NEURAL PROCESS OF EMOTIONAL AROUSAL FROM THE MALAYSIAN AFFECTIVE PICTURE SYSTEM: A P300 STUDY

By

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PROSES NEURAL EMOSIONAL DARI GAMBAR AFILIASI MALAYSIA: KAJIAN P300

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LIST OF SYMBOLS AND ABBREVIATIONS

Agcl	: Silver chloride
cm	: centimetre
Cz	: Central electrode
EEG	: Electroencephalogram
EGI	: Electrical Geodesics, Inc.
EOG	: electro oculogram
ERP	: Event Related Potentials
Fz	: Frontal electrode
Hz	: Hertz
KCl	: Potassium chloride
kΩ	: Kilo Ohm
L	: litre
MEG	: Magneto encephalography
ml	: mililitre
ms	: millisecond
Pz	: Parietal electrode
SAM	: Self – Assessment Manikin
SPSS	: Statistical Package for Social Science
USM	: Universiti Sains Malaysia
µV	: micro Volt

ABSTRAK

Proses neural emosional dari gambar afiliasi Malaysia: P300

Istilah emosi telah dijelaskan sebagai pelupusan tindakan penyesuaian dimana ia digunakan untuk organism sama ada sebagai pendekatan atau mengelakkan tingkah laku yang berkaitan. Kajian ini bertajuk 'Proses neural emosional dari gambar afiliasi Malaysia: P300'. Melalui kajian ini, pemerhatian yang mendalam telah dilakukan untuk mengenalpasti perbezaan latensi dan amplitud komponen P300 ERP merentasi tahap keterujaan dalam 'gambar afiliasi Malaysia' dan untuk memvisualisasikan dan menganalisis sumber komponen P300 ERP merentasi tahap keterujaan dalam 'gambar afiliasi Malaysia' meggunakan 128- elektrod jaringan pengesan. Terdapat dua fasa yang telah dilaksanakan dalam kajian ini, yang merupakan fasa pertama yang dikenali sebagai ukuran gambar afiliasi Malaysia dengan 47 peserta dan 'Event Related Potential' untuk fasa kedua berserta 32 peserta. Pelajar dengan gangguan neurofisiologi dan bergantung kepada alkohol adalah dikecualikan. Peserta melengkapkn 'pasif paradigma' dengan memberi tumpuan dan tindak balas terhadap rangsangan yang telah di tunjukkan kepada mereka. Amplitud, latensi dan sumber P300 ERP diperhatikan dan ditentukan. Keputusan yang diperoleh dianalisis dengan menggunakan 'One way-repeated measure ANOVA' daripada tujuh bahagian elektrod (Fz, Cz, Pz, C3, C4, P3 and P4). Analisis mendedahkan bahawa tidak ada perbezaan ketara untuk latensi dan terdapat perbezaan yang signifikan dalam amplitud yang merentas tahap keterujaan yang ditunjukkan oleh elektrod bahagian C3 dan P4, penempatan juga menunjukkan bahawa tidak ada unsur emosi terlibat dalam kajian. Jadi, kajian masa hadapan perlu melibatkan variasi jenis rangsangan emosi (keterujaan tinggi dengan nilai valens negatif).

ABSTRACT

Neural process of emotional arousal from the Malaysian affective picture system: A P300

The terminology of the emotions has been described simply as adaptive action disposition where it applied to the organism for either approach or avoidance related behaviors. This study title as 'Neural process of emotional arousal from the Malaysian Affective Picture system: A P300'. Through this study, deeper observation was conducted in order to identify the differences of the latency and amplitude of P300 ERP component across the level of arousal in Malaysian Affective Picture and to visualize and analyze the source of P300 ERP component across the level of arousal in Malaysian Affective Picture using 128-electrode sensor net. There are two phases that were implemented in this study, which the first phase is known as Affective measure of the Malaysian Picture with 47 participants and the Event Related Potential for second phase with 32 participants. Students with neuropsychological disorders and alcohol dependents are excluded. Participants completed the passive paradigm by focusing and responding to the stimuli that have been presented to them. The amplitude, latency and the source of P300 ERP component were observed and determined. The results obtained were analyzed using 'One way-repeated measure ANOVA' from seven electrode sites (Fz, Cz, Pz, C3, C4, P3 and P4). The analysis revealed that there is no significant difference for the latency and there are significant differences in amplitude across levels of arousal showed by the electrodes of C3 and P4 sites, the localization also showed that there were no emotional features involved in this study. Thus, the future research needs to include varying types of emotional stimuli (high arousal stimuli with unpleasant valence value).

CHAPTER 1

INTRODUCTION

Chapter one discusses the introduction of the thesis including the objectives, hypothesis and significance of the study.

1.1 Background of study

The terminology of the emotions has been described simply as adaptive action disposition where it applied to the organism for either approach or avoidance related behaviors (Berger, 2011). The action disposition may result on coping, compete for ongoing mental resources and will affect the stimulus appraisal as well (Hochman & Ayal, 2010). In addition, the autonomic nervous system activation is the one that marks the term for physiological arousal (Herman, 2018). To sum up, by the activation that happened, there is a mobilization produced by this excitatory state which increases the sharing process to occur (Berger, 2011). Through this hypothesis, it is not only claimed why some content that elicit more responses, may be shared more than other content, but also claimed a more accurate predictions where that emotions characterized by high arousal, such as anxiety or amusement, will boost sharing more than emotions characterized by low arousal, such as sadness and calm (Berger, 2011). The emotions have been related with the valence and arousal and how it reflects towards the stimuli was based on what image that have been presented (Morena et al., 2016). The Affective picture system (APS) was used in order to study how emotions affected (Morena et al., 2016). According to Morena et al, 2016, APS is the standard stimuli that involved attention and emotion for the experimental researcher.

In order to study the emotions, Event Related Potentials (ERPs) are marked as one process that is important while using the Electroencephalogram (EEG) and this process is described as voltage fluctuations which mean that they are linked and correlate time with some corporeal or psychological occurrence (Schupp et al., 2012). To clarify, the ERPs function is to record the potentials from the human scalp and it also can be extracted from the ongoing EEG, through the process of filtering and signal averaging (Schupp et al., 2012). Furthermore, even though ERPs can be measured in frequency and time domains, the main measure that applied for the ERPs is recorded in the time domain which it is because, the waveform plot the change in voltage as a function of time (Picton et al., 2000).

On the other hand, the ERPs components generally modulated by emotional variable (Rampone et al., 2014). The first ERPs response is known as the Early Posterior Negativity (EPN) which it is a response to the emotional content of the visual stimuli (Rampone et al., 2014). EPN has its own peak which is around 200-300 ms after stimulus onset with lateroccipital scalp distribution (Rampone et al., 2014). In addition, the EPN has the processing time within 200-300 ms latency range because it reflects early stimulus discrimination and response selection processes, Carillodelapena and Cadaveiran (2000). Fields and Kuperberg (2012) claimed that the ERPs modulation by affective arousal has been observed and it's primarily with high-density electrode arrays and these engage an 'average' reference derived from active-to-Cz recordings. For the EPN, it has been reported at 200–300 ms for arousing compared to neutral stimuli (Rampone et al., 2014). The EPN consists of a negative amplitude deflection over-fronto central sites and a positive going waveform over temporo-occipital sites (Rampone et al., 2014).

Moreover, the EPN has been described theoretically through 'natural selective attention indexes', such that the evaluation process of image features is navigated by the perceptual qualities that select affectively arousing stimuli for further processing (Keil et al., 2001). For instances, the stimulus arousal level devotes to EPN by reason of highly arousing pictures (devastation and erotica) which elicit larger amplitude EPN than less arousing pictures for both unpleasant and pleasant categories (Keil et al., 2001). Furthermore, the middle latency arousal-related ERPs modulations have been attained across tasks (passive viewing, target detection, neutral non-picture target-detection), picture presentation inter-stimulus intervals (0 ms to 6 s), and stimulus durations (120-1500 ms) (Keil et al., 2001). Thus, these findings signify that the middle latency arousal modulation can take place in an automatic way while the affective picture was viewed even when processing resource availability is limited by rapid presentation rate (Kensinger and Schacter, 2006). The sensitivity for arousal level took place showed that the rapid affective amygdala processing of aversive information (Kensinger and Shacter, 2006).

Typically, the ERPs are familiar for their high temporal resolution, and this strongly suggested this method applied to the study of attentional orientation in compatible and incompatible arousal states (Rampone et al., 2014). In addition, the late positive potential (LPP), which occurs several hundred milliseconds after stimulus onset (about 300 ms- 600 ms), is another relevant component, distributed in the centro-parietal scalp region (Mao et al., 2015). For instances, it reflects an automatic increase in attention to visual emotional stimuli, and is mediated by the valence and arousal of affective pictures (Mao et al., 2015). The emotional intensity of a stimulus will regulate or adjust the amplitude of the LPP (Miranda et al., 2003).

Emotional stimuli with more arousing pictures trigger a larger LPP than those pictures that are less arousing (Miranda et al., 2003).

1.2 Significance of the study

The study of the emotion is important to determine or to relate well being as the emotion plays an important role in decision making. The different levels of arousal has a varying effect on emotion of the person where some arousal pictures showed result in more desire to watch or to avoid depending on the level of the pictures (Dew et al., 2014).

It is well known that emotionally arousing stimuli are better recalled compared to neutral stimuli (Dew et al., 2014). According to Dolcos et al., 2004, the effect that happened was mediated by the release of stress hormone that affect noradrenergic transmission in the basolateral amygdala and its relation with the anterior medial temporal lobes which is important for memory formation, consolidation and retrieval. These show that the emotional stimuli attract more attention of a person compared to non - emotional (non attractive) stimuli. Through this, it can be applied in the different context at different area in science or non science view such as advertising or marketing. This is because the presented visual stimuli are interesting and tend to attract persons rather than visual stimuli that are boring and extreme (causing avoidance) (Dew et al., 2014). The visual stimuli that were presented will affect the attention of person and also level of the attention either full attention or just partially giving an attention (Dew et al., 2014). In other way, this can be seen clearly where the marketers try to attract their customers in order to buy their products. So, the visual looks will be the main factor in order to make customer

buy their products. The better it looks, the more likely customers will be attracted to it hence increasing their tendency to purchase the product.

Besides that, the ERPs also can be used for visual attentional studies (Taylor and Badelweg, 2002). Recent report has shown that very early stage of processing may be important for elucidating details of specific attentional changes with development (Taylor and Badelweg, 2002). In addition, the application of the EEG in clinical as well as for the research can be broaden and can be practiced. According to Taylor and Badelweg (2002), the EEG can be used to study about the ERPs where the studies have contributed to our knowledge of cognitive process including attention, memory, face perception, language and reading. ERPs can also be a valuable method for studying abnormal cognitive development in patient population such as dyslexia and autism.

According to Tok et al., (2010), there is a study of emotions using the APS but none of the study using the Malaysian Affective Picture System as their stimuli presented to the subjects. In this study, there was an application of the Malaysian Affective picture system in studying the neural process of emotions among Malaysian population.

1.3 Objective of study

1.3.1 General:

The general objective of the study is to observe the neural process of emotional arousal from Malaysian Affective Picture through ERPs.

1.3.2 Specific:

1. To identify the differences of the latency of P300 ERPs component across the level of arousal in Malaysian Affective Picture.
2. To identify the differences of the amplitude of P300 ERPs component across the level of arousal in Malaysian Affective Picture.
3. To visualize and analyse the source of P300 ERPs component across the level of arousal in Malaysian Affective Picture.

1.4 Hypothesis:

1. Different levels of arousal produce significant differences of amplitude of emotional arousal component (P300).
2. Different levels of arousal produce significant differences of latency of emotional arousal component (P300)

1.4.1 Null Hypothesis:

1. There is no significant difference of the amplitude of P300 ERPs component across the level of arousal in Malaysian Affective Picture system.
2. There is no significant difference of the latency of P300 ERPs component across the level of arousal in Malaysian Affective Picture system.
3. The source of P300 ERPs component is localized in region that related to the visual and emotions.

CHAPTER 2

LITERATURE REVIEW

In this chapter two, for the first part, it provides the definition of the emotions, the theories of emotions. Second part discusses affective visual stimulus, the types of APS, ERPs and its component.

2.1 Emotions

Emotions are categorized as one of the human needed components for human to survive (Goshvarpour et al., 2017). It is important to produce fast reaction towards emotional stimuli in life as it involves decision-making process in every thinking task. According to Goshvarpour et al., (2017), emotions are very crucial in daily human communications as some express calmness and other can produce excited feeling through human intonations when talking. Based on Fok et al., (2008), the expressions of emotions turn to produce directly by the environmental surroundings and based on types of stimulus presented to a person. Calm situations produce calm feeling whereas excited situations exert excited feelings (Fok et al., 2008).

2.1.1 Theories of emotions

Based on figure 1.0, emotional state can be classified into two groups which are valence (positive against negative) and arousal (high against low) (Chih Yu et al., 2015). From time to time and up until now, most of human emotional processing

researchers use more evocative objects such as the facial expression (Rajhans et al., 2016) and also emotional pictures (Packard et al., 2018) towards their subjects. The human perception capability can be boosted by the fear followed by guiding the attention to hazardous stimulation (Zhang et al., 2017). According to Yu et al., (2015), the emotional stimuli tend to catch the attentions but the attentional reserve (for example applied by the task at hand where there was an unused attentional resource) can appear as one of the factors that could adjust the attention itself. In addition, high arousing content supposedly claimed to capture more attentions on a person (Berger & Milkman, 2011).

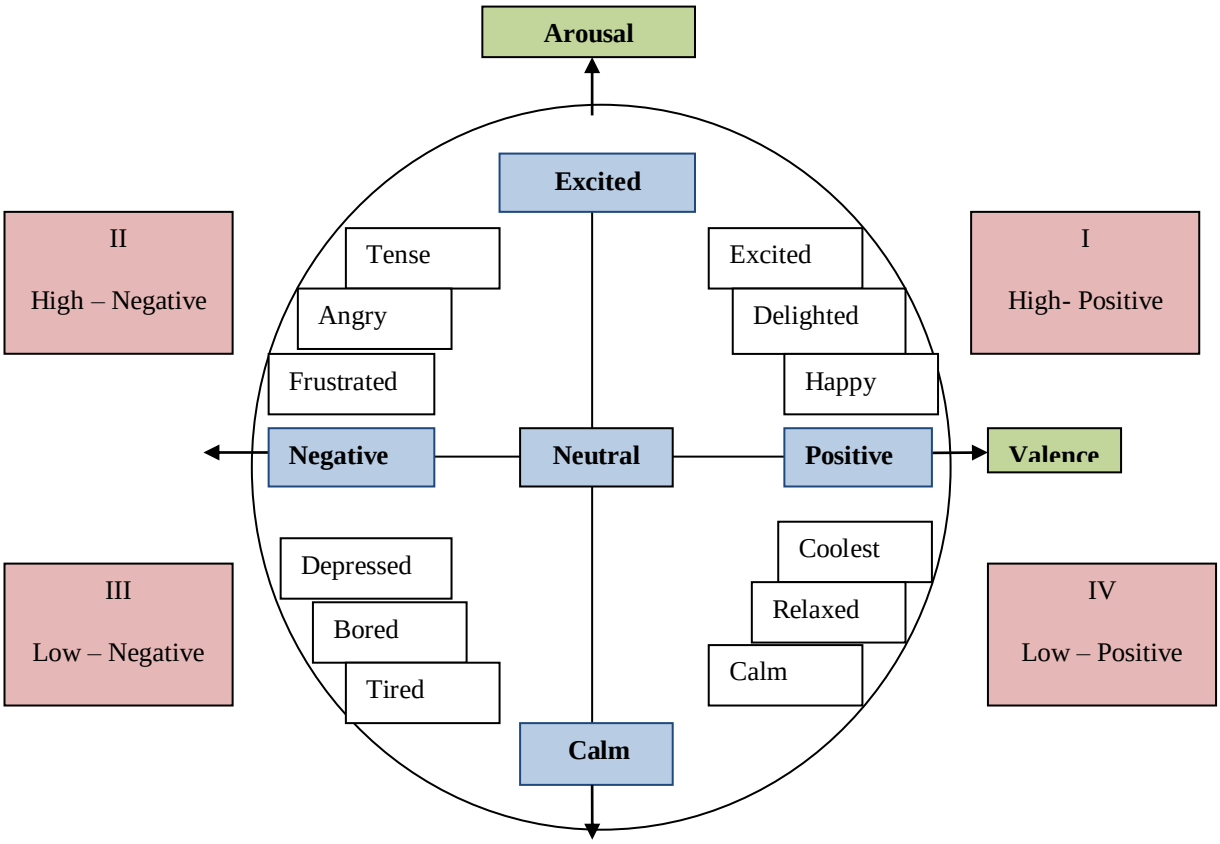

Figure 1.0: Two - dimensional valence - arousal level. The horizontal axis represents valence and the vertical axis represents arousal. Image adapted from Chih Yu et al., 2015. International Joint conference on Natural Language Processing (short papers): Predicting Valence-Arousal Ratings of Words Using a Weighted Graph Method.

Berger (2011) claimed that, there were two types of emotions that produced high and low arousal positive and negative emotions. From the experiment, Berger found that the neutral emotions do not produce either high or low arousal. On the other hand, Carretie et al., (2001) state that the ERPs showed greater signs when presented with high arousing stimulation. It showed that the high arousing stimulation produces high arousal and thus affects the ERPs recordings. Arousal influence the attention thus producing memory either short term or long term memory and it depends on the type of arousal presented (Carretie et al., 2001). For example, when there was negative memory like watching robbery scene, it will increase the emotions and one with high emotions turn out to store more inside the brain compared to those with neutral emotions (Carretie et al., 2001).

Debora et al., (2017), claimed that the arousal even play a role in attitude formation and change where the arousal was looked in subjectively as one of felt emotions. For example, an emotional response was consciously created by recognizing the cause (Debora et al., 2017). Mourao et al., (2003) state there is difference between emotional and neutral pictures not only in terms of valence but also in terms of arousal level.

2.2 Affective visual stimuli

From time to time as the emotion studies (valence and arousal) were widely applied for science researches, there were variety of stimuli presented to the subjects and it was clearly shown that the main stimuli that have broadly used in emotional study are visual and audio stimuli.

2.2.1 Definition of Affective Visual Stimuli

According to Morena et al., 2016, the affective visual stimuli are known as a set of standard emotional stimuli which involving the attentions and emotions for the experimental researchers. Through this, APS supplied a set of standardized pictures in color which produced positive, neutral and negative affective states and also provide contents which vary in semantic categories (Morena et al., 2016).

2.2.2 Affective Visual Stimuli

Mourao et al., 2003, applied these stimuli either in combination or separately used different stimuli in different experiments. According to Berger (2011), the effect of the high arousal such as the amusement or excitement produce the boost sharing more compared to those emotions indicated by the low arousal such as calm and sadness. Keil et al., (2003) showed that there is attention motivated directly from high arousing stimuli even though the arousal dimension of the pictures content consist both the high arousing (amusement) and low arousing (calm) pictures.

According to Schimmack and Reisenzein (2002), the sadness or contentment visual stimuli were presented towards the subjects will then activate low arouse condition to the subjects. According to Barret (2006), the high arousal will be produced on the excited feeling or situations, which is the same as happiness where it turns to show the high arousal and awareness activation. The pictures that were visually presented to the subjects which contain the extreme element turn to affect the high arousal of persons (Barret, 2006). The extreme stimuli such as violence pictures presented to subject also showed the alert response toward the stimuli (Barret, 2006). The same result appears when the subjects presented with pictures that were claimed attractive to them such as luxurious car pictures (Barret, 2006).

In addition, by looking through the emotional stimuli, the visual processing was boosted as there is an increase in perceptual sensitivity to the events which contain high value to the persons (Anderson & Phelps, 2001). According to Mourao et al., (2003), the unpleasant visual stimulus was compared with the neutral stimulus and obviously showed there was high arousal for the unpleasant stimuli presented. Interesting and unpleasant pictures produce significantly higher in arousal ratings compared with the neutral and pleasant ones (Mourao et al., 2003). From the result, it shows that the pleasant and interesting pictures were significantly different in arousal level.

There was a similaity between the unpleasant stimuli with the pleasant (interesting) stimuli that both produced high arousal (Gonzalez, 2007). These showed that any emotional stimulus produced high arousal when there was more attention applied while the stimuli were presented to the subjects (Barret, 2006). Tonic arousal changes are slow and graded responses toward the stimulus where the phasic arousal changes are fast and energetic reactions towards the stimuli (Gonzalez, 2007).

There was an increase in activation in visual cortex when the pictures content increasingly demanding (Tabert et al., 2001). The visual cortex has appeared to contribute in processing the affective stimuli, which is confirmed through the neuroimaging study (Tabert et al., 2001). From the study, it was strongly suggested that by looking through the emotional pictures and words, there was a broader activation on the visual cortex area rather than looking through the neutral pictures (Tabert et al., 2001). According to Bouvier & Treisman (2010), an image that was presented will begin to activate the early visual cortex through the activation of the feature detectors.

2.2.3 Affective visual stimuli in emotions study

Table 1.0 shows the summarization of the past research on the types of Affective Picture System involved related to different emotions. Through the study of emotions by Tok et al., (2010), there were applications of International Affective Picture system (IAPS) that have been used in order to study the emotions state in valence and arousal. Through the study, the IAPS pictures were found to be modulated by the personality traits. These results showed that the personality traits affect the emotional state especially the people who belong to Neuroticism and Extraversion traits (Britton et al., 2009). The results obtained also accordance with the previous study by Britton et al., (2009) where neuroticism was correlated with the brain areas of dorsomedial prefrontal cortex activation which response to the positive stimuli. According to Weitig (2009), the dorsomedial prefrontal cortex correlation was produced in high neuroticism people results from increased self-association.

In studying emotions of valence, arousal dimensions and dominance, Szymanska et al., (2015) conducted a study using the Besancon – Affective Picture

Set Adolescents. By using the pictures, the result indicated that the dimension of valence and dominance were not significantly different for comfort and complicity pictures category. According to Allen and Manning (2007), the pictures that were selected as comfort were not fully displayed as comfort and that emphasizes some adolescent or participants produced mixed feelings simultaneously or sequentially while presented with pictures related.

One study modeled by Aluja et al., (2015) study on the personality affects and sex differences using the IAPS in Spanish and Swiss countries. Based on the study, the pictures were mixed including the valence and arousal according to Tok et al., (2010) procedure and the result showed significant difference in sex comparison where the female show higher score in anxiety factor compared to male sex. According to Aluja et al., (2015), the countries factor does not affect the valence and arousal difference. From the previous study of personality variables by using the Swiss and Spanish samples, it indicated that the countries did not show any differences (Aluja et al., 2005). According to Drace et al., (2013), only medium country does affect the negative valence-low arousal pictures of IAPS. The result of how sex difference affect the anxiety factors have been confirmed by the study done by Tok et al., (2010) through Structural Equation Analysis Model and the model also supported the result showed by 12 female participants which showed higher score in all 12 slides of negative valence-high arousal in both countries.

There was one study conducted by Goodman et al., 2015, in studying the emotions- based stimuli in military populations using the Military Affective Picture System. From the study, it contradicted with past studies of Bradley et al., 2001 which showed that the males reported overall higher valence but lower arousal than females which affected from the different nature of the pictures. The results were

affected by some of the pictures but not all the pictures that were presented (Bradley et al., 2001).

The first study to delineate IAPS pictures as different vector for pure emotions was done by Xu et al., (2017). From the study, disgust and fear was mixed together based on the previous study that mentioned these two emotions were hard to distinguish as there were close negative valences (Barret, 1998; Van Overveld et al., 2006) and similar cerebral areas involved (occipital, prefrontal and cingulate cortices and nucleus accumbens) as referred by Stark et al., 2007; Kluckens et al., 2012). Even though there was an activation in the anterior insula and amygdala involved in disgust and fear, the specificity of the involvement in these emotions has not been confirmed (Calder et al., 2000; Zaki et al., 2012). To mark, the ERPs play as one of important methods for emotions studied which involved in brain signal activity.

Table 1.0: The summarization of the past research on the types of Affective Picture System involved related to different emotions

Authors	Target group (Analysis)	Emotion task	Objective	Modalities	Types of Affective Picture system (APS) involved	Results
Tok et al., 2010	Athlete populations	Visual	To study the emotions state based on personality traits	Paper and pen	IAPS	Neuroticism shows high arousal score compared to extravert
Szymanska wt al., 2015	Adolescent populations	Visual	To study the emotions in adolescents populations	Paper and pen	Besancon Affective Picture Set – Adolescent	Some of the adolescents participants produced mixed feelings to the picture related
Aluja et al., 2015	Spanish and Swiss populations	Visual	To observe the effects of personality and sex difference on emotions	Personality test	IAPS	Females show higher score in anxiety factor compared to males and the personality from both countries does not affect valence and arousal
Goodman et al., 2015	Military populations	Visual	To observe the emotions level on military populations	Paper and pen	Military Affective Picture System	Males show higher valence but lower arousal than females
Xu et al., 2017	Chinese university students	Visual	To distinguish between two emotions :disgust and fear	EEG, fMRI	IAPS	There was unclear result to distinguish disgust and fear (close negative valence)

2.3 Event Related Potentials (ERPs)

ERPs were known as one of the instructive, communicative, powerful and effective methods in observing brain signals activity (Freeman & Quian Quiroga, 2013). The sensory information that has been received or processed was reflected through the ERPs by the voltage deflection (Duncan et al., 2009). It was also involved in the higher level processing that consists of selective attention and other types of cognitive activity (Duncan et al., 2009).

In addition, the ERPs were extracted from the scalp recorded EEG by means of signal averaging (Zhang et al., 2017). In order to describe the ERPs component, it depends on its positive or negative polarity, its latency, scalp distribution and the connection to the experimental variables (Zhang et al., 2017).

To sum up, ERPs promote noninvasive method of study as it consists of extraordinary temporal resolutions characteristics for the normal human brain cognitive process and thus it promotes pathological states assessing (Duncan et al., 2009). The ERPs components of sequence and latencies track the time course of processing activity in milliseconds while the amplitudes specify the extent allocation of neural resources to specific cognitive processes (Duncan et al., 2009).

There are natural ERPs conditions of their low signal to noise ratio that cause response to certain presentations which typically averaged in order to improve the visualization of the evoked response by cancelling out the background activity (Freeman & Quian Quiroga, 2013). After the average ERPs, the standard approach is then applied in order to categorize the peak amplitude, latency and topography of observed responses (Freeman & Quian Quiroga, 2013).

Even though this analysis strategy has provided meaningful information about the responses of different brain areas to many types of stimuli and tasks, it ignored the information that may not be reflected by these quantifications based on the average responses (Freeman & Quian Quiroga, 2013).

2.4 ERPs component

For over 40 years ago, the P300 was found and that was the time where the P300 begun as tool in cognitive functions and now it is widely used in emotional experiment by the researchers (Sutton et al., 1965). Mostly, researcher's interest on recording the amplitude followed by latency on P300 ERPs component as the P300 is the brainwave where the first cognitive process occurred (Sutton et al., 1965). To sum up, the P300 ERPs components is the powerful cognition related wave which by the reflection of elaborative processing of the data or information (Zhang et al., 2017). In general, the task relevant stimuli which happened to be unpredicted and need a motor response or cognitive decision will produce the P300 (Schurrman et al., 2001).

P300 amplitude involved the differences of the mean pre-stimulus baseline voltage with largest positive going peak of the ERPs waveform within a time window (Polich, 2007). Based on Johnson (1993), the P300 latency was measured as the time where the stimuli begin presented to subject to the point where it shows the highest positive amplitude within a time window. According to Pfabigan et al., (2014), P300 was expressed as positive going ERPs deflection where it has its own peak between 300 and 600 ms after stimulus has been presented. There are elements that create the amplitude variations, which are stimulus value, attention (Polich &

Kok, 1995), task relevance (Coles et al., 1995), task complexity (Israel et al., 1980) and effort spent on the task (Brocke et al., 1997). In addition, the P300 amplitude variation also occurred because of the reinforcer magnitude (Goldstein et al., 2006). Thus, a positive ERPs deflection in the time window around 300 ms post stimulus can be observed (with maxima at the midline electrodes) when there is task relevant stimulus that was presented during an experiment (Pfabigan et al., 2014). There is a relation in P300 amplitude variation to context upgrading the working memory (Bonala & Jansen, 2012).

Through the experimentation that involved the P300 brainwaves, it showed the P300 function on information processing in the brain and it was proven by the P300 analysis (Veiga et al., 2004). In addition, the P300 also represented the positive deflection which occurred at 300 ms after the stimulus (audio or visual) was presented, this was produced by the process of attentional resource allocation and based on the speed of mental cognitive process that took place (Dietrich and Kanso, 2010). There are multiple P300 which could take place in relation to the different stages of cognitive processing (Ouyang et al., 2017). Thus, there are more than one late positive component that are found in the late time window that indicates standard P300 waveforms like P3a and P3b (Polich, 2007) and late positive component in emotion processing (Rostami et al., 2016).

There is a provocation or challenges related to the P300 latency estimation reflected by its association with different response stages (Ouyang et al., 2017). In a nutshell, P300 has been shown to address the index stimulus (McCarthy & Donchin, 1981), response selection (Leuthold & Sommer, 1998), response execution (Doucet & Stelmack, 1999) and also the bridging of stimulus and responses (Verleger et al., 2005).

There is one element that was claimed to be sensitive on the P300 amplitude during dual task performances, which is the amount of the attentional resources (Polich, 2007). According to Polich (2007), there were larger amplitude and short peak latency when the task presented to the subject was simple and undemanding. This condition explained that the simple task that was presented on the subject reflected the attentional resources. Increasing level of difficulty for primary task, relatively affect the P300 amplitude from the oddball task to decrease (Tabassum &Nazole-E, 2015). For any task presented to the subject that obviously needs focusing (hard and demand task), it showed that the P300 amplitude produced is smaller and latency is longer where the information processing takes time.

There is perception of bodily signals (interoceptive awareness) which modulated evoked potential components typically for P300 which exerted by the response to the emotional pictures or stimuli, (Pollatos et al., 2007). In addition, Schurrman et al., (2001), claims that there is study that has been built by cognitive physiologist where they found that in performing complex task, there is selective attention in the human subject and this activity captured the attentions with even simple or complex responses, as there is more attention needed when performing the complex task rather than simple task (Pollatos et al., 2007). These situations are same as the arousal stimuli presented whether that stimuli capture more attention as that stimuli reflect the happiness or excitedness compared to those pictures which are neutral or low arouse (Pollatos et al., 2007). The P300 showed that it falls as one of the brain wave that is essential for cognitive studies.

CHAPTER 3

METHODOLOGY

Introduction

There are three purposes of the study which are:

1. To identify the differences of the latency of P300 ERP component across the level of arousal in Malaysian Affective Picture.
2. To identify the differences of the amplitude of P300 ERP component across the level of arousal in Malaysian Affective Picture.
3. To visualize and analyse the source of P300 ERP component across the level of arousal in Malaysian Affective Picture.

The method that was used in this study comes in two phases and was explained in general through the flowchart in figure 2.0.

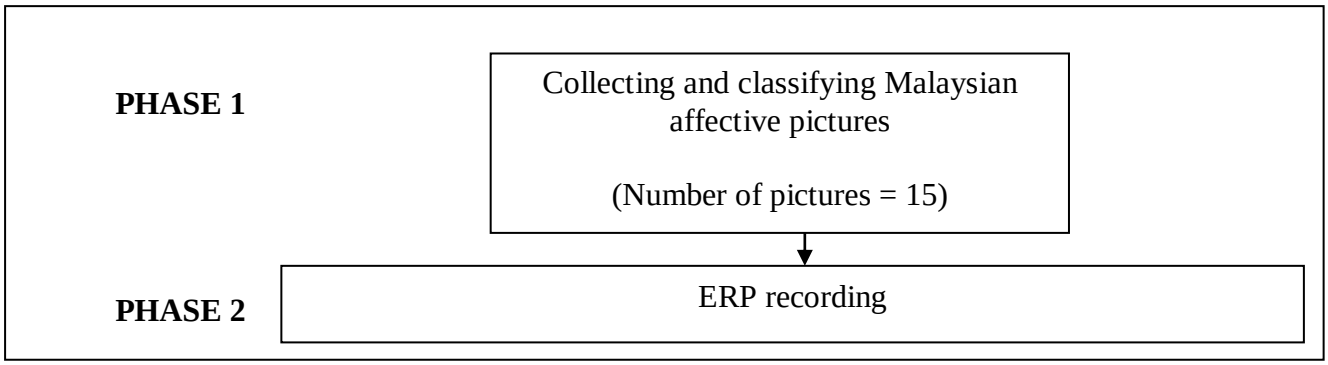

Figure 2.0 Flowchart for two phases involved in study (general)

This study was implemented in two phases as below:

Phase 1: Affective measure of the Malaysian Picture

3.1 Research Design

Cross-sectional design was implemented.

3.2 Research Ethic

Ethical approval was obtained from Universiti Sains Malaysia Ethical Committee Board. USM/JEPeM/ 15040127

3.3 Sample and population

A total of 47 volunteers agreed to rate the Malaysian Affective picture through the Self Assessment Manikin (SAM) test (see Appendix section). Mean age of the subjects were 20.28 years old (±0.67). They were completing diploma (2%) and bachelor degree (98%) in Health Campus, USM. The summary of sample demographic data was tabulated in table 2.0.

Table 2.0: The summary of sample demographic data for phase 1.

Mean age (SD)	20.28 (±0.67)
Genders (%): Male Female	 4 (9%) 43 (91%)
Level of study (%): Diploma Degree	 1 (2%) 46 (98%)

3.4 Sample size

A total of 50 subjects (3 were excluded due to incomplete answer) were invited to rate the affective value of the pictures into high, average and low level of arousal. The data gathered from these 47 subjects was not for the statistical analysis but for the classifying of pictures into different levels or categories (high, average, low) based on the scores of arousal domain, assessed by using ‘ Self – Assessment Manikin’ (attached in Appendix section).

3.5 Sampling

Convenient sampling was applied in which subjects were recruited through an advertisement in Health Campus, USM. However, the subjects were required to fulfill the inclusion and exclusion criteria of the study (refer to the section of inclusion and exclusion of phase 1).

3.6 Location

Health campus, USM, Kubang Kerian, Kelantan, Malaysia.

3.7 Inclusion and Exclusion

3.7.1 Inclusion criteria

Young adult aged between 18 to 35 years old, right handed, normal or corrected to normal vision, no history of affective disorders and not using any psychiatric medication.

3.7.2 Exclusion criteria

Alcohol dependent, drug dependent, lifetime history of major medical disorder (neurological hepatic or cardiovascular), head injury resulting in loss of consciousness, seizures (including drug related seizures) and chronic smoker.

3.8 Study procedure

Study procedure for phase 1 was described together with study procedure of phase 2 (refer to section study procedure Phase 2).

3.8.1 Visual stimulus (Malaysian Affective Picture)

The Malaysian affective Picture (N=15) was taken from the internet (it was taken from the open source and there were no copyright restriction, free to use), ranging in all types of pictures including physical things and people activities related to Malaysian population. In phase 1 study, subjects (N=47) were asked to rate the level of arousal, by using Self – Asessment Manikin (SAM) (attached in Appendix section), which ranges from calm (score as 9) to excited (score as 1). The pictures then were separated into three categories based on scores [1-3 for low, 4-6 for average, 7-9 for high]. From 60 pictures, 15 pictures (5 for high, 5 for average, 5 for low) were chosen to be installed in the E-prime system. The examples of pictures that were used in phase 1 and 2 as in figure 3.0. The internal consistencies of the 15 pictures were excellent with Cronbach's alpha of 0.92.