .10$).

N1 Amplitude and Latency (130 -160ms)

The analysis of the N1 amplitude revealed a main effect of stimuli ($F(1, 29) = 26.73$, $p < .001$, $\eta^2p = .48$), but not of group. There was a significant interaction between stimuli and hemisphere ($F(1.88, 54.37) = 23.94$, $p < .001$, $\eta^2p = .45$), stimuli and location ($F(1.77, 51.41) = 46.27$, $p < .001$, $\eta^2p = .62$), and stimuli, hemisphere and location ($F(4.16, 120.63) = 5.52$, $p < .001$, $\eta^2p = .16$). Pairwise comparisons showed that the amplitude of the N1 component was larger for the RSS than for the FSS (RSS>FSS, p<.001), and was larger in the mid line hemisphere than in either the left or right (M>L, p<.01, M>R, p<.005), and larger at frontal and central sites than at parietal or occipital sites (F>P, p <.005; F>O, p<.005; C>P, p<.001; C<O, p<.005). There was also a significant interaction between group and location ($F(2.12, 61.41) = 4.31$, $p < .05$, $\eta^2p = .13$) with artists showing larger amplitude at frontal and central sites than non-artists (see grand average ERP topographic map, Figure 23). Figures 21 and 22 below (showing grand average ERPs for Non-Target Rare Simple Stimuli (RSS) and Frequent Simple Stimuli (FSS), respectively, for Artists (blue) and Non-Artists (red), at selected frontal, central, parietal and occipital sites. Time 0–500ms. Scale -6 - +6 µV), shows larger amplitude of the N1 component in both groups in response to the RSS than for the FSS at midline frontal and central sites, and that the amplitude of this component is larger for the artists than non-artists in response to both stimuli. The N1 component (latency 130-160ms) is indicated at mid-line frontal and central electrodes Fz and Cz with a blue arrow.

Analysis on the latency of the N1 component revealed no main effects, nevertheless a significant interaction between stimuli and location ($F(2.34, 67.92) = 10.65$, $p < .001$, $\eta^2p = .27$), and a significant interaction between group, hemisphere and location ($F(2.69, 77.83) = 2.77$, $p < .05$, $\eta^2p = .09$) was found. Pairwise comparisons showed the latency of the N1 component being longer at central locations than at either parietal or occipital (C>P, $p<.05$; C>O, $p<.05$).

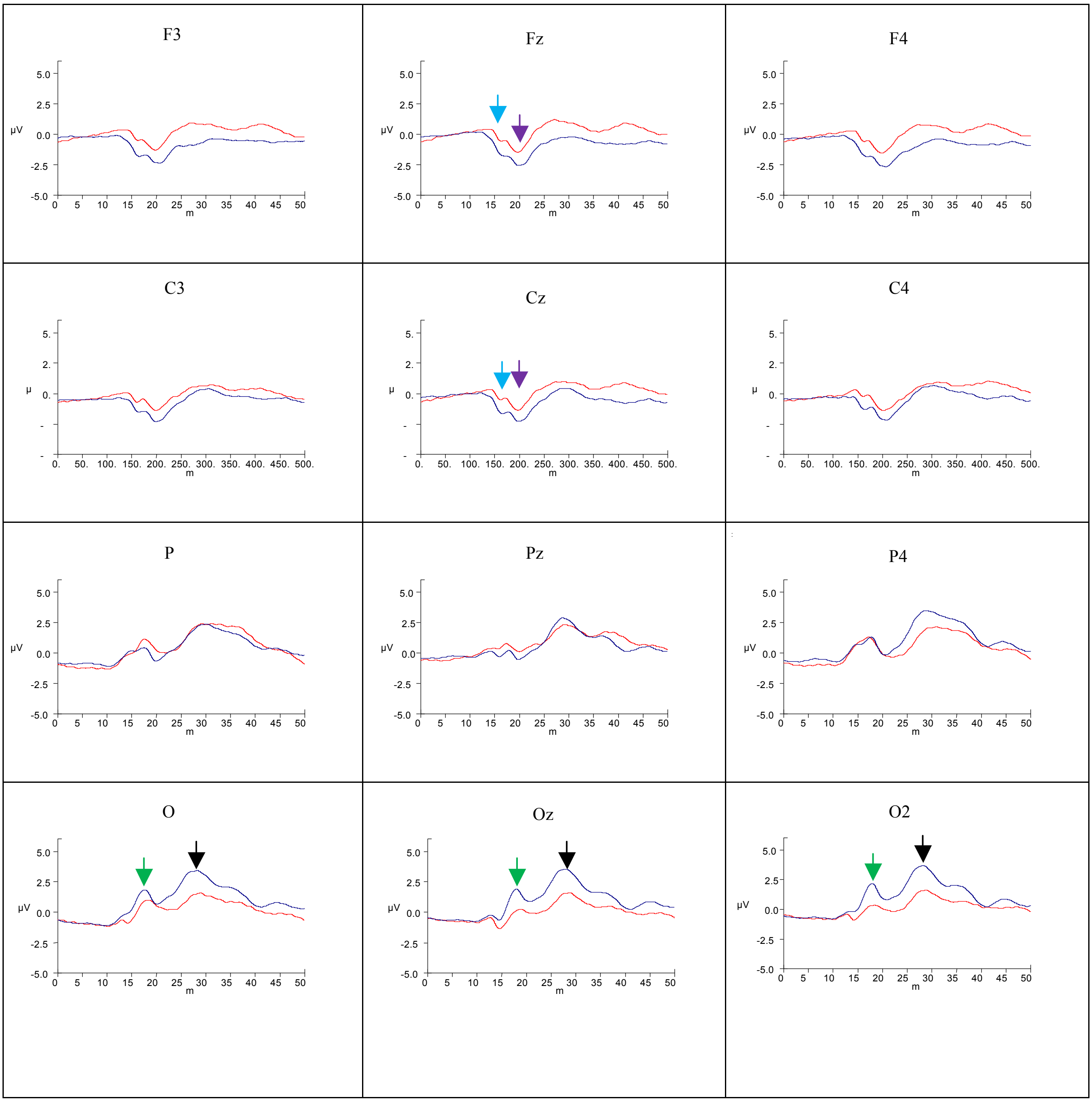


Figure 21. Grand average ERPs for Non-Target Frequent Simple Stimuli (FSS) for Artists (blue) and Non-Artists (red), at selected frontal, central, parietal and occipital sites. Time 0 – 500ms. Scale -6 - +6 µV. N1 component (latency 130-160ms) is indicated at mid-line frontal and central electrodes Fz and Cz with blue arrow, P2 component (latency 150-220ms) is indicated at occipital electrodes O1, Oz, O2 with green arrow, N2 component (latency 150-220ms) is indicated at midline frontal and central sites with purple arrow, P3 component (latency 250-500ms) is indicated at occipital electrodes O1, Oz, O4 with black arrow.

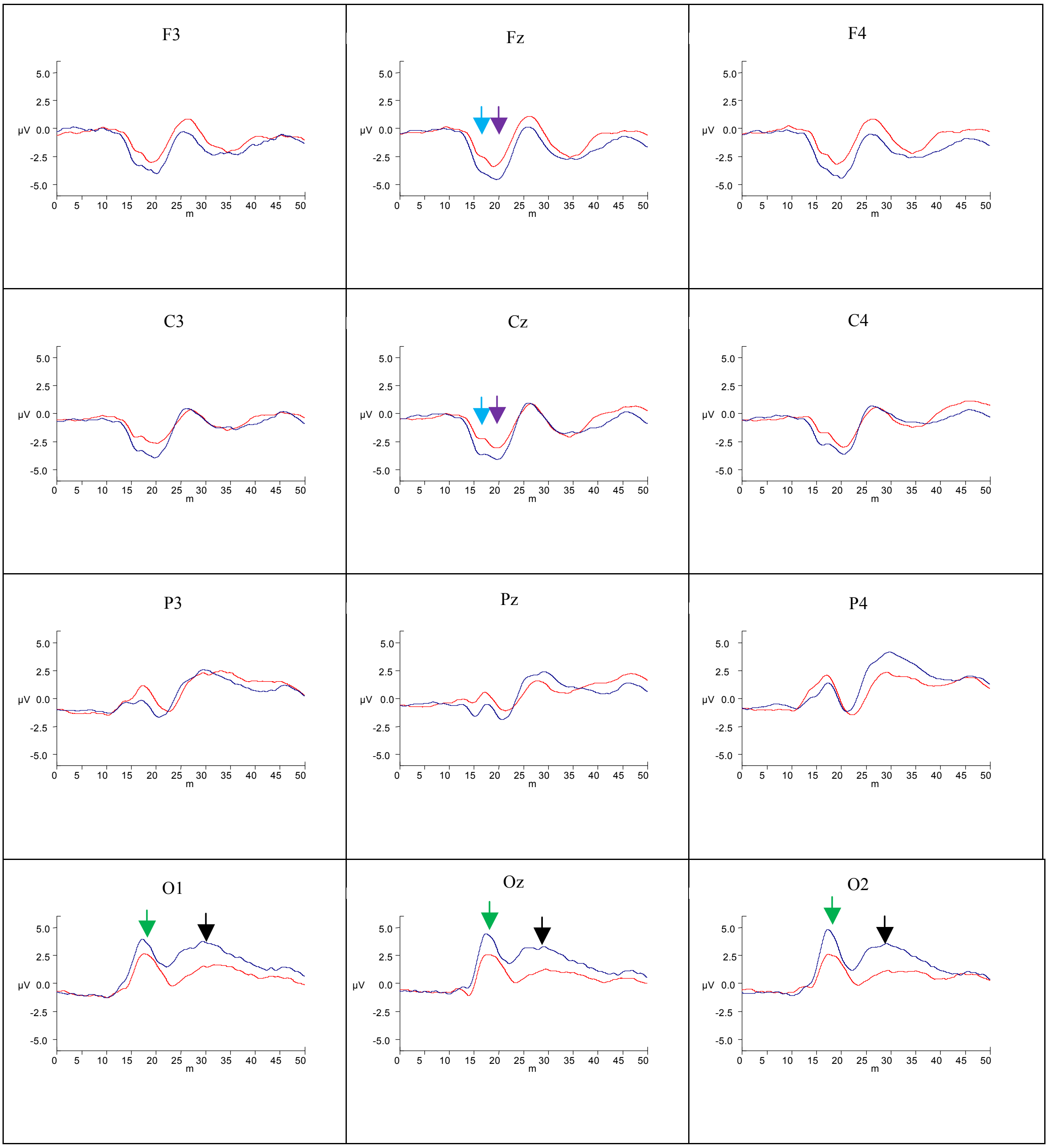


Figure 22. Grand average ERPs for Non-Target Rare Simple Stimuli (RSS) for Artists (blue) and Non-Artists (red), at selected frontal, central, parietal and occipital sites. Time 0 – 500ms. Scale -6 - +6 µV. N1 component (latency 130-160ms) is indicated at mid-line frontal and central electrodes Fz and Cz with blue arrow, P2 component (latency 150-220ms) is indicated and occipital electrodes O1, Oz, O2 with green arrow, N2 component (latency 150-220ms) is indicated at midline frontal and central sites with purple arrow, P3 component (latency 250-500ms) is indicated at occipital electrodes O1, Oz, O2 with black arrow.

P2 Amplitude and Latency (150 -220 ms)

At the latency range 150-220 ms the data showed no significant main effects of group or stimuli. There was a significant interaction between stimuli and hemisphere in the P2 amplitude ($F(2, 58) = 6.10$, $p < .005$, $\eta^2p = .17$), stimuli and location ($F(1.78, 51.70) = 48.84$, $p < .001$, $\eta^2p = .63$) and stimuli, hemisphere and location ($F(3.87, 112.29) = 11.79$, $p < .001$, $\eta^2p = .29$). Pairwise comparisons revealed that the P2 amplitude was larger at parietal and occipital sites than at frontal and central sites, and the amplitude at occipital sites was greater than that at parietal (P>F, p<.001; O>F, p<.001; P>C, p<.001; O>C, p<.001; O>P, p<.05). There was also a significant interaction between group and location ($F(1.59, 46.23) = 5.55$, $p<.05$, $\eta^2p = .16$). Whilst both artists and non-artists showed larger amplitude at occipital sites for the RSS than for the FSS, the amplitude for artists at this location and for this stimulus was greater than for non-artists, (see grand average ERP topographic map, Figure 24). Figures 21 and 22 above indicate the P2 amplitude at occipital electrodes O1, Oz, O2 with a green arrow.

Analysis of the P2 latency revealed only the main effect of stimuli as significant ($F(1,29) = 33.19$, $p < .001$, $\eta^2p = .53$), with shorter latency for the RSS than for the FSS (FSS>RSS, p <.05). Whilst the interaction between stimuli and location ($F(2.10, 60.82) = 2.9$, $p = .06$, $\eta^2p = .07$) and group, hemisphere and location approached significance ($F(3.26, 94.5) =2.53$, $p = .06$, $\eta^2p = .08$), pairwise comparisons revealed that the latency was significantly shorter in the left hemisphere than either the mid line or right hemispheres (L<M, p<.005; L<R, p<.05).

N2 Amplitude and Latency (150 – 250 ms)

As with the N1 component there was a main effect of stimuli, but not of group, on the amplitude of the N2 component ($F(1, 29) = 33.19$, $p < .001$, $\eta^2p = .53$), with significant interactions between stimuli and hemisphere (F $(1.6, 46.39) = 5.19$, $p < .05$, $\eta^2p = .15$), stimuli and location ($F(1.88, 54.58) = 42.91$, $p < .001$, $\eta^2p = .60$), and between stimuli, hemisphere and location ($F(6, 174) = 6.43$, $p < .001$, $\eta^2p = .18$). Pairwise comparisons revealed greater amplitude of the N2 component was found for the RSS than the FSS

(RSS>FSS, $p<.05$), and at the mid line than at the left (M>L, $p<.005$). The amplitude was larger at frontal and central locations than at occipital and parietal (F>P, $p<.05$; F>O, $p<.001$; C>P, $p<.001$; C>O, $p<.001$; P>O, $p<.001$). There was also a significant interaction between group, hemisphere and location ($F(3.69, 107.08) = 3.14$, $p < .001$, $\eta^2p = .18$). As the grand average ERP topographic map (Figure 23) demonstrates artists show larger amplitude of the N2 component for both stimuli at frontal and central locations and the mid line hemisphere than non-artists. The amplitude at these locations is larger for the RSS than for the FSS in artists.

Analysis of the latency of the N2 component revealed no main effect of group or stimuli, but two significant interactions, the first between stimuli and location ($F(1.61, 46.63) = 6.65$, $p < .01$, $\eta^2p = .19$), the second between group, hemisphere and location ($F(2.99, 86.80) = 2.86$, $p < .05$, $\eta^2p = .09$) were found. The latency was longer in the right hemisphere than either the left or mid line (R>L, $p<.01$; R>M, $p<.05$), and longer at parietal than at frontal sites (P>F, $p<.01$).

P3 Amplitude and Latency (250 -500ms)

Finally, analysis of the P3 component revealed two results of interest. Although there were no main effects of group or stimuli, with regard to the amplitude of the P3 there was a significant interaction between group and location ($F(2.04, 59.12) = 11.21$, $p < .001$, $\eta^2p = .28$), with the largest amplitude found at occipital then at parietal sites (O>P, $p<.001$; O>C, $p<.05$; O>F, $p<.01$; P>C, $p<.001$; P>F, $p<.001$; C>F, $p<.05$). Examination of the grand average ERPs (Figures 21 and 22) demonstrates that the amplitude of the P3 component was greatest for artists at occipital locations than non-artists for both FSS and RSS. P3 component is indicated at occipital electrodes O1, Oz, O2 with black arrow on Figures 21 and 22 above.

There was also an interaction of group, hemisphere and location with regard to the latency of the P3 component ($F(2.97, 86.23) = 3.4$, $p < .05$, $\eta^2p = .11$), the latency was significantly shorter in the left hemisphere than either the mid line or right hemispheres (L<M, $p<.05$; L<R, $p<.05$), whilst it was significantly longer in occipital locations than the central locations (O>C, $p<.05$).

These data reveal that the amplitude of the 5 components analyzed was consistently larger for the RSS than for the FSS. The amplitude of the early components was largest for artists at occipital and parietal sites, with regard to the N2 it was larger at frontocentral sites for this group, whilst the P3 was larger at occipital electrodes.

Analysis of target stimuli; Abstract Art (AA), Representational Art (RA) and Indeterminate Art (IA)

The main focus of the present work was on the pattern of ERP effects across participant group (artist vs. non-artist) and type of art (AA vs. RA and IA, and RA vs. IA). The mean amplitude and latency of each ERP component was analysed in a 2 (Group: non-artist, artist) x 3 (Stimuli: abstract art, representational art, indeterminate art) x 3 (Hemisphere: left, midline, right) x 4 (Location: frontal, central, parietal, occipital) analysis of variance (ANOVA). For completeness Table 9 below outlines all significant main effects and interactions. Figures 23 and 24 below show the grand average topographic scalp maps showing ERP components for P1, N1, P2, N2, P3 and LPP for 5 stimuli: frequent simple stimuli (FSS), rare simple stimuli (RSS), abstract art (AA), representational art (RA) and indeterminate art (IA), for 2 groups, artist and non-artist, for 16 electrodes (F7, F3, C3, P7, P3, PZ, O1 OZ, O2, P4, P8, C4, F4, F8, FZ, CZ). Figures 25, 26 and 27 below show the grand average ERPs evoked in response to abstract art, representational and indeterminate art, respectively, for artists (blue) and non-artists (red) at selected frontal, central, parietal and occipital sites (F3, Fz, F4, C3, Cz, C4, P3, Pz, P4, O1, Oz, O2). The P1 component is indicated by dark red arrow, N1 component indicated by light blue arrow, P2 component indicated by green arrow, N2 component indicated by purple arrow, P3 component indicated by black arrow and LPP indicated by gold arrow

Table 9. Showing the significant main effects of a 2 (Group: NA, A) x 3 (Art Stimuli: AA, RA, IA) x 3 (Hemisphere: L, M, R) x 4 (Location: F, P, C, O) analysis of variance (ANOVA) to interpret EEG responses to target stimuli. In instances where the data failed the Mauchly's W sphericity test (p < .05) the Greenhouse-Geisser test was substituted. All pairwise comparisons were Bonferroni adjusted, the mean difference was significant to .05 level. *(blue italics = nearly significant, would be significant if Greenhouse-Geisser test not applied)*

Interaction	P1 amplitude	P1 latency	N1 amplitude	N1 latency	P2 amplitude	P2 latency	N2 amplitude	N2 latency	P3 amplitude	P3 latency	LPC amplitude
Art Stimuli	*F* (2, 58) = 23.67, p < .001, η^2p = .45	*F* (2, 58) = 27.61, p < .001, η^2p = .49		*F* (1.34, 38.78) = 231.71, p < .001, η^2p = .89	*F* (2, 58) = 23.1, p < .001, η^2p = .44	*F* (1.37, 39.70) = 178.98, p < .001, η^2p = .86	*F* (1.64, 47.64) = 12.79, p < .001, η^2p = .31	*F* (1.19, 34.44) = 596.27, p < .001, η^2p = .95		*F* (1.5, 43.7) = 12.41, p < .001, η^2p = .30	
Art Stimuli x Group					*F* (1.97, 57.04) = 4.08, p ¸.05, η^2p = .12						
Hemisphere		*F (1.39, 40.16) = 3.14, p=.07, , η^2p = .10*	*F* (2, 58) = 15.86, p < .001, η^2p = .35	*F* (1.34, 38.78) = 9.74, p < .005, η^2p = .25		*F* (2, 58) = 7.18, P < .005, η^2p = .20	*F* (2, 58) = .19.41, p < .001, η^2p = .40	*F* (1.41, 40.82) = 12.64, p < .001, η^2p = .30		*F* (1.38, 39.98) = 9.17, p < .005, η^2p = .24	*F* (2,58) = 5.70, p<.001, , η^2p = .56
Hemisphere x Group											
Location	*F* (3, 87) = 23.80, p < .001, η^2p = .45	*F* (1.74, 50.38) = 12.33, p < .001, η^2p = .30	*F* (3, 87) = 6.26, p < .005, η^2p = .18		*F* (1.91, 55.48)= 41.74, p < .001, η^2p = .59	*F* (1.98, 57.31) = 5.18, p < .01, η^2p =.15	*F* (1.78, 51.56) = 77.90, p < .001, η^2p = .73		*F* (2.18, 63.25) = 45.97, p < .001, η^2p = .61	*F* (92.05, 59.43) = 5.43, p < .01, η^2p = .16	*F* (3, 87) = 36.67, p <.001, η^2p = .56
Location x Group	*F* (1.98, 57.28) = 4.71, p < .05, η^2p = .14		*F* (3, 87) = 4.58, p < .01, η^2p = .14		*F* (1.91, 55.48) = 7.07, p < .005, η^2p = .20		*F* (1.78, 51.56) = 5.43, p < .01, η^2p = .16		*F* (2.18, 63.25) = 3.64, p < .05, η^2p = .11		*F (1.97, 57.16) = 2.90, p = .06, η^2p =.09*
Art Stimuli x Hemisphere			*F* (4, 116) = 3.38, p < .01, η^2p = .10	*F* (3.11, 90.14) = 8.25, p < .001, η^2p = .22			*F* (3.13, 90.70) = 3.23, p < .05, η^2p = .10	*F* (2.72, 78.88) = 6.01, p <.005, η^2p = .17	*F* (2.60, 75.38) = 3.38, p < .05, η^2p = .10		
Interaction											
Art Stimuli x											

Hemisphere x Group											
Art Stimuli x Location	*F* (2.73, 79.28) = 8.94, p < .001, η^2p = .24	*F* (6, 174) = 7.16, p < .001, η^2p = .20		*F* (2.46, 71.39) = 7.19, p < .005, η^2p = .20	*F* (3.10, 89.75) = 17.98, p < .001, η^2p = .38	*F* (2.58, 74.95) = 12.59, p< .001, η^2p =.30	*F*(2.04, 59.19), = 43.55, p < .001, η^2p = .60		*F* (2.66, 77.12) =15.29, p < .001, η^2p = .35		*F* (2.45, 70.95) = 3.46, p < .05, η^2p = .11
Art Stimuli x Location x Group					*F (3.10, 89.75) = 2.65, p = .05, η^2p = .08*				*F* (2.66, 77.12) = 4.92, p < .01, η^2p = .15		*F (2.45, 70.95) = 2.29, p = .098, η^2p = .07*
Hemisphere x Location	*F* (2.96, 85.74) = 4.13, p<.01, η^2p = .13	*F* (3.36, 97.38) = 3.27, p < .01, η^2p = .10	*F* (6, 174) = 5.43, p < .001, η^2p = .16	*F (2.85, 82.65) = 2.44, p = .07 , η^2p = .07*	*F* (3.74, 108.41) = 9.18, p < .001, η^2p = .24	*F* (2.88, 83.51) = 3.20, p < .05, η^2p = .10	*F* (3.21, 93.06) = 4.31, p < .01, η^2p =.13	*F (2.71, 78.65) = 2.62, p=.06, η^2p = .08*	*F* (3.09, 89.71) = 8.89, p < .001, η^2p =.24	*F* (2.85, 82.76) = 2.77, p < .05, η^2p = .09	*F* (2.86, 82.89) = 7.32, p < .001, η^2p =.20
Hemisphere x Location x Group		*F (3.36, 97.38) = 2.45, p=.06, η^2p = .18*		*F* (2.85, 82.65) = 3.36, p < .05, η^2p = .10		*F* (2.88, 83.51) = 3.41, p < .05, η^2p = .11		*F* (2.71, 78.65) = 3.00, p < .05, η^2p = .09		*F* (2.85, 82.76) = 2.95, p < .05, η^2p = .09	
Art Stimuli x Hemisphere x Location	*F*(3.88, 112.50) = 5.96, p<.05, η^2p = .08	*F* (12, 348) = 2.42, p < .01, η^2p = .08	*F* (12, 348) = 4.46, p < .001, η^2p = .13	*F (5.76, 167.12) =2.13, p = .056, η^2p = .07*			*F* (5.53, 160.49) = 4.27, p < .005, η^2p =.13	*F* (4.54, 131.68) = 3.31, p < .05, η^2p = .10	*F (2.77, 80.43) = 1.90, p=.14 η^2p = .06*		
Art Stimuli x Hemisphere x Location x Group						*F (6.99, 202.63) = 1.91, p =.07, η^2p =.06*		*F* (4.54, 131.68) = 2.55, p < .05, η^2p = .08			
Pairwise comparisons											
Group					*F* (1, 29) =4.96, p < .05, η^2p = .15						
Art Stimuli	AA>IA p<.001 RA >IA p<.001.	AA>IA p<.001. RA>IA p<.001		IA>AA, p<.001 IA>RA, p<.001	IA>AA, p<.001 IA>RA, p<.001	AA>IA, p<.001 AA>RA, p<.05 RA>IA, p<.001	AA>RA, p<.01 AA>IA, p<.001	AA>IA, p<.001 RA>IA, p<.001		AA>IA, p<.001 RA>IA, p<.005	
Hemisphere			L>M, p<.001	M>L,		M>L,	M>L, p<.001	M>L,		M>L,	

			R>M, p<.001	p<.01 R>L, p<.05		p<.05 R>L, p<.05	R>M, p<.005	p<.005 R>L, p<.005		p<.005 R>L, p<.01	
Location	P>F, p<.001 P>C, p<.001 O>F, p<.001 O>C, p<.001	C>F, p<.005 P>F, p<.001 O>F, p<.005 P>C, p<.005	F>P, p < .05 C>P, p < .01		P>F, p<.001 P>C, p<.001 O>F, p<.001 O>C, p<.001	C>F, p<.05 P>F, p<.01 P>C, p<.05	C>F, p<.05 P>F, p<.001 O>F, p<.001 P>C, p<.001 O>C, p<.001		C>F, p<.001 P>F, p<.001 O>F, p<.005 P>C, p<.001 P>O, p<.001	C>F, p<.005 C>O, p<.05 P>O, p<.05 P>F, p<.05	

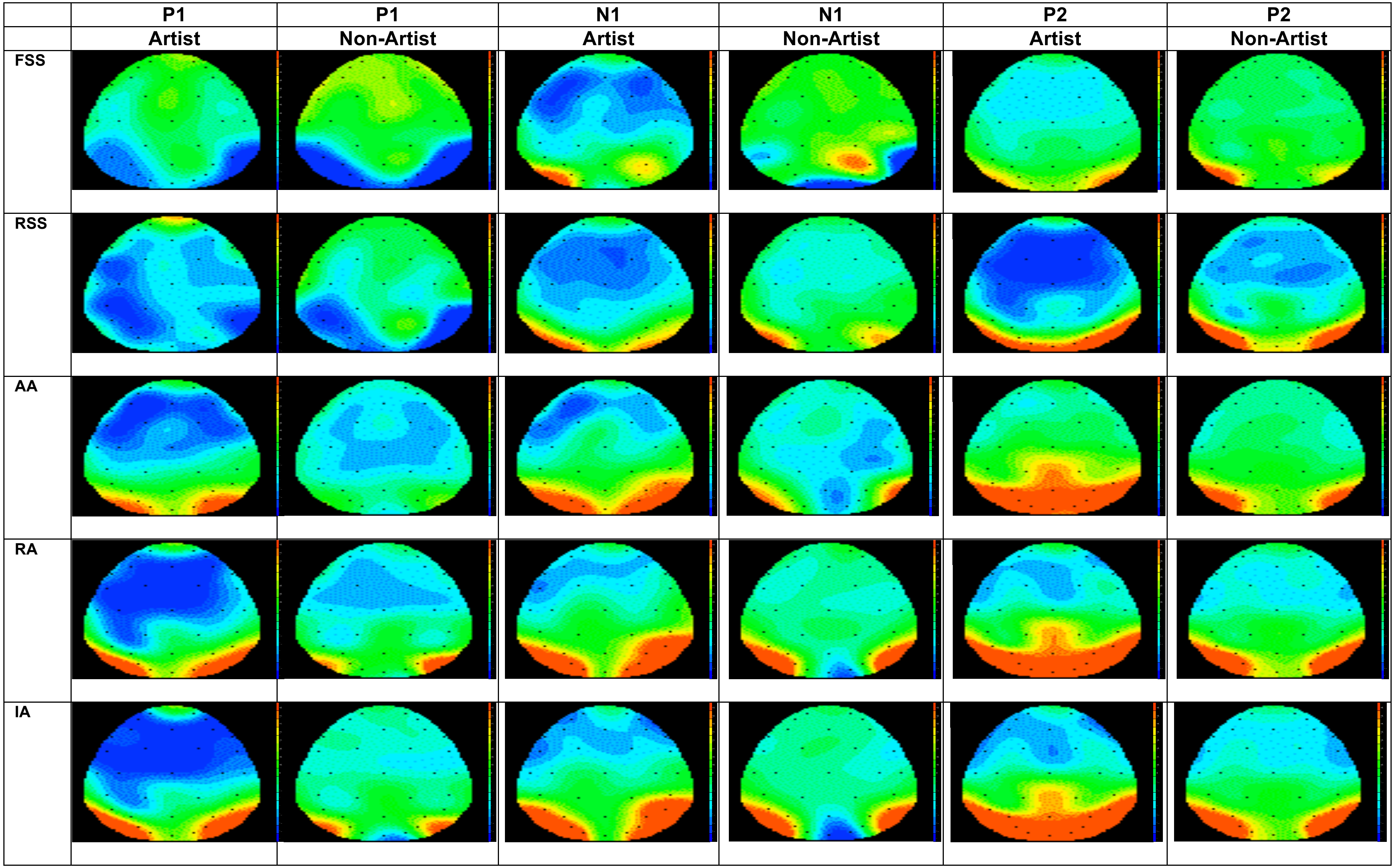


Figure 23. Grand average topographic scalp maps showing ERP components for P1, N1 and P2, for 5 stimuli: frequent simple stimuli (FSS), rare simple stimuli (RSS), abstract art (AA), representational art (RA) and indeterminate art (IA), for 2 groups, artist and non-artist, for 16 electrodes (F7, F3, C3, P7, P3, PZ, O1 OZ, O2, P4, P8, C4, F4, F8, FZ, CZ),

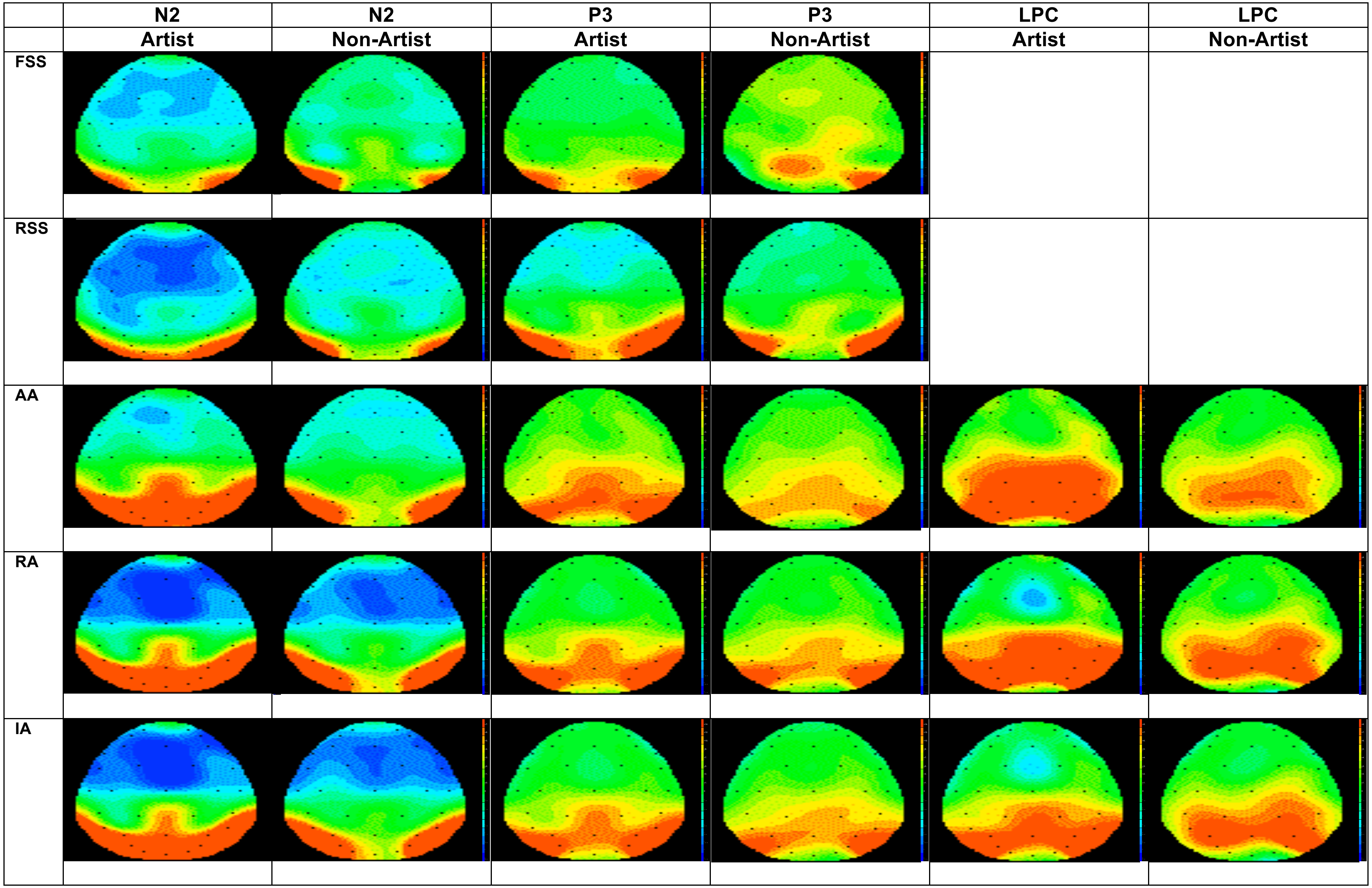


Figure 24. Grand average topographic scalp maps showing ERP components for N2, P3 and late positive component (LPC) , for 5 stimuli: frequent simple stimuli (FSS), rare simple stimuli (RSS), abstract art (AA), representational art (RA) and indeterminate art (IA), for 2 groups, artist and non-artist, for 12 electrodes (F3, C3, P3, PZ, O1 OZ, O2, P4, C4, F4, FZ, CZ),

P1 Amplitude and Latency (100-180ms)

For the P1, analysis of mean amplitude revealed a main effect of type of art ($F(2, 58) = 23.67$, $p<.001$, $\eta^2p = .45$). Pairwise comparisons and examination of the topographic maps (Figure 23 above) demonstrated more positivity for both RA and AA than for IA, ($IA<AA$, $p<.001$; $IA<RA$, $p<.001$). There was a significant interaction between type of art and location ($F(2.45, 71.15) = 15.04$, $p<.001$, $\eta^2p = .24$) with occipital and parietal sites showing more positivity than frontal and central sites ($P>F$, $p<.001$; $O>F$, $p<.001$; $P>C$, $p<.001$; $O>C$, $p<.001$), see Figures 25, 26 and 27 below which show the grand average ERPs for abstract art (AA), representational art (RA) and indeterminate art (IA) for artists (blue) and non-artists (red) respectively, at selected frontal, central, parietal and occipital sites. The P1 component is indicated by the dark red arrow. There was also a significant interaction between group and location ($F(1.98, 57.28) = 4.71$, $p <.05$, $\eta^2p =.14$), with artists showing larger amplitude at occipito-parietal locations for all types of art than non-artists. There was a significant 3-way interaction between type of art, hemisphere and location ($F(3.88, 112.50) = 5.96$, $p <.05$, $\eta^2p =.08$).

Analysis of the latency of the P1 revealed a main effect of type of art ($F(2, 58) = 27.61$, $p<.001$, $\eta^2p =.49$) with increased latency for both AA and RA than for IA ($AA>IA$, $p<.001$; $RA>IA$, $p<.001$). There was a significant interaction between type of art and location ($F(6, 174) = 7.16$, $p <.001$, $\eta^2p =.20$) with occipital, parietal and central locations showing a later peaking P1 than frontal ($O>F$, $p<.005$; $P>F$, $p<.001$; $C>F$, $p<.005$) and parietal locations peaking later than central ($P>C$, $p <.005$). There were 3-way interactions between group and hemisphere and location, ($F(6, 174) = 2.45$, $p <.05$, $\eta^2p =.08$), and between type of art and hemisphere and location, ($F(12, 348) = 2.42$, $p < .01$, $\eta^2p =.08$).

Overall, these data point to group differences in both the amplitude and latency of the P1 component. Artists demonstrated larger amplitude and latency of the P1 for all types of art at occipito-parietal locations than non-artists. Furthermore in terms of stimulus type the activation in artists is similar for all three types of art, whereas the activation in non-artists is dissimilar for all three. This pattern is evident from Figures 25, 26 and 27 below which indicate the P1 component at occipital and parietal locations.

N1 Amplitude and Latency (170 – 220ms)

Analysis of the N1 mean amplitude revealed no significant main effects. However there were significant interactions between group and location, ($F(3, 87) = 4.58$, $p < .01$, η^2p =.14), between type of art and hemisphere ($F(4,116) = 3.38$, $p <.01$, η^2p =.10), and a significant 3-way interaction between type of art and hemisphere and location, ($F(12, 348)$ = 4.46, $p < .001$, η^2p= .13). Pairwise comparisons, revealed that artists showed more negativity than non-artists at frontal and central locations than at parietal (F>P, $p<.05$; C>P, $p<.01$), and more negativity in the amplitude at left and right hemispheres than at the mid line (L>M, $p< .001$, R>M, $p<.001$) for all types of art. Inspection of the grand average charts, Figures 25, 26 and 27 below show that IA stimulated more N1 amplitude than either AA or RA in these areas, the N1 component is indicated at frontal and central locations (electrodes F3, F4, C3 and C4) with a blue arrow.

Analysis of the mean latency of the N1 revealed a significant main effect of type of art, ($F(1.34, 38.78) = 231.71$, $p < .001$, η^2p= .89), with pairwise comparisons revealing increased latency for both AA and RA than for IA (AA>IA, $p<.001$; RA>IA, $p<.001$). There were significant interactions between both type of art and location, ($F(2.46, 71.39) = 7.19$, $p < .005$, η^2p= .20), and type of art and hemisphere, ($F(3.11, 90.14) = 8.25$, $p < .001$, η^2p = .22), with increased latency found at both mid line and right hemispheres compared to left (M>L, $p<.01$, R>L, $p<.05$). There was a significant 3-way interaction between group and hemisphere and location ($F(2.85, 82.65) = 3.36$, $p<.05$, η^2p = .10).

These data suggest that the N1 component was evident for artists only, with larger amplitude for this group for all types of art at frontal and central locations and left and right sites, whilst the latency was longer for AA and RA than for IA. This pattern is evident from Figures 25, 26 and 27 which show the N1 at selected electrodes F3, F4, C3 and C4 with a blue arrow.

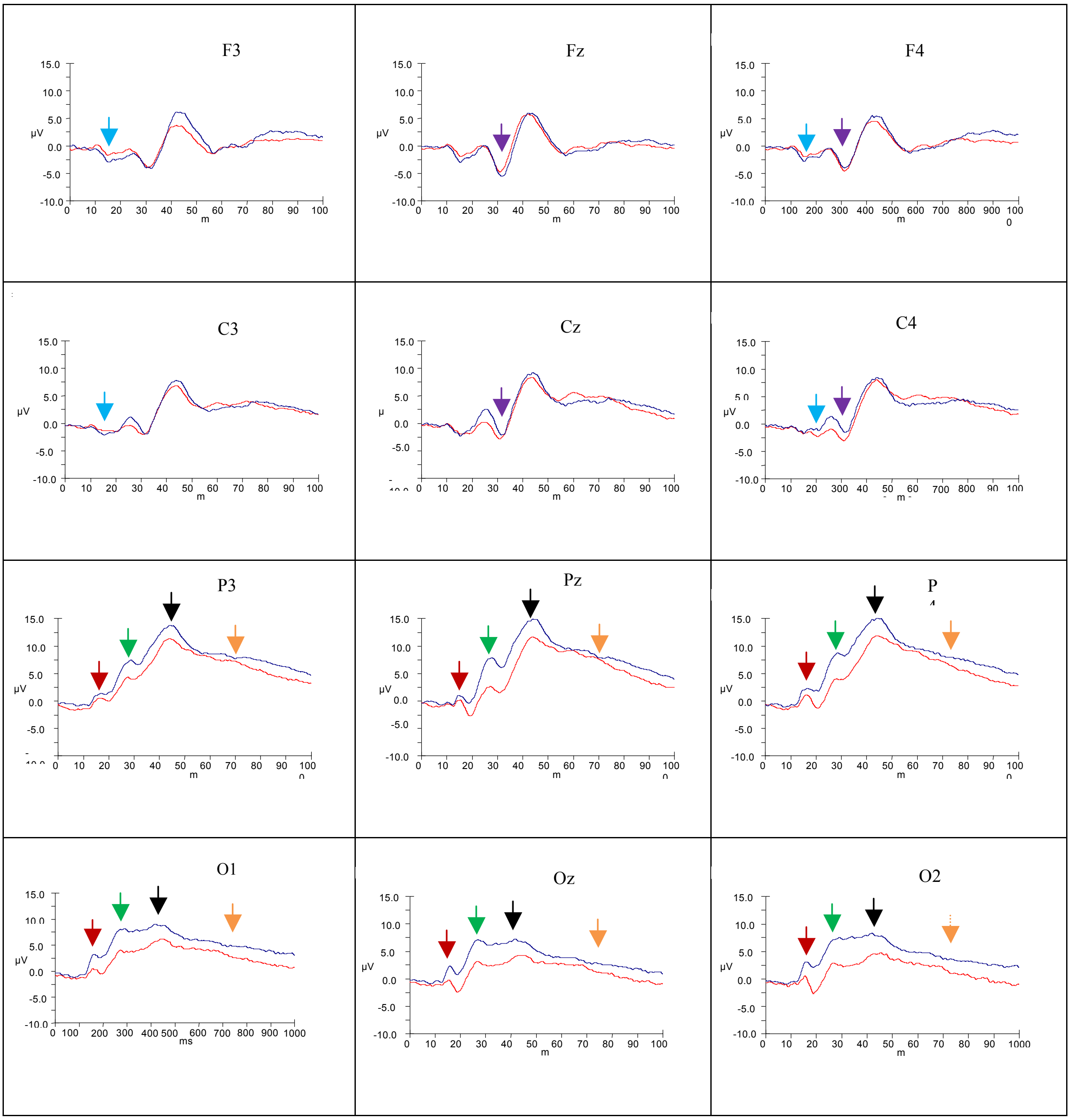


Figure 25. Grand average ERPs for Abstract Art (AA) for artists (blue) and non-artists (red). Time 0 – 1000 ms, at selected frontal, central, parietal and occipital sites. Scale -10 - +15 µV. P1 component indicated by red arrow, N1 component indicated by blue arrow, P2 component indicated by green arrow, N2 component indicated by purple arrow, P3 component indicated by black arrow, LPP indicated by gold arrow.

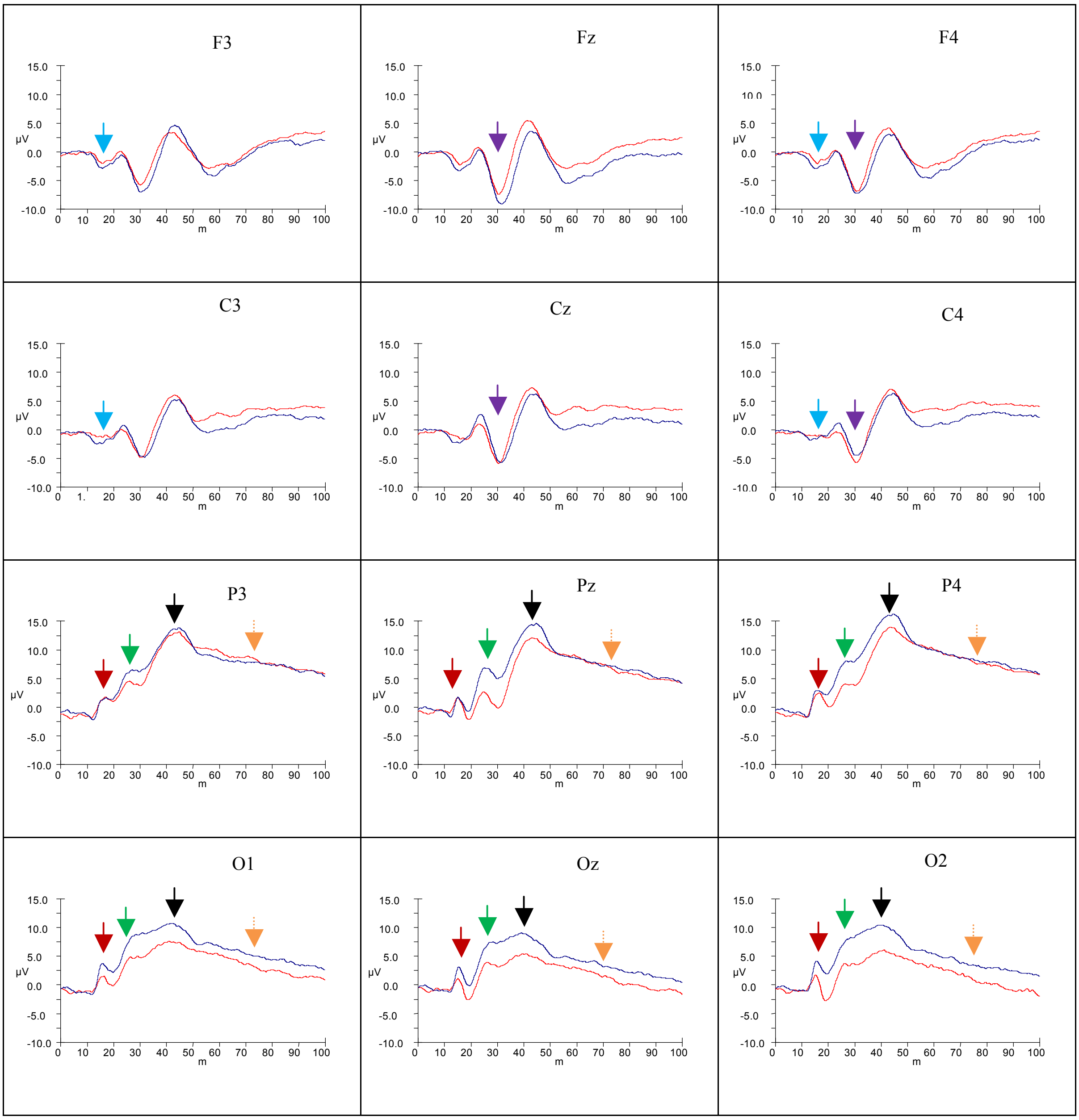


Figure 26. Grand average ERPs for Representational Art (RA) for artists (blue) and non-artists (red). Time 0 – 1000 ms, at selected frontal, central, parietal and occipital sites. Scale -10 - +15 µV. P1 component indicated by red arrow, N1 component indicated by blue arrow, P2 component indicated by green arrow, N2 component indicated by purple arrow, P3 component indicated by black arrow, LPP indicated by gold arrow.

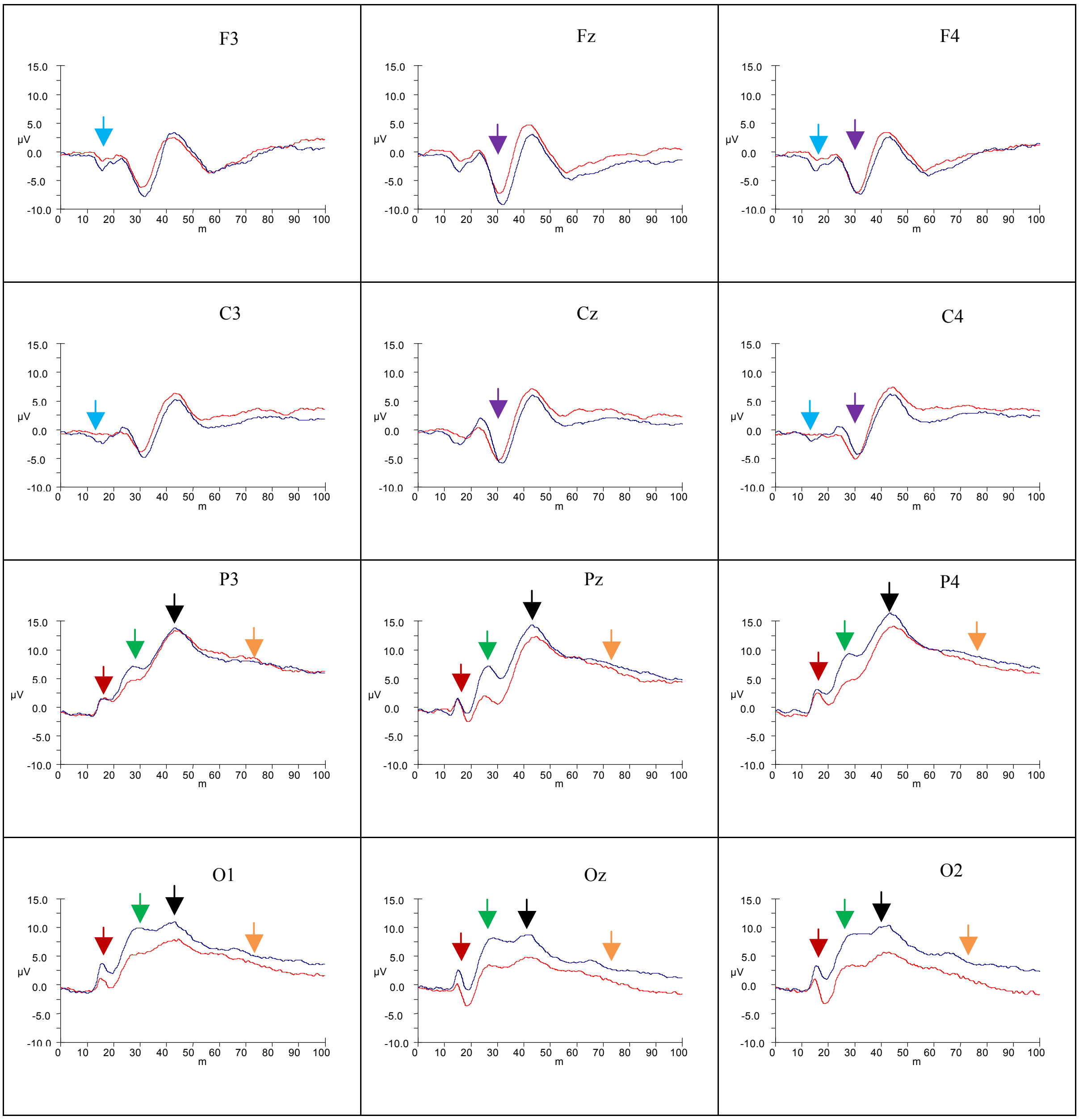


Figure 27. Grand average ERPs for Indeterminate Art (IA) for artists (blue) and non-artists (red). Time 0 – 1000 ms, at selected frontal, central, parietal and occipital sites. Scale -10 - +15 µV. P1 component indicated by red arrow, N1 component indicated by blue arrow, P2 component indicated by green arrow, N2 component indicated by purple arrow, P3 component indicated by black arrow, LPP indicated by gold arrow.

P2 Amplitude and Latency (190 – 300ms)

Analysis of the amplitude of the P2 revealed a significant main effect of type of art, (F(2, 58) = 23.10, $p < .001$, η^2p= .44), in the time window of 190 – 300ms, with the mean amplitude of the P2 component being larger for both RA and AA than for IA (RA>IA, $p < .001$; AA>IA, $p < .001$). The mean amplitude did not differ between RA and AA. A significant main effect of group (F(1, 29) = 4.96, $p < .05$, η^2p= .15) demonstrated that the mean amplitude was larger for artists than non-artists. There were significant interactions between group and type of art, (F(1.97, 57.04) = 4.08, $p < .05$, $\eta^2p = .12$), group and location, (F(1.91, 55.48) = 7.07, $p < .005$, $\eta^2p = .20$) and type of art and location, (F(3.10, 89.75) = 17.98, $p < .001$, $\eta^2p = .38$). Finally, the 3-way interaction between group and type of art and location, approached significance (F(3.10, 89.75) = 2.65, $p = .05$, η^2p= .08). Figures 25, 26 and 27 show the P2 component at parietal and occipital sites (P3, Pz, P4, O1, Oz, O2) indicated by a green arrow.

The group and type of art interaction shows that in both groups, artists and non-artists, the mean P2 amplitude was larger for both AA and RA than for IA, however it was significantly greater for artists than non-artists for all three types of art. The type of art and location interaction revealed that whilst the P2 amplitude was larger at all locations for AA and RA than for IA, it was significantly larger at occipital and parietal locations compared to central and frontal locations (O>C, $p<.001$; O>F, $p<.001$; P>C, $p<.001$; P>F, $p<.001$) and at central compared to frontal locations (C>F, $p<.005$) for all types of art. The group and location interaction and inspection of the grand average charts (Figures 25, 26 and 27) show that at all locations other than frontal the amplitude of the P2 was larger for artists than non-artists. Finally, the interaction between group and type of art and location approached significance. Inspection of the topographic scalp maps (Figure 23) and grand average charts (Figures 25, 26 and 27) indicate that for all three types of art the amplitude of the P2 at occipital, parietal and central sites was greater for artists than non-artists.

Analysis of the mean latency of the P2 component revealed a significant main effect of type of art (F(1.37, 39.70) = 178.98, $p <.001$, $\eta^2p = .86$), and a significant interaction between type of art and location (F(2.58, 74.95) = 12.59, $p < .001$, $\eta^2p = .30$). The latency was greatest for AA, and smallest for IA (AA>RA, p <.05; AA>IA, p <.001; RA>IA, p < .001) at central and parietal locations compared to frontal, and at parietal compared to central locations (C>F, p < .05; P>F, p < .01; P>C, p < .05). There was also a 3-way interaction between group and location and hemisphere (*F*(2.88, 83.51) = 3.20, p < .05, η^2p = .10).

In summary the amplitude of the P2 was largest for artists, and for AA and RA rather than for IA, and in both groups it was largest at parietal-occipito sites. The P2 peaked earlier for IA and later for AA. This pattern is evident in Figures 25, 26 and 27.

N2 Amplitude and Latency (275-350ms)

Statistical analysis of the N2 component (275 – 350ms) confirmed that there was a significant main effect of type of art (F(1.64, 47.64) = 178.98, p < .001, η^2p = .31). There was also a significant interaction between both type of art and hemisphere (F(3.13, 90.70) = 3.23, p < .05, η^2p = .10) and type of art and location (F(2.04, 59.19) = 43.55, p < .001, η^2p = .60), and a significant 3-way interaction between type of art, hemisphere and location (F(5.53, 160.49) = 4.27, p < .005, η^2p = .13). Pairwise comparisons revealed significant differences between types of art, with larger negative amplitude for both RA and IA than for AA (RA>AA, p < .01; IA>AA, p < .001).

Further analysis revealed that the negative amplitude was larger in the right and mid line sites (M>L, p < .05; R>L, p < .05), than the left, and at frontal and central locations (F>C, p < .05; F>P, p < .001; F>O, p < .001; C>P, p < .001; C>O, p < .001) than at posterior locations. Finally, there was also a significant interaction between group and location (F(1.78, 51.56) = 5.43, p < .01, η^2p = .16), with artists show larger negative amplitude at central sites than non-artists, see topographic maps, Figure 24 and grand average ERPs in Figures 25, 26 and 27.

With regard to the latency of the N2 component there was also a significant main effect of type of art (F(1.19, 34.44) = 596.27, p < .001, η^2p = .95), a significant interaction between type of art and hemisphere (F(2.72, 78.88) = 6.01, p < .005, η^2p = .10), and significant 3-way interactions between group, hemisphere and location (F(2.71, 78.65) = 3.00, p < .05,

$\eta^2p = .09$) and between type of art, hemisphere and location ($F(4.54, 131.68) = 3.31$, $p < .05$, $\eta^2p = .10$). The latency was longer for both AA and RA than for IA (AA>IA, $p < .001$; RA>IA, $p < .001$), and at mid line and right sites than at the left (M>L, $p < .005$; R>L, $p < .005$). There was also a significant interaction between type of art, hemisphere, location and group ($F(4.54, 131.68) = 2.55$, $p < .05$, $\eta^2p = .08$).

These findings indicate that there are significant differences both between types of art and group. Both groups demonstrate more negativity for RA and IA than for AA at frontal and central locations, and in the mid line and right sites, whilst artists show larger amplitude than non-artists at these sites. The latency of this component, however, is longer for AA and RA than for IA.

P3 Amplitude and Latency (340 -590ms)

No significant main effects were revealed in the time window 340 – 590 ms. There was a significant interaction between group and location ($F(2.18, 63.25) = 3.64$, $p < .05$, $\eta^2p = .11$), significant interactions between type of art and hemisphere ($F(2.60, 75.38) = 3.38$, $p <.05$, $\eta^2p = .10$) and type of art and location ($F(2.66, 77.12) = 15.29$, $p < .001$, $\eta^2p = .35$), and a 3 way interaction between group, type of art and location ($F(2.66, 77.12) = 4.92$, $p < .01$, $\eta^2p = .15$). Post hoc analyses and inspection of both the topographic maps (Figure 24) and the grand-average charts (Figures 25, 26 and 27) reveal that the magnitude of the P3 was larger at parietal sites than at occipital, central or frontal sites (P>O, $p < .001$; P>C, $p < .001$; P>F, $p < .001$), and was larger at occipital sites than at frontal (O>F, $p < .005$) for artists than non-artists. There was enhanced positivity at parietal and occipital sites and at the right site for RA and IA compared to AA, in both groups, which was more pronounced for artists. However it can also be observed that the positivity in response to AA is more equally distributed across the three scalp sites than for the other two types of art and that when the differences between the two groups are inspected the *difference* in the amplitude is larger for artists in response to AA than non-artists, particularly at parietal sites.

With regard to the latency of the P3 component there was a significant main effect of type of art (F (1.5, 43.7) = 12.41, $p < .001$, $\eta^2p = .30$). Both AA and RA produced longer latencies in this time window than IA (AA> IA, $p < .001$; RA> IA, $p < .005$). There was also a 3-way interaction between group, hemisphere and location (F(2.85, 82.76) = 2.95, $p < .05$, $\eta^2p = .09$). Pairwise comparisons reveal longer latency in the mid line and right hemispheres than the left (M>L, $p < .005$; R>L, $p < .01$). The latency was longer at occipital sites than at parietal (O>P, $p < .001$; O>C, $p < .05$) and was longer at parietal and central sites than at frontal (P>F, $p < .05$; C>F, $p < .005$), in both groups. However, as before, these differences in latency are larger in artists than non-artists. Figures 25, 26 and 27, illustrate these effects.

In summary, the effect of both the type of art and the group appear on both the amplitude and latency of the P3 component. The amplitude was larger for all types of art at occipito-parietal sites for artists, however the distribution across the left, mid and right sites was more pronounced in response to AA for the artists than non-artists. With regard to the latency, the P3 latency was longer for both AA and RA than for IA in both groups, but overall, the latency was longer for all types of art and at occipital and parietal sites for artists than non-artists.

Late Positive Potential (LPP) Average Amplitude (500 – 1000ms)

An ANOVA of the Late Positive Potential (LPP) also revealed no significant main effects, and only one significant interaction of interest, that between type of art and location (F(2.45, 70.95) = 3.46, $p <.05$, $\eta^2p = .11$). Post hoc analysis revealed that the amplitude was significantly larger in both the left and right hemispheres than the mid line hemisphere (L>M, $p <.01$; R>M, $p <.005$), and that it was largest at parietal sites (P>O, $p<.001$; P>C, $p <.001$; P>F, $p<.001$), and larger at central and occipital sites than at frontal (C>F, $p <.001$; O>F, $p<.005$). Inspection of the topographic scalp maps (Figure 24) shows that starting at 500 ms a large posterior effect can be observed, with larger amplitude at parietal sites for all types of art in both groups. In artists the amplitude in this location appears to be larger and more widespread than for non-artists, and larger for AA than for

RA and IA, whilst for non-artists the amplitude is smaller for AA than for either of the others. Furthermore, inspection of the grand average charts (Figures 25, 26 and 27) suggests that the amplitude is generally larger at occipital sites for all categories of art for artists than for non-artists, is smaller in response to IA than to either AA or RA, and that the difference between the groups is most evident in response to IA.

To summarize, the amplitude of the LPP was largest at left and right parietal sites in response to all categories of art, in both groups, but artists demonstrated larger amplitude in response to AA at these sites. At occipital sites artists' demonstrated larger amplitude than non-artists to all categories of art, whilst it was larger for AA, the difference between the groups appears to be greater in response to IA.

3.3.3 Discussion

Main results

The aim of this study was to investigate the electro-cortical correlates of expertise and the affect of modern art. Two groups of participants, artists and non-artists, viewed pictures of modern art in three categories, representational (RA), indeterminate (IA) and abstract (AA). They were asked to rate their immediate, emotional, visceral response whilst EEG was recorded. They also viewed two plain coloured shapes, rare (RSS) and frequent (FSS) non-target stimuli, but were not required to make a response to these.

Representational art allowed the investigation of visual art where clear semantic content may have influenced affect ratings. Abstract art has no recognisable content; emotional responses are simply to line, colour and shape. Finally, indeterminate art represents a perceptual challenge, objects are not immediately, if at all, recognisable, like seeing faces or galloping horses in clouds.

The following main results were found. Frequency of rating the level of affect revealed that RA had greatest emotional effect on non-artists, whilst artists rated IA as most affective. Whilst AA was rated as evoking the least affect in both groups, artists rated AA as having greater affect than non-artists. Art expertise was associated with larger ERP amplitudes in response to all categories of art. This positive expertise amplitude relationship was most evident in response to AA compared to either RA or IA. Where artists displayed an increase in mean amplitude in response to AA, non-artists displayed the converse, mean amplitude in this group decreased in response to AA compared to RA and IA. The N1, thought to index early visual processing of emotional stimuli, was evident only for artists. Furthermore, the N2, thought to index natural selective attention, was evident for RA and IA, but not AA, in both groups. The P3 and LPP, components most associated with affect and long term memory, were evident in both groups for all types of art, but the difference between groups was most evident in response to AA. Finally, lack of expertise appears to impact on the link between self-reported emotional affect and magnitude of the ERP. Non-artists demonstrated larger ERP amplitudes in response to RA and IA, art they rated as having greatest affect. This was not evident in artists.

Art and affect

As predicted, non-artists rated affect of AA significantly lower, and significantly faster, than that for both RA and IA. On the other hand, there were no significant differences in either affect rating or time taken between the three categories of art by artists. The mean rating for IA was virtually the same in both groups. When we look at high and low affect ratings artists found almost equal numbers of AA to have high or low affect, and took almost the same time to make their decision as for the other categories of art, whilst the opposite was found in the non-artists, who, as expected, rated significantly more AA as having low affect than high (Pihko et al., 2011), and made their decision significantly faster than for the other two categories. This suggests that expertise encouraged more consideration and interest before a decision was made regarding affect. This supports findings of Ishai et al., (2007) and Vartanian and Goel (2004a) regarding aesthetic affect and preference, and also the proposal of Sylvia (2009) that knowledge emotions such as confusion or surprise are involved in the appraisal of art. The affect ratings indicate a more equal emotional response from artists to the different categories of art, and, as expected, a strong lack of emotional effect of AA on non-artists (Cinzia & Vittoria, 2009; Pihko et al., 2011; Vartanian & Goel, 2004a; Wypijewski, 1997) suggesting that semantic content drives the emotional response to art, particularly in those with little art expertise.

With regard to RA and IA, non-artists rated virtually the same numbers as having high or low affect. But artists rated a significant number of IA as having high affect compared to low, compared to the other two categories. This suggests that visual indeterminacy is an important factor regarding affect (Ishai et al., 2007) and reflects the importance of visual ambiguity in art (Gregory, 1988). Non-artists rated RA as having greatest effect, suggesting that they responded to the real world content. Content rather than style has been found to be of central importance regarding the appreciation of RA (Augustin & Leder, 2006). It has previously been proposed that expertise enables greater discrimination of the style of AA and IA allowing for enhanced semantic processing, whilst art naive viewers depend more on content-related processing (Belke, Leder & Augustin 2006; Pihko et al., 2011) and refer to criteria such as personal feelings (Augustin & Leder, 2006). Leder et al., (2004) propose that the challenge of modern art requires additional stages of processing to result in an emotional response; the cognitive experience of modern art is more than simply an interesting perceptual process. The stimulation of successfully cognitively mastering the art results in the motivation to further expose oneself, increasing interest and expertise. Thus emotional responses to different categories of art appear to depend on art expertise (Augustin & Leder, 2006; Augustin et al., 2008; Cupchik et al., 2009; Pihko et al., 2011), particularly abstract art.

Non-Target Stimuli

Under free viewing conditions of the non-target stimuli the mean amplitude of the 5 ERPs of interest (the P1, N1, P2, N2 and P3) was larger in response to RSS than to FSS, and the latency was longer for the FSS. An early positivity was evident at occipital sites in response to both stimuli, with larger amplitude and shorter latency in response to RSS than for FSS, particularly for the artists. The P1 and N1 waves are obligatory, exogenous sensory responses, known to be larger for attended than non-attended stimuli, which vary in amplitude and latency according to low level physical characteristics of the stimuli (Hillyard & Anllo-Vento, 1998; Luck & Kappenham, 2012). The anterior N2 effect is observed only when subjects are searching for an item that differs from the rest of the array (Luck, 2012), and indexes selective attention (Olofsson & Polich, 2007). Here the amplitude of the N2 component was larger for the RSS at frontocentral sites. The P3 amplitude is also influenced by the amount of attention allocated to a stimulus (Luck & Kappenham, 2012; Polich 2007a) and here the increased amplitude in response to RSS at occipito-parietal sites suggests the attention and visual arousal of both groups increased, despite the fact that no response was required to either of these stimuli. The consistently longer latency in response to the FSS may be attributed to difference in the brightness or change in colour between the non-target stimuli (Kappenham & Luck, 2012). These findings suggest that the RSS recruited more attentional resources and selective attention than did the FSS, and that this effect was enhanced in artists.

Art expertise: increased ERP amplitude in response to art

In contrast with the findings of Pang et al. (2012), our results suggest that rather than expertise being associated with reduced ERP amplitude, it is the converse; greater expertise is associated with increased ERP amplitude. Whilst Pang et al., (2012) focussed on the P3 and LPP component in a passive task, here we found that not only did amplitude of the P3 increase in response to target stimuli, but overall, these data point to group differences in the amplitude of all 6 components analysed, with artists demonstrating increased magnitude in response to all types of art than non-artists. Rather than expertise being associated with *reduced* neural responses, reflecting increased neural efficiency due to extensive practice, we suggest that art expertise is associated with *increased* neural responses reflecting greater sensitivity to emotional content, attention and memory resources. The increased attention artists allocate to stimuli is clearly demonstrated when we look at the analysis of the components P1, N1, P2, N2, P3 and LPC which reveal a number of interesting interactions.

Both the P1 and N1 are known to be sensitive to low-level features such as colour, luminance and contrast (Anllo-Vento & Hillyard, 2006; Bradley et al., 2007; Vogel & Luck, 2000). None of these features were measured, controlled or manipulated in this study, as negligible changes can produce dramatic effects in art, particularly of luminance. Livingstone (2008) explains that the most primitive or necessary visual information is found in luminance variations, it determines depth, motion and spatial perception, and artists since the thirteenth century have employed luminance contrasts to enhance their art. Artists showed larger amplitude of the P1 than non-artists for all three categories of art, particularly at occipito-parietal sites. Furthermore in terms of stimulus type the activation in artists is similar for all three types of art, whereas the activation in non-artists is dissimilar, with almost no P1 evident in response to AA. This suggests that artists allocated more attention, may be more sensitive to differing levels of luminance and were more affected to all categories of art, than non-artists at this very early time point (Carretié et al., 2004; Delplanque et al., 2004). The P1 has been reported in response to unpleasant pictures at occipital sites (Carretié et al., 2004; Delplanque et al., 2004; Smith, Cacioppo, Larsen & Chartrand, 2003). Here, whilst reasonable to suggest that artists would find visual art generally more affective than non-artists, it is unlikely that they would find it more unpleasant. On this occasion the P1 appears to be in response to emotionally affective stimuli, pleasant or unpleasant. The lack of evidence of a P1 in response to AA in non-artists, art rated as least affective, supports this.

The N1 was evident only for artists, for all categories of art. The visual N1, indexed to the allocation of attentional resources, selection and discrimination (Anllo-Vento & Hillyard, 2006; Vogel & Luck, 2000), and to early visual processing of emotional stimuli (Carretié et al., 2007; Foti et al., 2009; Keil et al., 2002; Weinberg & Hajcak, 2010), has also been associated with expertise (Bigman & Pratt, 2004). A later N1 (about 170ms) component has been reported in response to dogs and birds in experts (Busey & Vanderkolk, 2005; Tanaka & Curran, 2001), and linked to face processing and recognition (Rossian & Jacques, 2008). Here we can conclude the artists allocated greater attentional resources, were more emotionally affected by all three categories of art, and were more expert at examining stimuli for recognisable objects or content, than non-artists.

Whilst the P2 and N2 components were evident for both groups, again amplitude was larger for artists than non-artists, in response to all art. The difference was most evident in response to AA at occipito-parietal sites for the P2, and at central sites for the N2 for RA and IA. This suggests that whilst both groups were responsive to emotional evaluation and affect of the artworks (Carretié et al., 2001, 2004; Delplanque et al., 2004; Luck & Hillyard, 1994; Olofsson & Polich, 2007), the effect was greater for artists. An enhanced P2 has been found in non-affective research in response to target stimuli, particularly infrequent targets (Luck & Hillyard, 1994), but early studies examining ERP responses to affective line drawings indicate that the magnitude of the P2 is sensitive to affective evaluation (Begleiter, Porjesz & Garozzo, 1979). Our findings support this. An increased P2 in response to AA in artists suggests they found AA more affective than non-artists, and their behavioural response reflected this. The N2 appears sensitive to the salience of the stimuli (Codispoti et al., 2006; Luck, 2012), emotion (Foti et al., 2009; Olofsson & Polich, 2007; Schupp et al., 2003a, b; 2004; 2006; Tommaso et al., 2007; Weinberg & Hajcak, 2010) and has been observed when subjects search stimuli stored in visual working memory (Dell'Acqua et al., 2010). Hajcak et al., (2012) report an early positive negativity (EPN) in the time range of the N2 generally observed following emotional content, related to increased selective attention. Accumulating evidence suggests that it may be particularly sensitive to pleasant rather than to unpleasant or neutral content (Foti et al., 2009; Schupp et al., 2003a, b; Weinberg & Hajcak, 2010). The increase in magnitude here suggests that it is in response to emotional valence. Artists were more engaged and affected than non-artists, particularly in response to IA and RA, which they also reported to be the most affective categories of art.

The findings of two later ERP components of interest, the P3 and LPP may reflect the role of knowledge in long-term memory and appreciation of art (Leder et al., 2004). The focus here is on attention and working memory operations during cognitive task performance, particularly those sensitive to emotional processing of visual stimuli. We observed an increase in magnitude of the P3 in response to evaluation of affect for all art, at occipito-parietal sites. The presence of this component, thought to be heavily dependent on attention (Hajcak et al., 2012), linked to context updating in working memory (Donchin & Coles, 1988) knowledge in long-term memory (Leder at al., 2004) and categorisation (Luck, 2012), suggests that participants in both groups were attentively processing all three categories of art. Latency was longer for both AA and RA than for IA in both groups.

Again, the effect was larger for artists than for non-artists, and more pronounced for AA. This suggests that the evaluation of affect of art appears to induce a higher level of attention and arousal in artists than in non-artists (Duncan-Johnson & Donchin, 1977; Polich, 2007b), with the effect being more evident for AA, art with no semantic content. The P3 has previously been reported to be sensitive to beauty and aesthetic discrimination of geometric shapes (Tommaso et al., 2008). The increased positivity in artists here reflects their higher affective rating of art, with the difference between the groups most evident in response to AA.

Although the data point to only one significant interaction with regard to the LPP, the topographic maps and the almost significant interactions point to a larger centro-parietal LPP for all art in artists than non-artists, with the difference most evident in response to AA. This long lasting increased ERP positivity in response to arousing pictures has often been observed (Cuthbert et al., 2000; Foti et al., 2009; Keil et al., 2002; Mini et al., 1996; Schupp et al., 2000), and again is associated with top-down processing influences, evaluation (Hajcak, Moser & Simons, 2006; Krompinger, Moser & Simons, 2008; Moser et al., 2006) and subjective emotional experience (Luck, 2012).

These results indicate that magnitude of the P3 and LPP increased in response to all art during affective evaluation, with the effect more pronounced in artists. This appears to contradict the findings of Pang et al., (2012). However, their study asked participants to simply view the paintings and stimuli, whereas on this occasion participants were required to make an affective evaluation, known to have a positive effect on the magnitude of these components (Cuthbert et al., 2000; Schupp et al., 2004, Weinberg & Hajcak, 2010). Nevertheless, our findings suggests that not only does expertise effect the evaluation of art, engagement is also required; simply looking at art may not be enough to experience its affect. Appreciating art appears to reflect the role of knowledge in long-term memory and involves top down processing.

Expertise and Abstract Art

The positive expertise amplitude relationship was most evident in response to AA. Where artists displayed an increase in mean amplitude of the ERP component in response to AA compared to RA and IA, non-artists displayed the converse, the mean amplitude in this group decreased. This is particularly evident for N1, P2, P3 and LPP. This difference suggests that the early attention of artists was engaged by AA (Carretié et al., 2004; Delplanque et al., 2004), they allocated greater attentional resources (Hillyard & Anllo-Vento, 1998; Luck & Kappenham, 2012), were more adept at engaging higher order visual processing (Carretié et al., 2001, 2004; Luck & Hillyard, 1994), experienced greater emotional arousal (Duncan-Johnson & Donchin, 1997; Polich 2007a; Tommaso et al., 2008) and that their expertise influenced top-down processing, specifically in response to AA (Hajcak et al., 2006; Moser et al., 2006). The opposite was true in non-artists. This is both in line with their subjective arousal ratings and supports previous research (Cuthbert et al., 2000; Pihko et al., 2011; Schupp et al., 2004; Vartanian & Goel, 2004a, b; Weinberg & Hajcak, 2010). It also suggests that not only knowledge and experience, but great effort is required to appreciate abstract art (Augustin & Leder, 2006; Belke et al., 2006), whilst for those with little knowledge and experience semantic meaning is necessary (Belke et al., 2006; Vartanian & Goel 2004; Cinzia & Vitoria, 2009; Vessel & Rubin, 2010).

The N2; not evident for AA

As we expected, the N2 amplitude was influenced by category of art. In both groups the N2 was evident in response to RA and IA, with larger amplitude at central sites, but not evident in response to AA. The N2 appears to index natural selective attention (Codispoti et al., 2006; Dolcos & Cabeza, 2002; Schupp et al., 2004) and is responsive to emotional stimuli (Olofsson & Polich, 2007). Here the N2 may have been responsive to valence, with larger amplitude observed in response to RA and IA, art rated as having most affect by both groups. Alternatively, this effect may simply be in response to the perceived semantic content of the art-works, supporting the proposal that familiar content, memory and mental imagery are all important regarding the appreciation of art (Augustin & Leder, 2006;

Fairhall & Ishai, 2008). As AA contained no recognisable objects to stimulate natural selective attention there was nothing to run away from, nothing to eat, nothing to mate with, so no N2 component.

Increased ERP amplitude for affective art

Previous studies using visual art as stimuli to explore aesthetic judgement and preference (Di Dio, Macaluso & Rizzolatti, 2007; Kirk, 2008; Kirk et al., 2009a,b; Vartanian & Goel, 2004a,b), aesthetic perception and beauty (Tommaso et al., 2008; Kawabata & Zeki, 2004; Ishuzu & Zeki, 2011) and the appeal of visual art (Lacey et al., 2011), have reported that looking at visual art (not necessarily beautiful) activates the reward-related areas of the brain. Lacey et al., (2011) propose that the appeal of visual art is based on its artistic status alone, not necessarily its aesthetic value, its beauty or its valence. These results support this notion, with a proviso. Looking at visual art with semantic content is rewarding, even if you have little or no knowledge (Belke, Leder & Augustin, 2006; Di Dio & Gallese, 2009; Vartanian & Goel 2004a; Vessel & Rubin, 2010), but not abstract art. However knowledge enhances that experience to include abstract art. Whilst both expertise and great effort are required to be able to sustain interest and to appreciate AA (Augustin & Leder, 2006; Belke et al., 2006), simply effort appears to be required to experience the emotions aroused by IA and RA.

Conclusions

In response to affective art the amplitude of both endogenous and exogenous ERP components increased in both groups. Artists demonstrated larger ERP magnitude in response to all categories of art than non-artists, although they did not rate all art as having more affect. Their increased stimulation is evidenced by enhanced perceptual and emotional responses, supporting our hypotheses. Rather than expertise having a negative correlation with amplitude (Pang et al., 2012), expertise appears to have a positive effect, with increased magnitude of P3 and LPP at centro-parietal sites indexing greater emotional arousal. This expertise effect is particularly evident in response to abstract art.

Due to artists' knowledge and expectations, it appears that reward-related areas of the brain were activated (Kirk et al., 2009a,b; Lacey et al., 2011), resulting in increased attentional demand (Kirk, 2008; Lengger et al., 2007) despite lack of semantic content. These results support Leder at al., (2004), regarding challenges, cognitive mastering and evaluation of modern art. Whereas attention of non-artists faded quickly, experts remained engaged, whether they found art affective or not.

We proposed that beauty, or aesthetic pleasantness is not the most important aspect of appreciating modern art, but that the positive or negative affect it elicits is (Silvia, 2009). Our results support this hypothesis, with increased magnitude of ERP components associated with emotional response evident for all art in artists, and that rated as affective in non-artists. As such, future research studying judgement of modern art should consider a range of emotions. To concentrate on beauty or pleasantness may degrade the power of art.

A limitation regarding this and previous studies is that, in fact, they are not using visual art as stimuli, but reproductions. The original size of the 300 artworks reproduced here ranged from 27cm x 20cm to over 3.5m x 2.5m but were displayed within 1931 x 1931mm format on a computer monitor. Reproducing art immediately diminishes its impact, rendering it to the status of interesting stimuli, no longer art. The whole intent of the artwork is compromised as soon as it is reproduced, no matter how well. Original paintings viewed in the context of a gallery have previously been rated as more pleasant or interesting than their reproduced counterparts (Locher, Smith & Smith, 1999). Despite logistical and paradigm problems research should endeavour to explore neurophysiological reactions to visual art using originals. Research into viewing habits of gallery visitors suggests that the average time spent contemplating art in galleries is 30 seconds (Locher at al., 2007). Although differences between schools of art have been identified in 1ms (Bachmann & Vipper, 1983, as cited in Augustin et al., 2008), and here we demonstrated differences in visual and visceral responses in presentation times of less than 1500ms, perhaps these differences are not specific to art, but are simply in response to visual stimuli. Most art is created to be contemplated, to be thought provoking, and to engage. In order to ensure responses are to art longer presentation times could be employed, in art galleries. Finally, the impact of expertise could be further explored. Does expertise impact on visual and affective processes more generally? Do art experts see all things faster, differently, and are more engaged?

We found that looking at art is interesting and rewarding, particularly for artists, and does not depend upon aesthetic preference. We report increased amplitude of ERPs sensitive to emotional content in response to modern art in two groups, artists and non-artists, with an enhanced effect in artists. Both groups report that indeterminate art and representational art had greatest affect, which is supported by the ERP magnitude. However, differences between groups are most evident in response to abstract art, suggesting that expertise is important regarding appreciation of abstract art.

4. Chapter 4: Effect of context on the art experience: arousal and aesthetic response, viewing time, and memory for visual art. Experiment 2: A behavioural study.

4.1 Introduction

In Chapter 3 the ecological validity of using reproductions of art, in a laboratory, to study the effect of art on cognitive, neural or affective processes was questioned. As previously discussed, a fundamental problem with this research is the context: both where the art is physically viewed and whether the art itself is original or reproduced. Most visual art was not created to be viewed as a reproduction, but to be experienced in its original form, in a specific setting, such as an art gallery, cathedral, museum, town hall, or above the fireplace in a home. The scale, colours, luminosity, texture, the status and authenticity, all depend on art being experienced in its original form, in an appropriate setting. However, for practical reasons, empirical research into aesthetic experience rarely uses original works of art as stimuli, but some form of reproduction (books, post cards, slide projections, or images on a computer screen), raising the question of comparability of the findings of experimental aesthetics with the aesthetic experience of viewing original art (Locher, Smith & Smith, 2001). Given this widespread use of reproductions of art in aesthetics research it is surprising how few studies have explored what may be lost, or possibly gained, in an aesthetic experience when the viewer interacts with a reproduction of a work of art, compared to the original.

4.1.1 Context: this is Art

When experiencing art there is nothing like the original, as most museum, gallery and auction house curators would assert. Attendance to art museums and galleries is steadily rising (as cited in Brieber et al., 2015b), and investment in exhibition spaces and galleries appears essential to the redevelopment of former industrial bases (Plaza, 2006) such as Liverpool Docks (Tate Liverpool), Bilbao (Guggenheim) or Newcastle (Baltic). Whilst digital media has had a huge impact on music and literature, it does not appear to have the same kind of impact on experiencing art. Although most major galleries have virtual tours available on the World Wide Web, they are used to complement rather than replace a real visit (Marty, 2007, 2008).

In 2004 Leder et al., drew attention to the influence of context in their information-processing model of aesthetic experience, indicating that context influences affective reactions. Whilst brain-imaging studies (in the laboratory) have concluded that context and prior expectations significantly modulate aesthetic value (Kirk et al., 2009a; Noguchi & Murota, 2013), the physical context in which art is experienced is also important regarding status and classification that the art is authentic (Huang et al., 2011; Newman & Bloom, 2012). Art experienced in a museum, gallery, or exhibition, or works labelled as art, are contextually perceived as art, encouraging aesthetic processing (Leder et al., 2006; Kirk et al., 2009b).

Similarly, Jacobsen's 2006 framework includes the 'situation' factor to establish that every art experience, whether in a museum or gallery, in a book or on a postcard, on a computer screen or television, is embedded within a variety of contexts (Locher, 2012). More recently Chatterjee and Vartanian (2014) contributed their aesthetic triad model of aesthetic processing, positing that the context in which objects are encountered and appraisals that focus on objects as art distinguish aesthetic experience from non-aesthetic experiences. They suggest that viewing and appreciating art is more than simply an interesting perceptual process; the experience emerges from the interaction between sensory-motor, emotion-valuation, and meaning-knowledge circuitry.

With modern and contemporary art context may be particularly important regarding the aesthetic experience. Traditionally artworks have been seen as autonomous objects, they are recognisable as art, wherever they are viewed. However, the twentieth century saw a movement towards art that lacked these traditional, recognisable, reassuring qualities. Two famous examples illustrate this; Pablo Picasso's 1942 'Bull's Head', and Marcel Duchamp's 1917 "Fountain', see Figures 28 and 29.

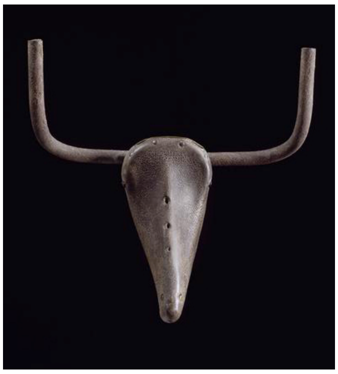


Figure 28. Pablo Picasso, Tête de taureau (Bull's Head), bicycle seat and handlebars, 1942, 33.5 x 43.5 x 19 cm. Musée Picasso, Paris

Figure 29. Marcel Duchamp, Fountain, 1917, replica 1964. 360x48x610mm. TATE

In 2004, Duchamp's 'Fountain' topped a poll of 500 British art experts as the single most influential artwork of the century (TATE, 2015), yet it is clearly a readymade urinal. It is a work that continues to challenge conventional definitions of art. When viewed in the context of an art gallery it is perceived as art, if viewed elsewhere, it would most probably be perceived as a urinal. Picasso's 'Bull's Head' is constructed from the seat and the handlebars of an old bicycle, but viewed in the context of art by Picasso, they become a sculpture of a bulls head. Whilst we are aware that these are found objects, the context in which they are perceived defines them as art. More contemporary examples of this would include works by YBA's (Young British Artists) in the 1980's. These artists have preserved dead animals (Damien Hirst), appropriated objects from medical history (Christine Borland), crushed found objects with a steamroller (Cornelia Parker) and presented their own bed as art (Tracey Emin). Nevertheless, when these objects are perceived in an appropriate context, they become art. Possibly the most famous contemporary and controversial example of this contextual definition of art is Banksy, the graffiti artist. His works have been seen on famous landmarks like the West Bank Barrier or outside a Bristol youth club. Once seen as an act of defiant vandalism collectors in the high-end art market now see a Banksy stencil as highly desirable. But, Banksy himself has declared that if his art is taken off the wall he put it on, then it is no longer art (Perry, 2015).

In order to explore the transferability of the aesthetic experience, whether viewing art as a form of reproduction evokes the same responses as viewing art in its original form, Locher et al., (1999) asked museum-goers at New York's Metropolitan Museum of Art (the Met) to evaluate each of nine paintings by renowned artists such as Bruegel, Rembrandt and Vermeer, on measures regarding the physical and structural properties, content and aesthetic qualities. A second group viewed the same pictures as slide-projected images, a third group on a computer screen, and made the same judgements. Only four of the sixteen evaluative ratings were statistically different. Paintings viewed in the gallery were rated as more pleasant, the details were seen as more immediate or apparent and content was seen as more similar (as opposed to contrasting) than in the other two conditions. Locher et al., (1999) conclude that the finding that most of the measures did not differ between conditions demonstrates that participants were able to adjust to the fact that they were looking at reproductions, and could 'look past' the limitations of the medium. They do, however, acknowledge that almost all the participants in this study were experienced in the visual arts. In order to address this limitation they replicated the study with individuals who had little or no art expertise. Again the ratings of the qualitative aspects of the artworks (i.e. symmetrical/unsymmetrical, patterned/random) and quantitative (i.e. crowded/uncrowded, simple/complex) were remarkably similar across the original and reproduction formats. However, the majority of the artworks studied were rated significantly more surprising, interesting and pleasant in the original than in reproduction, suggesting that the museum context enhances those aspects of art experience linked to emotion (surprising, pleasant, liking and interest). So, emotional responses to art may be stronger in settings more usually associated with looking at art, and, there is nothing like the original, particularly for the non-expert.

A number of more recent studies have further explored the impact contextual factors have on emotional responses to art. Gartus and Leder (2014) and Gartus, Klemer and Leder (2015) explored how two contexts - street and museum affected aesthetic judgement and aesthetic emotions. They embedded modern works of art and graffiti art in street and museum scenes. Participants with different style preferences (modern or graffiti) evaluated the art regarding liking, valence and interest. Context, in combination with personal preference affected the evaluation of art. For modern art, beauty and interest ratings were higher in the museum than street context, but context made no difference for graffiti art. Interest in modern art led to increased liking and interest ratings for modern art, but not for graffiti. Interest in graffiti led to higher ratings for graffiti, but not for modern art, and, higher valence ratings in the street context, where graffiti is usually seen. Finally, viewing times were longer in the museum than the street. The conclusion here is that although museums do not always elicit the most positive affect, context appears to influence aesthetic judgement, particularly beauty and interest, as does the style of art and personal preference.

In a recent ambitious and elegant study Brieber et al., (2015b) also asked participants to rate their experience of an art exhibition presented in two contexts: a museum and a laboratory, allowing them to assess the contextual sensitivity of the experience of art and the psychological value of experiencing art in a museum. The stimuli were 25 paintings, photographs and collages from an exhibition entitled Beauty Contest, held at the Museum Startgalerie Artothek (MUSA) in Vienna. A computer-simulated version of the exhibition was created which included the general information on the gallery’s panels, reproductions of the artworks, and their corresponding information labels. Participants could navigate from one artwork to another using the arrows on the computer keyboard, whilst participants in the museum could freely view the art, following the route prescribed. Three groups viewed the exhibition. The Museum-Lab group (ML) viewed it in the museum in the first session and in the laboratory, on the computer-simulated version, in the second and the other group vice versa (LM). A third group (LL) viewed only the computer-simulated exhibition, on both occasions. On completion of each condition they were asked to make five ratings for each artwork: Arousal, Valence, Liking, Interest and Understanding, by looking at each of the artworks again. Their results confirmed and extend their (and others) previous findings that original art in museums or galleries is liked more, and is experienced as more arousing, more positive and more interesting than in the laboratory (Brieber et al., 2014; Locher et al., 1999, 2001). They conclude that the experience of art is not isolated from the context in which it occurs, specifically, the affective and cognitive aspects of art appreciation (Leder et al., 2004) are enhanced in the museum context. Context may also impact on negative emotions in response to art. Gerger, Leder and Kramer (2014) suggest that defining an object as art may yield specific changes in how perceivers emotionally experience and aesthetically judge a stimulus. They asked participants to evaluate reproductions of artworks and pictures from the International Affective Picture System (IAPS, Lang et al., 1997) regarding how much they liked them, whilst facial EMG was recorded. Half the pictures had negative valence, half had positive valence. Half the participants were told that the stimuli they were going to study were modern press photographs, the other half were told that the stimuli they were going to study were of modern art. They found that 'artworks' with emotionally negative content were judged more positively than the non-art stimuli (i.e. press photographs). This suggests that negative emotions such as anger, disgust, fear, shame, sadness, are suppressed in response to negative artworks. Thus beauty or aesthetic pleasure may be found in the ugly or shocking, as long as it is seen in the context of art. However, as none of these stimuli were actually art, and all were viewed on a computer screen in a laboratory, such findings may not generalise to original art. Nevertheless, these results suggest that the context in which art is experienced influences affective and cognitive responses. It is more arousing, liked more, more interesting and is judged more positively when viewed in a museum or gallery, or when defined as art.

4.1.2 *Context and viewing time (glance or exploration)*

Looking at art and the subsequent emotional and aesthetic response to it is a complex process (see Chapter 1, Chatterjee, 2004a; Chatterjee & Vartanian, 2014; Leder et al., 2004; Jacobsen, 2010). Visual exploration is an active and dynamic process of gathering information and is influenced by contextual and personal factors (Rayner, 1998; Henderson & Hollingworth, 1999). Context may either facilitate or impede object recognition and identification (Oliva & Torralba, 2007) and investigations into the impact of the emotional state as an integral part of cognition are rare (Phelps, 2006). However, Kaspar et al., (2013) in two eye-tracking studies recently found that the emotional context, the mere presence of emotion-laden stimuli, significantly slowed down viewing activity, for all stimuli, positive, negative and neutral. Interestingly, there was no difference in the time taken to view the different categories of images, thus revealing that the intensity of the emotional context can be a significant moderator of viewing behavior.

Studies in galleries and museums suggest that the average time spent looking at original works of art is short, as little as 30 seconds (Locher et al., 2007). Smith and Smith (2001) reported a median viewing time of 17 seconds (mean 27 seconds) when people viewed paintings in The Metropolitan Museum of Art, New York, with the viewing times ranging from less than 10 seconds (about 50%) to longer than a minute (only about 10%). Whilst this study limited the number of paintings viewed to 6, they were exhibited as part of the museum's permanent collection, amongst hundreds of artworks. The number of artworks in a room has since been found to affect the time taken to view art, and the viewing time to decrease during the course of viewing an exhibition, due to museum fatigue (Bitgood, 2009). Heidenrich and Turano (2011) in a portable eye tracking study of only 4 participants found that viewing times ranged from 20 to 82 seconds, whilst participants' viewed only 5 abstract and 9 representational paintings in a museum. Although these studies highlight great variation in the amount of time people spend looking at art in an exhibition (10 – 82 seconds), these viewing times are surprisingly brief. However, it should be noted that longer viewing times have been reported when viewing art in a gallery than when viewing art in a street context (Gartus et al., 2015).

Brieber et al., (2014) propose that viewing time is the most basic indicator of viewing behaviour and examined the effect of context on the relation between the experience of art and viewing time. Participants viewed artworks (art photographs) selected from an exhibition held in the Museum of Contemporary Art, Vienna. One group freely viewed the artworks in the museum; the other viewed digital representations of the same art on the screen in the laboratory. They were encouraged to take as long as they wanted and their viewing time was measured using eye tracking. They were then asked to make a number of ratings regarding each artwork viewed (liking, interesting, understanding and ambiguity). Whilst there was no difference between contexts in the time spent viewing the labels giving information about the artist and the work, the participants in the museum group spent significantly longer (Median=38.75s) looking at the art in the museum than the laboratory group (Median=28.25s). They concur that although the viewing time in the museum was considerably longer than that previously reported (Smith & Smith, 2001) this might be due to differences in the methods of data collection (eye tracking versus observation). Also, participants were aware that their eye movements were being recorded, so a social desirability bias could not be excluded.

When participants are encouraged to freely view artworks in a gallery or museum, they have been observed to look at each artwork from less than 10 seconds to over a minute (Smith & Smith, 2001), with the average time being reported as less than 30 seconds (Locher et al., 2007). When participants are encouraged to freely view reproductions of artworks in a laboratory, the median time they look is 28.25 seconds (Brieber et al., 2014). In contrast to this, when participants take part in research into aesthetic responses in the laboratory they can be shown the reproduced image of the artwork for anything from 1 millisecond (Bachmann & Viper, 1983), 1500 milliseconds (Study 1, above) to 4 seconds (Ishai et al., 2007). Clearly the aims and design of the experiments influences the stimulus presentation time, but little is known about the effect differences in viewing time may have on the aesthetic and emotional response to art.

4.1.3 Context and memory for art

Brieber et al., (2015b) state that there are reasons to believe that context plays a substantial role in the memory for art. The perception of any object is not context free, contextual information is stored in memory with object-related information, facilitating subsequent object recognition (Oliva & Torralba, 2007). The museum or gallery context provides local spatial cues, such as the layout of the exhibition, the size of the artworks, the adjacent artworks, and the act of navigating a 3-dimensional space, all of which may aid the subsequent recall of the art experienced. This results in the successful recall of more artworks experienced in the museum than those experienced as a computer simulated version of the exhibition (Brieber et al., 2015b). Furthermore, genuine art in a museum is viewed for longer than reproductions in a laboratory (Brieber et al., 2014) allowing for a prolonged experience of art.

But, what makes art memorable? The emotional salience of an event is an important modulator of memory. Emotionally relevant events are more likely to be remembered than those that are not (Konig, 2008) with some studies suggesting that negative events are more likely to be recalled than positive ones (e.g. Charles, Mather & Carstenson, 2003). Studies have shown that arousing (both negative and positive) pictures with semantic content are more memorable than neutral pictures (Bradley, Greenwald, Petry & Lang, 1992). However, positive autographical memories, particularly those that are personally significant, appear to be more memorable than negative ones (D'Argembeau, Comblain & Van der Linden, 2005).

Ishai et al., (2007) found that both meaningful content and colour in visual art is necessary to make art memorable. When comparing representational art with indeterminate art more representational paintings were remembered than indeterminate, and the affective strength of the paintings increased the probability of subsequent recall. Whilst the aesthetic affect of art was independent of its' meaning and more heavily influenced by formal visual features (such as shape or form), recognition of familiar objects and semantic aspects influenced memory for the art. When colour paintings have been compared with monochrome pictures (Ishai et al., 2007), black and white line drawings or greyscale pictures, object recognition and memory retrieval was facilitated (Gegenfurtner

& Reiger, 2000). This suggests that colour provides important cues for object recognition. Interestingly, colour does not appear to influence aesthetic ratings (Ishai et al., 2007). Ishai (2011) comments that the human brain is not a passive viewer of art, but a dynamic interpreter that constantly generates predictions about the content and meaning based on previous encounters with similar visual input (not necessarily art). The ability to be moved by art appears to be universal. Looking at art recruits greater attentional resources than some other visual stimuli, and involves not only perceptual processes but also emotional and cognitive processes, suggesting that understanding and remembering the content of paintings, particularly modern and contemporary art, is an acquired, context-dependent skill.

Both context and content may influence the memorability of art. Whilst the content of the artwork may evoke emotions and autobiographical memories, the expectation of the visit to the gallery, and the actual physical environment may also affect subsequent memories of the artworks viewed (Brieber et al., 2015b).

4.1.4 Context: genuine art

A further aspect of the effect of context is the difficulty of differentiating the effect of physical location (the where), from the affect of genuineness (the real), and the original work of art. Are the differences reported so far due to the physical context; the atmosphere, the architecture, the layout, the space where the art is viewed? Or, are the differences due to the actual physical qualities of the art experienced?

There is evidence that art labelled as original is valued as more aesthetically pleasing than the same images labelled as reproductions, and that this is accompanied by increased neural activity in reward-related areas of the brain (Huang et al., 2011; Lacey et al., 2011; Kirk et al., 2009). However, this is in response to artworks viewed as some form of reproduction, in a laboratory, or an MRI scanner.

As Brieber, Leder and Nadal (2015a) point out, the limitation common to studies comparing experiencing art in museums and laboratories is that the genuine, original art is always experienced in the museum and the reproduced art is always experienced in the laboratory. Although this allows for a comparison of contexts, it does not facilitate the disentangling of the impact of physical context (museum or gallery vs. laboratory) and 'genuineness' (genuine vs. reproduction). In order to address this, participants viewed genuine artworks and computer-presented reproductions both in the gallery and the laboratory. They hypothesized that the experience of art would be enhanced in the gallery and when observing genuine stimuli, as opposed to the laboratory and reproduction stimuli. Furthermore, they expected that the genuine art experienced in the gallery would be appreciated the most.

Four groups of participants viewed 18 (unfamiliar) works of art from a contemporary art gallery, by 7 artists. A 2 (genuine vs. reproduction) x 2 (gallery vs. laboratory) design was employed. The first group viewed reproductions in the laboratory, the second genuine artworks in the laboratory, the third viewed reproductions in the gallery and the fourth group viewed genuine artworks in the gallery. After the initial viewing all were asked to view the art again (in the same manner as the first phase) and to rate their experience of each artwork (arousal, valence, liking, interest and understanding).

In contrast to previous research, neither physical context nor genuineness influenced participants' ratings. Brieber at al., (2015a) make two suggestions to explain these findings. The first is the nature of the exhibition; it was conceptual art, which by its very nature elevates the concept or idea over traditional aesthetic or material concerns (TATE, 2016). The participants were not experts in art, thus they likely found little to engage with or relate to in this exhibition. Second, the exhibition was a retrospective highlighting a sample of the work of a number of artists. It did not have a clear curatorial theme.

Previous studies had exploited exhibitions that did have a clear theme: they referred to social issues such as beauty (Brieber et al., 2015b) or nature and the urban environment (Brieber et al., 2014). Both were themes that people could relate to, have an opinion about, themes people could engage with. And, as Augustin and Leder (2006) indicate, non-experts tend to interpret art in relation to personal experiences or views.

These results raise a number of interesting issues regarding the effect of physical context and genuineness on aesthetic effect. The first is the impact of prior knowledge: is expertise essential to the appreciation of more challenging, perhaps less accessible art? The second is the importance of personal relevance: does art have to be meaningful and personally or socially relevant before physical context and genuineness enhances the experience? The third is the effect of genuineness itself: simply by creating an exhibition of original art in a laboratory did the researchers elevate the status of the laboratory to an art gallery? Did the context of genuineness override the context of the physical location?

The objective of this behavioural study was to determine whether the context in which artworks are viewed (original artworks or reproduced) influences the arousal and aesthetic response, viewing time and memory for contemporary art. The term context is used here to refer to the type of art (original or reproduction), and also to the setting.
Subsequently this study was conducted with 3 aims in mind:

- To examine the effect of context, original or reproduced works of art, on arousal, aesthetic response and viewing time.
- To examine the effect of context, original or reproduced, on memory for art.
- To explore what makes art memorable.

The experiment was conducted in a commercial art gallery not in a laboratory. The reason for this was to control for the context of the setting for both original art and reproductions of art. A popular commercial art gallery was chosen to ensure that the art was accessible to a wide range of participants and was not seen as elitist or requiring a high degree of expertise or specific knowledge. All the artworks were 2-dimensional pictures, either paintings or mixed media, allowing them to be reproduced in a form as close as possible to the originals. This allowed the contextual sensitivity of the experience of art (original or reproduction) to be addressed whilst controlling for the impact of the physical context.

It was expected that:

- There would be an enhanced affective response to original art: it would be more arousing and liked more than the reproductions, and viewed for longer, due to its physical qualities (such as size, texture, medium) and that it was viewed in its appropriate context, a gallery, and thus recognised as original art.

- The most memorable artworks would be those viewed as originals.
- The most memorable artworks would be those with clear semantic content, and which evoked personal memories. We also expected colour to influence the subsequent recall of the art.
- Arousal would be linked to memory, the memorable art would be the most affective, but not necessarily the most liked.

4.2 Pilot study

4.2.1 Introduction

A pilot study was conducted to identify twenty suitable contemporary artworks exhibited in a gallery as stimuli for this experiment. The Winter Exhibition of a large commercial art gallery, The Biscuit Factory, Newcastle upon Tyne, was chosen. The exhibition contained an eclectic mix of contemporary art. None of the artworks had previously been exhibited and were thus unlikely to have been seen previously by potential participants. In order to ensure the artworks had never been seen previously the pilot study was conducted on the opening night of the exhibition.

The aims of the pilot study were:

- To create two catalogues of artworks, with 2 artworks matched as far as possible by style, theme and content, by 10 artists, representing styles ranging from indeterminate to representational, and subjects ranging from figures to landscapes or interiors.
- To identify artworks that elicited a range of 'like' ratings, from dislike to like.

4.2.2 Method

Participants

45 gallery clients (30 female, 66.7%) with ages ranging from 18-77 years (mean age 49.3, SD 15.4) agreed to take part in the pilot study. They were randomly selected on the opening night of the exhibition. 30 (66.67%) were employed, 11 retired and 4 were students. 4 (8.89%) participants were artists. 15 had visited an art gallery fewer than 2 times in the last 12 months, 10 between 3 and 5 times, 9 between 5 and 8 times, whilst 11 had visited an art gallery more than 9 times in the last 12 months. All gave informed written consent. The study received ethical approval from the School of Life Sciences Ethics Committee at Northumbria University and was conducted in accordance with the Declaration of Helsinki.

Stimuli

The stimuli were all the 2-dimensional artworks (i.e. paintings, prints, multi media pictures) exhibited in the main first floor gallery of The Biscuit Factory during the galleries Winter Exhibition, representing the work of 88 artists (about 1100 artworks in total). Participants were requested to select only 2D artworks. 2D artworks were important because they provided greater opportunity for similarity between originals and reproductions than the 3-dimensional artworks.

Materials

Demographics: A short questionnaire to gather demographic information regarding age, gender, employment, and average annual number of visits to art galleries (Appendix 6). Task: Each participant was given a clipboard and pencil with a form to enter the artists' name, title of picture and a rating scale: 0 = extremely dislike to 10 = like very much (Appendix 6).

Procedure

After written consent was obtained a short demographic questionnaire was completed. Participants were asked to freely view the exhibition and whilst doing so choose 20 works of art from the main first floor gallery with a range of styles and subject matter. They were asked to choose art that elicited an immediate visceral response, art that made them go 'ooo', for either positive or negative reasons, then to rate how much they liked the picture as quickly as possible, and finally to record the name of the artist and title of the picture. On completion of the task participants were thanked and given the opportunity to ask any questions. Finally, they were given a debrief sheet. The total time of the experiment for each participant was between 30 minutes and 1 hour.

4.2.3 Results

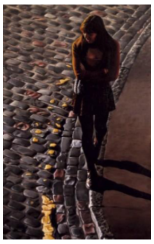
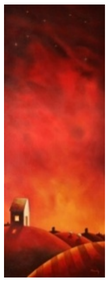
209 artworks by 89 different artists were originally selected. In order to narrow the stimuli for the main study only 2 works of art by 10 different artists were chosen. Artists who were only represented once and artworks that had been selected fewer than 5 times in total were then rejected. This resulted in 13 artists and 49 works. The work of a further 3 artists

(printmakers) were rejected as the gallery could not guarantee that that their work would remain in the exhibition for the duration of the study. The final criterion for selection of artworks was the range of 'like' ratings: those whose ratings were between 4 and 7 (limited affective reaction) on likeability were rejected.

The final set of stimuli comprised 2 works by each of the remaining 10 artists. The remaining artworks were then visually matched, as far as possible, regarding size, content, theme, style and colour. Table 10 shows the name of artist, title, medium and size, and the mean (and sd) of the like rating for the 20 works selected. Figure 30 shows the final matched pair of artworks, by artist, for Study 3, listed in 2 catalogues, Catalogue 1 and Catalogue 2.

Table 10. Name of artist, title of work, medium, size, mean (and sd) of 'like' rating for the artworks selected for Experiment 3.

Artist	Title	Medium	Size (cm)	Mean (sd) like rating
Chris Forsey	The Aln thru Trees	acrylic on canvas	50cm x 50cm	8.5 (2.9)
Chris Forsey	Misty Creek	acrylic on canvas	50cm x 50cm	6.5 (3.5)
Chris Jones	Emily	oil on canvas	80cm x 50cm	7.4 (3.1)
Chris Jones	Eye to Eye	oil on canvas	50cm x 50cm	3.5 (3.6)
Clifford William Blakey	A Barrier to the Sea	mixed media on paper	47cm x 67cm	7.1 (1.8)
Clifford William Blakey	The Battered Shore	mixed media on paper	26cm x 30cm	7.5 (2.4)
Darren Mundy	In the Dead of the Night	acrylic on canvas	50cm x 50cm	4.8 (2.9)
Darren Mundy	Shepherds Delight	acrylic on canvas	30cm x 81cm	4.4 (2.0)
Fletcher Prentice	Coffee Cans	oil on canvas	120cm x 90cm	5.6 (3.2)
Fletcher Prentice	Silver on Grey	oil on canvas	120cm x 90cm	2.8 (3.1)
Glynnis Carter	Bracken Landscape	mixed media on canvas	102cm x 102 cm	6.7 (2.0)
Glynnis Carter	Early Light	mixed media on canvas	92cm x 122cm	4.0 (2.0)
Huw Williams	Study in Blue	oil on canvas	168cm x168cm	5.40 (3.5)
Huw Williams	Storm	oil on canvas	168cm x168cm	2.50 (3.8)
Jill Martin Bovolaxai	Ancient City	mixed media on paper	126cm x 154cm	5.6 (2.9)
Jill Martin Bovolaxai	All Sorts	mixed media on paper	124cm x 155cm	7.4 (1.0)
Kevin Day	Plantation	oil on canvas	76cm x 100cm	8.7 (1.4)
Kevin Day	Storm Watching	oil on canvas	60cm x 76cm	6.9 (4.5)
Paul Kennedy	Party in My Head	oil on canvas	128cm x 124cm	4.6 (1.8)
Paul Kennedy	Race of Life	oil on canvas	77cm x 96cm	4.4 (1.8)

Artist	Catalogue 1	Catalogue 2
1 Chris Forsey	 **1 The Aln thru Trees**	 **11 Misty Creek and Seedheads**
2 Chris Jones	 **2 Emily**	 **12 Eye to Eye**
3 Clifford William Blakey	 **3 A Barrier to the Sea**	 **13 The Battered Shore**
4 Darren Mundy	 **4 In the Dead of the Night**	 **14 Shepherds Delight**
5 Fletcher Prentice	 **5 Coffee Cans**	 **15 Silver on Grey**
6 Glynnis Carter	 **6 Bracken Landscape**	 **16 Early Light**
7 Huw Williams	 **7 Study in Blue**	 **17 Storm**

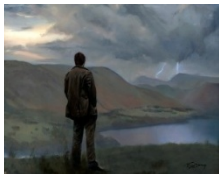
8 Jill Martin Bovolaxai	 **8 Ancient City**	 **18 All Sorts**
9 Kevin Day	 **9 Plantation**	 **19 Storm Watching**
10 Paul Kennedy	 **10 Party in My Head**	 **20 Race of Life**

Figure 30. Artists and artworks selected for Study 3, based on range of 'like' ratings and matched, as far as possible, regarding size, content, theme, style and colour.

4.2.4 Discussion

This pilot study was conducted to identify a range of stimuli for Study 3. The aims were to select 2 artworks each from 10 contemporary artists that had not been previously exhibited and that represented a range of styles and themes. They were to be suitable to be viewed as originals in the gallery and as reproductions on a computer screen, and should be should be both liked and disliked by viewers.

The result is a set of 20 two-dimensional artworks by 10 contemporary artists that are visually matched regarding style, size, theme, and wherever possible colour. Unfortunately, due to the nature of art it was not always possible to entirely match each artists work, thus compromises have been made, e.g. the works of Darren Mundy have similar content, but are clearly a different colour and proportion (see Figure 30).

4.3 Behavioural Study

4.3.1 Methods

Design

A within-subjects design was used. The dependent variables were reaction time, rating of affect and rating of like. Reaction time was measured in seconds (sec) from stimulus onset to button press response in the reproduction task and from stimulus onset to verbal response in the original task. 'Affect' was chosen to capture the immediate affective response to art. Affective responses to modern and contemporary art involve a wide range of both pleasant and unpleasant emotions; participants were to simply focus on their raw emotional response, not on the feelings the art evoked. Thus, other scales normally used in studies exploring this area, such as 'valence', 'interest' and 'understanding' (Brieber et al., 2014, 2015a,b) were not of interest here. "Like' was chosen as the second scale to see whether art which elicited high affect ratings was also liked the most. Affect was described as their immediate, visceral, intuitive response, how much it made them go "OOO", **not** necessarily how beautiful, or good, or pretty, or ugly, or shocking they thought the picture was (1 = no ooo, 9 = lots of OOOOOO). Like was described as simply how much they liked it, not how good, or skilled, or valuable, or desirable they thought the picture was, simply how much they liked it, or didn't (1 = don't like at all, 9 = like a lot). Qualitative responses were also collected from participants on completion of the viewing tasks. Participants were asked to recall one artwork and a short interview was conducted to gather data regarding affect, why it was the most memorable and their description of the artwork. Their summarised responses were recorded manually.

Participants

A total of fifty-five participants (31 female, 56%), with ages ranging from 18-75 years (mean 29.8, SD 14.6) consented and took part in the study. 23 were psychology undergraduates or post graduates, 32 were recruited via opportunity sampling. 16 participants reported further education or expertise in art and design and 7 reported working in the visual arts. 43 participants had visited an art gallery fewer than 5 times in the previous 12 months, 12 had visited a gallery 5 times or more in the last 12 months. All reported that they had normal or corrected-to-normal vision. The data from 3 participants was rejected before the final analysis, 1 due to the e-prime programme crashing during the reproduction task, 2 because they were unable to follow the procedure correctly. The study received ethical approval from the School of Life Sciences Ethics Committee at Northumbria University and was conducted in accordance with the Declaration of Helsinki. All participants gave their written informed consent before inclusion in the study and were given either a voucher for the gallery café (value £7.00) or course credits for their participation.

Stimuli

Stimuli were selected in the pilot study (see above). The stimuli were 20 2-dimensional artworks, 2 each from 10 contemporary artists, representing a range of styles, and themes. Digital images of all 20 artworks were selected either from the galleries website or were taken with a Sony SLT-A37R Digital SLT camera. Graphic manipulation of the stimuli was done using Paint.NET v3.5.10. The pictures were re-sized to fit within a 1931 x 1931 mm format (730x730 pixel), with a resolution of 96 dpi (dots per inch), without changing the original proportions, colour or luminance. The artworks were listed in two catalogues, Catalogue 1 and Catalogue 2, each containing 1 of the 2 artworks by each artist. See Figure 31. Catalogue 1 contained artworks 1 -10, Catalogue 2 contained artworks 11-20.

Materials and apparatus

Demographics: A short questionnaire to gather demographic information regarding age, gender, employment status, average annual number of visits to art galleries and years of art education (Appendix 7).

Task: The reproduction task was presented using E-Prime™ presentation software (E-Prime 2.0, Psychology Software Tools) on a MacBook Pro laptop computer, with a display resolution set at 1440 x 900, pixel depth 32- Bit Color, mirror off. On the computer each stimuli was preceded by a black centred fixation cross. All stimuli were presented in the centre of the screen on a white background, displayed for up to 60 seconds, followed by the 2 rating screens, 'affect' and 'like'. The numbers on the computer keyboard were used to record the responses. As soon as the participant responded the screen moved onto the next screen. For the original task the stopwatch app on a Blackberry Curve 8900 smartphone was used to record response times and a black cotton scarf was used as a blindfold.

Procedure

To minimise effects of different viewing contexts (i.e. gallery v laboratory) all testing took place in the gallery, during normal opening hours. The reproduction context was conducted in a quiet, small side gallery and the original context was conducted in the main gallery. The side gallery had no 2-dimensional artworks exhibited in it. To overcome order effects a counterbalancing procedure was employed. After written consent was obtained a short demographic questionnaire was completed. All participants viewed all 20 artworks, one catalogue as reproductions on the laptop in the empty side gallery, the other as originals in the main gallery. In order to counterbalance the procedure participants were randomly allocated to one of 4 testing protocols.

The 4 protocols were:

1: View Catalogue 1 as reproduction first, Catalogue 2 as original second.

2: View Catalogue 1 as original first, Catalogue 2 as reproduction second.

3: View Catalogue 2 as reproduction first, Catalogue 1 as original second.

4: View Catalogue 2 as original first, Catalogue 1 as reproduction second.

Reproduction Condition: participants stood in front of the laptop computer positioned on a display plinth in the side gallery. They were encouraged to stand at a comfortable distance and to angle the screen themselves. In order to allow participants to familiarize themselves with the laptop computer they first completed a 3-trial test task (see Chapter 3), followed by the experimental task. The stimuli were displayed, followed by 2 rating screens, the first asked them to rate the affect, the 'OOO', the second to rate how much they liked the artwork. Participants made their rating by using the numbers at the top of the laptops keyboard. As soon as the participant responded the screen moved onto the next screen. The 3 stimuli for the familiarization task on the computer were the same as those used for the familiarization task in Study 1 (see Chapter 3).

Original Condition: In order to attempt to replicate the method of presentation of the reproduction stimuli on the computer participants were blindfolded and escorted to each original artwork. This ensured that they did not see the art before the task commenced, they did not see surrounding artworks, and the artwork to be viewed was presented directly and immediately. They were positioned by the researcher at an appropriate distance from the artwork (depending on the size and location of the art), the blindfold was removed, and they were asked to look only at the artwork directly in front of them, and to try not to look around. Participants were asked to look at each work of art and in their own time verbally rate each one regarding first how much it affected them, then how much they liked it, both on a 9-point Likert scale. The time taken to respond was measured manually on a stopwatch by the researcher, and the two ratings were manually recorded as the participant responded (Appendix 8). They were then instructed to close their eyes and the blindfold was replaced. The researcher then led the participant to the next artwork. All stimuli were presented randomly.

Interview: Immediately after both the reproduction and original tasks were completed a brief (3-5 minute) face-to-face interview was conducted regarding their memory for one artwork. In the side gallery participants were seated in a comfortable chair and asked the following questions:

- Of all the artworks you have looked at, as part of this study, think back to the most memorable one, the one had the most impact. Imagine it.
- Tell me how this affected you?
- Can you tell me what made this artwork most memorable?
- Describe this piece of art to me as though describing it to a friend.

Their summarised responses were recorded manually. They were then shown a booklet with pictures of all 20 artworks they had seen and asked to identify the one they had chosen as most memorable. On completion of the task participants were thanked and given the opportunity to ask any questions. Finally, they were given a debrief sheet. The total time of the experiment for each participant was up to 1 hour.

Analysis

Quantitative Analysis: To address the research questions outlined above (section 4.1), paired sample t-tests were conducted to compare the mean ratings of affect, like and the mean time taken to respond between the original and reproduction contexts. Mean substitution was used in the cases where there was missing data. As two different methods were used to record the response time (RT) Z-scores were computed for the raw scores in the data set. In line with Brieber et al., (2014) the median (Mdn) response time in each context, and the variation of average viewing times was also computed. A Wilcoxon-Signed ranks test was conducted to compare the variation in the mean response time. Initial analyses of covariance were carried out on the data to investigate the moderating effects of age, gender and protocol. Post hoc analyses were conducted using the Bonferroni procedure with a significance level of $p < .05$ unless otherwise stated.

Qualitative Analysis: To bring order, structure and interpretation to the collected interview data (Braun & Clarke, 2006) a thematic analysis technique was employed for the interview. Each individual text was analyzed separately. Themes for analysis (phrases within the discussion) e.g. it made me sad, or, it was a sad picture; I liked the colour, or, the contrast between the colours, were taken from each text and coded. Once all the texts were coded a series of sub themes were created to group units of analysis, these sub themes were then condensed to identify themes. Both within-case and cross-case analyses were performed. The analysis concentrated on two areas, affect and memory.

4.3.2 Results

Descriptive statistics

Table 11 shows the participant characteristics for each protocol. Initial analyses of covariance were carried out on the data to investigate the influence of protocol, age and gender. As there were no significant effects (p > .05) in any analysis these variables are not discussed further.

Table 11. Participant demographic information, showing number of participants, age range, mean age (*and SD*) and gender, by protocol.

Protocol	No. of participants	Age *(SD)* (age range)	Gender F:M
1	15	29.1 *(13.8)* (18-75)	7:8
2	14	25.4 *(9)* (18-50)	6:8
3	13	32.2 *(16.4)* (19-63)	11:2
4	13	32.7 *(18)* (18-68)	8:5
Total	**55**	**29.8 *(14.6)* (18-75)**	**31:24**

Experience of art: analysis of rating of level of affect, liking and response time for original or reproduction art.

The mean rating of level of affect, liking and response time for the artworks in each context, original and computer are shown in Table 12. In line with the hypothesis, there were significant differences in both level of affect and liking. Original artworks were rated as having more affect than the reproductions ($t(51) = 5.41$, $p<.001$), and original artworks were liked more than the reproductions ($t(51) = 3.98$, $p<.001$).

Table 12. Mean (and SD) rating of the level of affect, liking and response time (RT), for artworks viewed as originals and as reproductions.

	Originals		Reproductions	
	Mean	*SD*	Mean	*SD*
Level of affect	5.31	*1.90*	4.57	*1.95*
Like	5.21	*2.05*	4.72	*2.00*
RT (sec)	10.30	*3.60*	1.37	*0.73*

As two different methods were used to record the viewing time no statistical analysis was conducted. Whilst the error in measurement for the original context is likely to be greater than the computer-timed viewing time in the reproduction context, a comparison of the observed difference in the mean viewing time was made. The mean viewing time in the original context was 10.3 seconds (range: 3.6 -27.9 seconds) whereas the mean viewing time in the reproduction context was 1.26 seconds (range: 0.43-2.37 seconds).

Analysis of the most memorable artworks.

Initial analysis of the artworks reported as the most memorable found that 45 were originals and 7 were reproductions (1 of these was a practice picture, so it is excluded from any further analysis). Overall, artworks by 9 of the 10 artists were selected. 6 artists had both of their works selected as the most memorable. A chi-square test of independence was performed to examine the relation between context and the most memorable artwork (with a Fischer's exact test). The relationship between these two variables was significant , $x2(1) = 55.54$, $p > .001$, indicating that original art was more memorable than reproduced.

Figure 31 shows the number of times each artwork was reported as being the most memorable, in each context, whether it was seen as an original or reproduction. Further analysis confirmed no difference in the mean rating of affect (Mean 7.04, SD 1.48) and mean rating of like (Mean 7.18, SD 1.95) of the memorable artworks, $t\ (50) = 0.55$, $p > .05$.

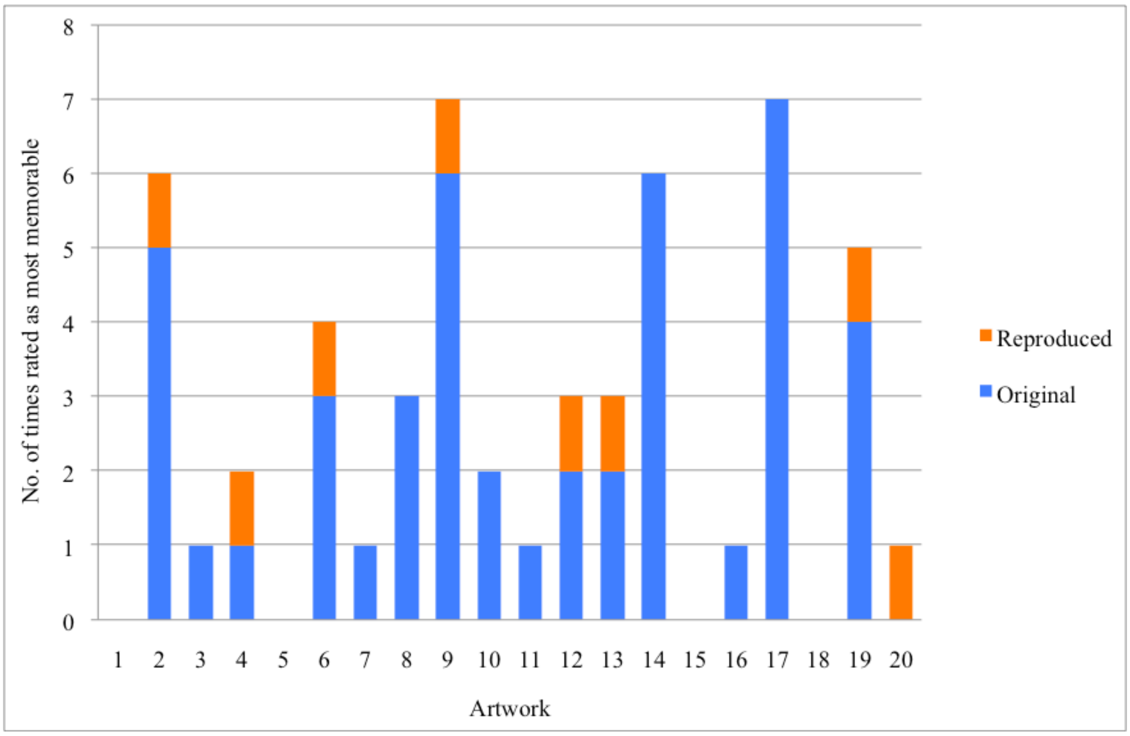


Figure 31. The number of times each artwork was reported as being the most memorable, in each context, Reproduced or Original.

Thematic analysis of the most memorable artworks

This research was interested in the effect of context on the experience of and memory for art. Thus initial analysis was conducted on the memorable artworks experienced as reproductions, then on those experienced as originals. The two contexts are then analysed. Table 13 below summarises the responses to the questions asked immediately after completing both tasks, regarding participants' most memorable picture.

Table 13. Responses to the questions posed after both tasks were completed regarding their most memorable picture, by context (R = reproduction, O = original), artist and artwork.

Artist	Picture	How did it affect you?	What made it memorable?	Describe it
1	O11	It had a very pleasing affect, made me feel happy and sunny and in touch with nature	Colours, I liked the colours	Square, lots of, not flowers, but depicting flowers, splashes of colour, colours I likes, purples and blues
2	R2	Similar age to me, dark and gloomy, stood out, the colours, made me feel sad, she looked lonely	She stood out more than the landscape	Winter scene, dark & gloomy, cobbled street, long hair, but can't see her face cos she's looking down, but she looks sad.
	O2	Profound effect on me. The emotion on her face, the detail of the cobblestones	The detail	Emily, looking down on the girl from above
	O2	It stood out, it was clear, could tell all the detail. Made me think back to my family, especially my cousin	It was like the days we had on holiday	Girl looking down, on cobbles, wearing a black coat with brown hair
	O2	Made me feel a bit anxious and reflective	Felt that could relate to it, felt familiar, visually came into head when asked which one was memorable, could imagine the person in the picture, it could have been me	A girl alone at night after a night out, walking along a cobbled street. She's lonely and maybe a little scared
	O2	Fear, anxiety, uncomfortable	The fact that you could imagine a story about it, its realism of the situation, the feeling of danger	Picture of a girl, alone, in the dark, walking along a street
	O2	Made me feel happier to see it	Painterly style, I like the style	Woman walking on a side of the road, on the cobbles
	R12	It made me go ooo the most. It’s a threatening and aggressive picture	Characters prominent, not much background	2 men looking as though about to have a confrontation, seen from above, muted

				colours
	O12	Aroused my curiosity and interest	I wondered whether the encounter was going to be antagonistic or not	Looking down on 2 men passing, left wondering if they knew one another or strangers, friendly or aggressive.
	O12	I could feel the tension, the aggression	The emotion in it	2 men challenging, 2 guys quarrelling, nearly bashing each other's skulls in
3	O3	It was beautiful, gorgeous, made me feel good, nice	I liked the texture, it added to the affect	It looked 3D, it was of the ocean
	O13	I really liked it, I love the sea. I like looking at waves, I could really relate to it and enjoy it.	The drama and movement, as well as the imagery, with the waves catching the cliffs	Picture of a cliff face with a tumultuous sea hitting the base. Its dark and moody
	O13	It was really effective, it was dangerous, epic, it was lively, it shocked me	The crash of the waves	Cliff with crashing waves against the sides, looked dangerous. Loads of different shades of blue, dark shades which made it dangerous
4	R4	The colours, really vibrant and pretty. Made me feel happy and relaxed	Bright vibrant colours	Bright blue background, little houses on hills
	O4	It was dark, night and stars. I love night-time, love looking at stars. I love pitch-black, no clouds, when the moon lights the place up	The stars and night landscape	Houses at night-time. Caricature of a house on a hill, lots of hills, cartoony, fantastic gradient of blue to black, solid colours, not solid, vivid colours and the stars in the sky
	O14	It was in your face, vibrant red, clean lines and round bits	Colour	Oblong, vibrant red landscape and sky, couple of buildings, fairy tale, like wind in the willows
	O14	It made me feel warm inside, snuggled up in	It made me feel as	Red with cute little cottage on top of

		front of warm log fire, cosy, twinkly	though I was in it	rolling hills, night time, twinkly stars, lights from cottage, quiet and tranquil
	O14	Interested, it made me interested	Vibrant colour, the house, the red background, the hills	House on a red background, yellow sun, house at front, on a hill
	O14	Happy	Colours	Very big bold sky and simple shapes, bright colours
	O14	It was warm, I wanted to be there, made me comfortable	Colour	Red shepherds. Different shades of red, single house on a hill, sheep, massive field
	O14	It made me reminisce. I long to be in a place like the picture. I would like to own it.	Vivid colour, simple shapes	Red houses, long and narrow, hills and houses
6	R6	Made me feel kind of apprehensive, not relaxing, then the colours and detail became interesting and the more I looked the more I liked	It was the one which I had the biggest emotional response to	Square, on a slant, diagonal, beigy blues, orange, splodges along diagonal, felt big, saw it on the computer
	O6	I likes the colours, lovely, feel fresh	Colours, lively, energetic	Red, diagonal. Looked like sea hitting cliff or shore, colours reminded me of larva but it was fast and dynamic. It was diagonal, added to its dynamism
	O6	It drew me in. I imagined myself in that landscape, even though it was fairly surreal, but it was enough to imagine myself there	It was the angles, dominant unusual angles in a landscape you wouldn't normally see. Unusual but recognisable. I want to be there.	The colours, overbright, but natural. Its spectacular, spectacular colours, like a sunset. I could imagine tackling it, wanted to climb through and up, imagined it to be more and challenging
	O6	Almost angry feeling, sort of immediate,	Partly the colour, the texture, red, diagonal	Red, orangy, diagonal down. It was orange and red,

		almost anger	downward bits	diagonal bits looked like blood, it was weird, wanted to touch it
	O16	I liked it cos of the colours and type of painting, made me feel calm	The colour and the fact that it was abstract. I prefer abstract art	Abstract and quite swirly
7	O7	I can imagine it in motion, a way to escape, freedom	It was the detail and the way it was painted, made it vivid	Black background, the horse was close, only his head
	O17	Powerful, dark and a bit strange, confused	Quite vivid	Giant scary horse with a wig on!
	O17	It was dramatic, lot of atmosphere, made me excited, positively emotional	It was direct, clear, focal point, it was intense, striking	Golden horses head and dark background, metallic tones, close focus, semi-realistic
	O17	Nausea	Nastiness of the maggots	Large canvas, 6ft tall, with a full frontal horses head and body, and lower portion of the horses head looked as though it was made of worms
	O17	Didn't like it, reaction against it, big and horrible, frightening	2 colours, yellow and greyish, looks unnatural, ugly	Like some grotesque my little pony. Horses head, reminded me of desperate fear of horses heads in my bed, from the Godfather
	O17	So large and in front of you. It was gold, the colour. Because we know what a horse is like, huge and overpowering, I should have been threatened, but I wasn't it was sublime	The size	Huge picture, horse looking at me, with gold all down its face
	O17	Happy, generally happy. The contrast in the colours was striking. I can still see the picture in my head after 10 minutes. I'd have it, it was inspiring.	The detail, made me think, what a beautiful animal	Unicorn, gold, mainly gold. Striking face and detailed, really pretty

	O17	Kind of overpowered, it was strong and dominant	The contrast between 2 colours and how big it was	Horses face on a black background, horse was gold, made of lots of strokes
8	O8	It startled me, jumped out at me	Colour and also the lines, looked jagged.	Its red and orange, abstract, but looks like lots of buildings together with lights on
	O8	I felt happy. All the colours came into your face	Colours and shapes	Series of squares and oblongs, brightly coloured seemed to be 3D
	O8	Liked the colours, reminded me of being on holiday, made me feel happy	The association of being away on holiday feeling. Reminded me of Italy	Colourful buildings that you couldn't really make out. Very colourful, warm colours, not particularly outlined, there were things behind the paint
9	R9	Oh, it's interesting, I wanted to know the story, why is she there	The colours, the way she was standing, the atmosphere	Woman standing in a dark wood looking at a black dog. It's a winter's day, perhaps evening, she looks sad.
	O9	Reminded me of me and my dog, I had an emotional connection. Dog is looking lovingly at its owner, it portrayed the dogs loyalty	The way the dog is looking at owner	The one with the dog. Lovely painting of a dog with its owner, dog looking lovingly at owner, who looks distracted. But it reminded me of Jessie, my dog.
	O9	Cos it was really bright colours, made me go wow. The colours made me feel and think of light	Chalky bits on outline. It looked really nice	Person walking a dog, light colour background
	O9	Lady and dogs in woods. Affected me, memories of home and my dog. Reminded me of my mum and dog. The face was very	Memories of home	Lady in black coat, with a black dog, hair tied back, very defined face, on an unclear background of a wood in autumn

	defined, striking		
O9	Peaceful, made me think, relaxing, beautiful colours, not bright but strong. Makes me think, takes me to another world, away from my life here and now	It makes me think of Jane Eyre	Woman and dog, woman's coming out of the frame, dark and light colours, she is standing in the middle, there's a forest and a dog
O9	Curious. Who was she? Made me interested	Stunning eyes, trees behind, light coming thru	The lady and the dog. She is standing sideways looking past the dog; the dog is looking up at her. She looks very confident. Light thru the trees softens it, but her eyes were stunning
O9	Comforting, like a mirror	The girl, how she was standing, as if I saw myself	Girl with a dog, standing, very confident, in a wood, with a long black jacket on
R19	Thought it was powerful, nature kind of thing. Just like it.	I could identify with it	Bloke watching a storm at the top of a hill
O19	Made me feel back home. I like lightning and storms. Pleasant serene environment, safe, the storm is a long way away.	The lightning and the colours	The one with the lightning bolt, dark blue sky in contrast with the lightning, bloke standing on vivid green hill
O19	Looked like me in the picture, it was like watching myself. Why was he there? I liked the lightning. I liked it, that’s me, I knew where I was, what I was doing	It was the feelings it brought out. It was about people, but not portraits	A large landscape, man on left side wearing a dark jacket, looking over a valley, winter or late, dark colours, far distance bolts of lightning
O19	Mixed affect, isolation and sense of pleasure in being alone and able to meditate on luminance. Feeling of space, relaxation, time to think and reflect	Feeling of being outside, open space, and room to manoeuvre and just be	Landscape, lightning
O19	Admiration for the artist’s original viewpoint. Not the	I liked the perspective. Appealed to me on an emotional level, I've	Large canvas, hill top view of the lakes, male figure standing

		normal painting by the yard.	stood in similar places, been similar, I empathised with the painting, powerfully	in foreground on the left with his back to us, lightning in the distance
10	O10	2nd picture, the man wearing a cap, how he felt stupid and alone	The starkness, how it stood out, it caught me	Pale background, grey scale. Sad looking man wearing paper party dunce cap, wearing a hoody and staring off into the distance
	O10	Trying to understand the meaning. It was a strange picture, didn't like it, made me feel miserable	Plain background and 1 figure in the middle. Its strangeness, I wasn't sure what it was about	Large picture, beige background with a miserable looking man looking down wearing a paper hat
	R20	The person in the picture looked like a family member. Evoked childhood memories. But it was a sad picture, so conflict between my memories and the picture	The face, it could have been that person, really shocked how alike, he could have been the model.	Grey background, man holding a spoon, looked just like my brother, but so sombre, so sad, caught my breath

Reproductions of artworks

In the reproduction context seven different pictures were selected by the participants as their most memorable artwork, with both positive and negative emotions reported. Whilst participants said that their most memorable picture made them feel sad, it may also have made them feel tender, or if it made them apprehensive, they also said they liked it. Overall, the main theme that emerged from the thematic analysis was empathy.

Empathy and the Story: The story, either curiosity regarding what the story could be 'I wanted to know the story', empathy with the story and personal memories stimulated by the picture.

Five different sub-themes emerge regarding affect and memory.

(i) Sadness: The first is sadness; 'made me feel sad, she looked lonely', 'it was a sad picture', 'so sombre, so sad it caught my breath'.

(ii) Fear: The second is fear and apprehension; 'it's threatening and aggressive', 'made me feel kind of apprehensive'

(iii) Power: In the case of two pictures in particular (12 and 19) the power of the subject matter appeared to evoke the strongest emotional reaction, but the participants found it difficult to articulate their emotional response; 'it made me go ooo the most', 'it was a powerful, nature kind of thing'.

(iv) Colour: The colour of the painting was mentioned for 6 of the 7 reproductions. Both bright vibrant colours were memorable, and dark, gloomy and muted colours. The colours clearly evoked emotions and memories; 'the colours made me feel sad', the colours….made me feel happy and relaxed', 'colours and detail became interesting'.

(v) Empathy, personal narrative and interest: In this small group of pictures it is clear that participants empathised with the subject matter, a personal narrative, and interest, was important in making the work of art memorable. The picture 'evoked childhood memories', and 'he looked just like my brother' or the subject matter was personally pertinent, 'I could identify with it' or 'she was a similar age to me'.

(vi)

Original artworks

It is clear that a range of styles and subject matter influenced the affect and memorability of the original artworks, with 15 of the 20 reported as the most memorable. Again, whilst both positive and negative emotions were reported, on this occasion original artworks elicit more positive than negative emotions. There were two main themes that emerged regarding what made original artworks memorable, empathy and colour.

Empathy, the story and personal narrative: Strong personal connections, or empathy with the story, either from their own recollections, or from being able to imagine themselves' in the picture, caused the artwork to be memorable. The comments ranged from the specific, 'I've stood in similar places… I empathised with the painting, powerfully', and 'it was like watching myself…..that's me, I knew where I was, what I was doing', 'it could have been me', and 'it drew me in, I imagined myself in that landscape' to 'it made me feel warm inside', or 'a sense of pleasure in being alone….'. Family memories were strong, with memories of home, mum, family, dogs, cousins and holidays all being evoked. The emotions were not always positive, with fear also being recalled 'horses head, reminded me of a desperate fear of horses heads in my bed…..'.

Colour: When asked what made their choice memorable, or when asked to describe their picture, colour was dominant. From simple, 'colour' or 'vivid colours' or 'colours, I liked the colours'. Colour was associated with both energy and arousal, and with calmness and comfort. Colour was 'vibrant', 'vivid', 'lovely, fresh', 'fast and dynamic', 'lively, energetic', 'dangerous' or it was 'relaxing, beautiful…. not bright but strong', it was 'nice'. It was also associated with fear and unease, it was 'a bit like blood…weird….wanted to touch it', it was 'bright' or 'unnatural, ugly', 'dark and moody', 'dangerous'. When asked to describe the picture the colours were often used in the description, such as 'gold, mainly gold', 'gold all down its face', or 'vibrant red', 'red', 'red background, yellow sun', 'shades of red', 'orange and red', 'red and orange', or 'shades of blue'. Interestingly, artworks that appeared to have a narrative, those that evoked empathy, did not appear to have as memorable colours. Phrases such as ‘light colour’, ‘bright colours’, ‘beautiful colours’, ‘dark and light colours’ and ‘pale’ were used when describing these pictures. Colour it was used to recall the detail and to describe the artwork, and more generally, in response to the general feel of the picture Within the context of these two main themes six sub-themes emerged:

(i) Happiness: Many of the pictures made the participants feel happy, particularly when depicting natural scenes. Sometimes the effect was of calm, peaceful happiness, ‘…sunny and in touch with nature’, ‘it was beautiful, gorgeous, made me feel good’, ‘I love night time, love looking at the stars….’. Happiness was associated with the personal narrative, with holidays, family and home and comfort. It was also linked to mixed emotions, isolation and a sense of pleasure, or security because the storm was a long way away. Colour also made people feel happy, ‘I felt happy. All the colours came into your face’, or ‘Happy, generally happy. The contrast in the colours was striking….’.

(ii) Sadness: only one picture (10) was memorable because it made two participants sad. Both commented on the sad or miserable looking man, how he ‘felt stupid and alone’ and that it ‘made me feel miserable’.

(iii) Fear and anxiety: A number of pictures evoked feelings of fear or anxiety. Some participants reported a general feeling, ‘made me feel a bit anxious and reflective’, ‘fear, anxiety, uncomfortable’, or ‘I could feel the tension, the aggression’, or ‘, others reported very specific feelings and memories evoked, ‘big and horrible, frightening…..like some grotesque my little pony.’, or, a ‘giant scary horse with a wig on’.

(iv) Anger: Two participants reported negative feelings of anger or nausea evoked by their memorable picture. Anger was associated with the colour (orange and red), when asked how the picture had affected them the participant replied ‘almost angry feeling, sort of immediate, almost angry’, as though they were shocked by their own response. The participant who said that the memorable picture made him feel nauseous, was angry that it had done so, he hated the ‘nastiness of the maggots….. the horse’s head looked as though it was made of worms’.

(v) Energy: Participants found energetic artworks memorable, using adjectives such as ‘tumultuous’, ‘crash’, ‘crashing’, ‘vibrant’, and ‘dynamism’ to describe them. They also described the affect as being ‘powerful’ or ‘dramatic’.

(vi) Conflicting responses: One picture in particular (17) evoked almost opposing reactions. Participants found it very beautiful and moving, or were shocked and upset by it. Their responses ranged from ‘it was sublime’, ‘inspiring’, ‘strong and dominant’, ‘really pretty’ ‘made me excited, positively emotional’ to ‘it looked as though it was made of worms’, ‘giant scary’, ‘from the Godfather’. The same picture was described as a beautiful unicorn, a ‘golden horses head’, or as a ‘grotesque My Little Pony’.

4.4 Discussion

4.4.1 Main results

The aim of this study was to investigate the effect of context, original or reproduced visual art, on arousal, aesthetic affect, viewing time and memory. All the participants viewed 20 artworks by 10 artists, half were viewed as originals in the main art gallery, and half were viewed as reproductions on a computer, in a small, empty gallery. Participants were asked to rate how much each artwork affected them and how much they liked it. On completion of the task they were asked to describe the affect the most memorable work of art had had on them and to describe it. The times taken to respond in each context were also recorded. The experiment was conducted in a commercial art gallery where it is common to experience art, rather than in a laboratory, where art is not commonly experienced. The reasoning for this was to both ensure that the context of the setting was the same for both original art and reproductions of art, and so that the artworks were experienced in a context that defines them as art.

It was expected that there would be an enhanced response to original art, it would be more arousing, liked more, viewed for longer and be the most memorable. The most memorable art was expected to be that with clear semantic content, particularly that which evoked personal memories, and colour would also be influential. The results demonstrate that the experience of art is not isolated from the context in which it is experienced. Original art elicited more of an affective response than reproduced, it was liked more and was more memorable. As expected, memorable art was that which had clear semantic content and which evoked personal memories, and which was experienced in the original context. Colour was clearly an influential factor regarding the memorability of art. However, aesthetic preference (i.e., liking) was more important than arousal regarding memory, and there were no differences in the variation of the time taken to respond between the two contexts.

4.4.2 Context affects arousal and aesthetic response to art

The main hypothesis of this study was that there would be an enhanced response to original art, it would be more arousing and liked more than reproduced art. The data supports this assumption; original art was rated as having more affect and was liked more than art viewed in the reproduction context. These results support and extend previous findings showing that original artworks in museums and galleries are liked more and are more arousing compared to reproductions in a non-museum or gallery setting (Brieber et al., 2014, 2015; Locher et al., 1999, 2001).

This study's design allows us to reject the possibility that the differences were due to the art being viewed in two different physical contexts (as in previous studies, original art in a gallery or museum, reproduced art in a laboratory) as both original and reproductions were experienced in the gallery. Nor could the differences be due to order or repetition, as no differences between the four different protocols were found.

One possible explanation for this enhanced effect is size. All the reproduction artworks were presented within a 1931 x 1931 mm format, whereas the originals ranged from a relatively small, but larger than those on the screen, 50 x 50 cm, to a huge 168 x 168 cm format. The reproductions were all viewed on a laptop computer screen. Whilst participants were encouraged to stand at a comfortable distance and to angle the screen to ensure they were looking at the pictures to suit themselves, they did not move once the task had started. In the original context participants were blindfolded and led to a space in front of each artwork at a distance appropriate for viewing the whole picture. For the smaller pictures they stood closer, for the large pictures they stood some distance away. There were no prescribed distances for viewing, and they were able to adjust their position, to move, once the blindfold was removed.

Sizes, viewing distance and locomotor responses (movements towards sources of stimulation) have previously been found to influence judgements of preference and interest of artworks (Berlyne, 1971; Clarke, Shortess & Richter, 1984; Joy & Sherry, 2003; Locher, 2011). Thus, a further reason for the enhanced effect of the original art may be that participants walked around the gallery (albeit blindfolded) and could choose and change the distance, the angle, and the perspective in which they viewed each original artwork presented to them, once the blindfold was removed.

Whilst Brieber et al., (2014) conclude that it is unclear whether it is the physical context, the authenticity of the artwork, or an interaction between the two which determines the enhanced aesthetic experience, these results suggest that the authenticity of the artwork, the experience of the ‘real thing’, and the opportunity to move and to choose the space in which to view, are important in enhancing the aesthetic experience.

4.4.3 Context and viewing time

Participants were expected to spend longer looking at original art than at the reproductions. The results indicate that they did. As two different methods of recording the time taken to respond were used (a manual stop watch, and Eprime, a software tool for presenting stimuli which accurately records reaction time with millisecond precision) no formal analysis was conducted on the raw scores. Nevertheless, the raw scores suggest that there was an effect of context, the mean response time for original art was 10.3 seconds (Mdn 9.52s), and only 1.26 seconds (Mdn 1.16s) for reproduced art. Thus, the experiment not only provides suggestive evidence that the enhanced experience of looking at original art results in longer viewing times than for reproductions of art, it also supports the previous findings of Brieber et al., (2014) and Gartus et al., (2015).

Previous studies in galleries suggest that the average viewing time for original artworks is around 20 seconds (Smith & Smith, 2001; Heidenrich & Turano, 2011; Locher et al., 2007) with large variations among people and artworks, with viewing times ranging from 10 seconds to over a minute. Eye-tracking studies investigating gaze patterns when looking at emotional pictures suggest that initial orienteering and engagement of attention happens within the first 500 milliseconds (e.g. Calvo & Lang, 2004), however Brieber et al., (2104) also used eye tracking and report median viewing times of 28.25 seconds in the laboratory context, and 38.75 seconds in the museum context. The mean viewing times in this study ranged from only 3.6 seconds to 27.9 seconds in the original context, and from less than half a second (0.43) to 2.37 seconds in the reproduction context. This suggests that the rating decisions were made very quickly, and that art in neither context required contemplation before an aesthetic response was made. Although participants were instructed to make their decision regarding affect and liking in their own time, they were also asked for their immediate, intuitive response. It is possible that this instruction emphasised speed of response, and discouraged contemplation of the art, in both contexts.

4.4.4 Context affects memory for art

In addition to showing the impact of context on the experience of art the effect of context on the memory for art was also explored. Memorable artworks were expected to be those viewed in the original context, and memorable art was expected to be both liked more and more arousing than the least memorable art. Memorable art was also expected to be rated as more arousing than liked. The reasoning behind this hypothesis was that modern and contemporary art is as likely to elicit negative emotions as positive emotions (Kieran, 1997). The data supports the first of these hypotheses.

Overall the most memorable art was viewed in the original context. It was liked more and rated as more arousing than in the reproduced context. 9 of the 10 artists' work was recalled by the participants as most memorable, with 5 artists having work recalled in both contexts, original and reproduced. However, 45 participants found an original artwork the most memorable and only 7 reported a work of art viewed as a reproduction as memorable. When the differences in the ratings in response to the art of the most memorable artist and the least memorable artist were explored, again it was clear that the ratings of both affect and like were higher for the most memorable artist than the least memorable, and that the ratings were higher when his artworks were viewed in the original context than the reproduction context. Contrary to the hypothesis memorable art was not rated as being more arousing than liked.

Brieber et al., (2105b) explain that original art viewed in the gallery is memorable due to the use of spatial clues participants had encoded in memory, enabling them to simulate navigating through the museum space and to recall individual artworks, which then prompts the recall of artworks exhibited in its vicinity. Although participants were blindfolded and escorted to each artwork, and asked to try NOT to look around, to focus only on the picture in front of them, it is unlikely that they experienced the original art in front of them in a vacuum. Despite being blindfolded participants will still have been aware of changes in light, space, adjacent artworks, they will have been conscious of their own movements through the gallery, and of other visitors, their physical presence, the hum of conversation around them. In order to ensure that participants were not stimulated or distracted by artworks not part of this experiment there were none on display in the side gallery, where art in the reproduction context was viewed. There were no changes in light, they did not move whilst viewing the reproduced artworks, there were no other visitors, no noise. Thus, physical context, the qualities of the main gallery, and the freedom to move, may have played a role in the memory for art, as well as the context of originality. Perhaps participants were unable to disassociate the physical context (the gallery) from the status context (original or reproduced), that original art viewed in a gallery has a different impact on the viewer than original art viewed in a laboratory (Brieber at al., 2015a). Perhaps the gallery environment, the status of the art as Art is as important as the actual physical properties of the art itself.

Or, it may be that the most memorable art was memorable because it was liked the most, and thus had the most emotional affect. Forster, Fabi and Leder (2015) suggest that according to the processing fluency account (Reber et al., 2004) the ease with which an object is processed leads to a subjective feeling of fluency. The more fluently a viewer processes an object, the more positive their aesthetic response, the increased fluency resulting in increased liking. Models of aesthetic processing (e.g., Chatterjee, 2004a; Leder et al., 2004) indicate that liking is the result of multiple processing stages, from early perceptual analysis, to higher cognitive processing, and liking (Chatterjee, 2004a) or satisfaction (Leder et al., 2004) influences the affective state and emotional response to art.

As the emotional salience of an event has long been recognised as an important modulator of memory (Konig, 2008), and arousing (both negative and positive) pictures with semantic content have been found to be more memorable than neutral ones (Bradley et al., 1992), we hypothesised that the most memorable artworks would have higher arousal ratings than like. This was not the case, there was no difference in the mean ratings of like or affect of the memorable pictures, nevertheless, as the analysis of the most and least memorable artists reveal, the ratings for memorable art were significantly higher than those for unmemorable art. Only five of the memorable artworks were memorable because they were disliked (rated 3 or below), and here the affect ratings **were** higher than the like ratings (between 4 and 6). Three of these disliked memorable artworks were experienced in the original context (45 of the memorable artworks were original) whilst 2 of the 7 reproduced memorable artworks were disliked. It appears safe to conclude that on this occasion art viewed in the original context was more memorable than when viewed as a reproduction because it was liked more.

There are a number of reasons that the art experienced in this study was particularly liked and memorable. The exhibition was in a commercial art gallery. The art had been selected to appeal to the general public, to sell. This art was intended for the domestic context, it had not been selected to shock, or provoke, it was not intended to be challenging, but to be pleasurable and desirable. With this in mind, much of the art in this exhibition was representational or indeterminate (see Study 1 above). Whilst there were different styles, subject matters and techniques almost all the work selected for this study contained clearly identifiable content, i.e. figures, dogs, faces, landscapes. Or the subject matter was suggestive, indeterminate, but objects or themes were recognisable, i.e., buildings or mountainsides. However, whilst this may explain why the art was liked, why it was arousing and why it was memorable, it does not explain why original art was liked more, was more arousing and memorable than reproduced art.

4.4.5 What made art memorable?

But, what makes art memorable? In order to explore this a thematic analysis (Braun & Clarke, 2006) was conducted. The aim was to get an understanding of what it was about an individual's **most** memorable picture that made it memorable for them. Memorable artworks were expected to be representational, those with clear semantic content, and narratives that evoked personal memories. Colour was also expected to influence the subsequent recall of the art. Thematic analysis revealed three main themes: i) curiosity regarding the story, ii) empathy with the narrative and iii) colour. The main themes for the memorable reproduced art was curiosity regarding the story, and subsequently empathy, fear and sadness were subthemes, and also colour. Two main themes were identified for the memorable original art, empathy and colour, with happiness, sadness, anger, fear and anxiety, energy and also conflicting responses, identified as the subthemes. Whilst the main themes were similar for original and reproduced art, interest in and empathy for the narrative or for content of the picture are intertwined, it is interesting that the subthemes have a slightly different bias. The reproductions seem to evoke more negative emotions, fear and sadness, whereas happiness and energy feature strongly in response to the original artworks. However, it is hard to draw any firm conclusions due to the disparity in the number of most memorable artworks between the contexts (45 original vs. 7 reproductions).

It is widely recognised that emotional salience is an important modulator of memory. Studies have shown that both positive and negative pictures are more memorable than neutral (Bradley et al., 1992), with some studies suggesting that negative events are more memorable than positive (Charles et al., 2003). Here, participants described strong emotional reactions to the art, particularly in response to art viewed in the original context. Positive emotional responses ranged from the fairly mild 'It had a very pleasing affect, made me feel happy and sunny…' and simply 'happy' to it had a 'profound affect on me. The emotion on her face..' and 'It was beautiful, gorgeous, made me feel good', it 'made me excited, positively emotional'. Whilst the reproductions elicited negative emotions, two made the viewers sad, 'it made me feel sad, she looked lonely', 'it was a sad picture', others were threatening, or made the viewer feel apprehensive, they were less likely to elicit positive emotions, such as happiness . These negative emotions were also reported in response to the originals, 'it made me feel miserable', 'he felt stupid and alone', but the originals were more likely to elicit positive emotions such as happiness. Some pictures (e.g., 'Storm' No.17, and 'Bracken Landscape' No.6) evoked strong reactions, both positive and negative. With regard to 'Storm', the negative emotions were vocalised forcefully. It made viewers fearful, anxious, uncomfortable, and even nauseous. If their response was a negative one they were very clear about how it made them feel; 'Didn't like it…..big, horrible, frightening'. On the other hand, the same picture was described as sublime, beautiful, powerful and exciting.

The power of the art was a clear theme. Sometimes it was a positive, exciting power, other times it was a frightening, threatening power. The subject matter was often described as powerful. The crashing waves of 'The Battered Shore' (No.13) were exciting, epic, dangerous, but evoked positive emotions, whereas 'Storm' (No.17) was equally powerful, but it was dark, strange and overpowering.

Colour was clearly influential. When asked to describe their most memorable picture almost all the participants described the colours and how the colour affected their mood in response to the picture. Their comments again ranged from the fairly mild 'splashes of colours I like… purples and blues', or 'muted colours' to the more evocative 'loads of different shades of blue, dark shades which made it dangerous', 'vibrant colour, the house, the red background, the hills', and the enthusiastic 'the colours, overbright, but natural. Its spectacular, spectacular colours, like a sunset'. It appears that it is colour generally, rather than any specific colour or hue that made the artwork memorable. Colour was mentioned when both articulating the affect of the art work, why it was memorable and when describing it. It was not limited to one or two of the memorable pictures, in fact, only in two pictures, 'Emily' (No.2) and 'Eye to Eye' (No.12), was colour not used extensively to describe the reaction and the qualities of the artwork. It is interesting to observe here that the non-memorable artworks, both the pictures by artist Fletcher Prentiss, were painted in muted shades of grey or blues (‘Coffee Cans’, No. 5 and ‘Silver on Grey’, No. 15).

Finally, it is clear that empathy, the ability to relate with the subject matter, to feel involved or curious about the story, and particularly strong personal feelings or memories evoked were the most powerful influence on memory. Artworks with people and those that suggested a narrative were the pictures that were most often recalled. These pictures were described very specifically by the viewers and were defined by the personal memories they evoked.

Both supporting (images of people are memorable) and in contrast (images of people in enclosed spaces are the most memorable) with the findings of Isola, Parikh, Torralba and Oliva (2011), it was pictures of people in open landscapes (Nos. 2 and 12), city streets, (Nos. 9 and 19), and undefined spaces (Nos. 10 and 20) which were the most memorable. These pictures created curiosity regarding what was happening, what had happened, what was going to happen next, with comments such as ‘A girl alone at night after a night out, walking along a cobbled street. She's lonely and maybe a little scared’ and ‘ Looking down on 2 men passing, left wondering if they knew one another or strangers, friendly or aggressive’ or ‘2 men challenging, 2 guys quarrelling, nearly bashing each other’s skulls in’. They stimulated the imagination. They also evoked strong feelings of empathy, both intensely personal, ‘Felt that I could relate to it, felt familiar…… could imagine the person in the picture, it could have been me’, or ‘the face……, really shocked how alike, he could have been the model….. [he] looked just like my brother, but so sombre, so sad, caught my breath’ and more general, it ‘made me think back to my family, especially my cousin. It was like the days we had on holiday’.

It was not only pictures of people that the viewers empathised with. Pictures that reminded them of holidays or places they where they liked to be were also memorable. Pictures of the sea and empty landscapes also evoked strong memories and desires: ‘reminded me of being on holiday, made me feel happy’ and ‘it made me reminisce. I long to be in a place like the picture’, ‘I love the sea. I like looking at waves’, ‘I love night-time, love looking at stars. I love pitch-black, no clouds, when the moon lights the place up, 'It made me feel warm inside, snuggled up in front of warm log fire, cosy, twinkly', 'It was warm, I wanted to be there, made me comfortable', and 'I could imagine tackling it, wanted to climb through and up, imagined it to be more and challenging'.

These results suggest that whilst images of people are memorable, images of vistas, landscapes and the sea, peaceful or dramatic natural scenes are too, when viewed as art. This is contrary to the findings of Isola et al., (2011) who suggest that photographic images of vistas and peaceful settings are not memorable.

Whilst the most memorable art was clearly representational, pictures of people and animals, landscapes with houses, trees, and dramatic weather, seascapes with crashing waves, it was not exclusively so. The semi-abstract or indeterminate artworks ('Bracken Landscape' No.6, 'Early Light' No. 16 and 'Ancient City' No 8) were also memorable. Here, colour was the dominant theme. The colours made the viewers happy, or angry, or energetic or apprehensive.

Whilst colour is clearly important regarding memorability, for all types of art, original or reproduced, representational, indeterminate or abstract, it is interest in and empathy for the story, personal recollections and memories, which appear to have the greatest impact on individual's memory for specific works of art.

4.4.6 Conclusions

Looking at original art in an art gallery was more arousing, more aesthetically affective, it was looked at for longer and it enhanced memory for art, compared to looking at reproductions of art, on a computer, in an art gallery. As expected these results demonstrate that the response to art is not isolated from the context in which it is experienced, thus supporting both the hypotheses, and previous findings (Brieber et al., 2014, 2015; Locher et al., 1999, 2001). However, contrary to the hypotheses, memorable art appears to be better related to being liked as opposed to its ability to arouse. The most memorable art was memorable because its content evoked personal memories, empathy and interest in the story implied. Colour was also an important theme regarding the memorability for art.

A limitation of this study was the two different methods of recording the time taken to view the artworks in each context, and the instructions to participants. Previous research into the viewing times of visitors to art galleries has been inconclusive, with times contemplating art varying from an average 30 seconds (Locher et al., 2007), a median 38.5 seconds (Brieber et al., 2015), a median 17 seconds and a mean 27 seconds (Smith & Smith, 2001), or between 20 and 82 seconds (Heidenrich & Turano, 2011). Future research should endeavour to simplify this by either employing only one method, such as a manual stopwatch, or eye tracking, and by clarifying and emphasising that viewers can contemplate the art, to take their time to come to a decision regarding their aesthetic response.

As expected the most memorable art evoked both positive and negative emotional responses (Bradley et al., 1992). Most of these pictures were representational. They contained images of recognisable objects, people, figures and faces, in open and closed settings (Isola et al., 2011). They aroused curiosity regarding the story, explicit personal memories and emotional responses, and empathy. But so too did the indeterminate and more abstract landscapes and seascapes. Here, it was the colour and the perceived power which affected the viewers' response, but with similar outcomes regarding memories and empathy. Future research could further explore the visceral and emotional affect of different categories of art, representational, abstract and indeterminate, in different contexts, original and reproduction.

What can be concluded from this study is that differences occur due to the different contexts of art, rather than the physical context of the gallery or laboratory. This both supports and expands on the findings of Brieber et al., (2014), who concluded that it was unclear whether it was the physical context or the authenticity of the artwork which determines the enhanced aesthetic experience. Our findings also suggest that Brieber et al., (2014) may be right to suggest that the differences are a result of the interaction between the physical context (gallery) and the authenticity, or originality, of the artwork. This experiment was conducted in a commercial art gallery, the art exhibited was intended for a domestic environment, and it was selected for its accessibility and its popularity.

Future research should endeavour to represent a broader, more challenging range of art to explore visceral and cognitive responses in response to contemporary art.

These findings suggest that future research into the visceral, visual and cognitive processes in response to visual art should endeavour to conduct studies in the physical contexts in which artworks are normally experienced, and to use original or authentic works of art rather than reproductions.

Chapter 5: The impact of expertise and context on the experience of contemporary art. Experiment 3: a behavioural and continuous EEG study.

5.1 Introduction

Evidence from Chapter 3 revealed that visual art elicits different levels of attentional and evaluative resources in experts and non-experts. Expertise is associated with enhanced amplitude of early ERP components related to attention and effort and higher order visual processing, and also with sustained attention, evident in later slow wave ERPs. A limitation of Chapter 3 was that the participants viewed art on a computer screen, in a laboratory, for a very short period of time (up to 1500ms). This did not allow the contemplation and evaluation of art in a real world context (e.g. observing original works in a designated space such as in an art gallery), and it may also have influenced the findings: were the observed differences due to viewing art, or due to viewing interesting visual stimuli? Tschacher et al., (2011) argue that psychological aesthetic research conducted in the laboratory compromises the external and ecological validity, since the 'aura' and authenticity of an artwork, its materiality, size and spatial arrangement are lost in reproductions on a computer screen. Chapter 4 demonstrated that the experience of art is not isolated from the context in which it is experienced. Original art elicited more of an affective response than reproductions; it was liked more and was more memorable. The final study of this thesis therefore sought to extend the findings of both these previous studies by investigating the impact of art expertise and context on the experience (mood, affect and response) of contemporary art. The impact of visual art on mood and affect was assessed before and after contemplating contemporary art. Aesthetic judgements and intellectual responses to original and reproduced artworks were compared, and the impact of imagery on the memorable themes of art was explored. Oscillatory EEG was recorded to further investigate differences in neural processes between art experts and non-experts during the contemplation of art.

5.1.1 Expertise

As mentioned in previous chapters, differences between art experts and non-experts have been identified in various aspects of aesthetic preference and judgements (e.g., Furnham & Walker, 2001; Hekkert & van Wieringen, 1996; Smith & Melara, 1990), in methods of processing complexity (Reber et al., 2004), how they view and perceive pictures (Vogt & Magnussen, 2007) and type of art and emotional appraisal (Silvia, 2006). Pang et al., (2013) also found differences between experts and non-experts. In their study art expertise correlated negatively with the amplitude of the ERP responses to both paintings and control stimuli. They suggest that this is due to increased neural efficiency in experts as the result of extensive practice in the contemplation of visual art. The evidence from Chapter 3 appears to contradict this, with expertise being associated with increased and sustained attention whilst viewing visual art. Bhattacharya and Petsche (2001) suggest that differences in cortical synchrony between artists and non-artists during the perception and imagery of art indicate that expertise is associated with an increased ability to binding various minute visual details and enhanced long-term memory operations. These results suggest that experts demonstrate greater effort and sustained attention whilst contemplating paintings than non-experts. Despite this interest in the influence of expertise on the evaluative aspects of art appreciation, little is known about the relation between level of art expertise and aesthetic emotion, how an artwork makes the viewer feel.

The judgement of beauty, whilst an emotional response, is also thought to be influenced by other factors such as artistic style, art-historic knowledge and fashion (Leder et al., 2004). Thus, beauty and liking judgements of visual art are likely to reflect individual differences in expertise. Studies have shown that participants with low art expertise prefer abstract artworks when also given information about the style, but the same information resulted in the opposite pattern for experts, they showed less preference when given stylistic information (Belke, Leder & Augustin, 2006). This suggests that the experts thought the information was trivial, or a repetition of what they already knew. Pikho et al., (2011) compared the emotional and aesthetic evaluations of experts and non-experts in response to artworks that varied in their abstraction level. They asked “Is this a good work of art?” and “What is the quality of emotion evoked by the painting?” Both questions were rated on a 5-point Likert scale. The level of abstraction affected the aesthetic judgement and emotional valence ratings of the non-experts, but not the experts. The non-experts gave the highest ratings for representational paintings and the lowest for abstract, whereas the ratings by the experts were independent of the abstraction level. Thus, important differences between experts and non-experts have been identified: non-experts prefer representational art to abstract, and like art more when stylistic information is provided. Art experts do not show preference for abstract or representational art, and prefer art without stylistic information. van Paasschen, Bacci and Melcher (2015) asked art experts and non-experts to view representational and abstract artworks in a laboratory and in a museum. They found that experts rated the artworks higher than non-experts on the aesthetic facets (beauty and liking), but no between-group differences were observed on affective evaluations (valence and arousal). They conclude that the affective components of art appreciation are less driven by expertise, but the more cognitive aspects of aesthetic viewing, the judgement of beauty and liking appear to depend on expertise.

Almost all the above mentioned studies have defined art experts as those with formal art education or working experience in fine art or art history, and non-experts as those with similar levels of education, unrelated to art and with no experience in the art world. Pang et al., (2013) argue that this approach renders art expertise a (quasi-) categorical variable (e.g., artists, non-artists, Bhattacharya and Petsche, 2001; experts and non-experts, Hekkert and van Wieringen, 1996) the results of an artificial dichotomisation of a continuous quantitative variable, the degree of study or practice. Attempts to address this drawback have resulted in an Aesthetic Fluency Scale (Smith & Smith, 2006) and Chatterjee, Widick, Sternschein, Smith and Bromberger’s (2010) Art Experience Questionnaire that offer a continuous measure for participants’ art expertise. These quantitative measures represent valid means for assessing levels of expertise (Silvia, 2007).

5.1.2 Context

Chapter 4 investigated the effect of context, original or reproduced visual art, on arousal, aesthetic affect, viewing time and memory for art. The results support and extend previous findings showing that original artworks in museums and galleries are liked more and are more arousing compared to reproductions in a non-museum or gallery setting (Brieber et al., 2014, 2015; Locher et al., 1999, 2001). These results suggest that how much an artwork is liked, the status of an object as 'art', whether the viewer recognises it as 'art', the 'aura' (the emotional impression, Tschacher et al., 2011), is also influential in the aesthetic experience. Clearly, the physicality of an artwork, its size, colours, content, the space in which it is viewed, all impact on emotional and cognitive responses. But, are these factors enough to classify art as art? Does the individual' classification of an object as 'art' influence the visceral and cognitive response? In order to explore how cognitive responses to art we perhaps need to consider whether individuals consider whether what they are contemplating is art, or not.

Bullot and Reber (2013) propose a psycho-historical framework for the science of art appreciation. They identify three modes of appreciation: basic exposure to art, artistic design stance, and artistic understanding. The artistic design stance, necessary for understanding art, is an attitude whereby individuals develop sensitivity to art-historical contexts through inquiring into the creating, making and function of art. The authors go on to suggest that most psychological and neuroaesthetic theories fail to account for artistic appreciation because they lack a model which accounts for the contextual nature of art. They use the example of Andy Warhol's *Brillo Soap Pad Boxes* (1962) to illustrate this. These artworks are visually indistinguishable from the regular Brillo boxes that were found in a supermarket, so they elicit the same kind of brain activation in the viewer as the Brillo boxes in the supermarket. However, the viewers' artistic understanding of the work (or not) will derive from their sensitivity to its art-historical context. A work such as this can only be appreciated as art if its audience is sensitive to certain art-historical facts. Thus, it appears that not only does the physical context, the 'where' an artwork is viewed, the classification that it is actually a work of art, the 'what', but also the art-historical context, the 'why' is important regarding the appreciation of art.

5.1.3 Is it Art?

What is art? What is it for? These are philosophical questions far too big to consider within the confines of this thesis, but important regarding aesthetic judgements, cognitive responses, effects on mood and disposition. Dissanayake (2015) proposes that art just is, it is simply there, and when questions regarding the meaning, purpose and necessity of art are considered then intriguing possibilities arise. The word ‘art’ is like ‘love’ or ‘poetry’, in that everyone knows what they mean or recognize what they refer to, but when pressed, these words are difficult to define with consistency or wide application. Visual art is usually recognised as anything that has been drawn, painted, sculpted but not everything that has been drawn, painted or sculpted is art. Evidently, some sort of judgement is made: there is some kind of qualitative difference or essence that an object has that defines it as art, art has an ‘aura’ (Tschacher et al., 2011). Although ‘anything can be art but not everything is art’ (Perry, 2015, pg 42), art is still considered as art if it is made by an artist’s hand, it has taken great skill and is pleasing to look at, or perhaps is not.

As previously discussed, aesthetics and art are by no means all embracing. Models of aesthetic processing have considered emotional responses, context and expertise as influential factors on the aesthetic experience whilst viewing art (Chatterjee, 2004a; Jacobsen, 2006; Leder et al., 2004). If, as Chatterjee and Vartanian (2014) suggest, the context in which an object is perceived, i.e., as an artwork, and the appraisal that focuses on that object, i.e., as an artwork, distinguishes the aesthetic experience from other perceptual experiences, then is it the status of the perceived object as art that identifies it as a candidate for contemplation or appreciation. Is it in a gallery, is it labelled as art, have we put our ‘art goggles’ on (Perry, 2015)?

5.1.4 Mood

The arts have long been viewed as therapeutic (de Botton, 2014). It is widely recognised that creating art improves mood (De Petrillo & Winner, 2005). In art therapy art-making is not only used as a diagnostic tool, but also as a means of improving depressed mood and reducing stress (Fryear 1992: Waller & Gilroy, 1992; Drake, Coleman & Winner, 2011). The act of creating a work of art makes people feel more positive in their mood, illustrated in self-reported measures of mood, both in those with experience in creating art, and in those with little or no experience. One need not be an artist to experience mood benefits from making art (De Petrillo & Winner, 2005).

It is well established that the aesthetic response to visual art evokes an emotional response (Tan, 2000). As discussed in Chapter 2 there is an emerging picture of brain networks and neural responses that suggest that even the expectation of looking at art, and the perception of art stimulates the reward circuitry of the brain (Lacey et al., 2011; Vartanian & Goel, 2004b; Vessel et al., 2012). The visual experience of art arguably includes both cognitive and emotional components (Silvia, 2005a), and there is evidence that viewing art in galleries is arousing (Brieber et al., 2014, 2015; Locher et al., 1999, 2001), supported by the results in Chapter 4. Yet there is very little empirical research exploring the impact of contemplating visual art on mood.

5.1.6 Contemplation

The time taken to perceive and contemplate art has previously been found to influence aesthetic preference. The longer it takes to decide whether a painting contains familiar objects, the more likely the painting is to be rated as aesthetically affective (Ishai et al., 2007), and the longer a painting is viewed the more it is liked (Vartanian & Goel, 2004). Kieran (1997) describes how when we look at that which is beautiful a certain kind of pleasure is experienced, and that it is the contemplation of this beauty that gives rise to the pleasure. Yet previous research has reported viewing times of original artworks, in galleries, of only between 10 seconds to over a minute (Smith & Smith, 2001; Heidenrich & Turano, 2011; Locher et al., 2007), with huge variations between individuals and works of art. When asked to make an aesthetic rating, viewing times appear to be particularly quick, as was the case in the previous study (Chapter 4). In studies exploring aesthetic responses to art stimuli, presentation time ranges from 1 millisecond (Bachmann & Viper, 1983), 1500 milliseconds (Study 2, above) to 4 seconds (Ishai et al., 2007). This results in remarkably quick decisions as the artworks are seen as stimuli, rather than beautiful creations to be contemplated. In order to explore whether contemplation of art influences mood, emotion, preference and the status of art viewing times were prescribed in this final study.

5.1.7 Memorable art

As discussed in Chapter 4, whilst colour was a dominant theme regarding the memorability of art, so too was art with clear semantic content that evoked personal memories, and art which was liked, in line with models of aesthetic processing (e.g., Chatterjee, 2004a, Leder et al., 2004) which indicate that liking (Chatterjee, 2004a) or satisfaction (Leder et al., 2004) influences the affective state and emotional response to art. Individual differences in preference for art and aesthetic attitudes have previously been investigated (e.g., Chamorro-Premuzic & Furnham, 2004; Feist & Brady, 2004; Furnham & Bunyan, 1998; Furnham & Walker, 2001; Furnham & Rao, 2002; McManus & Furnham, 2006; Tommaso et al., 2008). Music and art education (McManus & Furnham, 2006), the frequency of visits to galleries (Furnham & Walker, 2001), artistic self perception (Chamorro –Premuzic, Reimers, Hsu, & Ahmetoglu, 2009) have all been positively correlated with aesthetic activities and artistic preference. As yet, there appears to be little research into the effect of expertise: does art expertise influence what it is about the art that makes it memorable?

Research using affective pictures (not artworks) has concluded that highly arousing pictures are remembered better than low-arousing pictures and while pleasantness is processed at initial encoding, long term memory is mainly affected by arousal (Bradley et al., 1992). But as discussed in Chapter 2 the viewing of artworks also involves artistic style. Both style and content are central to the processing of art (Leder et al., 2004), with content important regarding classification and appreciation (Augustin & Leder, 2006). Interpreting art also involves perception and knowledge. Whilst perceptual processes may be hardwired, directed perception incorporates personal history and knowledge, which affects visceral responses (Solso, 2003). Thus, artworks that are arousing and knowledge regarding the style and content of art may all impact on their memorability. The status of art has also been acknowledged as imperative. Lacey et al., (2011) report that when artworks were matched with photographs for content participants liked the art images better than then the non-art images, rated them as more beautiful, but the aesthetic ratings were not significantly different. This suggests that it is the status of art, the content and style, whether semantic content, the colour or techniques, and arousal which impacts on the memorability of art.

5.1.8 Electroencephalography (EEG)

Differences in the degree of phase synchronization between neuronal assemblies during the perception and imagination of visual art, between artists and non-artists, have been reported (Bhattacharya & Petsche, 2001). These differences suggest artists have enhanced binding capabilities of numerous visual attributes and higher involvement of long-term visual memory. Attributes are the visual qualities of an object, such as 'red', 'spotted', 'round' or 'tall' (Ferrari & Zisserman, 2007). In the central nervous system neural oscillation is a rhythmic or repetitive neural activity. Oscillatory activity in groups of neurons results in the synchronization of their firing patterns. In large-scale oscillations amplitude changes are considered to result from changes in synchronisation within a neural ensemble, referred to as local synchronisation. Neural oscillations and synchronisation have been linked to many cognitive functions such as information transfer, perception, motor control and memory (Fell & Axmacher, 2011; Fries, 2005), and to cognitive states such as awareness and consciousness (Engel & Singer, 2001; Varela, Lachaux, Rodriguez & Martinerie, 2001).

The synchronized activity of large numbers of neurons can be measured by EEG that reveals oscillatory activity in specific frequency bands: alpha, delta, theta, beta and gamma. Alpha (8-13Hz) can be detected during relaxed wakefulness and increases when the eyes are closed. Alpha synchrony is strongest during relaxation. Delta (1-4Hz) is usually associated with Slow Wave Sleep. Theta (4-8Hz) relates to working memory processing, visualization and access to the subconscious. Beta (13-30 Hz) is mainly associated with performing a task, and Gamma (30-70Hz) activity is associated with cognitive, auditory and motor tasks, and visual processing (Krause, 2003). Martinovic and Busch (2011) argue that early evoked gamma-band activity reflects an initial stage of concurrent bottom-up and top-down processing in vision, while later induced gamma band activity is a neural marker of representational processing, ensuring efficient and timely information intake and integration. It has been suggested that moderate levels of gamma coherence occur in the 'binding' together of the many elements comprising normal consciousness into a unified experience, and furthermore that gamma coherence may be a marker for heightened states of awareness (Echenhofer et al., 2004).

Bhattacharya and Petsche (2001) asked ten artists and ten non-artists to look at slides of famous paintings projected onto a white wall for 2 minutes and then to imagine that painting for 2 minutes whilst EEG was recorded. They looked at four artworks by four famous artists from different periods and schools of art. In artists as compared to non-artists, significantly higher phase synchrony was found in the high frequency beta and gamma bands during the perception of paintings, whilst during the imagination period, low frequency bands (primarily delta) phase synchrony was enhanced. Strong decreases in phase synchrony of alpha were evident for artists during both tasks. The authors conclude that the enhanced synchrony in the high frequency band is possibly due to enhanced binding capabilities of numerous visual attributes in the artists, whilst the enhanced synchrony in the low frequency band is due to the higher involvement of long-term memory involved in the imagery of art. The decrease in alpha during imagery in the artists compared to the non-artists is interpreted as the additional involvement of subcortical structures in the artists.

A subsequent study (Bhattacharya & Petsche, 2005) also found significant differences in patterns of functional cooperation between cortical regions between artists and non-artists. During the mental creation of drawings artists showed significantly stronger delta band synchronization and alpha band de-synchronisation than non-artists. Bhattacharya and Petsche (2005) attribute the higher synchrony in the low-frequency band in the artists to the involvement of a more advanced long-term visual art memory and to extensive top-down processing.

Evidence from Chapter 3 revealed that visual art elicits different levels of attentional and evaluative resources in experts and non-experts; with expertise being associated with enhanced amplitude of early ERP components related to attention and effort and higher order visual processing with sustained attention. This final study sought to extend these findings regarding expertise, by exploring neural processes during the visual perception and imagining of visual art. With this in mind the role of art expertise on the intellectual consideration of ‘is it art?’ was investigated. In order to explore how expertise and context influenced the judgement of art the response to the question ‘is it art?’ regarding original and reproduced artworks were compared. In order to explore whether contemplation of art influences mood, emotion, preference and the status of art three measures of mood (alertness, calmness and contentedness), and dispositional affect (positive and negative) were assessed, as well as judgements of ‘like’ and ‘beauty’, and viewing times were prescribed to encourage contemplation.

This study had two objectives. The first objective was to examine the impact of art expertise (expert and non-expert in visual art) and context (original and reproduction) on mood and affect, aesthetic judgement and intellectual response and the memorable themes of the art whilst viewing contemporary visual art. The second objective was to investigate differences, if any, between art experts and non-experts on the dynamic interactions between neuronal assemblies in the brain during the contemplation and during the imagination of visual art, by recording continuous EEG.

Subsequently this study was conducted with the following aims:

- To examine the impact of contemplating visual art and the effect of art expertise (expert and non-expert in visual art) on mood and affect.
- To examine the combined effect of art expertise (expert and non-expert in visual art) and context (original and reproduction) on art appreciation, using emotion (affect), aesthetic judgments (like and beauty), and intellectual response (is it Art?) in response to contemporary art.

- To examine the correlation between aesthetic affect (like and beauty) and cognitive response (is it Art?) in art experts and non-experts.
- To identify the effect of expertise (art expert and non-expert) and of context (original and reproduced) on the experience of art and the themes which make visual art memorable.
- To investigate differences in the 5 individual frequency bands (delta, theta, alpha, beta and gamma) during the perception and contemplation of visual art and during visualisation of a memorable artwork, in two groups, art experts and non-experts.

Two groups were compared. Visual art experts (experts) and those not expert in art (non-experts) were identified by means of a bespoke art expertise and experience questionnaire developed to identify individuals with varying degrees of art training, expertise and experience in visual art.

It was hypothesised that:

Effects on Mood and Affect:

- There will be a main effect of contemplating visual art on mood: In both experts and non-experts participants will be calmer and more content after contemplating visual art. This effect would be more pronounced in experts.
- There will be an interaction of contemplating art and expertise: the above effect on calmness and contendedness will be more pronounced in experts. Furthermore, the experts will be more alert after contemplating visual art, whilst this effect will be reversed in the non-experts.
- There will be a main effect of expertise on affect: both experts and non-experts will report an increase in positive affect and a decrease in negative affect after contemplating visual art.
- *Effects on Arousal and Aesthetic Judgements:*

- There will be a main effect of context on arousal and aesthetic judgements: for both experts and non-expert, original art will be more arousing, liked more and judged as more beautiful than reproduced art.
- There will be a main effect of expertise on arousal and aesthetic judgements experts will rate both original and reproduced art as more arousing, more liked and more beautiful than non-experts.

Effects on Cognitive Response:

- There will be a main effect of expertise on cognitive responses, but no main effect of interactions associated with the context: experts will give higher ratings than non-experts in response to the question 'is it Art?' in both original and reproduction contexts, but there will be no differences in the rating of 'is it Art?' between the original and reproduction contexts, by either experts or non-experts.

Correlations between measures and themes arising from qualitative responses:

- The aesthetic affect ratings 'like and beauty' will be positively correlated with the rating of 'is it Art?' in the non-experts only.
- Colour, style, empathy and curiosity will be the main themes that make the most memorable artwork memorable, in both contexts and in both groups. Reproduced artworks will evoke more negative emotions than positive in the non-experts, but this would not be evident in the experts. Both contexts will evoke positive emotions in the experts.

Effects on EEG Measurements:

- There will be a main effect of expertise on phase synchrony of beta and gamma during contemplation of artworks: higher phase synchrony will be found in beta and gamma bands in the experts than in the non-experts.
- There will be a main effect of expertise on phase synchrony of delta activity during the imagining and visualisation of the most memorable artwork: phase synchrony will be enhanced in delta band in the experts but not the non-experts.
- Strong decreases in phase synchrony of alpha band will be found in the experts during both contemplation and visualisation tasks, but not in non-experts.

5.2 Materials and Methods

5.2.1 Design

A mixed design was used. The between-subjects groups were art experts and non-experts. Art was viewed in two contexts by all participants, original and reproduction. The dependent variables were mood and affect, and ratings of affect, like, beauty and 'is it art?' As in the previous study 'affect' was chosen to capture the immediate affective response to art. The factors 'like' and 'beauty' were chosen to explore whether art which elicited high affect ratings was also liked the most and considered to be the most beautiful. The final rating was in response to the question 'is it art?' To overcome order effects a counterbalancing procedure was employed for both group and context. There were 4 protocols and the presentation of the artworks was randomised by the experimenter in each protocol. The four protocols were:

1: Catalogue 1 reproduction, Catalogue 2 original

2: Catalogue 1 original, Catalogue 2 reproduction

3: Catalogue 2 reproduction, Catalogue 1 original

4: Catalogue 2 original, Catalogue 1 reproduction

5.2.2 Participants

Forty participants took part in the study. Twenty were art experts (5 males), with ages ranging from 22-56 years (mean 25.6 yrs, SD 11.22). Twenty were non-expert in art (4 males), with ages ranging from 21-50 years (mean 37.2 yrs, SD 1.33). Art experts were self-selected. To ensure this self-selection was appropriate a bespoke Art Expertise questionnaire was administered (Appendix 4). No reallocation of participants to an alternative group was necessary. Participants were recruited by email from Northumbria and Newcastle University staff and graduate populations, artist networks and through publicity at the British Science Festival. All participants were right handed, fluent English speakers and reported normal or corrected to normal vision and no history of neurological damage. The study received ethical approval from the School of Life Sciences Ethics Committee at Northumbria University and was conducted in accordance with the

Declaration of Helsinki. All participants gave written informed consent before inclusion in the study and were paid £10.00.

5.2.3 Stimuli

The stimuli were twelve 2-dimensional artworks. All stimuli were taken from an original art exhibition held at BALTIC 39, Newcastle upon Tyne. The artworks were 2-dimensional to ensure accurate reproduction and there were at least two artworks exhibited by each artist. The work of 6 international contemporary artists was exhibited. The pictures were all paintings depicting faces, objects, natural scenes, abstract, or indeterminate interpretations inspired by digital images. Two works by each artist were selected as stimuli, and matched, as far as possible, regarding style, size, theme, style and colour. Figure 32 shows the final matched pairs of artworks, by artist, listed in two catalogues, Catalogue 1 and Catalogue 2. Digital images of the 12 artworks were downloaded from the artists' websites. Graphic manipulation of the stimuli was done using Paint.NET v3.5.10. The pictures were re-sized to fit within a 1931 x 1931 mm format (730x730 pixel), with a resolution of 96 dpi (dots per inch), without changing the original proportions, colour or luminance.

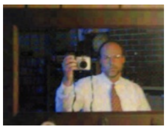
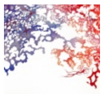
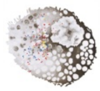
Artist	Catalogue 1	Catalogue 2
Joy Garnett	 1. Bubbilicious Oil on Canvas 36 x 28 cm	 1. Pinko Oil on Canvas 36 x 28 cm
Paul Goodfellow	 2. Untitled Acrylic on Board 27 x 54 cm	 2. Untitled Acrylic on Board 68 x 141 cm
Dan Hays	 3. Self Portrait Oil on Canvas 76 x 203 cm	 3. Nymph Lake Oil on Canvas 107 x 142 cm
Daksha Patel	 4. Diffusion 1.4 Duratrans, Framed Drawing 100 x 100 cm	 4. Diffusion 1.2 Duratrans, Framed Drawing 100 x 100 cm
Rachel Sharp	 5. New Yorker Series (XI Oil on Canvas 13 x 18 cm	 5. New Yorker Series (XII) Oil on Canvas 13 x 18 cm
Jo Wilmot	 6. Predator Oil on Canvas 185 x 180 cm	 6. Twinkle Oil on Canvas 30 x 30 cm

Figure 32. Artworks selected from 'Digital Sensations' Exhibition as stimuli, showing name of artist, title, medium and size, in two Catalogues, Catalogue 1 and Catalogue 2. Artworks were matched, as far as possible, regarding size, content, theme, style and colour.

5.2.4 Materials and apparatus

Demographics: A short questionnaire to gather demographic information regarding age, gender, handedness, brain injury, and visual impairment (see Appendix 9).

Expertise Questionnaire: An art expertise questionnaire, based on that of Chatterjee et al., (2010) was developed (Appendix 9) to focus not only on elements of formal art education but also on time spent creating art, contemplating art, educating others in art and collaborating with other artists. (The reason for the adaptation was that the Art Experience Questionnaire was created with the American education system in mind). The first question asked whether they worked in the visual arts, then nine questions focused on elements of formal art education, interest and time spent contemplating artworks, and time spent creating art or teaching art. Five of the questions asked how many hours a week were spent in activities associated with visual art, i.e., looking at visual art, reading about it, teaching it, creating it and collaborating with visual artists. e.g., ‘In the average week how many hours do you spend making visual art?’ (the response scale ranged from 0 to more than 6). Two questions asked about the frequency of visits to art galleries and museums, and two gathered information regarding years of formal art education, (Chatterjee et al., 2010; Pang et al., 2012). Whilst there is no principled way to establish a categorical cut-off for experience participants with scores of 0 to 14 were considered artistically naïve, and those with scores greater than 14 were considered art experts (Chatterjee et al., 2010).

Bond-Lader Mood Scale: Mood was assessed using the visual analogue scales of Bond and Lader (Bond & Lader, 1974), (Appendix 10). These scales have been widely utilised (Kennedy et al., 2004) and their reliability and validity have been demonstrated (Ahearn, 1997). The scales comprise a total of sixteen 100mm lines anchored at either end by antonyms and participants mark their current subjective state, on the line. Each line is scored by measuring the millimetres the mark is from the negative antonym. From these scores three measures, derived by factor analysis (Bond & Lader, 1974), can be derived from these scores representing ‘alertness’, ‘calmness’ and ‘contentedness’. ‘Alertness’ is represented by lines anchored by alert-drowsy, attentive-dreamy, lethargic-energetic, muzzy-clearheaded, well-coordinated-clumsy, mentally slow-quick witted, strong-feeble, interested-bored, and incompetent-proficient. ‘Calmness’ is represented by lines anchored by calm-excited, and tense-relaxed, and ‘contentedness’ by contented-discontented, troubled-tranquil, happy-sad, antagonistic-friendly, and withdrawn-sociable.

PANAS: The Positive and Negative Affect Schedule is a 20-item self-report measure of positive and negative affect developed by Watson, Clark and Tellegen (1988) and is regarded as a reliable and valid measure of mood (Crawford & Henry, 2004). Negative Affect (NA) and Positive Affect (PA) reflect dispositional dimensions. 10 items measure NA and 10 items measure PA. Each item is scored on a scale of 1 (very slightly or not at all) to 5 (extremely). High NA is associated with unpleasurable engagement with their environment and subjective distress and low NA with an absence of these feelings. PA represents the extent individuals experience pleasurable engagement with their environment and subjective happiness (Appendix 11).

Ratings: The arousal, aesthetic judgement and cognitive response to art were rated on a Likert type scale of 1-10, with 1 = not at all or no, 10 = a lot or absolutely yes. The 4 ratings were:

1: Affect or WOW

How much did the picture you have just looked at make you go WOW?

Participants were given the following instructions to interpret this question: *Please give your gut-level response, your visceral reaction to the picture you have just seen. This may be because the picture was beautiful, or it made you happy, equally it may be because it was horrible or made you angry. It is not about how much you liked it, it is about how much it moved you, either positively or negatively, how powerful your reaction to it was.*

2: Like. How much did you like this picture?

3: Beauty. How beautiful did you find this picture?

4: Is it art?

Task: The reproduction task was presented using PowerPoint Mac 2008, on an Apple iMac OS X with 27” widescreen. The display resolution was set at 2560 x 1440, pixel depth 32- Bit, LED backlit display. The brightness and colour automatically adjusted as the ambient light changed. All stimuli were presented in the centre of the screen on a white background and displayed for 60 seconds (see “Procedure” below for more detail).

5.2.5 Apparatus

Testing took place in two identical, adjacent galleries in BALTIC39 in Newcastle upon Tyne, a cultural hub for contemporary art practice and research. The reason for this was to control for the context of the setting for both original art and reproductions of art, as in the previous study (Chapter 4), and to ensure that the art was experienced in contemporary and professional gallery space. BALTIC 39 is a vibrant community of practising artists and is regarded as an important cultural hub for contemporary art practice. It is home to BALTIC’s project space, a gallery space, 33 artists’ studios and the BxNU (a collaboration between BALTIC and Northumbria University) Institute of Contemporary Art. The exhibition ‘Digital Sensations’ from which the artworks were selected was a specially curated exhibition for the British Science Festival. The curator, Rachel Sharp, identified contemporary painters who have harnessed the creative potential of digital media in their practice to explore how the rapid-fire digital world influenced the traditionally slow process of painting. This venue allowed us to address the contextual sensitivity of the experience of art (original or reproduction) whilst controlling for the impact of the physical context.

An Apple iMac OS X was used to present the reproduction task. The timer app on an Apple iPhone 4 was used to time the viewing time. EEG was recorded on a MacBook Pro laptop computer using the ActiView acquisition programme and the Biosemi Active Two, multi channel, high-resolution measurement system (Biosemi, Amsterdam, Netherlands). BDF file-format conversion to Neuroscan CNT file-format was converted using Polyrex (Kayser, 2003). Interviews were recorded on an Olympus Digital Voice Recorder VN-5500PC.

5.2.6 Procedure

Participants were enrolled by email, they were sent the study briefing documents and subsequently a mutually agreeable time was arranged. All participants were met at the reception of BALTIC39 and escorted to Gallery 2. There were no artworks exhibited in

Gallery 2, which contained only an Apple iMac, EEG recording equipment, chairs and a table. After written consent was obtained the experimenter briefed the participant regarding the experiment protocol. The demographic and expertise questionnaires were then completed. The Bond-Lader and PANAS were then administered to identify baseline mood and ratings of PA and NA. Participants sat in a wheelchair and the electrode cap was fitted and electrodes applied following the extended international 10-20 system (Jasper, 1958). Participants were requested to move as little as possible and to try not to chew or blink during the experiment. They were told that they were going to be shown works of art both in the next-door gallery (Gallery 1) and in the current gallery (Gallery 2). They were asked to keep their eyes closed in the periods between looking at the pictures. They would be told when to close their eyes, and when they could open them again. When they opened their eyes there would be a picture in front of them. They were asked to try to look only at that picture and to contemplate it. After they had observed the picture they would be asked to close their eyes and give the picture just contemplated four ratings, on a scale of 1 -10. 1 = not at all or none or no, 10 = a lot, very or definitely. The 4 ratings were: Affect or WOW, like, beauty and ‘is it Art? In order to encourage the contemplation of the artworks participants were asked to look at the picture presented for 60 seconds.

Three tasks were completed whilst EEG was recorded. See Figure 34 for the sequence of the three EEG tasks. The three tasks were:

(i) *Calibration and baseline recording:* The first task required participants to sit in the wheelchair in Gallery 2 (the empty gallery) whilst EEG was recorded. First a bio-calibration was performed to determine the personal characteristics of the individuals’ EEGs (Geyer, Talathi & Carney, 2009). They were asked to close their eyes, open their eyes, look left, look right, look up, and look down for 3 seconds each. They were asked to do this 3 times. In order to collect individual baseline data participants were then asked to sit quietly with their eyes closed for 2 minutes.

(ii) *Art contemplation:* The second task required participants to view the artworks whilst EEG was recorded. They viewed all 12 works of art, one Catalogue as reproductions in Gallery 2, the other Catalogue as originals in Gallery 1.

In the reproduction condition (Gallery 2) participants were wheeled, in the wheelchair, to a comfortable distance from the table with the Apple iMac OS X screen on. When they opened their eyes a work of was presented on the screen in front of them. They were asked to contemplate it for 60 seconds, then to close their eyes and give their four ratings (affect/wow, like, beauty, art?). The 6 artworks (either Catalogue 1 or Catalogue 2) were presented randomly on the screen for 60 seconds each, after which the screen went blank.

In the original condition (Gallery 1) participants were wheeled, in the wheelchair, to a comfortable distance in front of each of the artworks individually, with their eyes closed. They were told that when they opened their eyes there would be an artwork directly in front of them, they should contemplate it for 60 seconds, and try not to look at any of the other artworks nearby. See Figure 33 below. After 60 seconds they were asked to close their eyes and to give the 4 ratings in response to the artwork they had just seen (affect/wow, like, beauty, art?). They were then wheeled to the next artwork and the same instruction given. All artworks were presented randomly. The 60 seconds were timed manually using the timer app on an Apple iPhone 4.

In both conditions EEG was recorded throughout and the researcher manually recorded which artwork was presented in order to match the artwork presentation with the recorded EEG. The F1-F6 keys on the recording computer were utilized as triggers to mark the timestamp for each artwork presentation. As each artwork was presented the researcher manually sent the appropriate trigger, F1-F6, to mark the onset of the presentation of the artwork. The same trigger was sent to mark the end of the presentation. The triggers matched the number of the artwork in each context, e.g. F1 marked the presentation of artwork 1, F2 marked the presentation of artwork 2. The number and order of the pictures presented and the participants' ratings were manually recorded (Appendix 12).

Figure 33. Participant contemplating original art in Gallery 1 while EEG recording was taken

(iii) Memorable Artwork Visualisation: On completion of both the original and reproduction task participants were asked to think which one of all the artworks contemplated was their most memorable. They were asked to sit quietly, with their eyes closed and to visualize that single artwork, to imagine it, what it looked like, its colours, its content, for 2 minutes. EEG was recorded. The 2 minutes were timed manually.

The EEG cap and electrodes were then removed.

Participants were then asked a number of questions regarding their most memorable artwork, the one they had visualized:

- Tell me how this picture made you feel, what sort of affect did it have on you?
- What was it about the picture that made you feel that way?
- What was it about this picture that made it the most memorable for you?
- Can you describe it to me, as though you were describing it to a friend, so that they could easily find it in the exhibition?

Their responses were recorded on a portable voice recorder.

Participants were then shown a sheet with all the artworks on and asked to identify the most memorable picture, and whether they had viewed seen it in Gallery 1, in the original condition, or in Gallery 2, on the computer.

The participants then completed a second Bond-Lader Mood Questionnaire and a second PANAS questionnaire. Following this participants were allowed to ask questions, thanked for their time, debriefed and paid £10.

Total EEG recording time was approximately 17 minutes. Total time of the experiment for each participant was about 1.5 hours.

See below for procedure over view and Figure 34 for the sequence of tasks.

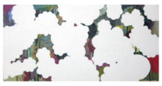
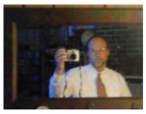
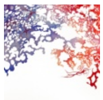
Procedure Overview and Timeline:

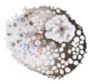
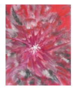
- Met at reception and escorted to Gallery 2: 5 minutes
- Briefing and Written consent: 2 minutes
- Demographic and expertise questionnaire: 5 minutes
- Bond-Lader 1: 2 minutes
- PANAS 1: 2 minutes
- EEG cap up and task explained: 15-20 minutes
- EEG bio calibration and baseline data collection: 3 minutes
- Art contemplation, in both Gallery 1 and 2: 30 minutes
- Memorable artwork visualisation: 2 minutes
- EEG cap and electrodes removed: 2 minutes
- Memorable artwork interview: 2 minutes
- Bond Lader 2: 2 minutes
- PANAS 2: 2 minutes
- Debrief and payment: 1 minute

Total experiment time: 1 hour 15 minutes

EC EO ↑↓←→	EC EO ↑↓←→	EC EO ↑↓←→	EC
20 seconds	20 seconds	20 seconds	120 seconds

(i) Sequence of tasks for the EEG bio calibration and baseline data collection: Eyes closed (EC) 3 seconds, Eyes open (EO) 3 seconds, look up (↑) 3 seconds, look down (↓) 3 seconds, look left (←) 3 seconds, look right (→) 3 seconds, performed 3 times, then eyes closed (EC) for 120 seconds. Total EEG recording time up to 3 minutes (180 seconds).

Catalogue 1					
					
60 seconds	60 seconds	60 seconds	60 seconds	60 seconds	60 seconds

Catalogue 2					
					
60 seconds	60 seconds	60 seconds	60 seconds	60 seconds	60 seconds

(ii) Sequence of viewing of artworks task. Each catalogue was presented either as originals (Gallery 1) or reproductions (Gallery 2), depending on protocol (1-4). Presentation of artworks in each context was randomised. Each artwork was viewed for 60 seconds whilst EEG was recorded. Total EEG recording time 12 minutes (720 seconds).

120 seconds

(iii) Final EEG task: Visualisation of most memorable artwork with eyes closed. Total EEG recording time 2 minutes (120 seconds)

Figure34. Sequence of the three EEG tasks. Total EEG recording time for each participant was 17 minutes.

5.2.6 Analysis

Quantitative Analysis: To address the research questions outlined above (section 5.1), a series of analyses of variance (ANOVAs) and correlations were conducted. Initial analyses of covariance were carried out on the data to investigate the moderating effects of age, gender, years of further education and protocol. Post hoc analyses were conducted using the Bonferroni procedure with a significance level of $p < .05$ unless otherwise stated.

In line with Kennedy, Little and Scholey (2004), before the primary analysis of viewing art on mood effect, and affect, initial two-way ANOVAs were conducted on the Bond-Lader mood scores and PANAS affect scores. A series of 2 (Group: Expert, Non-Expert) x 2 (Time: Before, After) ANOVAs were completed. With regard to the primary statistical analysis the scores completed on the Bond-Lader Mood Questionnaire and the PANAS questionnaire before viewing art were subtracted from the scores on these questionnaires completed after viewing art. This provided a single score representing the change engendered by viewing art. Three-way ANOVAs were conducted, 2 (Group: E, NE) x 2 (Time: B, A) x 3 (Mood measure: change in: alertness, calmness and contentedness) on the Bond-Lader Mood change scores, and on the PANAS affect change scores, 2 (Group: E, NE) x 2 (Time: B, A) x 2 (Change score: PA, NA).

With regard to the behavioural ratings of affect, like, beauty and 'is it art?' in response to contemporary visual art, participants mean response for each measure in each context was calculated and a 2 (Group: E, NA) x 2 (Context, O, R) x 4 (Ratings: affect, like, beauty, art) ANOVA was conducted.

A series of Pearson product-moment correlation coefficients were computed to assess the relationship between the aesthetic ratings in response to contemplating art (WOW, like, beauty) and the ratings of 'Is it Art?' The data was first analysed overall, then separately for each expertise group.

In order to examine the relation between expertise and the context in which the most memorable artwork was contemplated a chi-square test of independence was performed.

Qualitative Analysis: To bring order, structure and interpretation to the collected interview data (Marshall & Rossman, 1990) a mixed quantitative and qualitative thematic analysis technique was employed for the interviews. Each individual text was analyzed separately. Themes for analysis (phrases within sentences) e.g. it caught my attention, or, I was intrigued by it; it reminded me of something I had seen previously, or, it reminded me of….., were taken from each text and coded. Once all the texts were coded a series of sub themes were created to group units of analysis, these sub themes were then condensed to identify themes. The analysis concentrated on emotional affect, aesthetic affect and memory. Analysis was conducted on the most memorable artworks experienced as originals, then on those experienced as reproductions, by each group, experts and non-experts.

5.2.7 EEG recording and data collection and analysis

The details pertaining to the recording and pre-processing of the EEG data were similar to those outlined in Chapter 3. EEG data was recorded and pre-processed from 40 participants. Due to the unforeseen high noise levels in an adjacent gallery (loud conversations and rock music) and outside the venue (e.g., seagulls, a street market, an open air rock concert, and waste collection) it was determined that the EEG data contained too many auditory artefacts for appropriate analysis, as such the EEG files were not analysed further.

5.3 Results

5.3.1 Descriptive Statistics

Table 14 shows the participant characteristics for the expert and non-expert groups. Initial analyses of covariance were carried out on the data to investigate the moderating effects of protocol, age, gender and years of further education. As there were no significant effects ($p > .05$) in any analysis they are not discussed further. As expected, experts scored significantly higher on the mean level of art expertise than non-experts.

Table 14. Mean (and *SD*) participant characteristics, showing age, years of further education, expertise score, and gender ratio in each group, experts and non-experts.

	Expert	**Non-Expert**
Age (yrs)	35.60 *(11.22)*	37.20 *(11.33)*
Further Education (yrs)	4.70 *(1.69)*	4.30 *(1.87)*
Expertise *	31.7 (*10.44*)	3.75 (*3.16*)
Gender (F:M)	15:5	16:4

* (t(19)= 16.97, p<.001)

5.3.2 Subjective Mood Measures

In order to establish the main effects of viewing art on mood and any interaction between expertise and change in mood scores pre and post viewing art two-way ANOVAs were conducted on the raw Bond-Lader mood scores (alertness, contentedness, calmness) and the raw PANAS (positive affect, negative affect) scores. Table 15 shows the mean (and SD) of mood scores: alertness, contentedness, calmness, pre and post-viewing art, and the change in mood scores.

Table 15. Mean (and SD) of mood scores: alertness, contentedness, calmness, pre and post viewing art, and the change in mood scores, for experts and non-experts and overall.

	Experts	**Non-Experts**	**Overall**
Alertness: pre	70.22 (11.57)	71.65 (10.44)	70.94 (10.9)
Alertness: post	64.2 (16.15)	67.98 (12.67)	66.09 (14.46)
Alertness: change	-6.02 (13.16)	-3.67 (13.71)	-4.85 (13.32)
Contentedness: pre	75.07 (18.23)	74.97 (10.09)	75.02 (14.54)
Contentedness: post	77.75 (13.84)	80.24 (13.09)	79.00 (13.36)
Contentedness: change	2.68 (13.94)	5.27 (10.08)	3.98 (12.08)
Calmness: pre	61.13 (21.98)	62.23 (17.8)	61.68 (19.75)
Calmness: post	71.28 (18.51)	72.3 (19.4)	71.79 (18.72)
Calmness: change	10.15 (24.01)	10.08 (21.85)	10.11 (22.66)

Bond-Lader Initial Analysis: There was a significant main effect ($F(1,38) = 5.2$, $p<.05$) of looking at art on 'alertness' scores with overall average ratings declining from 70.94 (average millimetres) pre viewing art to 66.09 mm. There was a significant main effect on 'contentedness' scores after looking at art ($F(1,38) = 4.27$, $p<.05$) with overall average scores increasing from 75.02 mm to 79.00 mm, and a significant main effect on 'calmness' scores ($F(1,38) = 7.76$, $p<.01$) with overall average scores increasing from 61.68 mm to 71.79 mm. There were no significant interactions between alertness and group (expert or non-expert) ($F(1,38) = .31$, $p = .58$), contentedness and group ($F(1,38) = .45$, $p=.51$), or calmness and group ($F(1,38) = .00$, $p=.99$).

Bond-Lader Primary Analysis: For the primary statistical analysis the mood scores completed before viewing art were subtracted from the mood scores completed after viewing art. This provided a single score representing the change in each mood factor engendered by viewing art. The three-way ANOVA showed a significant main effect of viewing art on mood ($F(2,76) = 8.25$, $p<.005$). There was no significant interaction between the change in mood and group ($F(2,76) = .08$, $p=.78$).

To summarise, viewing art increased scores of contentedness and calmness and decreased scores of alertness, in both experts and non-experts equally.

PANAS Initial Analysis: Initial two-way ANOVAs on the raw pre and post viewing art affect scores revealed no significant main effect of looking at art on ratings of positive affect scores ($F(1,38) = .00$, $p=.95$) or on negative affect scores ($F(1,38) = 3.44$, $p=.88$). There was also no significant interaction between group (expert and non-expert) on either ratings of positive affect ($F(1,38) = .04$, $p=.85$) or negative affect ($F(1,38) = .02$, $p= .88$) pre or post viewing art. Table 16 shows the raw mean (and SD) scores of positive and negative affect scores both pre and post viewing art, by group, experts and non-experts, and overall.

Table 16. Mean (and SD) of affect scores, positive and negative, pre and post viewing art, for experts and non-experts, and overall.

Rating	Expert	Non-Expert	Overall
Positive affect: pre	35.75 (6.89)	34.7 (5.55)	35.23 (6.2)
Positive affect: post	35.9 (5.55)	34.4 (8.17)	35.2 (7.0)
Positive affect: change	0.15 (6.04)	-0.3 (8.26)	-0.08 (7.14)
Negative affect: pre	13.65 (4.57)	12.3 (3.2)	12.98 (4.0)
Negative affect: post	12.65 (3.51)	11.45 (2.65)	12.05 (3.13)
Negative affect: change	-1.0 (3.03)	-0.85 (3.28)	-0.93 (3.12)

PANAS Primary Analysis: For the primary statistical analysis the positive and negative affect scores completed before viewing art were subtracted from the affect scores completed after viewing art. This provided a single score representing the change in the affect factor engendered by viewing art. The primary two-way ANOVA showed no significant main effect of viewing art on the change in affect ($F(1,38) = .36$, $p=.55$), nor any interaction between group and change in affect ($F(1,38) = .05$, $p = .83$).

In summary, there was no effect of viewing art on positive or negative affect scores, overall, or by group expert or non-expert.

5.3.3 Effects on Arousal and Aesthetic Judgements and on Cognitive Response:

In order to examine how context impacts on the behavioural ratings of affect, like, beauty and 'is it art?' in response to contemporary visual art a 2 (Group: E, NA) x 2 (Context, O, R) x 4 (Ratings: affect, like, beauty, art) ANOVA was conducted. The mean rating of level of affect, liking, beauty and 'is it art?' for the artworks viewed in each context, original and reproduction, by group, expert and non-expert, are shown in Table 17.

This analysis revealed that contrary to the hypothesis there was no significant main effect of context ($F(1,38) = .61$, $p=.44$), and there was no interaction between context and group ($F(1,38) = .65$, $p = .43$). There was a significant main effect of rating type ($F(3,114) = 30.68$, $p<.001$), but no interaction between rating type and group ($F(3, 114) = 1.06$, $p=.37$). Finally, there were no interactions between context and rating type ($F(3,114) =$

2.45, p=.09) or between context, mean art rating and group (F(3,114) = 2.45, p=.07). These results suggest that neither context nor expertise affected the mean ratings of affect, like, beauty or ‘is it art?’ in response to contemporary visual art.

Table 17. Mean (and SD) rating of affect, liking, beauty and ‘is it art?’ for artworks viewed as originals (O) and as reproductions (R) by group, expert and non-expert

Rating	Context	Expert	Non-Expert
Affect	Original	5.38 (1.31)	5.84 (1.14)
	Reproduction	5.59 (1.31)	5.9 (1.31)
Like	Original	5.42 (1.26)	5.48 (1.41)
	Reproduction	5.22 (.95)	5.46 (1.15)
Beauty	Original	5.44 (1.13)	5.24 (1.37)
	Reproduction	5.24 (1.03)	5.15 (1.3)
Art?	Original	7.66 (1.83)	6.93 (1.46)
	Reproduction	6.93 (1.59)	6.99 (1.45)

5.3.4 Correlations between Arousal and Aesthetic Judgements and on Cognitive Response

Overall: In order to assess the relationship between the aesthetic ratings made in response to contemplating artworks and the ratings of ‘Is it Art?’, the combined ratings of affect (WOW), like and beauty, and the combined ratings of ‘Is it Art?’ of all the participants (E and NE) in both contexts (O and R), a one-tailed Pearson’s product-moment correlation co-efficient was computed. Table 18 shows correlations between the combined mean aesthetic ratings (WOW, like, beauty) and the combined mean rating of ‘Is it Art?’ for both groups (E and NE) in response to contemplating art in both contexts (O and R). Means and SD for each measure are also presented.

Whilst there was no correlation between the overall rating of affect (WOW) and the overall rating of ‘Is it Art?’, increases in the overall ratings of ‘like’ and ‘beauty’ were correlated with increases in the rating of ‘Is it Art?’ This suggests that ‘like’ and ‘beauty’ are important factors in assessing whether an artwork is perceived as Art, the more an artwork is liked and the more it is thought to be beautiful, the more likely it is to be perceived as Art, or vice versa, when an artwork is perceived as Art it is liked more and the more it is thought of as beautiful.

Table 18. The combined mean aesthetic ratings (WOW, like, beauty) and the combined mean rating of ‘Is it Art?’ for both groups (expert and non-expert) in response to contemplating art in both contexts (original and reproduction). In order to show the relationship between aesthetic ratings and ‘Is it Art?’ ratings the Pearson’s r-value and significance values are shown.

Combined ratings of artworks Expert: 20 Non-Expert: 20	**Mean rating**	***SD***	**Pearson’s r (one-tailed)**
WOW	5.67	*1.23*	r = -.02, p = .42
Like	5.39	*1.18*	r = .20, p = .04 *
Beauty	5.27	*1.19*	r = .22, p = .02 *
Is it Art?	7.12	*1.56*	

* Correlation is significant at the 0.05 level.

Non-Experts and Experts: Further analysis was conducted to determine whether the ratings of WOW, like, beauty and ‘is it art?’ differed according to expertise. A one-tailed Pearson’s product-moment correlation co-efficient was computed on the combined ‘WOW’, ‘like’ and ‘beauty’ ratings of the non-expert’s in both context’s (O and R) to assess the relationship of these ratings with those of the non-experts combined ratings of ‘Is it Art?’. As can be seen in Table 19 there were no significant relationships.
Subsequently, a one-tailed Pearson’s product-moment correlation co-efficient was computed on the combined ‘WOW’, ‘like’ and ‘beauty’ ratings of the expert’s in both context’s (O and R) to assess the relationship of these ratings with those of the experts combined ratings of ‘Is it Art?’ As in the overall analysis, whilst there was no correlation between the experts’ overall rating of affect (WOW) and their overall rating of ‘Is it Art?’, increases in their overall ratings of ‘like’ and ‘beauty’ were significantly correlated with

increases in the rating of 'Is it Art?'. This suggests that 'like' and 'beauty' are important factors for experts in assessing whether an artwork is 'Art'. Table 20 shows the combined mean aesthetic ratings for experts.

Table 19. The combined mean aesthetic ratings (WOW, like, beauty) and the combined mean rating of 'Is it Art?' for non-experts in response to contemplating art in both contexts (original and reproduction). In order to show the relationship between aesthetic ratings and 'Is it Art?' ratings the Pearson's r value and significance values are shown.

Non-Experts (20) combined ratings of artworks	**Mean rating**	***SD***	**Pearson's r (one-tailed)**
WOW	5.87	*1.15*	r = .00, p = .50
Like	5.47	*1.27*	r = -.06, p = .34
Beauty	5.2	*1.31*	r = .00, p = .49
Is it Art?	6.96	*1.44*	

* Correlation is significant at the 0.05 level

Table 20. The combined mean aesthetic ratings (WOW, like, beauty) and the combined mean rating of 'Is it Art?' for experts in response se to contemplating art in both contexts (original and reproduction). In order to show the relationship between aesthetic ratings and 'Is it Art?' ratings the Pearson's r value and significance values are shown.

Experts (20) combined ratings of artworks	**Mean rating**	***SD***	**Pearson's r (one-tailed)**
WOW	5.48	*1.29*	r = .00, p = .48
Like	5.32	*1.10*	r = .35, p = .01 *
Beauty	5.34	*1.07*	r = .48, p = .001 *
Is it Art?	7.29	*1.73*	

* Correlation is significant at the 0.05 level

5.3.5 Analysis of the most memorable artworks

Initial analysis of the most memorable artworks found that 14 of the expert group reported that their most memorable artworks had been viewed in the original context and 6 as reproductions, whereas 10 of the non-expert group reported originals as the most memorable and 10 reported reproductions as the most memorable artworks. Table 21 shows how many of the most memorable artworks were viewed in the original context and how many in the reproduction context by experts and non-experts in a contingency table.

Table 21. Contingency table showing how many of the most memorable artworks were viewed in the original context (Gallery1) and how many were viewed in the reproduction context (Gallery 2) by experts and non-experts.

	Original Context (Gallery 1)	**Reproduction Context (Gallery 2)**
Expert	14	6
Non-Expert	10	10

A chi-square test of independence was performed to examine the relation between expertise and the context in which the most memorable artwork was contemplated (with a Fischer's exact test). The relation between these two variables was not significant, $x2(1) = 1.67$, p= .20, indicating that preference for art in different contexts was not significantly related to expertise.

5.3.6 Thematic analysis of the most memorable artworks

Original Artworks

Tables 22-25 below summarize and quantify the themes and adjectives identified from the responses to the questions asked immediately after the visualization task.

Table 22. Experts: Original Context, summary of experts' responses to the most memorable artworks viewed in the original context.

How did it make you feel?	**What was it about this picture that made you feel that way?**	**Why was it memorable?**
• Happy (5) • Satisfied (3) • Content (1) • Pleased (3) • Lovely (6) • Interested (8) • Amazed (2) • Intrigued (2) • Curious (7) • Excited (1) • Awe (1) • Taken aback (1) • Small (1) • Insignificant (1) • Overwhelmed (1)	• Colour (12) • Style (2) • Composition (5) • Subject (1) • Technique (6) • Detail (5) • Skill (7) • Texture (2) • Size (6) • Lovely (4) • Like (11) • Cheeky (1) • Satisfying (2)	• Colour (5) • Technicality (2) • Detail (4) • Quality (11) • Skill (3) • Time had been taken (2) • Size (3) • Surprising (1) • Unusual (1) • Interaction, science and art (1) • Soft and elegant (1) • Lovely (2)

Experts*:* There are three main themes regarding the responses experts made regarding their choice of the most memorable artwork in the original context; colour, positive emotions and artistry.

Colour: although colour is rarely specified as the dominant theme regarding affect or memorability, colour is used to describe why the emotional response was elicited, and why the picture was memorable a total of 17 times: 'the colour against the monochrome', the general colour scheme was more pleasing than the subject matter', 'a mixture of colours and styles' and 'it was a large green painting, abstract, bright pinks inside the shapes, mostly green'.

Positive emotions: the emotional response was almost exclusively positive, with adjectives such as happy, satisfied, content, pleased, lovely, amazed, intrigued and curious being cited 39 times when describing the affect their most memorable picture had. Happiness and loveliness were dominant: 'It was just a lovely little picture', 'it made me feel happy because, well it just made me feel happy' or 'I felt happy, hope..'. They felt happy and satisfied, 'Happy, satisfied and really pleased', 'It made me feel satisfied', excited,' It made me feel excited', amazed, 'I feel amazed at the way the painter, at the detail of it, in awe of the person who created it.'

Artistry: Artistry was clearly influential in evoking these positive emotions. Adjectives associated with artistry were cited a total of 59 times when explaining why the picture had been the most memorable, and when describing it, with skill (cited x 10), detail (x 9) size (x 9) and technique (x 8) being the most cited. Experts were pleased by the techniques employed, the skill, the time taken, and the accomplishment of the artists:' I was amazed by detail,' 'It was the detail of the paint-strokes, even though quite thick, and the quality of the final piece,' 'I thought it was quite accomplished; it was really well done', 'It made me feel satisfied because of the way it was painted, the technique' and 'time had been taken it was the fact that time had been taken'.

Within the context of these three main themes three sub-themes were evident.

(i) Interest and curiosity (cited 15 times): 'Interested, definitely, curious because I wanted to know how they did it', 'I thought about it. It intrigued me', and 'I like it because it made me think about things I am already interested in'.

(ii) Skill, technique and detail (cited 27 times): 'I thought it was really well done. It had a technicality about it,' 'It was the detail of the paint-strokes, even though quite thick, and the quality of the final piece. It wasn't just thrown at the canvas, time had been taken it was the fact that time had been taken', and, 'What is the technique? The small dots, he used a mesh, I asked myself the questions. The idea is brilliant, he dreamt a dream and then he painted his dream'.

(iii) Power of Art: 'Taken aback by it, made me feel small and insignificant' and 'it made me feel excited and overwhelmed in a way'.

The subject matter or content of the most memorable painting was mentioned by only one participant regarding its memorability.

Non-Experts: Two main themes are evident in the non-expert group in response to the artworks viewed in the original context: again colour was a frequent theme but there was also interest.

Table 23. Non- Experts: Original Context, summary of non-experts responses to the most memorable artworks viewed in the original context.

How did it make you feel?	What was it about this picture that made you feel that way?	Why was it memorable?
• Calm (2) • Interested (6) • Curious (4) • Intrigued (4) • Content (1) • Beautiful (1) • Wow (1) • Off-centred (1) • Taken aback (1)	• Colour (8) • Composition (1) • Texture (1) • Technique (3) • Relate to it (3) • Objects (3) • Shapes (6) • Memory (1) • Impressive (1)	• Thought provoking (1) • Different (2) • Detail (3) • Technique (2) • Colour (3) • Ambiguity (1) • The one I would like to have (1) • Recognition (3)

Colour: Colour was used 11 times to describe why the picture affected them and to describe the picture itself. It was 'the most colourful', 'the basic colours and shapes', 'the colours, the big white space at the bottom', 'that looked like art because of the white bits and the colours came out', 'colour combination, I liked that…don't know whether it was the way it was painted?'' I was quite impressed by it, the different texture, colours', ' a picture of a young girl with vibrant red lips…it is quite dark but her red lips stick out, her eyes are piercing, but the thing I like is her hood, it went from pure white to colour..'

Interest and Curiosity: Whilst the original artworks evoked feelings of calmness and contentedness (x 3), they also elicited interest (x 6), curiosity (x 4) and intrigue (x 4), both with the subject matter and the artistry: 'Calm, I think, and interested', 'quite calming and interesting, it made me think', 'interested, curious….how did they do that?', 'I think it was just that I thought about it a lot more', 'I was intrigued by it, more the technical art than the picture', and 'Content, I suspect' or 'Curious, I suppose'.

Two sub-themes linked to colour and interest are apparent:

(i) Technique (x 10): ‘How did they do that?’, ‘Don’t know whether it was the way it was painted, the texture I was intrigued by it, more the technical art than the picture’, ‘The method it was painted was what I looked at rather than what I was seeing’ and ‘I just wanted to understand how the vision had come about, how he or she physically made it come about’, ‘I just loved the technique’.

(ii) Object recognition (x 12): ‘I was interested ….objects I could relate to, things I could recognise’, or ‘anything with occlusion I want to see underneath …curious, I suppose’.

One exquisitely detailed response to why the picture was memorable sums up the main themes and sub-themes: ‘Calm, I think, and interested. Don’t know whether it was the way it was painted, the texture. It was more than a portrait, the background….side portrait of a lady with a turban on, reddish orange with yellow embroidery, she had glasses, but there was purply mauve, may have been a pavement…’

A further sub-theme, or non-theme, is that of lack of affect: some participants either found it difficult to articulate any emotional affect, or they were not affected. When asked how their most memorable picture had affected them replies included, ‘Tough one’, ‘I dunno’, and ‘I have seen one that is half decent’!

Reproduced artworks

Tables 24 and 25 summarize and quantify themes and adjectives experts and non-experts employed to describe their responses to the most memorable artworks viewed in the reproduction context.

Experts: The main themes evident in response to the most memorable reproduced artworks are the expert group is colour and tenderness.

Colour: once again colour is the dominant theme when describing why the picture had an affect, being cited 9 times: ‘the colours, shape, curvy’, ‘the one that was quite light, I liked the big white bubbles, the intriguing colours’, ‘ a golden chain and the background is a deep dreamy blue..’, and ‘I really like the coloured dots’.

Tenderness: feelings of homesickness (x 1), intimacy, loving and lightness (x 4) are evident: 'It actually made me homesick', 'Beautiful, romantic', 'It was sort of a warm, sort of um I dunno, a slight sexual overture', and 'I think it made me feel quite light', 'it is very beautiful very calming'.

Table 24. Experts: Reproduction Context, summary of experts responses to the most memorable artworks viewed in the reproduction context.

How did it make you feel?	**What was it about this picture that made you feel that way?**	**Why was it memorable?**
• Analytical (3) • Curious (1) • Warm (1) • Sexual (2) • Romantic (1) • Beautiful (2) • Calming (1) • Light (3) • Homesick (1) • Not emotional (1)	• Colours (6) • Shapes (1) • Technique (3) • Detail (4) • Pleasant (1) • Beautiful (1) • Fun (1)	• Colour (3) • Science/ art (3) • Most emotional (1) • Imagination (1) • Detail (2)

One sub-theme is apparent, artistry. The technique (x 3), detail (x 4) and the shapes (x 1) were admired:

(i) Artistry: 'it is detailed, very detailed, I can still see some details', ' so you can see the details, looks like it's painted in small blocks, but can't really see till you look at the detail', ' 'explosion of white bubbles either coming out of the picture or hiding the picture, element of fun, technically good'.

Non-Experts: Once again two-main themes are evident, colour and the range of emotions elicited by the reproduced art.

Colour: cited 15 times, is clearly influential in evoking emotions in the non-experts. Although participants did not always specify that it was the colour, as specifically as 'the colours were nice complementary colours' they did describe what it was that had influenced their emotional response by describing the colours, ‘it was deep blue, on some kind of chain’, ‘a rose, white centre, sharp dark pink petals merges into dark shades of pink, mottled colours’.

Emotions: A range of emotions were evoked. The reproduced art made non-experts happy (x 2), ‘happy, I liked it’, sad (x 2) ‘it reminded me of something sad’, participants felt tranquil (x 1), relaxed (x 2) and soothed (x 1), ‘quite tranquil’, ‘it made me feel relaxed’, ‘soothing effect’, or excited (x 1), ‘it was quite an exciting picture’.

Table 25. Non- Experts: Reproduction Context, summary of non-experts responses to the most memorable artworks viewed in the reproduction context.

How did it make you feel?	**What was it about this picture that made you feel that way?**	**Why was it memorable?**
• Happy (2) • Enlivened (1) • Excited (1) • Curious (2) • Relaxed (2) • Soothing (1) • Reminisce (1) • Memories (2) • Tranquil (1) • Sad (2) • No affect (1)	• Colours (13) • Composition (2) • Subject matter (2) • Like (1) • Beautiful (1) • Quirky (1) • Unusual (1) • Size (1)	• Colour (2) • Contrast (1) • Detail (5) • Like (1) • Subject (1) • Patterns (3) • Technique (3) • Skill (1) • Mood (1) • Simplicity (1)

One sub-theme is related to the main themes:

(i) Artistry: technique (x 3), detail (x 5), composition (x 2), patterns (x 3): ‘For me the definition of art is how much skill and talent went into the creating of the picture. That picture looked like something I would be completely unable to create therefore it was the best piece of art.’ ‘That’s what I was drawn to, the technique.’ ‘Made you think about the image, could it actually be there, could it really exist?’, ‘It was intriguing in that it didn’t look like anything I had seen before’, ‘I couldn’t see what it was, then I looked more carefully and I could see all the details’.

The impact of the artistry, the colour and composition to sooth and evoke happiness are evoked when one participant described her most memorable artwork: 'the background was a combination of sunrise and sunsets, the blues of the sunrise on one side, the other side was red like a sunset but in front of all that, almost big fluffy clouds, like when you get the kettle boiling'.

It is clear that colour is the dominant theme regarding the most memorable artwork, for both groups in both contexts. For experts artistry is evidently influential in both contexts, whilst it is evident only in response to the reproduced art for the non-artists. Interest and curiosity are evident for both groups in response to the original art, but not as dominant in response to the reproduced. Finally, it is interesting that the experts only mentioned the subject as memorable once (original art), and the non-experts reported lack of affect as making the art memorable (original art).

5.4 Discussion

5.4.1 Main results

This study had two central aims. The first was to examine the impact of art expertise and context on mood, affect, aesthetic judgement, intellectual response, and memory, on viewing contemporary visual art. The second was to investigate the dynamic interactions between neuronal assemblies in the brain during the contemplation and imagination of visual art, and any differences between art experts and non-experts. Unfortunately, due to unforeseen external auditory influences the EEG data was not analyzed. It was decided that the impact of these unintentional auditory triggers on the EEG recording could not be calculated, and that it would be difficult to ascertain whether any changes in the EEG data was due to auditory or visual stimuli. Therefore this discussion will focus only on the behavioural aspects of the study.

The behavioural results revealed that, as expected, viewing art increased scores of contentedness and calmness. However, contrary to the hypothesis there were no differences in change scores between experts and non-experts. The decreased scores of alertness in both groups were unexpected, as it was predicted that the experts would be more alert after viewing art, whilst this effect would be reversed in the non-experts. There was no effect of viewing art on positive or negative affect scores, either overall, or by group. Contrary to our hypotheses neither context nor expertise influenced arousal ratings, aesthetic judgement, or the, 'is it art?' rating. There were no differences in the mean ratings of these variables, either between contexts, original or reproduced, or between the groups, experts and non-experts. Increases in the overall ratings of 'like' and 'beauty' were correlated with increases in the rating of 'is it art?' This suggests that 'like' and 'beauty' are important factors in assessing whether an artwork is perceived as art, the more an artwork is liked and the more it is thought to be beautiful, the more likely it is to be perceived as art, or vice versa. When an artwork is perceived as art it is liked more and the more it is thought of as beautiful. The increases in the experts overall ratings of 'like' and 'beauty' were significantly correlated with increases in the rating of 'Is it Art?' suggesting that 'like' and 'beauty' are important factors for experts in assessing whether an artwork is 'Art'.

With regard to the most memorable artworks it was expected that in both groups the most memorable artworks would be those viewed in the original context. This was not the case. Whilst the context of the most memorable artwork was not related to expertise, it is clear that there was no contextual preference in the non-experts; with equal numbers of participants stating their most memorable artwork was viewed in the original context and the reproduction context. The experts appeared to show a contextual preference, with fourteen stating that their most memorable picture was viewed in the original context and only six as reproductions. In line with the results from Study 3 we predicted that colour, style, empathy with the subject and curiosity would be the main themes that made an artwork memorable, in both contexts and both groups. We also expected the experts to articulate more positive emotions in both the reproduction and original contexts than the non-experts and non-experts to experience more negative than positive emotions in response to the reproduced artworks. Colour and artistry, or style, were reported as the dominant themes regarding the most memorable pictures, in both groups and both contexts, interest and curiosity, positive emotions and the power of art were also evident Whilst empathy was evoked in both groups, personal memories were more evident in the non-experts than the experts, particularly in the reproduction context, this did not emerge as a dominant theme.

5.4.2 Mood

The subjective measures of mood and affect revealed interesting results regarding the contemplation of art. Two self-report measures were utilised, Bond-Lader and PANAS. Although contrary to our predictions, the lack of change in either groups' subjective ratings of positive and negative affect after viewing art was an intriguing result. Both groups reported high levels of positive mood and low levels of negative mood before the experiment began, and these levels were retained after contemplating art. Whilst positive affect and negative affect (PANAS) suggests that the two mood factors are opposites (i.e., strongly negatively correlated) they are considered distinct dimensions (Watson, Clark & Tellegen, 1988). The high positive affect indicates that individuals felt enthusiastic, active and alert. High ratings reflect a state of high energy, full concentration and positive engagement, as opposed to low ratings indicating sadness and lethargy. The low negative mood rating indicates that participants felt calm and serene (Watson et al., 1988). These results are supported by participants' subjective ratings of contentedness, calmness and alertness. As predicted, contemplating art did significantly increase feelings of calm and contentedness, and decreased alertness in both experts and non-experts equally. This effect was not enhanced for the experts, as we predicted, nor were the experts more alert. These findings support the brain imaging findings which suggest that both the expectation of looking at art and the perception of art stimulates the reward circuitry of the brain (Lacey et al., 2011; Vartanian & Goel, 2004b; Vessel et al., 2012), and that viewing art in galleries has been found to be arousing (Brieber et al., 2014, 2015; Locher et al., 1999, 2001). These findings add to the previous conclusions: both the expectation of an art experience, and the actual experience enhance positive mood, feelings of enthusiasm, increased concentration, engagement, and energy are enhanced, but also feelings of calmness and serenity. As studies in art therapy have established, one does not need to be an artist, or indeed an art expert, to experience benefits in terms of positive mood from experiencing art (De Petrillo & Winner, 2005). The fact that the experts did not report feeling more alert after contemplating art may be accounted for in a number of ways. The first is that the experiment took about one and a half hours, and the participants were sitting for the duration. Although they may have been energized and excited by viewing art (as is evident in the sustained positive affect ratings and the thematic analysis) they were passive and still throughout the experiment. This may have resulted in a less alert state than expected through fatigue. Whilst this may have impacted on both experts and non-experts, it was only in the experts that we predicted increased alertness rather than decreased. The second reason may be that, as Pang et al., (2013) argued, expertise has been shown to result in increased neural efficiency during the contemplation of visual art. Decreases in the extent and intensity of brain activation related with expertise and practice has been observed in many other domains (Kelly & Garavan, 2005), and has also been reported by Solso (2003) whilst artists drew portraits. This suggests that experts show lower levels of neural activation when engaged in a task they are expert in. Bhattacharya and Petsche (2002) report enhanced phase synchrony in experts in low frequency bands (especially delta) during the imagination of visual art. Participants concluded this study by imagining their most memorable picture for 2 minutes. In experts this may have resulted in higher involvement of long-term visual memory resulting in enhanced neural synchrony in delta, which is usually associated with deep meditation (On, Jailani, Norhazman & Zaini, 2013) or sleep. So, despite being engaged and reporting feeling aroused during the contemplation of art, due to their previous knowledge and experience, they became relaxed and meditative during the imagining of their most memorable artwork, resulting in decreased alertness. The visualisation effect may be applicable to both groups, it is widely reported that meditation which uses visualisation as part of its practice not only induces relaxation but also leads to improvements in attentional tasks (Amihai & Kozhevnikov, 2014).

5.4.3 Arousal and Aesthetics:

Contrary to expectations neither context, original and reproduced art, nor expertise affected arousal ratings, aesthetic judgement, or the, ‘is it art?’ rating. With regard to the expected differences between contexts, not only did this experiment fail to support the findings of Study 3, reported in Chapter 4, it also failed to support a substantial body of literature reporting the positive effects of viewing original art in a gallery as opposed to viewing reproductions of art (Brieber et al., 2014, 2015b; Locher et al., 1999, 2001). That said, it does support more recent findings of Brieber et al., (2015a) and van Paasschen et al., (2015). There are a number of suggestions to explain these contradictory results. Whilst Brieber et al., (2014, 2015b) and Locher et al., (1999, 2001) report differences in aesthetic judgments between contexts such as post cards, slide projections, reproductions on computer screens and original artworks in a gallery or museum, it is only the more recent studies (Brieber et al., 2015a; van Paasschen et al., 2015) which have shown the same participants the artworks in the different contexts. A further limitation common to these studies (Brieber et al., 2014, 2015b; Locher et al., 1999, 2001) is that the genuine, original art is always experienced in a gallery or museum, whereas the reproduced art is always experienced in a laboratory. These issues were also addressed van Paasschen et al., whose participants viewed art in both the gallery and the laboratory, and by Brieber et al., (2015a) who exposed participants to both original and reproduced art in a gallery context.

In order to address this all the participants viewed artworks in both contexts, original and reproduction in a gallery environment. As such it could be concluded that this was not the reason that Brieber et al., (2105a) did not get the results they expected. Contemporary art is found in many shapes and guises, not only paintings. Performance art, conceptual art, video art, photography, photorealism, print, pottery etc. If a beautiful woman sleeping in a glass case (*The Maybe*, 1995/2013, Tilda Swinton) can be considered art then perhaps the nature of the experiment created an art experience independently of the art itself. It is not inconceivable that participants experienced the experiment as a live participatory art performance, thus experiencing the art viewed in both galleries as one and the same. In hindsight, perhaps the way the participants viewed the artworks, both times in a small gallery, may have contributed to shifting their perception of the context of original and reproduced art, thus reducing the intrinsic differences between the two contexts. Brieber et al., (2015a) suggest that in their case the lack of differences between either physical context and genuineness may be due to an *inverse* of the white cube effect (O'Doherty, 1999). Participants saw original art in a laboratory, and so the physical context, the laboratory, was enhanced by the original art, into a gallery, the white cube. In this case perhaps the opposite happened and participants were wearing their 'art goggles' whilst viewing the art in a space they would consider the white cube (the gallery). Thus, encountering real art in a museum enhances cognitive and affective processes involved in the appreciation of art (Brieber et al., 2015b), even if some of the artworks are reproductions.

Another reason for the failure to find a difference in arousal, aesthetic judgement or cognitive response may be that, like Brieber at al., (2015a) participants were asked to view contemporary art. Whilst the full exhibition utilised photography, this study used only paintings that had been inspired by digital images taken from the internet. These paintings reproduced fantastically well on the computer screen: they either looked remarkably like the images that had inspired them, or they looked like enlarged digital images. For example, the works by Rachel Sharp were all inspired by a series of photographs sourced from Brandon Stanton's Humans of New York Facebook page. Entitled the New Yorker Series, she reinterprets these digital images in thickly painted portraits. See Figure 35 for a comparison of the painting by Rachel Sharp and the downloaded photograph that inspired it. Or consider the 'Self-Portrait' by Dan Hays (Figure 32), a painting of man taking a photograph of himself in a mirror. Every pixel of the original photograph has been reproduced in the painting, so when this was displayed on the iMac screen it looked almost like an enlarged version of the original photograph. Some had created to be exhibited in light boxes, and had previously been exhibited thus (Daksha Patel's works), and whilst in the original context they were not back-lit, in the reproduction context they were, and so were enhanced. The detail of the paintings and the skill of the artist were two of the dominant themes regarding the memorability of the artworks. When the paintings were reproduced the detail, the individual brushstrokes or dabs of paint, reinterpreting the pixilation of the original images was magnified.

	
Rachel Sharp, New Yorker Series (XII), Oil on Canvas, 13 x 18 cm	Photograph from Brandon Stanton's Humans of New York Facebook page

Figure 35. New Yorker Series (XII) by Rachel Sharp, and the digital photograph that inspired the painting.

Additionally, the computer used to display the reproductions was an Apple iMac OS X with a 27" widescreen, the brightness and colour automatically adjusted as the ambient light changed, and the LED was backlit. In previous studies exploring the contextual affect of art that found significant differences between the contexts the reproduced art has been reproduced on a standard desktop pc (Brieber et al., 2014, 2015b) or a Macbook pro laptop (Study 3, Chapter 4). Although Brieber et al., (2015a) presented images on a laptop computer (15" screen), and failed to dissociate the two contexts, they also encouraged participants to browse through the presentation, they could go forwards and backwards, simulating the exhibition, rather than simply presenting one stimuli after another as was also done in the present study. However, their artworks were all photographs, and they suggest that the aura of genuineness may have been diminished in both contexts. In the case of the present study, the quality of the digital images presented on the iMac computer was exceptional and may have enhanced the original artwork. Participants at the end of the experiment commented on this with a number of participants stating that they preferred the images on the computer to those in the gallery.

Perhaps the aura of genuineness was transferred to the digitally represented images through the quality of the reproduction, the original source of inspiration for the artists (digital images) and the fact that they were viewed in a galley context.

Whilst these results were surprising, van Paasschen et al., (2015) have made similar observations. Whilst they did find differences in ratings between experts and non-experts on the more cognitively-influenced aspects of viewing and judging art, they found that both experts and non-experts appeared to prefer the digitally reproduced artworks compared to the originals viewed in a gallery. Their explanation for these differences include: the originals were viewed amongst all the other paintings in the exhibition, and so were not isolated, adjacent pictures may have been more interesting, and museum fatigue as it took several hours to view the whole exhibition. Neither of these explanations is applicable here. It could be suggested in this case that perhaps individuals are now so familiar with viewing high quality digital images, on phones, laptops, ipads, desktop computers, that this has become the norm, the digitally reproduced image is what we have become familiar with, rather than the original, which may prove disappointing in comparison. It has been estimated that the average time spent on digital media has grown from 2.7 hours a day since 2008 to 5.6 hours a day in 2015 (Based on USA figures, Meeker, 2015) and that the digital universe will grow by a factor of 300 (it will double in size every two years) from 2012 until 2020 (Gantz & Reinsel, 2012). Most of the studies that found differences in the aesthetic response between artworks viewed as originals with those viewed as reproductions were conducted before 2005. It is only in the most recent studies (Brieber et al., 2015a; van Paasschen et al., 2015) where contextual differences in the aesthetic response have not been observed.

5.4.4 Contemplation

In Chapter 4 participants self regulated viewing times of between half a second to less than 2.5 seconds in the reproduction context, and between less than 4 seconds to less than 30 seconds in the original context were reported. Here, to encourage contemplation, whilst controlling for the time spent looking at art, participants were asked to contemplate the artworks in both contexts for one minute. When the minute was up they were asked to close their eyes. Thus, all participants viewed all the artworks, in both contexts for one minute. The time spent looking at art has previously been found to influence aesthetic preference, with longer viewing times resulting in a painting being rated as aesthetically affective (Ishai et al., 2007) and liked more (Vartanian & Goel, 2004). Longer viewing times result in greater object recognition resulting in an enhanced aesthetic experience (Ishai et al., 2007). The results of the thematic analysis (discussed in more detail below) support this assertion. Participants described how the longer they looked, the more detail they saw, the more impressed they were with the technique and the skill, or vice versa, the longer they looked the more they thought the artwork was poor. Contemplating the artworks for a set time, the same time for each, and for longer than is usual in studies may have resulted in greater appreciation of the art in each context, not necessarily always positive. It is not unreasonable to assume that when confronted with a work of art, which is unpleasant, boring or disliked, viewers would have quickly moved on to the next piece. On this occasion they were given no choice, they sat in front of each picture for one minute. This contemplation gave more time to consider their aesthetic response, the affect of each artwork, and its artistic merit. Locher et al., (1999) found only four of sixteen evaluative ratings were different between original and reproduced contexts. They attribute this to the viewer being able to 'look past' the limitations of the medium, and that this was particularly apparent in experts in the present study. Here, even though participants were looking at reproductions the time spent contemplating them enabled them to 'look past' the fact that they were reproductions and appreciate them as art, or at least as reproductions of art, and so were considered as art. This contemplation time may account for the failure to find any differences between original and reproduced art.

5.4.5 Is it art?

Whilst there were no differences in the mean ratings of 'is it art?' either between contexts or groups, the correlation analysis suggests that increases in the overall ratings of 'like' and 'beauty' were correlated with increases in the rating of 'is it art?'. But, this correlation appears to be primarily driven by expertise, rather than lack of expertise as we had predicted. This finding suggests that for experts in particular the factors 'like' and 'beauty' are important when assessing whether a work is perceived as art. The more an artwork is liked, the more it is thought to be beautiful, the more likely it is to be perceived as art, or vice versa. If a work is not liked, not thought of as beautiful, then it is also less likely to be thought of as art. This is an unexpected difference, as it was predicted that the experts knowledge, their intellectual response would override their aesthetic response, and that even if they disliked the art, found it ugly, shocking, boring, they would still consider it art. In an attempt to understand this finding it may be worth examining individual participants' ratings in response to the question 'is it art?' It was expected that experts would rate the works they contemplated here as art. Only three experts (and one non-expert) consistently gave ratings of 10 (it is art) in response to the original works of art, and only two of them (and two non-experts) remained consistent, by also giving ratings of 10, in their response to the reproductions.

5.4.6 Memorable art

In order to further explore emotional responses to art, a thematic analysis was conducted (Clarke & Braun, 2014) on the transcripts of brief (1-2 minutes) interviews conducted immediately after the two-minute imagining of the participants' most memorable picture. Based on the results reported in Chapter 4 colour, style, empathy and curiosity were predicted to be the main themes that make the most memorable artwork memorable, in both contexts and in both groups. Reproduced artworks would evoke more negative emotions than positive in the non-experts but this would not be evident in the experts and that both contexts will evoke positive emotions in the experts.

The thematic analysis revealed three main themes in both groups regarding their most memorable artworks: colour, positive emotions and artistry. In the expert group these positive emotions were intertwined with interest in the artistry, whereas in the non-experts artistry was intertwined with curiosity. Nevertheless, in both groups and both contexts colour was the main theme regarding the most memorable artwork. Colour is extracted in early stages of visual processing (Zeki, 1980) and has previously been discussed as a variable affecting aesthetic preference (Martindale, Moore & Borkum, 1998). Here, neither group, nor context, appear to have impacted on the dominance of colour as the main theme. Both meaningful content and colour in visual art is necessary to make art memorable (Ishai et al., 2007), so this result was expected. As such, the power of colour to elicit emotion is clear. When asked what it was that made their picture the most memorable or why it was memorable, colour was the main reason. Not a specific colour, in fact descriptions of the colours were quite rare, participants simply said that it was because of the colour. Whilst there are many anecdotal links regarding emotions elicited by colour (e.g., red = anger) there is little systematic research (Simmons, 2011), and it was not the aim of this study to explore the emotional impact of colour. Nevertheless, Valdez and Mehrabian's (1994) surprising conclusion that it was saturation and brightness that dominated emotional responses to colour rather than hue may account for the lack of difference between contexts: due to the quality of the reproduced images there was little difference in the saturation and brightness of the colours between the two contexts.

As Ishai et al., (2007) reported content makes art memorable. Unlike the results reported in Chapter 4 here there was little emphasis on the semantic content of the artworks. Details regarding this only emerged when the participants were asked to describe their most memorable artwork, nevertheless the content was still clearly crucial regarding memorability. Here the memorable content appears to be linked to the detail, the skill and technique, rather than what the picture was about. This is not really surprising bearing in mind the nature of the art exhibited. Only 3 of the 12 artworks were clearly representational (portraits or faces) whereas the others were quite indeterminate, as some of the descriptions revealed; 'it was lovely, the colours of tropical fish, then there were mountains, and snow, all mixed up together'. Whereas in Chapter 4 participants clearly became engaged in the narrative of the figurative pictures, or pictures themselves in the landscapes or scenes presented, here it appears to be the formal visual features (such as shape or form), recognition of familiar objects (Ishai et al., 2007) and recognition of the skill and techniques that influenced memory for the art. Thus, content is clearly important regarding making art memorable, but not necessarily semantic content, narrative or recognizable objects. The artistry, the skill, the technique, composition, the physical presence rather than semantic content appears to be of equal importance.

Whilst in the previous study the emotions expressed in response to the most memorable picture were both positive and negative, on this occasion participants appear to have had a mainly positive response to the art. Rather than a negative reaction, such as shock, horror or disgust, as in Chapter 4, here, if the art did not elicit a positive response it appears to have elicited no response at all. This is possibly explained by the response to the content. Here, the semantic content was fairly elusive, whilst tropical fishes swimming in the snowy mountains may have been an attempt to interpret the content, it was not actually what the picture represented. The art in the previous study (Chapter 4) was mainly representational, with figures, landscapes, portraits, narratives, and giant horses. Here, unless the artworks contained faces or figures (3 of the 12), the content was difficult to decipher. It is possible that the mainly positive response was due to the engagement with the physicality of the art, the artistry, rather than the semantic content. Both groups in both contexts voiced their curiosity, interest, awe, excitement or tranquillity, relaxation and calming in response to the colours, shapes, composition and technicality of the art, rather than the narrative. When negative emotions were expressed, such as homesickness or feeling small and insignificant, these appeared to be in the context of positive emotions, i.e., the homesickness was instigated by the beauty of the painting and how it evoked friendship, and home.

Based on the results in Chapter 4 it was hypothesized that the reproduced art would elicit negative emotions in the non-experts. This was not the case. There are a number of explanations for this. First, there was very little difference in the visual quality between the contexts, as explained above: the colour saturation, brightness and hue were perhaps enhanced in the reproduction context due to the quality of the presentation computer. In the previous study the average time the artworks were viewed was 1.37 seconds, on this occasion the art was viewed for 60 seconds. This allowed participants to contemplate, to think and to consider the artwork presented, rather than making a very quick decision regarding their aesthetic judgement. The content of the art in the present study was not as clearly narrative; it required consideration, top-down processing, which inspired interest and curiosity regarding its creation rather than its content. Finally, as explained above, it is not inconceivable that all the participants experienced the experiment as participating in an art performance; they were part of the art experience. Due to the nature of the experiment, its location in an experimental art hub, as part of the British Science Festival, it is possible that they were not as aware of the different contexts as in the previous study. They were contemplating art, some of it hanging on a wall in a gallery, some of it viewed as a digital image in a gallery. The fact that the half of the non-experts most memorable artworks were viewed as originals in Gallery 1 and half were viewed as reproductions in Gallery 2 supports this proposal.

The thematic analysis supports the behavioural results. Whilst viewing art scores of calm and contentedness were enhanced in both groups, experts described feeling calm, relaxed happy and satisfied in response to their most memorable original artwork and warm, calm, sexual and romantic in response to reproduced art. Non-experts also reported feeling calm and content in response to their most memorable original artwork, and relaxed, tranquil and soothed by the reproduced artwork. The high ratings of positive affect and low ratings of negative affect are also reflected in the thematic analysis. Both groups describe a range of positive emotions experienced in response to their most memorable artwork, and whilst feelings of sadness were described, they were in relation to beautiful art, which evoked a sort of positive sadness. Whilst like and beauty are important factors regarding the experts judgement of art, they are also factors that influence a range of positive emotions in both experts and non-experts in response to their most memorable art: liking and beauty, lovely and amazing are clearly important regarding the memorability of art.

As in Chapter 4 colour is clearly the most important factor regarding the memorability of art. Rather than empathy and curiosity being the two other dominant themes, here a range of positive emotions were expressed as the second main theme. Memorable art elicited mainly positive emotions, intertwined with the artistry, in both experts and non-experts. Curiosity emerges as a sub theme. Whilst participants were curious about the narrative of the art in the previous study (Chapter 4), here they were curious about the art, the artistry.

A particular strength of the present study is that it was conducted in an art gallery rather than attempting to recreate an art gallery environment either in a laboratory or by utilising an interactive computer programme (Brieber et al., 2014, 2015a). Whilst previous studies compared different groups looking at art in different contexts (Briber at al., 2014, 2015 a, b; Gartus & Leder, 2014: Gartus et al., 2015; Locher et al., 1999, 2001; van Paasschen et al., 2015) both groups were asked to look at both reproduced and original artworks in the context of an art gallery. It has provided insights into the importance of physical context and environment has on the experience of art. It has also clarified that it is not impossible, not even difficult, to take research such as this outside of the laboratory, and into a real world environment. However, this may also have been a limitation for this study. Whilst this experiment failed to find any significant differences in arousal or aesthetic judgement between contexts, or between experts and non-experts, this may be explained by the fact that the participants may have been influenced more by the taking part in an open experiment during the British Science Festival which was themed along the premise of the interaction between art and science. This may have resulted in the lack of awareness of the different contexts: all the art was experienced in a gallery, some of it was hanging on a wall and some of it was digital art. The experiment may have been experienced more as performance art, an experience in which they participated, rather than as a scientific experiment.

A second limitation, closely linked to this, is the art itself. Due to the nature of the exhibition all the art had been inspired by digital images, the exhibition was entitled 'Digital Sensation', and the art reproduced remarkably well as digital reproductions. Perhaps the theme of this exhibition was limiting. Whereas the art in the previous study, the winter exhibition at the The Biscuit Factory, may have been too commercial, too 'low brow' to have been considered a real test of response to viewing artworks, the artworks utilized in this exhibition may have been the opposite. Whilst not particularly challenging, shocking or impenetrable, this exhibition consisted of artworks, which may have been seen as more conceptual. This may have resulted in the concept of the art taking precedence over the aesthetic, resulting in the lack of features that non-experts may find meaningful and which they can relate to (Cupchik & Gebotys, 1988). Perhaps the theme of the exhibition was too limited. The themes of previous studies have referred to social issues such as beauty (Brieber et al., 2015b) or the human relation to the transformation of nature (Brieber et al., 2014), or graffiti and street art (Gartus & Leder, 2014; Gartus et al., 2015). Given that non-experts tend to interpret artworks in relation to personal experiences or views (Augustin & Leder, 2006, and Chapter 4), perhaps this exhibition did not provide that personal framework. The theme of the 'Digital Sensation' exhibition was to explore how the slow process of painting reinterpreted the instancy of the digital image, not perhaps something that is necessarily of interest to the layperson. However, the behavioural results would suggest otherwise. Both groups reported positive emotions in response to the art viewed, and reported positive mood before and after viewing the artworks.

However, the main limitation of this study is that it was a combined behavioural and EEG study and any conclusions regarding the behavioural results must be considered in light of this fact. Participants were not simply looking at art in two contexts; they were also having their brainwaves recorded whilst doing so. They were not able to move around the exhibition at their leisure, or view the art amongst the other adjacent artworks. They were in a wheelchair with their eyes closed until told to open them. Some commented on feelings of disorientation, other said that they loved the element of surprise. The actual experience of taking part in the experiment may have influenced their responses. The length of the experiment may also have had an influence. Although the overall recording time of the EEG was only about 17 minutes the EEG part of the experiment took about an hour: an hour in which they were asked to move as little as possible, to neither blink nor chew, whilst wearing an elastic cap with wires attached to it.

A further limitation of the study is, clearly, the environment was not suitable for recording EEG. This does not mean that future EEG experiment should only be conducted in a laboratory, but that greater care needs to be taken to prepare outside venues. With hindsight this experiment could have been conducted at quiet times such as weekends and evenings, the windows could have been sealed to minimise the external noises, and the other venue users could have been informed of the importance of silence around the galleries. Precautions could also be taken regarding external electrical influences, such as air conditioning units, which may impact on the EEG signals. Also, any auditory influences could have been manually recorded and thus taken into consideration during the analysis of the EEG data.

As in all studies utilising artworks as stimuli, or exploring aesthetic responses to art, the art itself may well influence the results. Notwithstanding levels of expertise, if participants did not ‘rate’ the art, if they did not think it was of sufficiently good ‘quality’ then this would have impacted on their responses. Individual differences on ideas of beauty, of aesthetically pleasing artefacts, of what is art, have a huge impact on any studies of this nature. An alternative, using famous artworks, which naturally would be recognised as art, would have been one way forward but this approach comes with its own problems. Is it rated as beautiful because of the ‘mere exposure effect’, or because it is famous and therefore must be beautiful? Here comparing experts with non-experts is fraught with difficulties, as it is likely that experts will have prior knowledge influencing their judgements, whilst non-experts may be less confident in their own judgement.

5.4.7 Conclusions

In conclusion, the most noteworthy result of the present chapter is that the act of looking at art enhances positive mood and decreases negative mood, whether the individual is an art expert or not. Simply looking at art increases calmness and contentedness and decreases alertness: looking at art is relaxing. Moreover, if an artwork is to be considered as art then it must be both liked and considered beautiful, particularly by art experts. Colour, positive emotions, both calming and energising, and artistry are the dominant themes regarding what makes art memorable. And finally, at least within the confines of the present study design, context appears to have little impact on any of the above results, simply looking art, either original art or digitally reproduced appears to confer a positive impact.

The conclusions of this study, in line with the results of the previous two studies, suggest that the lines between original art and reproduced art have become blurred, perhaps due to the exponential increase in the use of digital media, perhaps because of the burgeoning museum and gallery attendance: visiting art galleries may now be seen as much as an experience as a means of experiencing art. Expertise impacts on the cognitive components of art appreciation, but not on mood and emotion, and that the physical context, the white cube or the space of the art gallery may have as much influence on the art experience as the art itself. Clearly there is still opportunity for further research.

Chapter 6: General Discussion

The aim of this thesis was to explore visual, cognitive and emotional responses in response to twentieth century modern and contemporary art in art experts and non-experts. Whilst neuroimaging studies have yielded a wealth of information regarding aesthetic appreciation and beauty using visual art as stimuli, few have considered the effects of a wider range of emotions, or differing context or expertise, or different schools or styles of art. In order to explore these a series of EEG and behavioural studies were conducted. We began by utilising EEG to investigate the time-course of the visual, visceral, cognitive and emotional responses to twentieth century art in artists and non-artists. Whilst the results of this study were unique and interesting, they told us only about the neural response to visual art viewed on a computer screen, in a laboratory. Thus, a further aim was to examine the impact that context has on the emotional and cognitive responses to visual art: whether the physical context of the venue, such as a gallery or museum, or whether the art is viewed as a reproduction or as an original artwork, affects these responses. The final aim of this thesis was to extend the findings of both the initial EEG study and the contextual study. To further explore the effects of art expertise and context on subjective feelings and mood, on emotional and cognitive processes and cortical synchrony during the contemplation and imagining of contemporary visual art, continuous EEG was recorded from two group: art experts and those not expert in visual art.

Twentieth century art was chosen for a number of reasons. As discussed in Chapter 2 the twentieth century was a period that embraced change and controversy, art moved from aesthetics and realism to cubism, abstract art, conceptual art, and performance art. Many previous studies appear to have regarded art as interesting stimuli, or have categorised all art as ‘art’, whether it be 30,000 years old, 3000 or 300, with all its varied schools, styles, history, techniques. Very few studies have utilised twentieth century modern or contemporary art. This period provides a comprehensive range of artworks that can be presented whilst maintaining its integrity as art. Without any manipulation there are totally abstract images, representational and indeterminate artworks, beautiful, ugly, shocking, mundane, pleasing or abhorrent. With this is mind, expertise was also of interest. Whilst the ability to be moved by art appears to be universal, and neurological processes in humans may be approximately the same, it is clear that personal history, individual experiences, expectation and context affect perceptual, emotional and cognitive processes, aesthetic preferences and visceral responses to art. This suggests that looking at and experiencing art involves more than an aesthetic response, and as Brown and Dissanayake (2009) and Kelly (2012) argue, the focus of neuroaesthetics is too narrow and that we should seek to understand art more broadly. To focus simply on aesthetic judgement of art or on the judgement of beauty is to underestimate the brains responses to art.

The intention of the first study was to explore the effect of visual art on visual and visceral responses in artists and non-artists: ERPs were used order to study the time course of visual, cognitive and emotional processes in response to twentieth century visual art. Two groups, artists and non-artists viewed and rated representational, abstract and indeterminate twentieth century regarding its visceral affect. It was expected that both groups would demonstrate greater ERP amplitude in response to representational and indeterminate art than to abstract art due to the actual or perceived semantic content. Artists would more frequently rate all artworks as having higher affect than non-artists, and artists would show larger ERP magnitude to all categories of art than non-artists, with a more pronounced difference between the groups in response to abstract art. The artists would show greater magnitude in the early ERP components, indexing increased attentional resources, and the later P3 and LPP, indexing greater emotional arousal, than the non-artists. Further, these processes would be most pronounced in response to representational art, with the differences between the two groups (artists and non-artists) being most extreme in response to abstract art.

As expected, there were no significant differences in the affect ratings between the three categories of art in the artists, whereas the non-artists rated both representational and indeterminate art as having significantly more affect than abstract art. However, whilst the artists affect ratings for abstract art were significantly higher than the non-artists, there were no differences between the groups for representational or indeterminate art. Early components, particularly the N1, related to attention and effort, and the P2, linked to higher order visual processing, were enhanced for artists when compared to non-artists. This effect was present for all types of art, but further enhanced for abstract art, which was rated as having lowest visceral affect by the non-artists. The later, slow wave processes (500 -1000ms), typically associated with arousal and sustained attention, also showed clear differences between the two groups in response to both type of art and visceral affect. Abstract art increased arousal and sustained attention in artists, whilst it decreased in non-artists. These results suggest that aesthetic response to visual art is affected by both expertise and category of art, thus supporting the aesthetic processing frameworks discussed in Chapter 1. Chatterjee (2004a), Leder et al., (2004) and Chatterjee and Vartanian (2014) all include knowledge and experience as important contributors to the aesthetic experience. It is clear that expertise impacted on arousal and attention during the viewing of art, particularly abstract art, art with no clear semantic content, or objects. So, expertise appears to impact on perceptual processes, artists do not appear to be as dependent on object recognition as non-artists regarding aesthetic processing and affect. Whilst these results are both unique and interesting, they tell us only about the brains immediate responses to reproductions of twentieth century art viewed on a computer. As the models proposed by Leder et al., (2004), and Chatterjee and Vartanian (2014) propose, context, both the physical location of art, and the status of art, is a key component of the aesthetic experience.

This led to Experiment 2 (Chapter 4) in which we questioned the ecological validity of using reproductions of art in a laboratory to study the effects of art on the brain. As previously discussed, a fundamental problem with neuroaesthetics research is the context: both where the art is physically viewed and whether the art itself is original or reproduced. Most visual art was not created to be viewed as a reproduction, but to be experienced in its original form. Nevertheless, for practical reasons, empirical research into the aesthetic experience rarely uses original works of art as stimuli, but reproductions. This raises the question of comparability of the findings of experimental aesthetics with the aesthetic experience of viewing original art (Locher, Smith & Smith, 2001). In order to investigate the effect of context on arousal, aesthetic response (which most previous studies have focussed on, see Chapters 1 and 2, and Appendix 1a, b, c), viewing time and memory, contemporary art was viewed as original art as part of an exhibition and reproduced on a computer. One further limitation, common to studies comparing the aesthetic judgement of original and reproduced art, is that original art has been viewed in a gallery, reproduced art in the laboratory, and often by two different groups of individuals. This was addressed by conducting the experiment in a commercial art gallery, and all the participants saw all of the artworks, in both contexts. This allowed us to address the contextual sensitivity of the experience of art (original or reproduction) whilst controlling for the impact of the physical context (art gallery). As expected, original art viewed as part of the exhibition was more arousing and liked more, and was more memorable than the reproduced art viewed on a computer, in the gallery. However, contrary to the hypothesis, memorable art was liked more than it was seen as arousing. This clearly links to the findings in the subsequent study, Chapter 5, which suggest that 'like' and 'beauty' are important factors in assessing whether an artwork is perceived as art. There were two main themes regarding the most memorable artworks, colour and interest in the story, which evoked empathy and personal memories. Previous studies have suggested that semantic content and object recognition impact on memory for art (Augustin et al., 2011; Ishai et al., 2007; Vartanian & Goel, 2004a) and the results of Chapter 3 also indicated that semantic and suggested content (representational and indeterminate art) increased arousal.

These results demonstrate that the response to art is not isolated from the context in which it is experienced, thus supporting both our hypothesis and the findings of Brieber et al., (2014, 2015b) and Locher et al., (1999, 2001), in that original art viewed in a gallery is more arousing, liked more and is more memorable than reproduced art viewed on a computer screen. With this in mind, the final empirical chapter of this thesis aimed to extend the findings of Experiments 1 and 2 by recording continuous EEG whilst two groups of participants, art experts and non-experts, contemplated original and reproduced artworks in a contemporary art gallery. There were two main aims: first, to investigate the dynamic interactions between neuronal assemblies in the brain during the contemplation and imagination of visual art, and second, to examine the impact of art expertise and context on mood, affect, aesthetic judgement, intellectual response, and memory during the contemplation and imagination of art. This study was believed to be the first investigation using EEG to examine these processes in the context of an art gallery with original works of art. Regrettably, due to a number of unforeseen and uncontrollable external auditory influences on the EEG data it was not analysed.

As opposed to the very brief exposure normal in laboratory studies the artworks were presented for 60 seconds in each context before asking for the participants' response. In Chapter 4 participants viewed reproduced art for an average of 1.37 seconds and originals for only 10.3 seconds before responding. By exposing participants to the art for 60 seconds we aimed to encourage contemplation. Although the results of this study did not fully support the original hypotheses there were a number of noteworthy results. Contemplating and imagining art impacts on mood in terms of increasing feelings of calmness and contentedness. Despite low negative mood ratings at the start of the study, on calm and serene feelings (Watson et al., 1988), on completion of the study individuals subjective ratings of how calm and content they felt had increased. Similarly, the expectation of looking at art appeared to have enhanced positive mood. Individuals experienced pleasure and happiness at the prospect of viewing artworks, and these feelings were prolonged, with similar positive mood being reported after the contemplation and imagining of art. The expected increased alertness in the experts after contemplating art was not evident with both experts and non-experts reporting feeling less alert. This may be due to a number of factors: the length of the experiment, the lack of physical movement (Brieber et al., 2015 b), increased neural efficiency (Pang et al., 2013). However, it may also be due to the processes involved in the two minutes of visualisation, or imagining, of their most memorable artwork. There is evidence that meditation which uses visualisation as part of its practice not only induces relaxation (On et al., 2013) but also leads to improvements in attentional tasks (Amihai & Kozhevnikov, 2014). Thus, the prospect of looking at art evokes pleasurable feelings and happiness, contemplating and imagining art is relaxing, maintains that happy mood, and no prior knowledge or expertise is needed.

In line with Chapter 4 and previous studies (Brieber et al., 2014, 2015 b; Furnham & Walker, 2001; Hekkert & van Wieringen, 1996; Locher et al., 1999, 2001; Smith & Melara, 1990) it was expected that both expertise and context would impact on aesthetic and intellectual judgement. Original art would be liked more, would be more beautiful and more likely to be considered as ‘Art’, than reproduced art, and this would be more pronounced in experts. Neither of these predictions was realised. However, the overall ratings of ‘like’ and ‘beauty’ were positively correlated with those of ‘is it art?’ suggesting that ‘like’ and ‘beauty’ are important factors when assessing whether an object is ‘Art’. Surprisingly, this was particularly evident in the expert group: the more an artwork was liked and considered beautiful, the more likely it was perceived as ‘Art’, and vice versa. This was an unexpected difference, as it was predicted that due to the experts’ knowledge and expertise their intellectual response would override their aesthetic response. Even if they disliked the art, found it ugly, shocking or boring, they would still consider it art. They did not.

As discussed in more detail in Chapter 5, there are a number of possibilities for these results. Perhaps the status of the event, part of the British Science Festival, the venue, BALTIC39, an important cultural hub for contemporary art practice, the sheer expectation of experiencing contemporary art meant that the experiment was experienced more as a performance or conceptual art than as science. Perhaps participants wore their ‘art goggles’ (Perry, 2015), throughout. They were experiencing art, in an art gallery, whether viewed on the walls in one gallery or on a computer screen in the other. Whether or not they considered it art appears to be linked more to whether it was beautiful and liked than to where it was experienced. Another reason may be the quality of the reproductions and the theme of the exhibition. The artworks looked amazing on the Apple iMac, due to the technique, size (Rachel Sharp’s paintings were reproduced larger than the originals) or the lighting (Daksha Patel’s works on paper were back lit on the computer, but not in the original context). In some cases perhaps the reproductions looked more colourful, brighter, more detailed or more interesting than the originals. A further reason may be linked to all the previous ones. These artworks were all based on digital images found on the Internet; perhaps individuals are now so familiar with viewing high quality digital images that the differentiation between originals and reproductions is diminished. Nevertheless, as in Chapter 4, the recurrent themes regarding memorable artworks were colour, positive emotions and interest. Whereas in Chapter 4, the interest was in the subject matter, often resulting in empathy or curiosity regarding the narrative, here the experts' positive emotions were intertwined with interest in the artistry, whereas in the non-experts artistry was intertwined with curiosity. The lack of a clear relationship between context and expertise regarding the most memorable artwork may be explained by two factors. First, the art was contemplated; it was studied for 60 seconds, as opposed to the more usual, brief view. This allowed, even encouraged, participants to explore the art, to appreciate the details, the skill of the artist, the technique and the ideas behind the creation of it. Second, all the art was viewed in an art gallery and there may have been a blurring of the lines between contexts: all artworks contemplated were art, it was not context which categorised them as such, but how beautiful they were and how much they were liked.

6.1 Novel findings from the current thesis in context of existing literature

6.1.1. Expertise

Whilst the appreciation of art and of beauty appears to be an innate behaviour and the ability to be moved by art universal, personal experience, cultural influences, exposure, education and training, and expertise, appear to affect aesthetic preferences and visceral responses to art. Aesthetic preference, as measured through affect ratings, has frequently been explored (Chamorro-Premuzic & Furnham, 2004; Feist & Brady, 2004; Furnham & Walker, 2001; Furnham & Rao, 2002; McManus & Furnham, 2006), with differences between art-experts and non-experts identified, but little difference between abstract, indeterminate and representational art (Ishai et al., 2007). Silvia (2006) found that whilst art experts find art more interesting and understandable, particularly complex or abstract art, people high and low in art training make the same emotional appraisals of art.

The results of both Experiments 1 and 3 confirm those findings. In Chapter 3 no significant differences in the mean ratings of affect between representational and indeterminate art, either by group, or within each group, were identified. However, in response to abstract art, significant differences were observed. Expertise appears to influence emotional responses to abstract art with artists reporting significantly higher mean affect in response to abstract art, and more frequently rating abstract art as having high affect, than the non-artists. Moreover, non-artists' mean rating of abstract art was significantly lower than that for both representational and indeterminate art. It therefore appears that art is art for the artists. Whilst non-artists required affective semantic content, thus supporting the findings of Vartanian and Goel (2004a) and Di Dio and Gallese (2009), artists' response to abstract art suggests that knowledge and expertise broadens the aesthetic response, and that simplified forms that do not relate to anything are enough to stimulate an affective response.

These results appear to suggest that expertise may encourage a cognitive rather than affective response to art. The results of Experiment 3 both support and contradict this. Whilst thematic analysis suggests that it is the artistry, the skill, technique, detail, the thought behind the creation of an artwork, that are dominant themes in experts regarding the memorability of art, the positive correlation between how much art is liked or considered beautiful and the assessment of whether an artwork is 'art' suggests that emotion and affect remain important factors in the aesthetic judgement of art in experts, thus supporting the models of aesthetic processing proposed by Chatterjee (2004a), Leder et al., (2004) and Chatterjee and Vartanian (2014). The visual attributes of art are processed like any other objects, but previous experience or domain specific expertise impacts on cognitive mastering and evaluation, resulting in aesthetic judgement and aesthetic emotion (Leder et al., 2004). Leder et al., (2004) suggest that exposure to art presents viewers with perceptual challenges, which require classification and understanding, resulting in satisfaction, positive aesthetic emotions, and interest. This results in the motivation to seek further exposure to art, increasing interest and expertise. Expertise in art enhances the aesthetic response to artworks and viewers are not dependent on the subject matter, the content or the narrative, but experience pleasurable emotions due to the cognitive mastering of the visual properties of art. Whilst non-experts were also interested in the artistry involved in the creation of art, their interest appears to be focussed more on what was being portrayed. Although they were interested in the composition and the patterns, when asked to describe their memorable picture the non-experts described searching for recognisable content, e.g., ‘Made you think about the image, could it actually be there, could it really exist?’ ‘It was intriguing in that it didn’t look like anything I had seen before’, or ‘I couldn’t see what it was, then I looked more carefully and I could see all the details’. On the other hand, the experts were more interested in the skill and technique. They wanted to know how and why the artists had done it. The power of art to influence emotions was also acknowledged by the experts, with statements such as ‘Taken aback by it, made me feel small and insignificant’ and ‘it made me feel excited and overwhelmed in a way’. Thus whilst content appears to be more important than style for non-experts, and style appears to be more important than content for experts (Di Dio & Gallese, 2009; Vartanian & Goel, 2004a; Vessel & Rubin, 2010) regarding the affect and memorability of art, visual preference is highly individual, which is certainly an avenue for future research. Chatterjee (2004a) and Leder et al., (2004) posit that the aesthetic response is distinguished from responses to other visual stimuli by emotion, and that not only perception but memory, cognitive mastering (measured by the amount of expertise), evaluation and knowledge are involved. Leder et al., (2004), Chatterjee and Vartanian (2014) and Silvia (2009) suggest that it is the evaluation of the stimuli, the interest and attention given to it, which provokes the emotional response. Leder et al (2004) and Chatterjee (2004a) associate this response with liking and wanting, or pleasure. The results of Experiment 3 support this in that the descriptions of participants most memorable pictures. They clearly demonstrate interest, attention, attempts at ‘making sense’ of the art presented, whether it was interpreting the images, the subject or the content, or interest and curiosity regarding the skill, technique or intellectual and cognitive processes regarding the creation of the art.

The behavioural results of Experiment 3 support brain imaging research which suggests that looking at art, and even the expectation of looking at art, appears to activate the reward circuitry of the brain (Kirk et al., 2009b; Lacey et al., 2011). The high positive and low negative affect scores reported by both experts and non-experts, and the increased ratings of calm and contentedness after contemplating art, suggests that the prospect of looking at art, and contemplating art appears to increase positive mood and affect, and expertise does not appear to be as important. Nevertheless, expertise has been found to impact on the perception of art. Differences in brain activity, specifically in the reward related areas, whilst performing art-related tasks (Bhattacharya & Petsche, 2002; Solso, 2001), whilst making aesthetic judgements (Kirk et al., 2009b), and during the contemplation of art (Pang et al., 2012) have been reported. Experiment 1 revealed further differences. In contrast with the findings of Pang et al., (2012) art expertise was associated with larger ERP amplitudes in response to all categories of art (representational, indeterminate and abstract). Rather than expertise being associated with *reduced* neural responses, reflecting increased neural efficiency due to extensive practice, we suggest that art expertise is associated with *increased* neural responses reflecting greater sensitivity to emotional content, attention and memory resources. This is particularly evident in response to abstract art. The early attention of artists was engaged by abstract art (Carretié et al., 2004; Delplanque et al., 2004), greater attentional resources were allocated (Hillyard & Anllo-Vento, 1998; Luck & Kappenham, 2012), they were more adept at engaging higher order visual processing (Carretié et al., 2001, 2004; Luck & Hillyard, 1994), experienced greater emotional arousal (Duncan-Johnson & Donchin, 1997; Polich 2007a; Tommaso et al., 2008) and their expertise influenced top-down processing, (Hajcak et al., 2006; Moser et al., 2006). The opposite was true in non-artists. These results suggest that not only knowledge and experience, but great effort is required to appreciate abstract art (Augustin & Leder, 2006; Belke et al., 2006), again conforming to Leder et al's., (2004) information processing model of aesthetic experience. Aesthetic judgement is the result of cognitive mastering of art, resulting in interpretation, understanding and satisfaction, resulting in an emotional reaction, a by-product of the processing stages of the aesthetic experience.

These findings contribute to both brain imaging research exploring visual art, aesthetics and expertise, and to behavioural research exploring emotional impact, visual perception and contextual differences in experts and non-experts, which suggests that the aesthetic response to visual art is affected by both expertise and category of art (e.g., Augustin & Leder, 2006; Belke et al., 2006; Brieber et al., 2014, 2015 b; Carretié et al., 2004; Delplanque et al., 2004; Locher et al., 1999, 2001) Whilst reported mood and affect, prior to and after the contemplation of art, does not appear to be affected by expertise, responses to abstract art suggests that there are clear differences between experts and non-experts, in visceral affect, arousal and attention. These differences are also evident regarding the memorability of art, with expertise relating to the cognitive assessment of art. Art experts express interest, were aroused and their attention sustained in response to art. Their curiosity is engaged regarding the 'how' and 'why' an artwork was created, and their assessment regarding the status of art was influenced by their evaluation regarding aesthetic judgement and aesthetic emotion. On the other hand, for non-experts, attention, curiosity and interest in art is engaged in the semantic and narrative content of art.

6.1.2. Context

The main aim of exploring the effect of context on visceral responses to contemporary art was to establish whether viewing original art in an art gallery evoked different emotional and cognitive responses compared to viewing reproductions of art. Increasing awareness that the physical context in which art is appreciated impacts on the aesthetic process is evident in theoretical frameworks such as those of Leder et al., (2004) and Locher, Overbeeke and Wensveen (2010) who place the process within a specific context, such as an art gallery. Factors such as verbal and semantic contextual framing have been found to influence art appreciation (Gartus & Leder, 2014; Noguchi & Moruta, 2013, Swami, 2013; Westphal-Fitch, Oh, & Fitch, 2013), and genuine artworks viewed in a gallery have been found to be more interesting and pleasant than their reproductions (Locher et al., 1999, 2001). In line with previous research (Brieber et al., 2014, 2015b; Locher et al., 1999, 2001) an enhanced arousal and aesthetic response to original compared to reproduced art was expected. However, as with Brieber et al., (2015a, b) the results of Experiments 2 and 3 appear to conflict. The first study appeared to replicate a substantial body of research confirming the positive effects of viewing original art in an art gallery (Brieber et al., 2014, 2015b; Locher et al., 1999, 2001). Looking at original art in an art gallery was more arousing, more aesthetically affective, it was looked at for longer and it enhanced memory for art, compared to looking at reproductions of art, on a computer, in an art gallery. These results demonstrate that the response to art is not isolated from the context in which it is experienced, thus supporting both our hypotheses, and previous findings (Brieber et al., 2014, 2015; Locher et al., 1999, 2001). However, the final study, using the same protocol, produced very different results. There was no affect of the context of art (original or reproduced) on arousal, aesthetic judgement or cognitive responses. That said, this latter finding does appear to support the recent findings of van Paasschen et al., (2015), who found that both experts and non-experts appeared to prefer the digitally reproduced artworks compared to the originals viewed in a gallery, and Brieber et al., (2015a) who found no effect of physical context and genuineness on art appreciation. These null effects suggest that there may be a mutually reinforcing effect between physical context and genuineness; the white cube effect of the gallery influences the aesthetic interpretation of art viewed there, whether original or digitally reproduced. The conflicting results of Experiments 2 and 3 are more likely due to the involvement and participation in the experience of Experiment 3 than to the contextual differences of the artworks.

6.1.3. Visceral responses to art

Memorable art was liked more than it was arousing. Ratings of 'like' and 'beauty' were positively correlated with cognitive assessment of whether a work is perceived as art (is it art?), whereas arousal ratings (WOW) were not. Whilst studies using affective pictures as stimuli have shown that both positive and negative pictures are more memorable than neutral (Bradley et al., 1992), with some studies suggesting that negative events are more memorable than positive (Charles et al., 2003), here positive emotions in response to colour, content, narrative and artistry were the dominant themes regarding memorable art. The results of the experiments in this thesis demonstrate that whilst arousal is important regarding the appreciation of art, beauty and liking are more so. However, this does not mean that art must 'beautiful' in a traditionally aesthetic sense described by Kant and Baumgarten (Nuzzo, 2006). As the thematic analyses demonstrated, interest and curiosity regarding the content and narrative, or the skill and technique, colour and composition, were the factors that elicited positive mood and emotions. Rather than considering the aesthetic experience as that overwhelming feeling of beauty there are different kinds of aesthetic experiences that are more focussed on conceptual features (Shimamura, 2012). As Goya's terrible but beautiful *Disaster of War (1808)* suite of engravings or Andreas Serrano's beautiful but shocking *Piss Christ (1987)* demonstrate, beauty can be found in the most unlikely places. As the responses to the artworks viewed and contemplated during the research for this thesis demonstrates, colour, interest, curiosity, empathy elicit positive and occasionally negative emotions, but overall, looking at art is pleasurable, makes you happy and has a positive effect on mood.

6.2 Art is good for you.

These results demonstrate that it is imperative that the importance of art is never underestimated. Arts budgets are the first to be cut in times of financial uncertainty, and can be seen as an indulgence, not a necessity. Yet as has been demonstrated here, art is good for you. Anyone can enjoy art, anyone can make art (perhaps not very good art, but…), and everyone can experience art. Whilst looking at reproductions of art in a brain scanner stimulates the reward systems of the brain (e.g., Lacey et al., 2011), experiencing art in an art gallery improves mood and increases feelings of calm and contentedness. Simply the prospect of looking at art in an art gallery improves mood. Expertise in art enhances perceptual processes, particularly early visual processes, and sustains attention whilst looking at art, even abstract art. Beautiful art impacts on emotions, particularly representational and narrative art. Whilst beauty may be in the eye of the beholder, nothing can stop great art being awesomely beautiful (Perry, 2014). It seems that even in the digital age visual art continues to inspire people to visit art galleries, to be in the presence of art, to be part of the art experience.

6.3 Limitations

A number of limitations within each empirical study chapter of this thesis have been considered. This section will consider general limitations that may have impacted on the outcomes of this thesis. One is the classification of expertise. Many of the studies considering art expertise have defined art 'experts' according to their formal education background or experience working in fine art or art history, with 'non-experts' as those with similar levels of education but little or no training or experience in fine art. In Chapter 4 the ERPs of self-categorised artists and non-artists were compared. The status of the participants who volunteered to take part in the experiment as 'artists' was qualified by asking them questions regarding years of art education they had, how often they visited art galleries, and, whether they called themselves an 'artist'. Pang et al., (2013) suggest that using formal education background and work experience has resulted in art expertise being considered as an artificial dichotomisation of an otherwise continuous variable: the degree of study or practice. In order to overcome this drawback, in Chapter 5 an Art Experience Questionnaire was developed (along the lines of that of Chatterjee et al., 2010, and Pang et al., 2013). It considered not only years and level of education but also time spent working in the art world, creating art, looking at art (Appendix 9). However, there were also weaknesses with this approach. Whilst all the participants' who volunteered as 'experts' scored highly on the Art Experience Questionnaire, they were not all practicing artists. Commercial photographers, art historians, graphic designers, curators and even civil servants, all 'qualified' as 'experts'. With regard to the 'non-experts', whilst they may have had similar levels of education, and may not have been working within the fine art field, some of them revealed after the experiment that they were keen 'Sunday' painters, or they regularly attended painting or printing workshops. Creating art, whilst a hobby, was something they were passionate about. Thus, the art experts in this study may have been expert in art, but they were not artists, whereas the non-experts may not have been experts, but were artists. The classification of an art expert is perhaps as elusive as the classification of art.

Arguably, the best method of recruiting experts in order to explore neural processes involved in the perception of art would be to recruit only practicing artists. The 'artist'

participants in Experiment 1 were recruited from staff and post-graduate students from the Universities of Newcastle and Northumbria Fine Art departments, and from artist networks and organisations such as Northern Print, Network Artists North East and North East Art Collective. The ‘non-artist’ participants were taken also taken from a university population, but not necessarily from post-graduate students or staff. Thus the samples may not be comparable of the population at large. The ‘expert’ participants in Experiment 3 were also recruited from artist networks but the ‘net’ was widened to include staff and graduate populations from Northumbria University’s ‘Arts’ department, such as Art and Design History, Art MREs and Conservation of Fine Art, and BALTIC. The non-experts were recruited through British Science Festival publicity and a convenience sampling. As such the samples may not have been representative of the general population, as they were self-selected, and self-categorised as either ‘expert’ or ‘non-expert’. Whilst they were screened in order to ensure that they did fit into the categories required as previously discussed, this screening may not have clearly differentiated experts from non-expert.
Another limitation of this thesis is the sample size. The behavioural results in this thesis are based on relatively small samples. Behavioural studies investigating the impact of context have used much larger samples (e.g. Brieber et al., 2015a), and as such the limited samples of the present thesis may have influenced the results. However, the sample sizes of the EEG studies are comparable, in fact larger, than most other studies investigating neural responses to visual art (Augustin et al., 2011; Bhattacharya & Petsche, 2002; Karkare et al., 2009; Pang et al., 2013). The final study (Experiment 3) was designed to be both a behavioural and EEG study, thus the sample size was originally appropriate for the methodology. Unfortunately, due to the unforeseen external influences, only the behavioural data has been utilised for this thesis. Thus, the behavioural results regarding the context of memorable art in particular should be viewed with a degree of caution.

The physical context in all three empirical chapters may have been a limitation. Whilst in the Experiment 1 the context of the laboratory was seen as a limitation regarding the perception of art, in Experiments 2 and 3 the context of the art gallery may have influenced the perception of the reproduced art, enhancing the status of the reproductions so that they were viewed as art, the ‘white cube’ effect (Nadal, Brieber & Leder, 2014). This may account for the lack of difference between original and reproduction contexts in Experiment 4. However, differences in these contexts were observed in Experiment 2. This may be explained by the differences in experiment protocol. Whilst in Experiment 2 participants were only briefly shown artworks in the two contexts, in Experiment 3 their brainwaves were being recorded throughout and more behavioural factors were explored, before, during and after the contemplation of art.

The final limitation raised by this thesis is perhaps a philosophical one. Whilst there has been a burgeoning interest in neuroaesthetics over the last 15 years, more recently, a level of scepticism has developed. There is some doubt regarding what colourful brain scans, head maps and wiggly lines can actually tell us about deeply cultural aesthetic practices (Brincker, 2015). As Noë (2012) and Kelly (2012) point out much neuroaesthetic research simply applies what is known about perception to the experience of art, i.e. Augustin et al., (2011), Ishizu and Zeki (2011), Tomasso et al., (2008) or Vartanian and Goel (2004a, b). Brincker (2015) describes how current neuroaesthetics often target perceptual and emotional responses generally, but has not yet provided an empirical story of what makes the aesthetic experience special. As Experiment 3 attempted to address, one of the main problems with the neuroaesthetic approach is that of the conditions and consequences of being an aesthetic beholder rather than a perceiver. Most theories of aesthetic perception have focused on perceptual and emotional processes regarding art, but as Brincker (2015) explains, looking at art involves engaged perception and that the temporal process of becoming a beholder must understood in its embodied, contextual and dynamic specificity.

6.3 Future directions and implications

With these limitations in mind, future research should focus on how beholders of art experience art, the whole experience, rather than only how art is perceived. As has briefly been explored in this thesis, experiencing art is more than a perceptual process; it involves emotions, cultural and physical contexts. Art is experienced as reproductions, as originals, in galleries, on the street, in virtual tours. Thus, future research should attempt to consider all of these aspects equally.

One of the first considerations should be the quality of the artworks utilised in research. Whilst art plays a fundamental role in all human societies, embodying cultural significant meaning (Danto, 2013), little consideration has been given in previous studies to its quality, appropriateness, or significance. The focus of future research into neuroaesthetics, the contemplation or beholding of art should ensure that the research should be as much about the art as about the neural processes. Responses to the art exhibited at Summer Exhibition at the Snods Edge Village Hall should be quite different from those experienced at the National Gallery's next blockbuster exhibition. Thus art, which is appropriate to the research aims, should be sourced and utilised. In order to further explore differences (if any) in the impact of reproduced and original artworks on visceral responses, mood and affect more control regarding physical (the where) and the genuineness (the real) contexts needs to be considered. For example, perhaps future research could exhibit full-scale digital reproduction of artworks adjacent to the originals, in both an art gallery and a laboratory setting.

With regard to expertise, the real world implications of the results observed in Experiment 1 suggest that visual and aesthetic responses to art are affected by expertise and category of art, representational, indeterminate and abstract. There is a wealth of opportunity to further explore the impact of visual expertise on perceptual and affective processes. Different types of visual expertise should be considered, perhaps as a more suitable control group, such as naturalists or bird watchers, quality auditors at banknote printers, or astrologers, people who have been trained to see detail or differences. A wide range of visual stimuli could be developed to explore principles of gestalt, the simplicity of line drawings, indeterminate images, and the neural processes involved in making visual sense of them, the impact of luminosity, and the speed of visual processing in different groups.

The final study of this thesis did not succeed in recording continuous EEG whilst participants viewed and imagined original art. Many lessons were learned during this experiment regarding the suitability and planning for recording EEG outside the laboratory. It is feasible but requires detailed planning, collaboration and co-ordination. Therefore, further work to explore the impact of contemplating and imagining art on neural processes, and to identify any differences in meditative states, or not, of doing so, could extend the findings of Bhattacharya and Petsche (2002) by simply recording EEG whilst participants contemplated original art, in a gallery, and then imagined it.

It is important to establish the differential impact that visual art, the expectation of viewing it, of contemplating or beholding it, whether as originals or reproductions, has on visual and affective processes. Behavioural and neuroimaging research has concluded that art is good for you, it stimulates the reward centres of the brain, it improves mood, is calming and makes people content. Yet we do so little to educate or train people to see, to perceive, to make sense of what they see or have not seen. There is still much to be learnt about the neural processes of perception, and further research into the impact of visual art on these processes and its impact on well-being should be supported.

6.4 Summary and conclusions

The premise of this thesis was to investigate the moderating effects of expertise on the impact of the aesthetic response to modern art on behaviour, emotional arousal and cognition. By using the precision of event-related potential (ERPs) measurement the aim was to track the impact of modern art on known ERP components related to emotion/arousal and both conscious and unconscious cognitive processes. A further aim was to explore the impact of context (both where and what) on visceral and emotional responses, and how the contemplation and imagery of contemporary art impacts on behavioural measures of cognitive performance and oscillatory neuronal dynamics. The current thesis supports the plethora of research that has identified the cognitive aspects of sensory processing that are sensitive to emotional content and the time course of emotional processing of the stimuli, typically using affective picture (Hajcak et al., 2012; Luck 2012). It has contributed to the study of neuroaesthetics, the study of the responses in the brain to the appreciation of beauty, harmony and pleasure (Cela-Conde et al., 2004; Cupchik et al., 2009; Leder, et al., 2004), and to the understanding of the perceptual processes involved whilst viewing modern and contemporary art (Augustin & Leder, 2006; Ishai et al., 2007; Kirk et al., 2008; Leder et al., 2004; Yago & Ishai, 2006). It has also contributed to current research exploring contextual influences on the viewing and experiencing art and the interplay between art expertise and emotional and preference judgements (Brieber et al., 2014, 2015a, b; Paasschen et al., 2015). Evidence revealed by the novel behavioural and ERP studies of this thesis allow a number of conclusions to be drawn about the neurocognitive mechanisms involved in the perception, evaluation and judgement of modern and contemporary art, in experts and those not expert in art.

- Firstly, looking at art is interesting and rewarding, particularly for artists, and does not depend upon aesthetic preference. However, differences between groups are most evident in response to abstract art, suggesting that expertise is especially important regarding the appreciation of abstract art.
- Secondly, the response to art is not isolated from the context in which it is experienced, whether the physical context of an art gallery vs. a laboratory, or whether viewed as original vs. reproduction.
- Thirdly, looking at art enhances positive mood and decreases negative mood, whether the individual is an art expert or not. Simply looking at art increases calmness and contentedness and decreases alertness: looking at art is relaxing and good for you.

In essence, art is good for you, looking at it, understanding it, anticipating it. It enhances perceptual and cognitive processes. No expertise is needed to experience the benefits of looking at art, but knowledge and experience can enhance them. Yet it can be undervalued. Given the prominence of art in our day to day lives further research regarding the impact of visual art on perceptual and emotive processes should be conducted to ensure that judgement regarding the role of art in culture is enhanced rather than devalued.

Appendices

Appendix 1a: Description and main results of brain imaging studies in chronological order using non-art stimuli to explore aesthetics

Appendix 1a: Description and main results of brain imaging studies in chronological order using non-art stimuli to explore aesthetics

Study (year)	**Metho-dology**	**Number: Female/male (F/M) experts/ non-experts (E/NE), Age range or mean (yrs)**	**Stimuli (S) [duration] and basis for selection (B)**	**Special study features (F) and task (T)**	**Effects of stimulus affect**
Jacobsen and Höfel (2001) and Jacobsen and Höfel (2003)	EEG; ERP	F/M: 5/7 E/NE: 0/12 Age: 20-26 (22.3) 3 excluded from analysis	S: 252 black and white 2D patterns (3000ms) B: symmetry or no symmetry	F: symmetry and aesthetic value T: descriptive and evaluative judgement	Not beautiful evaluative judgement elicited early frontocentral phasic negativity (300-400ms). Symmetry judgement elicited a sustained posterior negativity (600-1100 ms) Evaluative judgement elicited stronger ERP right hemisphere lateralization of the Late Positive Potential (LPP, around 600ms).
Jacobsen et al. (2006)	fMRI	F/M: 9/6 E/NE: 0/15 Age 21-33 (25.4)	S: 220 formal black and white graphic patterns (2.5s) B: perceptual cues	F: symmetry and aesthetic value T: descriptive and evaluative judgement	Aesthetic judgement elicited activation in right frontomedian cortex, symmetry judgement elicited activation in parietal and premotor areas. Beautiful judgement led to higher signal changes in frontomedian cortex and left intraparietal sulcus.
Höfel and Jacobsen (2007a)	EEG; ERP	F/M: 17/15 E/NE: 0/32 Age: 20-32	S: 208 formal black and white graphic patterns [3000ms] B: symmetry	F: aesthetic appreciation T: evaluation and contemplation	Not beautiful aesthetic judgement *did not* elicit early frontocentral negativity. Contemplation evoked lateralised late positivity. Both viewing and contemplation elicited a posterior sustained negativity.
Höfel and	EEG;	F/M: 10/4	S: 220 black	F: symmetry	Not beautiful

Jacobsen (2007b)	ERP	E/NE: 0/14 Age: 19-31 (22.5) 3 excluded from analysis	and white patterns [3000ms] B: symmetry	and aesthetic value T: descriptive and evaluative judgement, and misreporting	evaluation elicited more negative early frontocentral effect (400-750 ms) Aesthetic judgment produced a more pronounced ERP lateralization to the right, but not in false condition. Viewing symmetrical patterns produced a sustained posterior effect.
Kirk, (2008)	fMRI	F/M: 6/9 Age: 24.4	S: 120 normal and abnormal photographs (3500ms) B: objects presented in normal or abnormal setting	F: violation of object-context relationship T: aesthetic rating	Aesthetic judgment, regardless of context, recruited medial and lateral aspects of the orbitofrontal cortex. Prefrontal areas were significantly more engaged when objects were viewed in unaccustomed settings.
Tommaso et al. (2008)	EEG; ERP	F/M: 4/4 E/NE: 0/8 Age: 33.4	S: 90 paintings and 90 geometric shapes [P1; 750ms, P2; 350 ms] B: famous	F: aesthetic perception and ERPs T: judgement	P3b amplitude increased during categorization of geometric shapes compared to art, and in response to beautiful stimuli, whilst P3 latency was greater during perception of geometric shapes
Kirk et al. (2009a)	fMRI	F/M: 13/11 E/NE: 11/13 Age: E 26-42 (30.8) N/E 22-32 (27.2)	S: 336, buildings and faces [3000ms] B: aesthetic appeal	F: aesthetic evaluation and expertise T: judgement	Expertise not only modulates cognitive processing but also modulates the response in reward related brain areas, such as orbitofrontal cortex and nucleus accumbens

Appendix 1b: Description and main results of brain imaging studies in chronological order using visual art stimuli to explore aesthetics

Appendix 1b: Description and main results of brain imaging studies in chronological order using visual art stimuli to explore aesthetics

Study (year)	Method-ology	Number: Female/male (F/M) experts/ non-experts (E/NE), Age range or mean (yrs)	Stimuli (S) [duration] and basis for selection (B)	Special study features (F) and task (T)	Effects of stimulus affect
Hansen et al. (2000)	event related fMRI	10 participants	S: 150 images of art [2s] B: unfamiliar	F: positive and negative valence judgement T: preference	Activation of primary and association visual cortices more marked for liked stimuli
Kawabata and Zeki (2004)	event related fMRI	F/M: 5/5, E/NE: 0/10, Age: 20-31	S: 192 paintings; abstract, still life, landscape or portrait [2 s] B: beautiful, ugly, neutral	F: brain structures involved in perception of beauty T: preference	Perception of beautiful or ugly stimuli mobilizes the orbito-frontal cortex and motor cortex differentially
Cela-Conde et al. (2004)	MEG	F/M: 8/0 E/NE: 0/8 Age:20	S: 160 paintings; abstract, classic, impressionist, post impressionist and 160 photos ; landscapes, artifacts, urban scenes. B: variety, no humans	F: role of prefrontal areas in aesthetic perception T: perception of beauty	Left prefrontal dorso lateral cortex was activated by beautiful stimuli (either artistic or natural) at a latency of 400-1000ms.
Vartanian and Goel (2004a)	event related fMRI	F/M: 10/2 E/NE: not reported, Age: 28	S: 120 paintings; 20 representation al, 20 abstract, 40 altered, 40 filtered paintings [6s] B: representation al or abstract; original, altered, filtered	F: brain structures involved in aesthetic preference for paintings T: preference	Preference increased activation in bilateral occipital gyri, left cingulate sulcus and bilateral fusiform gyri.
Vartanian and Goel (2004b)	fMRI	E/NE: 0/12	S: abstract and representation al paintings [6s] B: not reported	F: known emotional and cognitive neural pathways T: aesthetic preference	Activation in right caudate nucleus, left cingulate sulcus and regions of visual cortex covaried with preference ratings

Lengger et al. (2007)	DC-EEG	F/M: 16/16 E/NE: 0/32 Age: 27.5	S: 80 paintings, 20 with style related information [20 with info 60 s; 60 with no info, scrambled 3-7s, subsequently 10 s] B:representational/abstract	F: Brain structures involved in aesthetic experience and role of stylistic information T: understanding and rating	Stylistic information reduced activation in left hemisphere, but lack of stylistic information increased activation in left frontal and parietal lobes.
Di Dio et al. (2007)	fMRI	F/M: 8/6 E/NE: 0/14 Age: 24.5	S: 15 pictures of sculptures, 15 modified pictures of the same sculptures [2s] B: Classical or Renaissance, ratio 1:1.618 between body parts	F: objective and subjective experience of beauty T: observation, aesthetic judgement, proportion judgement	Observation of original sculptures activated right insula, lateral occipital gyrus, precuneus and prefrontal areas. Images judged as beautiful activated right amygdala.
Tommaso et al. (2008)	EEG; ERP	F/M: 4/4 E/NE: 0/8 Age: 33.4	S: 90 paintings and 90 geometric shapes [P1; 750ms, P2; 350 ms] B: famous	F: aesthetic perception and ERPs T: judgement	P3b amplitude increased during categorization of geometric shapes compared to art, and in response to beautiful stimuli, whilst P3 latency was greater during perception of geometric shapes.
Cela-Conde et al. (2009)	MEG	F/M: 10/10 E/NE: 0/20 Age: 23/25	S: 200 paintings and 200 photos [900ms] B: variety, close views of humans not included	F: gender-related differences in neural correlates of aesthetic preference T: judgement	Angular gyrus activity was greater for stimuli rated as beautiful for both sexes. Stimuli judged as beautiful activated parietal region bilaterally in women, but lateralized to right hemisphere in men
Cupchik et al. (2009)	fMRI	F/M: 8/8 E/NE: 0/16 Age: not reported	S: 32 representational and 16 non-representational paintings [10s] B: affective evocation, object recognition	F: perception, cognition, and emotion T: object identification and aesthetic viewing	Aesthetic perception activated bilateral insular, attributed to emotion, and left lateral pre-frontal cortex. Visuospatial exploration activated left superior parietal lobe, associated

					with visuospatial processing, episodic memory and aspects of consciousness
Kirk et al. (2009b)	fMRI	F/M: 5/9 E/NE: 0/14 Age: 26	S: 200 abstract paintings [5000ms] B: abstract	F: viewing context, aesthetic evaluation, reward expectation T: aesthetic rating	Prefrontal and orbito frontal cortices recruited by aesthetic judgement were significantly biased by participants expectations of hedonic value
Di Dio et al., (2011)	fMRI	Exp.1: F/M: 16/16 E/NE: 0/32 Age: 21/23 Exp2.F/M: 12/12 E/NE: 0/24 Age: 20/23	S: 16 canonical pictures of sculptures, 16 modified pictures of the same sculptures [2.5s] 16 canonical pictures of real human bodies (athletes), 16 modified pictures of the same athletes. B: Classical or Renaissance sculptures, professional photographs of athletes; ratio 1:1.618 between body parts	F: hedonic response during observation of non-art stimuli T: observation and aesthetic judgement	The two stimulus categories produced a rather similar global activation pattern. Relevant differences though were, activation of the right antero-dorsal insula during sculpture viewing only. This suggests that the hedonic state associated with the activation of right dorsal anterior insular underpins aesthetic experience for artworks.
Ishizu & Zeki, (2011)	fMRI	F/M:12:9 E/NA: 1:20 Age: 27.5	S: 30 paintings of portraits, landscapes, still life, classified into 3 groups (16s). 30 excerpts of classical and modern music, classified into 3 groups (16s). B: Beautiful (10), ugly (10), indifferent (10).	F: brain areas which correlate with the experience of beautiful art and music T: view, listen and rate into ugly, indifferent, beautiful category	The mOFC was active during the experience of musical and visual beauty, with the activity produced by the experience of beauty derived from either source overlapping almost completely within it. The strength of activation proportional to the strength of the declared intensity of the experience of beauty
Vessel et al., (2012)	fMRI	F/M: 5/11 E/NE:	S: 109 images of works of art from a variety of cultural	F: individual differences in aesthetic response	Activity increased linearly with ratings in sensory (occipito-

			traditions and historical periods, representational or abstract. B: Not commonly reproduced	T: intensity of emotional affect .	temporal) regions. Network of frontal regions showed a step-like increase only for most moving artworks. Aesthetic experience involves the integration of sensory and emotional reactions in a manner linked in their personal relevance.
Noguchi & Murota, (2013)	EEG	15 participants E/NE: 0/15	S: 24 images of Classical or Renaissance sculptures representing human bodies [7s]. B: original images conformed to golden ratio proportions, half were deformed into either short-leg or long-leg conditions.	F: EEG components sensitive to contextual information, visual information, or both. T: aesthetic rating for either 'genuine' or 'fake' images of sculptures.	Amplitudes of a positive EEG component (200-300ms) were significantly modulated by both visual and contextual factors, indicating a rapid integration of these 2 types of information in the brain.

Appendix 1c: Description and main results of brain imaging studies in chronological order using visual art stimuli to explore expertise, visual perception, style and content processing, object recognition, recognition memory and reward circuitry

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Study (year)	Method-ology	Number: Female/male (F/M) experts/ non-experts (E/NE), Age range or mean (yrs)	Stimuli (S) [duration] and basis for selection (B)	Special study features (F) and task (T)	Effects of stimulus affect
Bhattacharya and Petsche (2002)	EEG	F/M: 20/0, E/NE; 10/10, Age; 44.3/37.5	S: 4 paintings [2 min] B: variety	F: expertise, individual frequency bands, hemispheric asymmetries T: viewing and imagining	Viewing: higher phase synchrony in high frequency beta and gamma bands. Imagery: low frequency bands phase synchrony enhanced during imagery. Artists: strong decreases in phase synchrony for both tasks, with higher synchrony in right hemisphere.
Yago and Ishai (2006)	event related fMRI	F/M: 7/7, E/NE: 0/14 Age: 25	S: 60 portraits, landscapes and abstract paintings [3s] B: unique style	F: Recognition memory and visual similarity T: memory retrieval	Familiar pictures evoked stronger activation than new in face and object recognition regions of visual cortex, in caudate, insular and anterior cingulate cortex.
Fairhall and Ishai (2008)	fMRI	F/M: 5/7 E/NE: 0/12 Age: 25	S: 156 paintings, and 156 phase scrambled images [3s] B: 3 classes, representational, indeterminate, abstract	F: visual perception and object indeterminancy T: object recognition	Perception of art evoked activation within distributed cortical network including visual, parietal, limbic and prefrontal regions. Representational paintings evoked stronger activation in right fusiform gyrus, temporoparietal junction, scrambled paintings evoked activation in precuneus and prefrontal cortex.

Karkare et al., (2009)	EEG	F/M: 20/0 E/NE: 10/10 Age: 44/37.5	S: 4 paintings selected from 4 different periods	F: expertise, complex cognitive processing, long range correlation properties in EEG T:visual perception and mental imagery	Brain networks responsible for visual perception are reactivated by mental imagery. Specific complex cognitive task demands and task-specific expertise can modify the temporal scale-free dynamics of brain responses.
Wiesmann and Ishai (2010)	event-related fMRI	F/M: 11/13 E/NE: 0/24 Age: 24	S: 42 Cubist colour, 42 Cubist monochrome paintings, 84 scrambled images [3.5s] B: Abstracted forms of Cubist paintings unique stimuli	F: training, object recognition, Cubism T: object recognition	Training resulted in faster object recognition, enhanced activation in parahippocampal cortex, slower reporting of lack of object recognition correlated with activation in frontal-parietal network.
Lacey et al. (2011)	event-related fMRI	F/M: 4/4 E/NE: 0/8 Age: 23	S: 50 art images, 50 matched non-art images [1s] B: recognizable as works of art, non-art matched for content with art	F: viewing art, reward circuitry T: animacy judgement	Art images activated reward-related regions: ventral striatum, hypothalamus and orbito-frontal cortex
Augustin et al., (2011)	ERP	F/M: 10/12 E/NE: 0/22 Age: 23	S: 50 paintings by Paul Cezanne (French Post-Impressionist) and 50 paintings by Ernst Ludwig Kirchner (German Expressionist) [2000ms] B: represented 2 dimensions of style and content, and 2 clearly different styles	F: speed of classifying style and content T: combined go/nogo dual choice task	In the processing of art style follows content. Style related information is available around 224ms, between 40 and 94ms after content related information.

Huang et al., (2011)	fMRI	F/M: 6/8 E/NE: 0/14 Age: 20-27	S:25 original Rembrandt portraits, 25 fake Rembrandt portraits B: portraits by Rembrandt or in the style of	F: brains response to genuine and fake pictures compared to brains response to external advice regarding authenticity T: view each image	Portraits assigned as 'fake' evoked stronger responses in FPC and right precuneus. Advice about authenticity evoked psych-physiological interaction between FPC and lateral occipital area.
Pang et al., (2012)	ERP	F/M: 17/10 E/NE: 11/16 Age: 24	S: 50 representational Western paintings B: presented both in original appearance and filtered	F: electrocortical correlates of art expertise T: contemplation of visual art	P3b-/LPC-like bilateral ERPs were larger over the right hemisphere than the left. Art expertise correlated negatively with the amplitude of the ERP responses to paintings and control stimuli.

Appendix 2a. Full catalogue of artworks used as stimulii

Appendix 2a. Full catalogue of artworks used as stimuli

Artist	Title	Medium	Collection
Joseph Albers	Study for Homage to the Square: Beaming 1963	Oil on plastic and board	www.tate.org.uk
Josef Albers	Circle 1933	Woodcut on paper	www.tate.org.uk
Anselm Kiefer	Let a Thousand Flowers Bloom 2000	Mixed media	www.tate.org.uk
Karel Appel	Amorous Dance 1955	oil on canvas	www.tate.org.uk
Karel Appel	Untitled 1960	Lithograph on paper	www.tate.org.uk
Karel Appel	Hip, Hip, Hoorah! 1949	Oil on canvas	www.tate.org.uk
Eugene Atget	Bords de la Marne 1903	Gelatin silver printing-out-paper print,	www.moma.org
Frank Auerbach	Bacchus and Ariadne 1971	Oil on board	www.tate.org.uk
Frank Auerbach	Small Head of E.O.W. 1957-8	Oil on board	www.tate.org.uk
Frank Auerbach	The Sitting Room 1964	Oil on board	www.tate.org.uk
Francis Bacon	Portrait of Isabel Rawsthorne 1966	Oil on canvas	www.moma.org
Francis Bacon	Study of a Dog 1952	Oil on canvas	www.tate.org.uk
Francis Bacon	Figure in a Landscape 1945	Oil on canvas	www.tate.org.uk
Francis Bacon	Reclining Woman 1961	Oil on canvas	www.tate.org.uk
Balthus	Sleeping Girl 1943	Oil on board	www.tate.org.uk
Balthus	Still Life with a Figure 1940	Oil on paper mounted on wood panel	www.tate.org.uk
Matthew Barney	Drawing Restraint 9: Shimenawa 2005	Chromogenic color print in self-lubricating plastic frame,	www.moma.org
Georg Baselitz	Adieu 1982	Oil on canvas	www.tate.org.uk
Jean-Michel Basquiat	Untitled 1981	Oilstick on paper	www.moma.org
Jean-Michel Basquiat	Untitled, 1985	Cut-and-pasted paper and oilstick on paper,	www.moma.org
Georg Baselitz	Rebel 1965	Oil on canvas	www.tate.org.uk
Bernd Becha and Hilla Becha	Pitheads 1974	Photograph on board	www.tate.org.uk
Thomas Hart Benton	Homestead 1934	Tempera and oil on composition board	www.moma.org
Joseph Beuys	Acer platanoides 1945	Leaf on paper	www.tate.org.uk
Joseph Beuys	Sun and Pylon 1946	Pencil, watercolour and chloride on paper	www.tate.org.uk
Umberto Boccioni	The City Rises, 1910	Oil on canvas	www.moma.org
Alighiero e Boetti	Map of the World 1989	Embroidery on fabric	www.moma.org
David Bomberg	In the Hold circa 1913-4	Oil on canvas	www.tate.org.uk
David Bomberg	Bathing Scene circa 1912-13	Oil on wood	www.tate.org.uk
Pierre Bonnard	Basket of Fruit Reflected in the Mirror, 1944-46	Oil on canvas	www.moma.org
Pierre Bonnard	The Bowl of Milk c 1919	Oil on canvas	www.tate.org.uk
Pierre Bonnard	Pont de la Concorde 1913/15	Oil on canvas	www.tate.org.uk
Pierre Bonnard	The Window 1925	Oil on canvas	www.tate.org.uk
Pierre Bonnard	Coffee 1915	Oil on canvas	www.tate.org.uk
Louise Bourgeois	Untitled 1989-91	Drypoint etching on paper	www.tate.org.uk
Constantin Brancusi	Untitled Interior of Studio 1922	Gelatin silver print	www.moma.org
Constantin Brancusi	Viewof the Artist's Studio 1918	Gouache and pencil on board	www.moma.org
Bill Brandt	Evening in Kew Gardens	Gelatin silver print,	www.moma.org

	c.1935		
Georges Braque	Glass on a Table 1909/10	Oil on canvas	www.tate.org.uk
Henri Cartier-Bresson	Arsila, Spanish Morocco 1933	Gelatin silver print, printed 1947	www.moma.org
Gunter Brus& Arnolf Rainer	Charm - Flower - Ring 1984	Drawing on paper	www.tate.org.uk
Arnulf Rainer & Gunter Brus	from Deepening with Clouding Over (P77235-P77239; complete) [no title] 1985-6	Intaglio print on paper	www.tate.org.uk
Chris Burden	Creatures Beyond Fathom of Science 1979	Cut-and-pasted printed paper, gelatin silver print, snakeskin, and colored pencil on paperboard,	www.moma.org
Anthony Caro	Figure 1956	Monotype on paper	www.tate.org.uk
Paul Cezanne	The Avenue at the Jas de Bouffan circa 1874-5	Oil on canvas	www.tate.org.uk
Paul Cezanne	Boy in a red vest 1888-90	Oil on canvas	www.moma.org
Paul Cezanne	The Grounds of the Château Noir circa 1900-6	Oil on canvas	www.tate.org.uk
Marc Chagall	I and the Village 1911	Oil on canvas	www.moma.org
Marc Chagall	Bouquet with Flying Lovers circa 1934-47	Oil on canvas	www.tate.org.uk
Jake and Dino Chapman	from Exquisite Corpse (P78455-P78474; complete) Exquisite Corpse 2000	Etching on paper	www.tate.org.uk
Chuck Close	Self-Portrait/Pulp/Pochoir 2000	Paper pulp and pochoir, composition and sheet:	www.moma.org
Joseph Cornell	Untitled (Bird Box) about 1948	Mixed-media assemblage in glass-fronted wooden box with electric light	www.nationalgalleries.org
John Currin	The Wizard circa 1994	Oil on canvas	www.tate.org.uk
John Currin	Thanksgiving 2003	Oil on canvas	www.tate.org.uk
Salvador Dali	Autumnal Cannibalism 1936	Oil on canvas	www.tate.org.uk
Salvador Dali	Mountain Lake 1938	Oil on canvas	www.tate.org.uk
Salvador Dali	Metamorphosos of Narcissus 1937	Oil on canvas	www.tate.org.uk
Willem de Kooning	Minnie Mouse 1971	Lithograph	www.moma.org
Giorgio De Chirico	The Painter's Family 1926	Oil on canvas	www.tate.org.uk
Giorgio De Chirico	The Uncertainty of the Poet, 1913	Oil on canvas	www.tate.org.uk
Robert Delauney	Study for `The City' 1909-10	Oil on canvas	www.tate.org.uk
Robert Delauney	Windows Open Simultaneously (First Part, Third Motif) 1912	Oil on canvas	www.tate.org.uk
Robert Delauney	Endless Rhythm 1934	Oil on canvas	www.tate.org.uk
Charles Demuth	Eggplant and Tomatoes 1926	Watercolour on paper	www.moma.org
Richard Diebenkorn	from Five Aquatints with Drypoint (P07644; incomplete) #4 1978	Etching, aquatint and drypoint on paper	www.tate.org.uk
Otto Dix	The Nun 1914	Oil on cardboard	www.moma.org
Otto Dix	Cardplayers	Drypoint on paper (4/11)	www.nationalgalleries.org
Peter Doig	Ski Jacket 1994	Oil on canvas	www.tate.org.uk
Peter Doig	rom Cubitt Print Box (P78388-P78407; complete) Echo Lake 2000	Etching and aquatint on paper	www.tate.org.uk
Jean Dubuffet	The Busy Life 1953	Oil on canvas	www.tate.org.uk
Jean Dubuffet	Carrot Nose, 1962	Lithograph	www.moma.org

Jean Dubuffet	Monsieur Plume with Creases in his Trousers (Portrait of Henri Michaux) 1947	Oil and grit on canvas	www.tate.org.uk
Jean Dubuffet	The Tree of Fluids 1950	Oil on canvas	www.tate.org.uk
Jean Dubuffet	Large Black Landscape 1946	Oil on board	www.tate.org.uk
Marlene Dumas	Lucy 2004	Oil on canvas	www.tate.org.uk
Marlene Dumas	Magdalena 1 1996	Ink on paper	www.tate.org.uk
Tracy Emin	from Other Men's Flowers (P11422-P11436; complete) (no title) 1994	Lithography on paper	www.tate.org.uk
James Ensor	Effect of Light 1935	Oil on canvas	www.tate.org.uk
Max Ernst	Forest and Dove 1927	Oil on canvas	www.tate.org.uk
Max Ernst	Men Shall Know Nothing of This 1923	Oil on canvas	www.tate.org.uk
Walker Evans	City Lunch Counter, New York 1929	Gelatin silver print,	www.moma.org
Lyonel Feininger	Gelmeroda III 1913	Oil on canvas	www.nationalgalleries.org
Fischli & Weiss	from Fotografías (P20330-P20333; incomplete) Untitled 2005	Photograph on paper	www.tate.org.uk
Dan Flavin	Untitled 1973	Crayon and ink on graph paper on paper,	www.moma.org
Lucio Fontana	Spatial Concept 1958	Pastel and canvas collage	www.tate.org.uk
Lucien Freud	Girl with a White Dog 1950-51	Oil on canvas	www.tate.org.uk
Lucien Freud	Francis Bacon 1952	Oil on canvas	www.tate.org.uk
Gilbert & George	Existers 1984	Mixed media	www.tate.org.uk
Gilbert & George	Faith Drop 1991	Mixed media	www.tate.org.uk
Henri Gaudia-Breska	Leopard I circa 1912-13	Drawing on paper	www.tate.org.uk
Paul Gauguin	Auti Te Pape (Women at the River) from Noa Noa (Fragrance)	Woodcut on paper	www.moma.org
Isa Genzken	Fischcollage (#7) 2001	Cut-and-pasted printed paper on paper	www.moma.org
Alberto Giacometti	The Studio, 1955	Lithograph	www.moma.org
Robert Gober	Untitled 2000	Lithograph on paper	www.tate.org.uk
Nan Goldin	Vivienne in the green dress, NYC 1980	Photograph on paper	www.tate.org.uk
Juan Gris	The Sunblind 1914	Gouache, collage, chalk and charcoal on canvas	www.tate.org.uk
Juan Gris	Overlooking the Bay 1921	Oil on canvas	www.tate.org.uk
Georg Grosz	Suicide 1916	Oil on canvas	www.tate.org.uk
Georg Grosz	A Married Couple 1930	Watercolour on paper	www.tate.org.uk
Andreas Gursky	Bahrain I 2005	Photograph on paper	www.tate.org.uk
Philip Guston	Hat 1976	Oil on canvas	www.tate.org.uk
Philip Guston	The Return 1956-8	Oil on canvas	www.tate.org.uk
Richard Hamilton	Chromatic spiral 1950	Oil on wood	www.tate.org.uk
Barbara Hepworth	Kestor Rock, Gleaming Stone 1973	Lithograph on paper	www.tate.org.uk
Barbara Hepworth	Genesis 1969	Lithograph on paper	www.tate.org.uk
Barbara Hepworth	Family Group - Earth Red and Yellow 1953	Oil and drawing on board	www.tate.org.uk
Barbara Hepworth	Two Forms (White and Yellow) 1955	Oil and drawing on board	www.tate.org.uk
Eva Hesse	Untitled 1967	Drawing on paper	www.tate.org.uk
Damien Hirst	Round from In a Spin, the Action of the World on Things, Volume 1, 2002	One from a portfolio of twenty-three etching, aquatint, and drypoints,	www.moma.org

Damien Hirst	from London (P77924-P77934; complete) Untitled 1992	Screenprint on paper	www.tate.org.uk
Damien Hirst	from In a Spin, the Action of the World on Things I (P13034-P13056; complete) Global a Go-Go - for Joe 2002	Colour etching	www.tate.org.uk
David Hockney	Rocky Mountains and Tired Indians 1965	Acrylic on canvas	www.nationalgalleries.org
Howard Hodgkin	Come into the Garden, Maude 2000-3	Oil on wood	www.tate.org.uk
Howard Hodgkin	Dinner at West Hill 1964-6	Oil on canvas	www.tate.org.uk
Hans Hoffman	Pompeii 1959	Oil on canvas	www.tate.org.uk
Hans Hoffman	Nulli Secundus 1964	Oil on canvas	www.tate.org.uk
Edward Hopper	Night Windows 1928	Oil on canvas	www.moma.org
Edward Hopper	Gas 1940	Oil on canvas	www.moma.org
Jorg Immendorf	Café Deutschland 1978	Gouache on paper	www.moma.org
Augustus John OM	Robin circa 1912	Oil on wood	www.tate.org.uk
Augustus John OM	The Little Railway, Martigues 1928	Oil on canvas	www.tate.org.uk
Augustus John OM	Lyric Fantasy circa 1913-4	Oil and pencil on canvas	www.tate.org.uk
Augustus John OM	Blue Cineraria circa 1928	Oil on canvas	www.tate.org.uk
Augustus John OM	Woman Smiling 1908-9	Oil on canvas	www.tate.org.uk
Jasper Johns	Green Target 1955	Encaustic on newspaper and cloth over canvas,	www.moma.org
Jasper Johns	0 through 9 1961	Oil on canvas	www.tate.org.uk
Jasper Johns	Dancers on a Plane 1980-81	Oil on canvas and bronze frame	www.tate.org.uk
Donald Judd	from Untitled (P77496-P77505; complete) no title 1988	Woodcut on paper	www.moma.org
Donald Judd	Untitled 1961	Synthetic polymer paint and sand on composition board,	www.moma.org
Donald Judd	Untitled 1961_9	Woodcut on paper	www.tate.org.uk
Donald Judd	from Untitled (P11522-P11531; complete) (no title)1992-3	Woodcut on paper	www.tate.org.uk
Frieda Kahlo	Self Portrait With Cropped Hair 1940	Oil on canvas	www.moma.org
Frida Kahlo	My Grandparents, My Parents, and I (Family Tree) 1936	Oil and tempera on zinc	www.moma.org
Wassily Kandinsky	Swinging 1925	Oil on board	www.tate.org.uk
Wassily Kandinsky	Lake Starnberg 1908	Oil on board	www.tate.org.uk
Anish Kapoor	Untitled 1987	Gouache on paper	www.tate.org.uk
Anish Kapoor	from Blackness from Her Womb (P78608-P78620) [no title] 2000	Etching on paper on paper	www.tate.org.uk
Alex Katz	Night Branch 1994	Oil on board	www.tate.org.uk
Alex Katz	Pansies 1967	Oil on board	www.tate.org.uk
Alex Katz	East Window 1979	Oil on board	www.tate.org.uk
Ellsworth Kelly	Black Square with Blue 1970	Oil on canvas	www.tate.org.uk
Ellsworth Kelly	Orange Relief with Green 1991	Oil on canvas	www.tate.org.uk

Ellsworth Kelly	Méditerannée 1952	Oil on wood	www.tate.org.uk
Anselm Kieffer	Palette 1981	Oil, shellac and emulsion on canvas	www.tate.org.uk
Martin Kippenberger	Event Poster S.O. 36 1979	Lithograph on paper	www.moma.org
Martin Kippenberger	War is no Nice 1985	Oil and silicone rubber on canvas	www.moma.org
Paul Klee	They're Biting 1920	Drawing and oil on paper	www.moma.org
Paul Klee	Drinker c 1909	Etching and drypoint	www.moma.org
Paul Klee	A Young Lady's Adventure 1922	Watercolour on paper	www.moma.org
Paul Klee	The Protector 1926	Pen and ink on paper on board	www.tate.org.uk
Yves Klein	Blue Monochrome, 1961	Dry pigment in synthetic polymer medium on cotton over plywood,	www.moma.org
Yves Klein	IKB 79 1959	Paint on canvas on wood	www.tate.org.uk
Gustav Klimt	Hope, II 1907-08	Oil, gold and platinum on canvas	www.moma.org
Gustav Klimt	The Park 1910	Oil on canvas	www.moma.org
Gustav Klimt	Schwangere mit Mann nach links (Pregnant Woman with Man)about 1903 - 1904	Black chalk on paper	www.nationalgalleries.org
Franz Kline	Meryon 1960 -61	oil on canvas	www.tate.org.uk
Jeff Koons	Art Magazine Ads 1988-9	Lithograph on paper	www.tate.org.uk
Jannis Kounellis	from Kounellis 99 (P78423-P78434; complete) [no title] 1999	Etching on paper	www.tate.org.uk
Fernand Leger	Still Life with a Beer Mug 1921-2	oil on canvas	www.tate.org.uk
Fernand Leger	Three Bottles 1954	Oil on canvas	www.tate.org.uk
Fernand Leger	Leaves and Shell 1927	Oil on canvas	www.tate.org.uk
Sol LeWitt	Arcs from Four Corners 1986	Woodcut on paper	www.tate.org.uk
Sol LeWitt	A Square Divided Horizontally and Vertically into Four Equal Parts, Each with a Different Direction of Alternating Parallel Bands of Lines 1982	Watercolour and relief print on paper	www.tate.org.uk
Roy Lichtenstein	Landscape 5 from Ten Landscapes, 1967	One from a portfolio of ten screenprints, composition and sheet	www.moma.org
Roy Lichtenstein	Moonscape 1965	Screenprint on plastic	www.tate.org.uk
L S Lowry	Hillside in Wales 1962	Oil on canvas	www.tate.org.uk
L S Lowry	A Young Man 1955	Oil on canvas	www.tate.org.uk
L S Lowry	Coming out of School 1927	Oil on wood	www.tate.org.uk
Sarah Lucas	from Self-Portraits 1990-1998 (P78443-P78454; complete) Self Portrait with Mug of Tea 1993	Inkjet print on paper	www.tate.org.uk
Sarah Lucas	from Self-Portraits 1990-1998 (P78443-P78454; complete) Human Toilet Revisited 1998	Inkjet print on paper	www.tate.org.uk
Sarah Lucas	Sod You Gits 1991	Photograph on paper	www.tate.org.uk
Rene Magritte	Man with a Newspaper 1928	Oil on canvas	www.tate.org.uk
Rene Magritte	The Reckless Sleeper 1928	Oil on canvas	www.tate.org.uk
Kasimir Malevich	Dynamic Suprematism 1915 or 16	oil on canvas	www.tate.org.uk
Robert Mangold	Red Wall 1965	Oil on Masonite	www.tate.org.uk
Man Ray	Untitled 1969	Lithograph and screenprint on paper	www.tate.org.uk

Piero Manzoni	Achrome 1958	China-clay on canvas	www.tate.org.uk
Brice Marden	Han Shan Exit 1992	Etching and sugarlift aquatint on paper	www.tate.org.uk
Brice Marden	Couplet III 1988-9	Oil on canvas	www.tate.org.uk
Brice Marden	Untitled 1973-9	Etching on paper	www.tate.org.uk
Agnes Martin	Happy Holiday 1999	Acrylic and graphite on canvas	www.tate.org.uk
Henri Matisse	The Snail 1953	Gouache on paper, cut and pasted on paper mounted on canvas	www.tate.org.uk
Henri Matisse	Reading Woman with a Parasol 1921	Oil on canvas	www.tate.org.uk
Henri Matisse	Draped Nude 1936	Oil on canvas	www.tate.org.uk
Joan Miro	Message froma Friend 1964	Oil on canvas	www.tate.org.uk
Amadeo Modigliani	Portrait of a Girl c 1917	Oil on canvas	www.tate.org.uk
Amadeo Modigliani	The Little Peasant c 1918	Oil on canvas	www.tate.org.uk
Amedeo Modigliani	Caryatid with a Vase c 1914	Watercolour on paper	www.tate.org.uk
Piet Mondrian	Broadway Boogie Woogie	Oil on canvas	www.moma.org
Piet Mondrian	Composition with Red, Blue, Black, Yellow, and Gray	Oil on canvas	www.moma.org
Piet Mondrian	Tableau I: Lozenge with Four Lines and Gray 1926	Oil on canvas	www.moma.org
Piet Mondrian	Composition with Double Line and Yellow, 1932	Oil on canvas	www.nationalgalleries.org
Claude Monet	The Seine at Port-Villez 1894	Oil on canvas	www.tate.org.uk
Claude Monet	Woman Seated on a Bench c 1874	Oil on canvas	www.tate.org.uk
Henry Moore	The Artist's Sister Mary 1926	Pen and ink and ink wash on paper	www.tate.org.uk
Giorgio Morandi	Still Life 1946	Oil on canvas	www.tate.org.uk
Robert Morris	Blind Time XIII 1973	Graphite on paper	www.moma.org
Robert Motherwell	Game of Chance 1987	Lithograph, aquatint, collage, pastel and acrylic on paper	www.tate.org.uk
Robert Motherwell	Ulysses 1947	Oil and cardboard on wood	www.tate.org.uk
Robert Motherwell	Open No. 122 in Scarlet and Blue 1969	Acrylic and drawing on canvas	www.tate.org.uk
Edvard Munch	The Sick Child 1907	Oil on canvas	www.tate.org.uk
Laszlo Moholy-Nagy	K VII 1922	Oil on canvas	www.tate.org.uk
Bruce Nauman	Face mask 1981	Synthetic polymer paint, charcoal, and pencil on paper,	www.moma.org
Bruce Nauman	Raw-War 1971	Lithograph on Paper	www.tate.org.uk
Bruce Nauman	*from* Studies for Holograms (a-e) (P77629-P77633; complete) a 1970	Screenprint on paper	www.moma.org
Barnett Newman	Canto IX 1963-4	Lithograph on paper	www.tate.org.uk
Barnett Newman	Adam 1951-2	Oil on canvas	www.tate.org.uk
Barnett Newman	Moment 1946	Oil on canvas	www.tate.org.uk
Ben Nicholson	Feb 28-53 (vertical seconds) 1953	Oil on canvas	www.tate.org.uk
Hermann Nitsch	Poured Painting 1963	Oil on canvas	www.tate.org.uk
Hermann Nitsch	Blood Picture 1962	Mixed media on canvas	www.tate.org.uk
Georgia O'Keeffee	Lake George, Coat and Red, 1919	Oil on canvas	www.moma.org

Claus Oldenberg	Notes (Micky Mouse) 1968	Lithograph on paper	www.tate.org.uk
Eduardo Paolozzi	Inkwells Gold 1962	Screenprint on paper	www.tate.org.uk
Francis Picabia	Otaïti 1930	Oil and resin on canvas	www.tate.org.uk
Francis Picabia	Portrait of a Doctor circa 1935-8	Oil on canvas	www.tate.org.uk
Pablo Picasso	Bullfight Scene 1960	Brush and ink on paper	www.tate.org.uk
Pablo Picasso	Seated Woman in a Chemise 1923	Oil on canvas	www.tate.org.uk
Pablo Picasso	Head of a Young Boy 1945	Lithograph on paper	www.tate.org.uk
Pablo Picasso	Weeping Woman 1937	Oil on canvas	www.tate.org.uk
Jackson Pollock	Naked Man with Knife circa 1938-40	Oil on canvas	www.tate.org.uk
Jackson Pollock	Landscape with Steer 1936-37	Lithograph with airbrushed enamel additions,	www.moma.org
Jackson Pollock	Yellow Islands 1952	Oil on canvas	www.tate.org.uk
Richard Prince	Untitled 1999	Synthetic polymer paint and silkscreened ink on paper,	www.moma.org
Arnulf Rainer	Untitled (Death Mask) 1978	Oil, pastel and photograph on paper	www.tate.org.uk
Robert Rauschenberg	The Razorback Bunch (Etching I) 1980	Intaglio print on paper	www.moma.org
Odile Redon	Profile of a Woman with a Vase of Flowers circa 1895-1905	Oil on canvas	www.tate.org.uk
Paula Rego	War 2005	Pastel on paper on aluminium	www.tate.org.uk
Paula Rego	The Dance 1988	Acrylic on paper laid on canvas	www.tate.org.uk
Paula Rego	from Pendle Witches (P77902-P77913; complete) Moth 1996	Etching and aquatint on paper	www.tate.org.uk
Ad Reinhardt	Abstract Painting No. 5 1962	Oil on canvas	www.tate.org.uk
Ad Reinhardt	Abstract Painting circa 1951-2	Oil on canvas	www.tate.org.uk
Pierre Auguste Renoir	Pinning the Hat, 1897	Lithograph	www.moma.org
August Renoir	Nude on a Couch 1945	Oil on canvas	www.tate.org.uk
August Renoir	Head of a Girl 1898	Oil on canvas	www.tate.org.uk
August Renoir	Peaches and Almonds 1901	Oil on canvas	www.tate.org.uk
Gerhard Richter	Abstract Painting (809-3) 1994	Oil on canvas	www.tate.org.uk
Gerhard Richter	Abstract Painting (Silicate) (880-4) 2002	Oil on Alu-Dibond	www.tate.org.uk
Bridget Riley	Achæan 1981	Oil on canvas	www.tate.org.uk
Bridget Riley	Hesitate 1964	Oil on canvas	www.tate.org.uk
Bridget Riley	Nataraja 1993	Oil on canvas	www.tate.org.uk
Bridget Riley	Deny II 1967	PVA emulsion on canvas	www.tate.org.uk
Diego Rivera	Agrarian Leader Zapata 1931	Fresco,	www.moma.org
Alexsandr Rodchenko	Untitled 1929	Gelatin silver print,	www.moma.org
James Rosenquist	from Leo Castelli's 90th Birthday Portfolio (L02354-L02362; complete) The Flame Dances on Leo's Book 1997	Lithograph on paper	www.tate.org.uk
James Rosenquist	Off the Continental Divide 1973-4	Lithograph on paper	www.tate.org.uk
Marc Rothko	No.5/No.22, 1950	Oil on canvas	www.moma.org

Mark Rothko	Light Red over Black 1957	oil on canvas	www.tate.org.uk
Mark Rothko	Red on Maroon 1959	Oil on canvas	www.tate.org.uk
Mark Rothko	Untitled c 1950-2	Oil on canvas	www.tate.org.uk
Georges Roualt	The Three Judges circa 1936	Oil on board laid on canvas	www.tate.org.uk
Henri Rousseau	Bouquet of Flowers c 1909-10	Oil on canvas	www.tate.org.uk
Edward Ruscha	Time Is Up 1989	Lithograph on paper	www.tate.org.uk
David Salle	Muscular Paper 1985	Oil, synthetic polymer paint, and charcoal on canvas and fabric, with painted wood, in three parts,	www.moma.org
David Salle	from High and Low (P12243-P12247) Fast and Slow 1994	Lithograph and woodcut on paper	www.tate.org.uk
August Sander	Sisters 1927	Gelatin silver print,	www.moma.org
Egon Schiele	Girl putting on a Shoe 1910	Watercolour and charcoal on paper	www.moma.org
Egon Schiele	Sorrow 1914	Drypoint	www.moma.org
Richard Serra	Hreppholar I from Hreppholar I-VII, 1999	Etching	www.moma.org
Richard Serra	Screech 1996	Etching on paper	www.tate.org.uk
Richard Serra	from Leo Castelli's 90th Birthday Portfolio (L02354-L02362; complete) Leo 1997	Etching on paper	www.tate.org.uk
Cindy Sherman	Untitled #99 1982	Photograph on paper	www.tate.org.uk
Cindy Sherman	Untitled A 1975	Photograph on paper	www.tate.org.uk
Cindy Sherman	Untitled Film Still #48 1979, reprinted 1998	Photograph on paper	www.tate.org.uk
Cindy Sherman	Untitled 1976, printed 2000	Photograph on paper	www.tate.org.uk
David Smith	Painting 1964 1964	Oil on canvas laid on wood	www.tate.org.uk
Robert Smithson	Ithaca Mirror Trail, Ithaca, New York 1969	Mixed media	www.tate.org.uk
Chaim Soutine	The Road up the Hill c1924	Oil on canvas	www.tate.org.uk
Chaim Soutine	Landscape at Ceret c1920-1	Oil on canvas	www.tate.org.uk
Chaim Soutine	Cagnes Landscape with Tree 1925-6	Oil on canvas	www.tate.org.uk
Stanley Spencer	Zacharias and Elizabeth 1913-14	Oil and pencil on canvas	www.tate.org.uk
Stanley Spencer	The Centurion's Servant 1914	Oil on canvas	www.tate.org.uk
Stanley Spencer	Dinner on the Hotel Lawn 1956-7	Oil on canvas	www.tate.org.uk
Stanley Spencer	The Roundabout 1923	Oil on canvas	www.tate.org.uk
Nicolas de Stael	Marathon 1948	Oil on canvas	www.tate.org.uk
Nicolas de Stael	Landscape Study 1952	Oil on board	www.tate.org.uk
Nicolas de Stael	Composition 1950 1950	Oil on board	www.tate.org.uk
Alfred Stieglitz	The Steerage 1907	Photogravure	www.nationalgalleries.org
Antoni Tapies	Grey Ochre 1958	Oil, epoxy resin and marble dust on canvas	www.tate.org.uk
Jean Tinguely	Chaos I 1972	Intaglio print on paper	www.tate.org.uk
Cy Twombley	from Quattro Stagioni (A Painting in Four Parts) (T07887-T07890; complete). Quattro Stagioni: Primavera 1993-5	Acrylic, oil, crayon, and pencil on canvas	www.tate.org.uk

Cy Twombley	from Quattro Stagioni (A Painting in Four Parts) (T07887-T07890; complete). Quattro Stagioni: Estate 1993-5	Acrylic, oil, crayon, and pencil on canvas	www.tate.org.uk
Cy Twombly	Untitled, 1970	Oil-based house paint and crayon on canvas,	www.moma.org
Edouard Vuillard	Interior, Mother and Sister of the Artist, 1893	Oil on canvas	www.moma.org
Edouard Vuillard	Sunlit Interior c 1920	Oil on canvas	www.tate.org.uk
Edouard Vuillard	Landscape_House on the Left 1900	Oil on canvas	www.tate.org.uk
Edouard Vuillard	Girl in an Interior c1910	Oil on canvas	www.tate.org.uk
Edouard Vuillard	The Laden Table c 1908	Oil on canvas	www.tate.org.uk
Mark Wallinger	Half-Brother (Exit to Nowhere - Machiavellian) 1994-5	Oil on canvas	www.tate.org.uk
Mark Wallinger	From Bugs: A Portfolio (P78511-P78520; complete) King Edward and the Colorado Beetle 2000	Potato print on paper	www.tate.org.uk
Mark Wallinger	Where There's Muck 1985	Mixed media	www.tate.org.uk
Andy Warhol	Camouflage 1987	Portfolio of eight screen prints	www.moma.org
Andy Warhol	from Mao Tse-Tung, [no title] 1972	Screenprint on paper	www.tate.org.uk
Andy Warhol	Birmingham Race Riot 1964	Screenprint on paper	www.tate.org.uk
Andy Warhol	From Marilyn (P07121-P07130; complete) [no title] 1967	Screenprint on paper	www.tate.org.uk
Andy Warhol	Marilyn Diptych 1962	Acrylic on canvas	www.tate.org.uk
Weegee	Woman Shot froma Canon, New york	Gelatin silver print	www.moma.org
Weegee	Victory Celebration 1945	Gelatin silver print,	www.moma.org
David Hockney	Hawthorne Blossom near Rudston, 2008	Oil on two canvases	www.**hockney**pictures.com
David Hockney	Piscine a Minuit (paper pool 19), 1978	Coloured and pressed paper pulp	www.**hockney**pictures.com

Appendix 2b: Catalogue of artworks used as examples of Abstract Art, Representational Art and Indeterminate Art.

Appendix 2b: Catalogue of artworks used as examples of Abstract Art, Representational Art and Indeterminate Art

Artist	Title	Medium	Collection
ABSTRACT			
Frank Stella	from Polar Co-Ordinates for Ronnie Peterson, 1980	Screenprint and Lithograph on paper	www.tate.org.com
Richard Hamilton	Trainsition IIII 1954	Oil on wood	www.tate.org.com
George Braque	The Billiard Table 1945	Oil on sand on canvas	www.tate.org.com
INDETERMINATE			
Francis Bacon	Figures in a Garden, c 1936	Oil on canvas	www.tate.org.com
Juan Gris	Violin and a Fruit Dish 1924	Oil on canvas	www.tate.org.com
Willem de Kooning	Woman I, 1950 -52	Oil on canvas	www.tate.org.com
FIGURATIVE			
Henri Cartier-Bresson	Tivoli, Italy, 1933	Gelatin silver print	www.tate.org.com
Henri Matisse	The Inattentive Reader, 1919	Oil on canvas	www.tate.org.com
Stanley Spencer	Self-portrait, 1914	Oil on canvas	www.tate.org.com

Appendix 2c: Catalogue of artworks used as practice stimuli

Appendix 2c: Catalogue of artworks used as practice stimuli

Artist	Title	Medium	Collection
David Salle	Salon Three Inches within Your head, 1988	Acrylic and Oil on canvas	www.tate.org.uk
Arnulf Rainer	The Water is a Naked box, 1950	Lithograph on paper	www.tate.org.uk
David Bomberg	Vision of Ezekiel, 1912	Oil on canvas	www.tate.org.uk
Augustus John	An Old lady, 1912	Oil on canvas	www.tate.org.uk
Jannis Kounellis	Untitled, 1960-68	Mixed Media	www.tate.org.uk
Henri Gaudier-Brzeska	A Dog, c 1913	Drawing on paper	www.tate.org.uk
Jean Dubuffet	Nimble Free Hand to the Rescue	acrylic on canvas	www.tate.org.uk

Appendix 3: Demographic information and expertise questionnaire Experiment 2, EEG/ERP study.

Appendix 3: Demographic information and expertise questionnaire Experiment 2, EEG/ERP study.

Participant Information: Study 1, EEG/ERP, Visual and cognitive responses to twentieth Century art

Participant No: _______________

Date of testing: __________________ Location:__________________

Age: _______________________

Gender: Female_______ Male_______

Occupation/previous occupation: ________________________________

Do you wear glasses or contact lenses to correct your vision? Yes_____ No____

Are you colour blind, or have any other conditions which may affect your vision?

Yes_____ No____

Handedness, which hand do you most prefer/use? Left ________ Right_______

Have you ever suffered either a traumatic or acquired brain injury? Yes_____ No____

How many years of education do you have? ___________________________

Have you studied art or design at further or higher education? Yes_____ No____

If so, for how many years?_____________________________

If you are an artist/illustrator/art historian etc, how many years have you been working in this area?

____

How many times have you visited an art gallery or an exhibition of art in the last 12 months?

0-3____ 4-6____ more than 6___

Appendix 4: National Adult Reading Test (NART)

Appendix 4: National Adult Reading Test (NART**)**

Answer Sheet

CHORD	SUPERFLUOUS
ACHE	SIMILE
DEPOT	BANAL
AISLE	QUADRUPED
BOUQUET	CELLIST
PSALM	FACADE
CAPON	ZEALOT
DENY	DRACHM
NAUSEA	AEON
DEBT	PLACEBO
COURTEOUS	ABSTEMIOUS
RAREFY	DETENTE
EQUIVOCAL	IDYLL
NAIVE	PUERPERAL
CATACOMB	AVER
GAOLED	GAUCHE
THYME	TOPIARY
HEIR	LEVIATHAN
RADIX	BEATIFY
ASSIGNATE	PRELATE
HIATUS	SIDEREAL
SUBTLE	DEMESNE
PROCREATE	SYNCOPE
GIST	LABILE
GOUGE	CAMPANILE

NART total errors

Appendix 5: Toronto Alexythymia Scale (TAS-20)

Appendix 5: Toronto Alexythymia Scale (TAS-20)

TAS-20

Sex M:F Age: Date ID No.

Using the scale provided as a guide, indicate how much you agree or disagree with each of the following statements by circling the corresponding number. Give only one answer for each statement

Circle 1 if you STRONGLY DISAGREE

Circle 2 if you MODERATELY DISAGREE

Circle 3 if you NEITHER DISAGREE NOR AGREE

Circle 4 if you MODERATELY AGREE

Circle 5 if you STRONGLY AGREE

		Strongly Disagree	Moderately Disagree	Neither Disagree nor Agree	Moderately Agree	Strongly Disagree
1	I am often confused about what emotion I am feeling	1	2	3	4	5
2	It is difficult for me to find the right words for my feelings	1	2	3	4	5
3	I have physical sensations that doctors don't understand	1	2	3	4	5
4	I am able to describe my feelings easily	1	2	3	4	5
5	I prefer to analyze problems rather than just describe them	1	2	3	4	5
6	When I am upset, I don't know if I am sad, frightened, or angry	1	2	3	4	5
7	I am often puzzled by sensations in my body	1	2	3	4	5
8	I prefer to just let things happen rather than to understand why they turned out that way.	1	2	3	4	5
9	I have feelings that I can't quite identify	1	2	3	4	5
10	Being in touch with emotions is essential	1	2	3	4	5
11	I find it hard to describe how I feel about people	1	2	3	4	5
12	People tell me to describe my feelings more	1	2	3	4	5
13	I don't know what's going on inside me	1	2	3	4	5
14	I often don't know why I am angry	1	2	3	4	5
15	I prefer talking to people about their daily activities rather than their feelings	1	2	3	4	5

16	I prefer to watch 'light' entertainment shows rather than psychological dramas	1	2	3	4	5
17	It is difficult for me to reveal my innermost feelings, even to close friends	1	2	3	4	5
18	I can feel close to someone, even in moments of silence	1	2	3	4	5
19	I find examination of my feelings useful in solving personal problems	1	2	3	4	5
20	Looking for hidden meanings in plays or movies distracts from their enjoyment	1	2	3	4	5

Appendix 6: Demographic information and Stimuli Selection, Experiment 2 Pilot, Autumn Exhibition, Biscuit Factory

Appendix 6: Demographic information and Stimuli Selection, Experiment 2 Pilot, Autumn Exhibition, Biscuit Factory

'Oooooo, I like that!' Visceral responses to visual art.

A Pilot Study

Jane Else, Department of Psychology, Northumbria University, Newcastle upon Tyne

With the kind permission of The Biscuit Factory, Newcastle upon Tyne

Age: _________ yrs

Gender: M______ F________

Occupation: ____

No. of times visited an art gallery in last 12 months;

0-2 ______ 3-5 ________ 5-8 _________ More than 9 __________

Please pick 20 pictures from the current exhibition, only from the first floor galleries. Ones you like, ones you don't like!

Please do not pick any 3D/sculpture..... only things hanging on walls. This includes all medium... paintings, prints, photography, multimedia, felt etc

Try to choose as wide a variety of styles and subject matter as possible, i.e. abstract, representational, landscapes, cityscapes, interiors, animals, people......

Please write the title of the picture and the name of the artist, and then rate it regarding how much you liked it on the scale next to each picture. 0 = dislike extremely, 10 = like extremely. Please circle or cross the number closest to how much you like or dislike the picture, please try to use as much of the scale as possible.

Example;

Title _______________The Haywain ____

Artist ____________John Constable____

How much do you like this picture?

Dislike Extremely — Like Extremely

0 1 2 3 4 5 6 7 8 9 10

1. Title ____

Artist ____

How much do you like this picture?
Dislike Extremely — Like Extremely
0 1 2 3 4 5 6 7 8 9 10

2. Title ______________________________
Artist ______________________________
How much do you like this picture?
Dislike Extremely — Like Extremely
0 1 2 3 4 5 6 7 8 9 10

3. Title ______________________________
Artist ______________________________
How much do you like this picture?
Dislike Extremely — Like Extremely
0 1 2 3 4 5 6 7 8 9 10

4. Title ______________________________
Artist ______________________________
Dislike Extremely — Like Extremely
0 1 2 3 4 5 6 7 8 9 10

4
5. Title ______________________________
Artist ______________________________
Dislike Extremely — Like Extremely
0 1 2 3 4 5 6 7 8 9 10

6. Title ______________________________
Artist ______________________________
Dislike Extremely — Like Extremely
0 1 2 3 4 5 6 7 8 9 10

7. Title ______________________________
Artist ______________________________
Dislike Extremely — Like Extremely
0 1 2 3 4 5 6 7 8 9 10

8. Title ______________________________
Artist ______________________________
Dislike Extremely — Like Extremely
0 1 2 3 4 5 6 7 8 9 10

9. Title ______________________________
Artist ______________________________
Dislike Extremely — Like Extremely
0 1 2 3 4 5 6 7 8 9 10

10. Title ______________________________
Artist ______________________________
Dislike Extremely — Like Extremely
0 1 2 3 4 5 6 7 8 9 10

11. Title ____
Artist ____
Dislike Extremely | | | | | | | | | | Like Extremely
0 1 2 3 4 5 6 7 8 9 10

12. Title ____
Artist ____
Dislike Extremely | | | | | | | | | | Like Extremely
0 1 2 3 4 5 6 7 8 9 10

13. Title ____
Artist ____
Dislike Extremely | | | | | | | | | | Like Extremely
0 1 2 3 4 5 6 7 8 9 10

14. Title ____
Artist ____
Dislike Extremely | | | | | | | | | | Like Extremely
0 1 2 3 4 5 6 7 8 9 10

15. Title ____
Artist ____
Dislike Extremely | | | | | | | | | | Like Extremely
0 1 2 3 4 5 6 7 8 9 10

16. Title ____
Artist ____
Dislike Extremely | | | | | | | | | | Like Extremely
0 1 2 3 4 5 6 7 8 9 10

7

17. Title ____
Artist ____
Dislike Extremely | | | | | | | | | | Like Extremely
0 1 2 3 4 5 6 7 8 9 10

18. Title ____
Artist ____
Dislike Extremely | | | | | | | | | | Like Extremely
0 1 2 3 4 5 6 7 8 9 10

19. Title ____
Artist ____
Dislike Extremely | | | | | | | | | | Like Extremely
0 1 2 3 4 5 6 7 8 9 10

20. Title ____
Artist ____
Dislike Extremely | | | | | | | | | | Like Extremely
0 1 2 3 4 5 6 7 8 9 10

Appendix 7: Demographic information for Experiment 3, Autumn Exhibition, Biscuit Factory

Appendix 7: Demographic information for Experiment 3, Autumn Exhibition, Biscuit Factory

'Ooo, I like that!' Visceral responses to visual art. A behavioural study

Autumn Exhibition, The Biscuit Factory, Newcastle

Participant No:________________________________

Protocol:_______1_____________2_____________3____________4

Age: _________ yrs

Gender: M______ F________

Are you? Student ____ Employed ____ Unemployed ____ Retired ____

No. of times visited an art gallery in last 12 months;

0-2 ______ 3-5 ________ 5-8 _________ More than 9 __________

How many (if any) years of art education (post 16) have you had? __________________

Do you work in the visual arts: Y________ N ____________

Appendix 8: Original context 'score' sheet for Experiment 3, Autumn Exhibition, Biscuit Factory

Appendix 8: Original context 'score' sheet for Experiment 3, Autumn Exhibition, Biscuit Factory

I am now going to show you 10 pictures in the main gallery. I am going to show them to you for 60 seconds. As soon as you are ready I would like you tell me first how much each picture has an effect on you, what your immediate visceral, emotional, intuitive response is, on a scale of 1 -9, with 1 being 'no affect at all', 9 being 'a great deal of affect'. The effect may not necessarily be positive.
Then I would like you to rate each picture regarding how much you like it, with 1 being 'dislike extremely' and 9 being 'like extremely'.

Picture 1
How much affect does this picture have on you?
No affect at all A great deal of affect
1 2 3 4 5 6 7 8 9
How much do you like this picture?
Dislike Extremely Like Extremely
1 2 3 4 5 6 7 8 9

Picture 2
How much affect does this picture have on you?
No affect at all A great deal of affect
1 2 3 4 5 6 7 8 9
How much do you like this picture?
Dislike Extremely Like Extremely
1 2 3 4 5 6 7 8

Picture 3
How much affect does this picture have on you?
No affect at all A great deal of affect
1 2 3 4 5 6 7 8 9
How much do you like this picture?
Dislike Extremely Like Extremely
1 2 3 4 5 6 7 8 9

Picture 4
How much affect does this picture have on you?
No affect at all A great deal of affect
1 2 3 4 5 6 7 8 9
How much do you like this picture?
Dislike Extremely Like Extremely
1 2 3 4 5 6 7 8 9

Picture 5
How much affect does this picture have on you?
No affect at all A great deal of affect
1 2 3 4 5 6 7 8 9
How much do you like this picture?
Dislike Extremely Like Extremely
1 2 3 4 5 6 7 8 9

Picture 6
How much affect does this picture have on you?
No affect at all A great deal of affect
1 2 3 4 5 6 7 8 9
How much do you like this picture?
Dislike Extremely Like Extremely
1 2 3 4 5 6 7 8 9

Picture 7
How much affect does this picture have on you?

No affect at all						A great deal of affect		
1	2	3	4	5	6	7	8	9

How much do you like this picture?

Dislike Extremely								Like Extremely
1	2	3	4	5	6	7	8	9

Picture 8
How much affect does this picture have on you?

No affect at all						A great deal of affect		
1	2	3	4	5	6	7	8	9

How much do you like this picture?

Dislike Extremely								Like Extremely
1	2	3	4	5	6	7	8	9

Picture 9
How much affect does this picture have on you?

No affect at all						A great deal of affect		
1	2	3	4	5	6	7	8	9

How much do you like this picture?

Dislike Extremely								Like Extremely
1	2	3	4	5	6	7	8	9

Picture 10
How much affect does this picture have on you?

No affect at all						A great deal of affect		
1	2	3	4	5	6	7	8	9

How much do you like this picture?

Dislike Extremely								Like Extremely
1	2	3	4	5	6	7	8	9

Appendix 9: Demographic and Art Expertise Questionnaire, Experiment 4, Digital Sensations Exhibition, BALTIC39

Appendix 9: Demographic and Art Expertise Questionnaire, Experiment 4, Digital Sensations Exhibition, BALTIC39

Baltic 39 DIGITAL SENSATION

PD/AEQ

Code_________ Age____ Gender M F Protocol 1 2 3 4

Occupation________________________

1. Do you work in the visual arts? Y N
2. Are you left or right handed? L R
3. Which hand do you write with?_______________
4. No. of years higher education (post 16)? 0 1-2 3-5 6+
5. What is the highest level of education that you have completed?_____________________
6. Do you have any visual impairment?____
7. On average, how many times do you visit art galleries?

   Almost never (0) yearly (1) every 6 months (2) every 2 months (3) monthly (4) weekly (5)

8. On average, how many times do you visit art museums?

   Almost never (0) yearly (1) every 6 months (2) every 2 months (3) monthly (4) weekly (5)

9. In the average week how many hours each week do you spend looking at visual art?
   0 1 2 3 4 5 6 more

10. In the average week how many hours each week do you spend reading about visual art (publication/online/digital)?
    0 1 2 3 4 5 6 more

11. In the average week how many hours do you spend making visual art?
    0 1 2 3 4 5 6 more

12. In the average week how many hours do you spend teaching visual art?
    0 1 2 3 4 5 6 more

13. In the average week how many hours do you spend organising/collaborating/working with visual artists?
    0 1 2 3 4 5 6 more

14. How many years have you studied fine art after the age of 16?
    0 1 2 3 4 5 6 more

15. How many years have you studied art history after the age of 16?
    0 1 2 3 4 5 6 more

Appendix 10: Picture ratings score sheet, Digital Sensations Exhibition, BALTIC39

Appendix 10: Picture ratings score sheet, Digital Sensations Exhibition, BALTIC39

Protocol: 1 2 3 4
Picture ratings
1= not at all or none 10 = absolutely loads

1. How much did the picture you have just looked at make you go OOO or WOW?
2. How much did you like this picture?
3. How beautiful did you find this picture?
4. Is it art?

	Gallery Picture No	F	WOW/ OOO	LIKE	BEAUTY	ART	Computer Picture No	F	WOW/ OOO	LIKE	BEAUTY	ART
1												
2												
3												
4												
5												
6												

Most memorable picture? ____
Gallery______ or Computer _________

Appendix 11. Bond-Lader

Appendix 11. Bond-Lader
VISUAL ANALOGUE SCALES

ALERT	DROWSY
CALM	EXCITED
STRONG	FEEBLE
MUZZY HEADED	CLEAR HEADED
WELL COORDINATED	CLUMSY
LETHARGIC	ENERGETIC
CONTENTED	DISCONTENTED
TROUBLED	TRANQUIL
MENTALLY SLOW	QUICK WITTED
TENSE	RELAXED
ATTENTIVE	DREAMY
INCOMPETENT	PROFICIENT
HAPPY	SAD
ANTAGONISTIC	FRIENDLY
INTERESTED	BORED
WITHDRAWN	SOCIABLE

Appendix 12: PANAS

Appendix 12: PANAS

Participant Code_____________

1

2

PANAS Questionnaire

This scale consists of a number of words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word.

Indicate to what extent you feel this way right now, that is, the present moment.

1	2	3	4	5
Very slightly or Not at All	A Little	Moderately	Quite a Bit	Extremely

1. Interested ______________
2. Distressed ______________
3. Excited ______________
4. Upset ______________
5. Strong ______________
6. Guilty ______________
7. Scared ______________
8. Hostile ______________
9. Enthusiastic ______________
10. Proud ______________
11. Irritable ______________
12. Alert ______________
13. Ashamed ______________
14. Inspired ______________
15. Nervous ______________
16. Determined ______________
17. Attentive ______________
18. Jittery ______________
19. Active ______________
20. Afraid ______________

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