VISUAL PERCEPTION OF ABSTRACT ART IMAGES IN EXTRAVERSION AND AMBIVERSION AT P300 and N200

by

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LIST OF SYMBOLS

nA	nanoampere
%	percentage
SD	Standard deviation
kΩ	kilohertz
Hz	Hertz
nA	nanoampere
%	percentage

LIST OF ABBREVIATIONS

EEG	Electroencephalography
ERP	Event Related Potential
E-FFNPQ	Extraversion Five-Factor Nonverbal Personality Questionnaire
IAPS	International Affective Picture System
SWB	Subjective Well Being
USM	Universiti Sains Malaysia
BA	Broadmann Area
AA	Abstract Art
USM	Universiti Sains Malaysia
Fz	Frontal Midline
Pz	Parietal Midline
Cz	Central Midline
Oz	Occipital Midline

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VISUAL PERCEPTION OF ABSTRACT ART IMAGES IN EXTRAVERSION AND AMBIVERSION AT P300 AND N200

ABSTRAK

PENGENALAN: Selama beberapa dekad, ahli psikologi telah berusaha untuk merapatkan jurang antara keminatan seni dan keperibadian. Seni dan keperibadian seperti yang kita tahu adalah bidang yang sukar untuk diukur. Oleh itu, ahli neurosains sosial telah berusaha untuk merapatkan jurang antara seni, keperibadian, intensiti rangsangan dan substrat neural.

OBJEKTIF: Kajian ini bertujuan untuk mengkaji perbezaan substrat neural dalam seni abstrak ekstraversi dan ambiversi dalam proses emosi menggunakan Event Related Potential (ERP) serta lokasi pemprosesan emosi N200 dan P300 dalam kedua-dua personaliti tersebut - extraversi dan ambiversi.

METODOLOGI: Seramai 28 peserta (N = 14 untuk setiap keperibadian) berumur 18-25 tahun diambil dari Kampus Kesihatan USM, Kubang Kerian dan Kota Bharu untuk kajian rentas ini. Bagi gambar yang digunakan, 12 gambar (6 abstrak, 6 bukan abstrak) diambil secara rawak dari Sistem Gambar Afektif Antarabangsa (IAPS) berdasarkan nilai normatif IAPS (rendah dan sederhana). Rakaman potensi yang berkaitan dengan peristiwa (ERP) dilakukan menggunakan 128 HydroCel Geodesic Sensor Net pada peserta semasa melihat secara aktif rangsangan visual abstrak dan bukan abstrak.

DAPATAN: Hasil ANOVA campuran 2x3 menunjukkan bahawa terdapat perbezaan yang signifikan dalam kesan utama (kesan jenis gambar, tanpa mengira jenis keperibadian) dan antara kesan subjek (jenis keperibadian, tanpa mengira jenis gambar) pada latensi P300 pada Fz elektrod, perbezaan ketara kesan utama bagi kedua-dua elektrod Pz dan Oz untuk amplitud P300 dan perbezaan ketara dalam

kesan utama dalam elektrod Oz amplitud N200 di mana p <0.01. Sumber penempatan untuk kedua-dua N200 dan P300 terletak pada dua lobus utama. Lobus yang paling biasa adalah lobus oksipital kerana kajian ini berdasarkan persepsi visual, diikuti oleh lobus temporal. Dalam kajian ini, dua kawasan Broadmann (BA) yang berbeza dikenal pasti sebagai sumber penyetempatan untuk N200 dan P300 dalam ekstraversi dan ambiversi iaitu BA 18 dan 38. Kawasan khusus yang dikenalpasti adalah fusiform gyrus, inferior occipital gyrus, lingual gyrus dan lingual temporal gyrus.

KESIMPULAN: Sebagai kesimpulan, ambiversi mempunyai tindak balas emosi yang lebih tinggi daripada ekstra pada elektrod Pz dalam latensi P300 untuk gambar seni yang tidak abstrak. Ini mungkin disebabkan oleh preferensi bukan ekstraversi pada gambar kandungan semantik atau lebih dikenali sebagai gambar berstruktur yang kompleks yang boleh didapati dalam gambar seni bukan abstrak. Oleh kerana semua peserta yang menjadi sukarelawan dalam kajian ini bukan dari latar belakang kepakaran seni, pilihan seni bukan abstrak dapat difahami.

Kata Kunci: ERP, keperibadian, ekstravert, ambivert, N200, P300, Malaysia, Dewasa Muda, Seni Abstrak

VISUAL PERCEPTION OF ABSTRACT ART IMAGES IN EXTRAVERSION AND AMBIVERSION AT P300 AND N200

ABSTRACT

INTRODUCTION: Over decades, psychologist has been trying to bridge the gap between art preference and personality. Art and personality as we know are difficult areas to quantify. Therefore, social neuroscientist tried bridging the gap between art, personality, arousal intensity and neural substrates.

OBJECTIVES: This study aims to investigate the differences of neural substrates in abstract art of extraverts and ambiverts in the processing of emotion using the Event Related Potential (ERP) as well as its source of localization of N200 and P300 in the emotional processing of the two personalities – extraverts and ambiverts.

METHODOLOGY: A total of 28 participants (N=14 for each personality) aged 18-25 years old were recruited from USM Health Campus, Kubang Kerian and Kota Bharu area for this cross-sectional study. As for the pictures used,12 pictures (6 abstract, 6 non-abstract) were taken randomly from the International Affective Picture System (IAPS) based on the normative value of IAPS (low and moderate). An event-related potential (ERP) recording was done using the 128 HydroCel Geodesic Sensor Net on participants during active viewing of abstract and non-abstract visual stimuli.

RESULTS: A 2x3 mixed ANOVA results showed that there was a significant difference in the main effect (the effect of types of pictures, regardless of personality type) and between subject effect (type of personality, regardless type of pictures) on the P300 latency of the Fz electrode, a significant difference main effect for both Pz and Oz electrode for the P300 amplitude and a significant difference in the main effect in the Oz electrode of the N200 amplitude where $p < 0.01$. The source of localization

for both N200 and P300 lies in two main lobes. The most common lobe was the occipital lobe as this study is based on visual perception, followed by the temporal lobe. In this study, two different Broadmann areas (B.A) was identified for the source of localization for N200 and P300 in extraversion and ambiversion which is B.A 18 and 38. The specific areas identified are fusiform gyrus, inferior occipital gyrus, lingual gyrus and superior temporal gyrus.

CONCLUSION: In conclusion, ambiverts have a higher emotional response than extraverts at the Pz electrode in the P300 latency for non-abstract art images. This may be due to non-extraverts preferences on semantic content images or better known as complex structured images that can be found in non-abstract art images. As all the participants that volunteered in this study were not from an art expertise background, the preference of non- abstract art is understandable.

Keywords: ERP, personality, extravert, ambivert, N200, P300, Malaysian, Young Adults, Abstract Art

CHAPTER 1

INTRODUCTION

Visual art and personality have often been associated with one another over decades. Over the past years, psychologists have been trying to find a connection between different traits of personality and artistic preference. Many self-reported questionnaires such as the BIG FIVE Model of Personality that measures Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism has been established (Cloninger, 2008). This questionnaire covers the characteristics of the personalities in the model. One of the important finding in a study on personality, art interest, and aesthetic judgement styles using the Big Five Model of Personality found that openness to experience seem to have a positive association with general interest in art and its perception towards aesthetic styles and woman seem to appreciate more and is more interested in art when compared to men (Afhami & Mohammadi-Zarghan, 2018).

In 1960, Berlyne's arousal theory was popular as he describes enjoyment of humor as a new signal to an individual's psychological and physiological arousal level. He believed that there is an optimal arousal to an individual at a particular time. Many other scientist, has proposed various theories in linking emotion and personality (Strohminger, 2014). For example, in Charles Darwin's Evolutionary Theory of Emotion believed that emotion served as an adaptive role in order to motivate people to enhance chances of success and survival. Another example is the Appraisal Theory of Emotion is defined as emotion or emotional responses are caused and differentiated by appraisal depending on a person's experience (Moors, 2017).

Despite art being a very difficult area to quantify especially in measuring emotion, recently, social neuroscientist has been trying to find a connection between personality, art, arousal intensity and its neural substrates. Eysenck who was famous

for his works such as his Theory of Personality proposed the importance of extraversion, neuroticism and psychoticism in human personality. The reticular activating system that plays a role in arousal, wakefulness, and sleep is lower in extraverts compared to introverts (Eysenck, 1957). Eysenck suggest that extraverts has a low level of arousal making them find more intense stimuli (motivation) compared to introverts (Yusoff et al, 2018a). This is congruent with another research finding stating that people with low extraversion may be less motivated in increasing their happiness in a effortful contexts (Tamir, 2009).

In another study, on preference for abstract art according to thinking styles and personality found that abstract art is preferred over representational art among extraversion traits individuals and people who like art, field independent thinkers as well as abstract and random thinkers, are more likely to be fans of abstract art compared to field-dependent, concrete and sequential thinkers (Gridley, 2013). In a study to investigate preferences towards abstract art versus realist and low versus high complexity of paintings in contexts of personality traits found that Extraversion level was positively correlated with high ratings of abstract paintings (Krajewska & Waligorska, 2015).

Over the recent years, a new field called neuroaesthetics have come to light bringing a new perspective into neuroscience as well as aesthetics. Neuroaesthetics is a bridge between the arts (eg. Visual arts, architecture, design, digital media, music) and science which is the human brain, biological mechanisms and also behavior (Magsamen, 2019). In other words, a field about the biological bases underlying aesthetic experience (Chatterjee & Vartanian, 2014). As it is an emerging field, research on visual art and ERP is very scarce. Therefore, this study aims to examine

the differences of neural substrates when processing emotion in regards to abstract art in different personality (extraversion and ambiversion) using ERP measure.

1.1 Study Rationale

In a study on neural mechanisms that underlie the higher levels of subjective well-being in extraverts and its impact on extraversion towards human sensitivity against pleasant and unpleasant pictures of diverse emotional intensities found that there was a significant emotion (valence) effect which is highly positive and moderately positive in extraverts, but not in ambivert. Ambiverts showed a moderately negative effect at the N200 and P300 component which was absent in extraverts (Yuan et al., 2012). Therefore, the importance of this study is to further understand the ERP component, amplitude and latency of N200 and P300 between the personality type of extraversion and ambiversion as well as the effect of affective level by using the IAPS with regards to abstract art.

In this current study, the combination effect of both extravert and ambivert will be examined together with the intensity of emotional arousal on neural mechanisms underlying this process of emotional arousal. A 2x3 mixed analysis of variance – between subject effect (extraversion, ambiversion) X within subject effect (abstract art images, G-shape (neutral) images, non-abstract art images) will be applied in this in order to distinguish the influence of personalities within-subjects over the intensity of emotional arousal.

Based on previous research, it can be hypothesized that extraverts are more inclined towards to intensity of arousal compared to that of an ambivert as extraverts are better at regulating emotions which is critical in improving well-being (Bassal et

al., 2016). Since biological and physiological of the human body is greatly related to personality, it is important to assess this factor and its influence on wellbeing.

Hence, the Event Related Potential (ERP) technique that is known for its the spatiotemporal features for emotional effect by Woodman (2010), this technique will be used in this study together with two important theories that is Eysenck's Theory of Personality and Appraisal Theory of Emotion.

1.2 Objectives

1.2.1 General Objectives

To investigate the differences of the neural substrate in the processing of emotion of abstract art in different personalities – extraversion and ambiversion from the visual stimulus of abstract art and non-abstract images.

1.2.2 Specific Objectives

1. To examine the difference of the P300 amplitude and latency in the processing of emotion (with regards to abstract art) in different personalities – extraversion and ambiversion from the visual stimulus of abstract art and non-abstract images.
2. To determine the difference of the N200 amplitude and latency in the processing of emotion (with regards to abstract art) in different personalities – extraversion and ambiversion from the visual stimulus of abstract art and non-abstract images.

3. To localize the sources of N200 and P300 with regards to the difference in the processing of abstract-related emotion in different personalities

1.3 Hypotheses

1. There would be no significant difference in P300 amplitude and latency between extraverts and ambiverts in the emotion processing of abstract and non-abstract visual stimuli
2. There would be no significant difference in N200 amplitude and latency between extraverts and ambiverts in the emotion processing of abstract and non-abstract visual stimuli
3. There would be no difference in the source localization of ERP components between extraverts and ambiverts in the emotion processing of abstract and non-abstract visual stimuli

CHAPTER 2

LITERATURE REVIEW

INTRODUCTION

Psychologist has been trying to bridge the gap between art preference and personality – areas that are difficult to quantify. Social neuroscientist tried bridging the gap between art, personality, arousal intensity and neural substrates. This chapter will cover an overview of the current study and past study.

2.1 ERP Components (P300 and N200)

In a complex ERP waveform (latency and amplitude), the ERP component is one of the components in the waves (latency and amplitude) which are defined by their polarity (positive or negative voltage), timing, distribution of scalp and sensitivity to task manipulation (Woodman, 2010; Sur et al., 2009; Ghani et al., 2020). Event related brain potentials (ERPs) are electroencephalography (EEG) fluctuations that are time-locked and averaged to represent neural process (Luck, 2014; Usler et al., 2020).

Different ERP components emphasizes on different aspect features such as the P300 is involved in stimulus evaluation time, categorization, cognitive load, working memory updating (Hassan et al., 2016) and so on and the N200 which is the negative deflection peaking at about 200ms after presentation of stimulus (Sur et al., 2009) is involved in object recognition and categorization (Woodman, 2010; Wanchai, 2012; Ghani et al., 2020).

Latency in P300 is defined as the speed at which a stimulus is classified from discriminating one event from another where shorter latencies are linked to superior mental performance (Sripornpanich, 2020). Amplitude in P300 is classified as information on stimulus that reflect greater attention, larger P300 waves are produced.

A reduced P300 amplitude is an indicator of a broad neurobiological vulnerability (eg. Alcohol dependence, antisocial behavior) in the externalizing factor (Patrick et al., 2006; Oribe et al., 2014; Nan et al., 2018). Figure 2.1 below is the schematic representation of the ERP waveform.

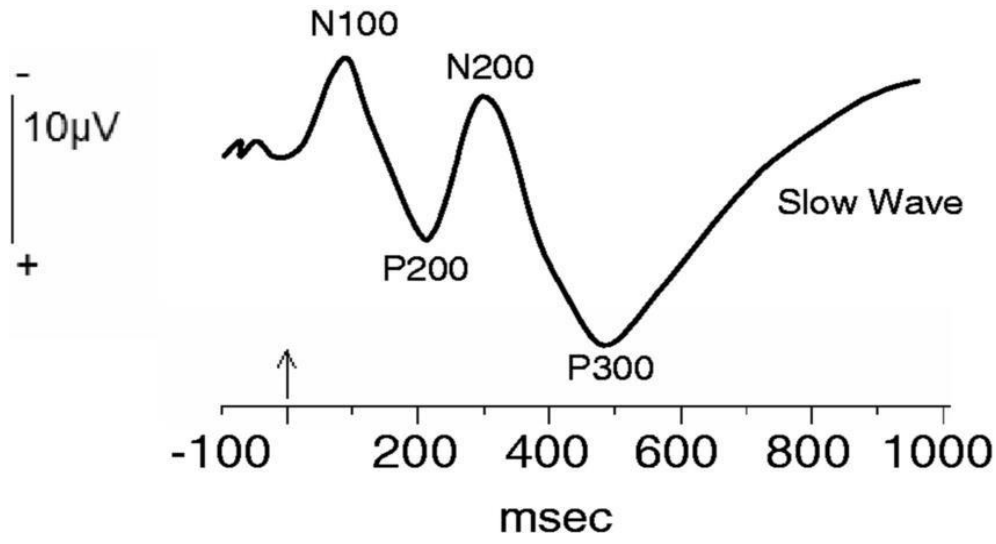


Figure 2.1: A schematic representation of an ERP waveform.

The vertical axis is the voltage where negative voltage is plotted up but ERP waveform sometimes display with positive voltage up. The vertical arrow represents the stimulus onset time and the horizontal axis represents the timeline. The numbers (100, 200, 300) is the ERP components and the letter P – positive deflection and N-negative deflection (Amodio et al., 2013; Krigolson et al., 2017b).

2.2 Personality

The underlying mechanism on how a person behaves based on experience can be described as personality. Personality description is a technique on how an individual is characterized. Motivational aspect of a direct behaviour is known as personality dynamic that comprises on the adjustment and adaptation of individuals towards life strains as well as its association with psychological health (Cloninger, 2008).

The development of personality changes over a person's lifetime (from childhood to adulthood). Primary socialization may be the starting point of the development of personality as it is the early period in a child's life as he or she learns to socialize. Conceptually, there is a threefold socialization process made up of family, school and peer clusters (Whitbeck, 1999). The main idea of this theory is that social behaviors and norms are learned predominantly through interaction with the primary socialization sources and these sources can come from family, school or peer clusters (Oetting, 1999). In other words, the early period of a person's life at which they learn and build themselves through social experience and interaction. This process usually starts at home where the family teaches the child the do's and don't's of a particular culture and social norms; then they move on to school and peer clusters. This would reflect on how they behave (development of personality) over time. A more reason model of personality would be the Big Five model reflecting on its five basic factors of personality. The Big Five Model of Personality measures five basic factors of personality that are conscientiousness, openness to experience, agreeableness, and extraversion trait (Merino-Tejedor, 2015; Afhami & Mohammadi-Zarghan, 2018; Delpe et al., 2019;). Most personality questionnaires like FFNPQ (Five Factor Non-Verbal Personality Questionnaire) was adapted from this Big Five Model (Ab Rashid et al., 2018).

2.3 Personality and ERP Components

The personality trait of extraversion is known as outgoing, loud, and enjoys social contact (Ashton et al., 2002; Ali, 2018; Lai & Qin, 2020). On the other hand, an ambivert is part extravert and part introvert. Someone who has the qualities of an extravert (outgoing) and an introvert (quiet) but has a 'mood' when choosing how they want to react at a certain situation (Yusoff et al., 2016; Davidson, 2017; Petric, 2019). In ERP, each ERP portion represents a separate category of information processing, response organisation, and stimulus processing of direct measure. In the reflection of cognitive processes and certain attentional areas, the P300 component reflects more than other components in the ERP.

A variety of experiments have been conducted to determine the relationship between personality and ERP components in order to apply Eyseck's theory of arousal mechanism (Eysenck, 1994; Geen et al., 1983; Zuckerman, 1991; Revelle, 2016; Picconi et al., 2018).

Early studies have found contradictory results, most likely due to a lack of understanding on the relationship between arousability, cortical, and potential arousal of experimental conditions with ERP components (Matthews & Gilliland, 1999; Revelle, 2016).

Gray (1991) found that extraverts are more sensitive to signals of reward (positive emotion) than to signals of punishment (negative emotion). Extraverts may be more sensitive to negative stimuli than ambiverts, but both are equally reactive to high levels of negative stimuli (Carretie et al., 2001). Extraverts, on the other hand, will be more receptive to friendly stimuli due to reward sensitivity signals in the brain (Canli et al., 2002; Yuan et al., 2009; Ku et al., 2020).

The frontal P200 and parietal P300 components are recognised as controlled evaluative and attentional indexing components (Carretie et al., 2004). Furthermore, in the oddball talk, the centrally peaking N200 portion reflects the attention orienting response to specific stimulus. As a result, the influence of extraversion on emotional brain effects for various processing phases can be reflected by the parietal P300, frontal P200, and central N200 components (Yuan et al, 2012).

The amplitude of P300 and P200 increases as cognitive processing and attention become more involved, and it is often more pronounced during fun stimulation in extraverts compared to non-extraverts (Yuan et al., 2009). Furthermore, extraverts are less sensitive to negative stimuli than non-extraverts (Carretie et al., 2004). N200 and P300 elements, on the other hand, index cognitive processing and attention alerting to negative stimuli, respectively (Yuan et al., 2012; Jiang et al., 2015).

2.4 Eysenck's Personality Theory

Eysenck proposed that extraversion, neuroticism, and psychoticism are three dimensions of human personality (Eysenck, 1994). He discovered that extraverts have a lower reticulo-cortical brain circuit that stimulates arousal than introverts (Eysenck, 1967). According to Yusoff et al. (2018a), Eysenck suggests that extraverts have a lower degree of arousal, causing them to seek out more extreme stimuli (motivation) than introverts. In other words, extraverts tend to be more inclined towards extreme stimuli as they have a lower degree of arousal.

2.5 Arousal

Arousal is a state of energization that has physiological, subjective, and behavioural manifestations. The neuroticism factor is thought to affect how an individual responds to emotional arousal, according to Eysenck's biological theory of personality (Eysenck, 1994; Eysenck & Eysenck, 1991; Zuckerman & Glicksohn, 2016).

Although high levels of neuroticism increase the reactivity of the limbic system, which influences individuals to react strongly to arousal experiences before returning to a pre-arousal state, extraversion is strongly correlated with changes in the reticulo-cortical brain circuit stimulated arousal system. According to research, extraverts have a smaller shift in cortical function in response to arousing stimuli than introverts, (Yusoff et al., 2018a) making them more sensitive to high levels of arousal than introverts.

2.6 Visualisation and Emotion

The International Affective Picture System (IAPS) is a set of pictures that represent a wide variety of topics and is widely used in the study of emotions, generally defining the dimensions of domain, valance, and arousal (Barke et al., 2012; Barbosa et al., 2019). In other words, valance and arousal are two orthogonal dimensions that can be used to interpret emotions. Emotions play an important role in how we act and think because they inspire us to act. The emotions we experience on a daily basis can have an impact on the decisions we make in our lives.

In emotion, there are three essential components. First, is emotional perception (subjective component), then a physiological response to emotion (physiological components), and finally is the behavioral part of emotion (expressive component). The

key criteria in defining a discrete or dimensional emotion model to mark their affective states are arousal focus and valance focus (Barrett, 1998; Zhang, 2019). A previous study discovered that both men and women have a large affective reaction when viewing high arousal pictures; women have a wide disposition when viewing violent pictures, while men have increased appetitive activation when viewing erotica pictures (Bradley et al., 2001). Previous research showed no substantial differences in arousal and valance between neutral and positive images, although there were significant differences between positive and erotic images (Jacob et al., 2011; Zhao et al., 2019; Ziogas, 2020).

Some findings on visual stimuli in ERP found activation in the P300 latency that increases from the anterior to posterior scalp areas which is the Fz, Pz and Cz electrode sites (Viega et al., 2004). In a study of stimulus arousal based on types of emotional expression across sensory modalities found that the amygdala activation plays a role in intensity of the arousal of stimulus which is linked to emotional intensity (Lin et al., 2020). In the processing of emotion using visual stimuli to investigate the modulation of cognition, it was found that in processing pictures and faces had more parietal and dorsal prefrontal activity (Keightley et al., 2003). The amygdala is sensitive in perceiving positive emotion visual stimuli (Bonnet et al., 2015).

2.6.1 Visual Art and Emotion

A non-verbal communication that connects people of different culture, language and society as well as time differences is visual art. Visual art is a production that enable a variety of emotional expression (Piechowski-Jozwiak et al., 2018). Visual art has been used as an intervention in many healthcare context and settings and the outcome was positive. Hospital-based art project activities that are therapeutic has a

positive impact on emotional well-being (Shorters, 2011; Konecni, 2015; Estes et al., 2018). Art therapy also helps in reducing anxiety levels (Abbing et al., 2018). In a study on the effect of visual art depicting nature in both still art (framed painting-photograph) and video art on patient behavior in the emergency department waiting room found that there was a significant reduction in the impatience level (restlessness), people staring at each other, noise level and queries. In fact, the result showed a significant increase in social interaction at the site. Therefore, it can be said that nature visual art has an impact in reducing anxiety and stress levels (Nanda et al., 2012; Lengen 2015; Mastandrea et al., 2019).

In another study by Hanson et al. (2013), to determine patient preference of photographic art in an inpatient hospital setting and the impact of the art viewing found patients with cancer preferred nature-type photographic art and these nature-type photographic art made them feel better. The study revealed that the preference of patients was influenced by the psychophysical and psychological qualities of the photographs and was affected by mood.

A study by Aviv (2014) stated that abstract art has an important cognitive and emotional role as it frees the brain from reality dominance. Poorer art emotions valence matching performance in frontotemporal lobar degeneration can be linked to reduce gray matter volume in the right lateral occipitotemporal cortex (Cohen et al., 2016; Couvy-Duchesne et al., 2018).

Kesner et al. (2018) found bilateral activation in the occipital lobe with local maxima in the lingual and fusiform gyrus in an fMRI and eye-tracking analysis of visual perception on guided versus averted gaze in portrait painting on neural and behavioural response to emotional faces in painting. It is explained that activation in these structures is connected to encoding of complex images during viewing of paintings and these areas

are involved in the processing of emotion. The activation of these structures is linked to the encoding of complex images during the viewing of paintings, and these areas are involved in the production of emotion.

Visual abstract art paintings during stimuli observation found an activation in reward related orbitofrontal areas and cognitive categorization-related prefrontal areas in the perception of works of art (Sbriscia-Fioretti et al., 2013). In a study of perceiving emotion in abstract artwork found emotion perceived in abstract artwork can be discovered in the human visual mechanism (Melcher & Bacci, 2013).

2.7 Appraisal Theory of Emotion

Appraisal Theory of Emotion is defined as emotion or emotional components are caused and differentiated by appraisal depending on a person's inner goals or expectation reflecting on their personal (Moors, 2017). Another researcher explained that the premise of this theory is based on an interpretation of situation where a person's emotional response is influenced based on that situation interpreted ("Boundless Psychology", n.d).

2.8 Source of localization

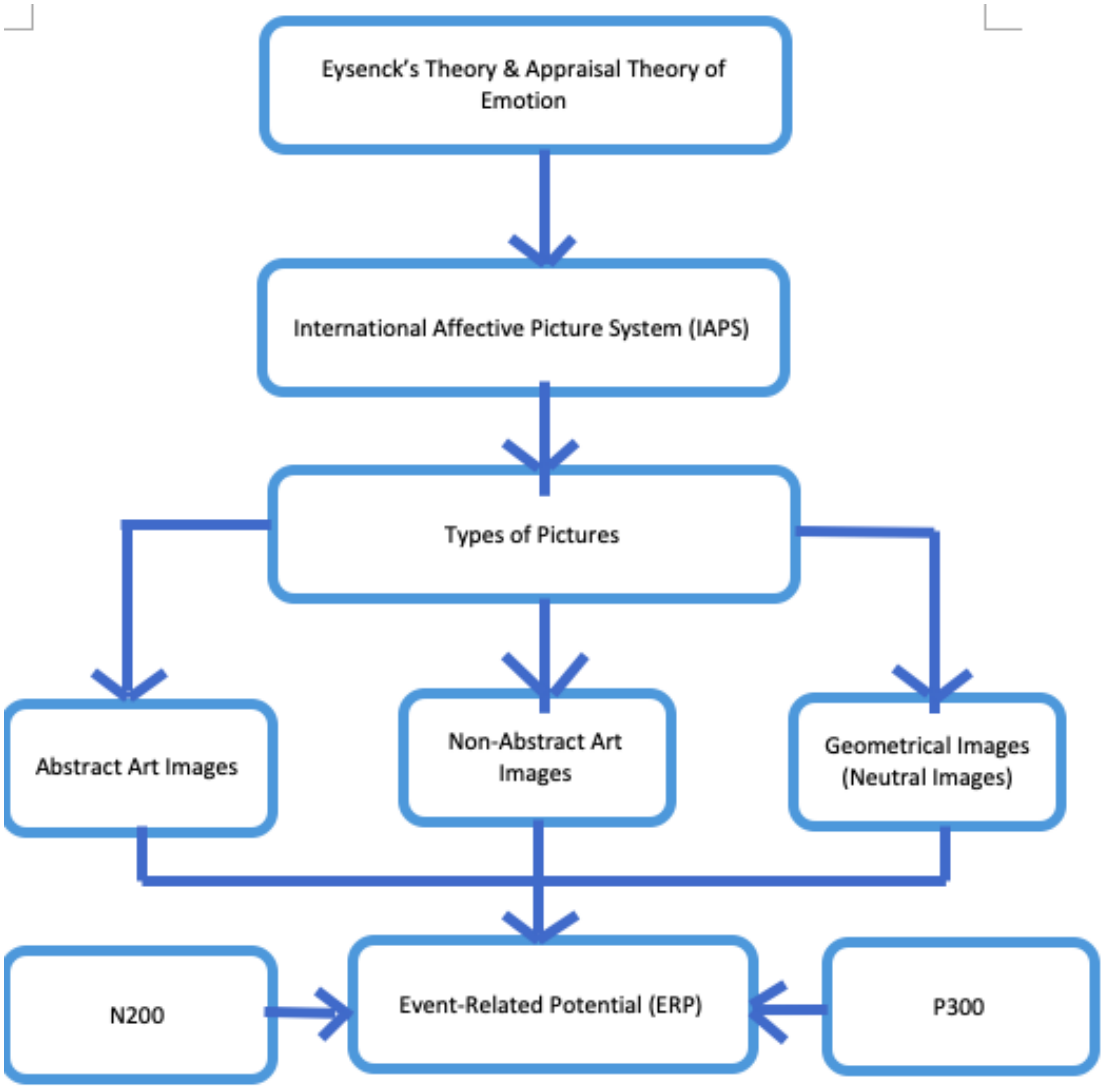
In every ERP study, the source of localization can be extracted depending on the research question. In order to identify which part of the cerebral cortex is involved in the processing of emotion, a summary of different literature review has been shown in Table 2.1. All brain region involved are linked to visual perception using affective visual or visual art stimuli.

Table 2.1: Findings on source of localization of affective visual or visual art stimuli

Author	**Study focus**	**Findings**	**Brain Region**
Gao et al. (2019)	Audiovisual affective processing	Identified areas in the processing of emotion network (Audiovisual)	Right posterior superior temporal gyrus, left anterior superior temporal gyrus, right amygdala and thalamus
Kesner et al. (2018)	Visual perception of gazing in emotional paintings (artwork)	Bilateral activation in occipital lobe with a local maxima in lingual and fusiform gyrus	Occipital lobe, fusiform gyrus, lingual gyrus
Sabatinelli et al. (2007)	Passive viewing of emotional pictures (IAPS)	Higher activation (arousal) of hemodynamic activity in three brain areas	Occipital, parietal and temporal lobe
Sbriscia-Fioretti et al. (2013)	Visual perception of abstract art paintings	activation in reward related orbitofrontal areas and cognitive categorization-related prefrontal areas	Orbitofrontal and prefrontal area
Keightley et al. (2003)	Modulation in cognition in the processing of emotion	Processing of emotion in picture and faces had more parietal and prefrontal activity	Parietal and dorsal prefrontal activity
Inman et al. (2018)	Activation of human amygdala in the connection of mental hsyiology and emotion	Activation in amygdala during subjective feelings, followed by irregular heartbeat	amygdala
Kawasaki et al (2012)	Processing of facial emotion	In the processing of facial emotion fusiform gyrus plays a role	Fusiform gyrus

Mellem et al. (2016)	social-emotional content and in sentence processing	Activation in superior temporal gyrus in social-emotional content and in sentence processing	superior temporal gyrus
Schlochtermeier et al. (2013)	Effect of emotional picture in processing of word through complexity of stimulus	No differences between pictures and words emotion response depends on perception of features in stimulus	parahippocampal gyrus, amygdala, the frontal pole and the anterior cingulate cortex and occipital region

2.8 Conceptual framework



2.9 Summary

Both visual art or visual stimuli come hand in hand in the study of emotion. Visual art also plays various roles in emotion processing in individuals. It is crucial to know and understand how different personalities react to art as it will be helpful for their well-being both psychologically and physically.

CHAPTER 3
METHODOLOGY

INTRODUCTION

This chapter covers ethical consideration, research design, study population, subject criteria, sampling method, subject recruitment, research tools, data collection method, flow charts of procedure, flow chart for extraction of raw data, and both data and statistical analysis.

3.1 Ethical Approval

This study has been approved by the Human Research Ethics Committee of USM with the reference number of USM/JEPeM/20050265.

3.2 Study Population

Participants were recruited from USM Health Campus, Kota Bharu, Kelantan and Kota Bharu area.

3.3 Sampling

Participants were recruited via convenience sampling by advertisement adhering to its inclusion and exclusion criteria (refer to section 3.6).

3.4 Sample size

A total of 31 people (28+10% drop out) were recruited as participants. The sample size was calculated using OpenEpi referring to Yusoff et al. (2020) research paper.

3.4.1 Sample Size Calculation

Sample Size For Comparing Two Means

Input Data

Confidence Interval (2-sided)	95%		
Power	80%		
Ratio of sample size (Group 2/Group 1)	1		
	Group 1	**Group 2**	**Difference***
Mean	5.41	2.49	2.92
Standard deviation	3.6	1.46	
Variance	12.96	2.1316	
Sample size of Group 1	14		
Sample size of Group 2	14		
Total sample size	28		

*Difference between the means

Results from OpenEpi, Version 3, open source calculator--SSMean
Print from the browser with ctrl-P
or select text to copy and paste to other programs.

Figure 3.1: Sample Size Calculation

3.5 Research Design

Cross-sectional study design .

3.6 Study Population

Young adult aged 18-25 years old

3.7 Inclusion and Exclusion Criteria

3.7.1 Inclusion criteria

- Young adult aged 18-25 years old
- Right-handed
- Normal or corrected to normal vision

- No history of affective disorder
- Not using any psychiatric medication
- Extraverts
- Ambiverts

3.7.2 Exclusion criteria

- Alcohol dependent
- Drug dependence
- Lifetime history of a major medical disorder (neurological, hepatic or cardiovascular)
- Head injury resulting in a loss of consciousness
- Seizures (including drug-related seizures)
- Chronic smoker
- Left- handed
- Introverts

3.8 Dependent and Independent Variable

3.8.1 Dependent Variable

ERP Components (P300, N200)

3.8.2 Independent Variable

Personality (Extraversion and Ambiversion) and Types of pictures (abstract, non-abstract and G-shape- neutral images)

3.9 Operational Definition

1. The Malay Version of Five Factor Non-Verbal Personality Questionnaire (FFNPQ) will be used to identify the personality of each participant (extravert, ambivert, introvert) (Ab Rashid et al., 2018).
2. Extravert = Score of 17 and above as measured by the FFNPQ Malay version.
3. Ambivert = Score of 9-16 as measured by the FFNPQ Malay version.
4. Abstract images = images that are labelled as ‘abstract art’ in the International Affective Picture System (IAPS) database.
5. Non-abstract images = Images of people activities and nature that can be understood clearly. Images that are not labelled as ‘abstract art’ in the IAPS database.
6. Neutral images = Geometrical images (G-shape).

3.10 Visual Stimuli

12 pictures were chosen randomly from the International Affective Picture System (IAPS) based on their normative value (Lang et al., 1999). Six of them were abstract art images and the other six was non-abstract.

Abstract art images were selected based on the operational definition as explained in section 3.8 “operational definition”. Similarly, non-abstract art images were selected based on the operational definition as explained in section 3.8 “operational definition”. All pictures chosen were ranged from low to moderate levels of valence and arousal. To be consistent with the odd-ball paradigm principle (Yusoff & Reza, 2021), these two groups of pictures represented 30% from the total pictures that were presented during ERP.

Meanwhile, the geometrical pictures (G-shape) that were selected as neutral images presented 70% from all pictures during ERP.

Figure 3.2: Example of abstract art image, non-abstract art image and neutral image.

Table 3.1: The reference numbers of IAPS chosen based on their normative value and their category

Arousal Level (Score)	Reference Number	Category

Low (1-3)	7184	Abstract Art
N = 3	7185	Abstract Art
	7186	Abstract Art
Moderate (4-6)	7187	Abstract Art
N = 3	7237	Abstract Art
	7249	Abstract Art
Low (1-3)	1670	Non-Abstract (Animal)
N = 3	2191	Non-Abstract (People)
	2206	Non-Abstract (Fingerprint)
Moderate (4-6)	2221	Non-Abstract (People)
N = 3	2235	Non-Abstract (People)
	2980	Non-Abstract (Food Basket)

3.11 Data Collection and Procedure

3.11.1 Before ERP Procedure

A recruitment of 41 participants by advertisement was done in order to achieve the preferred sample size of 28 participants where 14 were extraverts and 14 were ambiverts. Before the ERP test, on the day before, participants were reminded to not wash their hair using the two-in-one shampoo that has conditioner, to not apply any conditioner or oil or even wear any gel that may raise the impedance level. Before the participants join the study, a briefing on the objectives of the study was explained to the participants and only after that a consent form was distributed upon their agreement to join the study.

Thereafter, they filled up the sociodemographic data and the validated version of the Extraversion Five Factor Non-Verbal Personality Questionnaire (E-FFNPQ) questionnaire which ascertained their personalities (eg. Extravert, ambivert, introvert) based on a range of scores. Then, following the inclusion criteria, only extraverts and ambiverts are taken into account for this study. In addition, following the exclusion criteria, left-handed participants, participants with major medical disorder, chronic smokers, seizures and experience head injury resulting in unconsciousness, and alcohol or drug dependant was not selected for this study. An internal consistency was calculated based on the 28 participants. The results of the E-FFNPQ on the participants' personality trait was withheld until the ERP session ends and was only be given to interested participants after the session.

Next, the participants underwent the main procedure of this study which is the Event Related Potential (ERP) session that involves the electroencephalograph (EEG) recording for one and a half hours (1.5 hours). This includes the 10minutes taken for them to answer the FFNPQ, personality questionnaire, sociodemographic data as well as the ERP session that might take up to an hour for net fitting to record the whole session which was held in the Clinical Neuroscience Laboratory, Hospital University Sains Malaysia.

Participants were guided into the electroencephalograph (EEG) recording room for net outfitting at the same location – MEG/ERP Laboratory, Hospital of Universiti Sains Malaysia. The participants were informed about the study procedures as well as the associated risk (minimal fatigue only). Before each session, the participants were given a pre-training with ten practice trials to familiarise themselves with the technique.