IDENTIFYING THE DIFFERENCES OF NEURAL CORRELATE ON N200 AND P300 EVENT RELATED POTENTIAL (ERP) COMPONENTS FROM VISUAL STIMULI BETWEEN EXTRAVERSION AND AMBIVERSION TYPE OF PERSONALITY

By

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MENGENALPASTI PERBEZAAN KAITAN NEURAL KOMPONEN 'EVENT RELATED POTENTIAL (ERP)' N200 DAN P300 DARIPADA RANGSANGAN VISUAL ANTARA PERSONALITI EKSTRAVERSI DAN AMBIVERSI

Oleh

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Tesis diserahkan untuk memenuhi sebahagian keperluan bagi

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LIST OF SYMBOLS AND ABBREVIATIONS

cm	: centimetre
Cz	: Central electrode
EEG	: Electroencephalography
EOG	: electro oculogram
ERP	: Event/ Evoked Related Potentials
FFM	: Five Factor Model
Fz	: Frontal Electrode
g	: gram
HUSM	: Hospital Universiti Sains Malaysia
Hz	: Hertz
kΩ	: kilo Ohm
L	: Litre
MEG	: Magneto encephalography
ml	: millilitre
mm	: milimeter
MRI	: Magnetic Resonance Imaging
ms	: millisecond
NS	: Not Significant
Pz	: Parietal electrode
S	: Significant
SD	: Standard deviation
SPSS	: Statistical Package for Social Science
USM	: Universiti Sains Malaysia
USMP-i	: University Sains Malaysia personality inventory
μV	: micro Volt

Mengenalpasti perbezaan kaitan neural komponen ‘Event Related Potential (ERP)’ N200 dan P300 daripada rangsangan visual antara personality ekstraversi dan ambiversi.

Saidah Napisah binti Muhammad

Kebanyakan kajian yang meneroka kaitan fisiology neuro biasanya menggunakan kajian ‘Event Related Potential (ERP)’ semasa pendekatan visual ganjil- ‘visual oddball task’ dengan melihat corak perubahan komponen N200 dan P300. Selain itu, bidang sains otak mencadangkan, kelainan personaliti mungkin mempunyai perbezaan secara semulajadi dan bagaimana mereka memberi reaksi terhadap rangsangan. Objektif kajian ini ialah untuk menentukan amplitud dan tempoh pendaman komponen ERP N200 dan P300 diantara sifat personaliti ekstraversi dan dwiversi daripada rangsangan visual yang menggunakan 128 elektrod jejaring pengesan. Subjek dikumpulkan dan dibahagikan kepada dua kumpulan iaitu satu terdiri 19 subjek yang memaparkan ciri ekstraversi dan satu lagi yang terdiri daripada 20 subjek yang memaparkan ciri dwiversi. Subjek yang mempunyai masalah neuropsikologi dan sifat introversi dikecualikan daripada kajian sebagai kawalan sifat. Subjek yang telah menyelesaikan pendekatan visual ganjil dimana mereka perlu menekan butang ‘1’ atau ‘2’ jika melihat rangsangan standard (0) atau rangsangan target (X). Amplitud dan tempoh pendaman kompenan N200 dan P300 telah diamati dan ditentukan menggunakan ujian Mann Whitney-U dan ujian Wilcoxon yang telah diukur dari sembilan lokasi elektrod. Ujian Mann Whitney-U ,menunjukkan tiada perbezaan signifikan untuk amplitud dan tempoh kependaman antara dwiversi dan ekstraversi kerana kurang elektrod menunjukkan perbezaan antara dua personaliti tersebut. Walaubagaimanapun, Ujian Wilcoxon yang digunakan untuk melihat perbezaan antara rangsangan target dan standard mendapati subjek yang mempunyai ciri ekstraversi telah menunjukkan amplitud dan tempoh kependaman N200 dan P300 yang signifikan pada kebanyakan elektrod. Namun demikian, Ujian Chi Square telah menunjukkan tiada kaitan di antara elektrod yang signifikan dengan komponen ERP. Kajian di masa hadapan mungkin memerlukan penjelasan tentang aktiviti neural yang lebih baik dengan menggunakan paradigma dan kaedah yang berbeza untuk membuktikan bahawa personaliti dwiversi mempunyai kelainan dari segi proses neuralnya berbanding ekstraversi.

Identifying the differences of neural correlate of N200 and P300 ERP components from visual stimuli between extraversion and ambiversion type of personality

Saidah Napisah Muhammad

Studies that explore neurophysiological correlates with personality traits have commonly used event-related potential (ERP) during a visual oddball task with results being the main changes in the N200 and P300 components. Besides that, the science of the brain of each personality suggested there are differences in nature and how they react towards stimuli might be differ between personalities. The objectives of this study are to determine the amplitude and latency of P300 ERP component between extravert and ambivert trait of personality from visual stimuli and to determine the amplitude and latency of N200 ERP component between extravert and ambivert trait of personality from visual stimuli using 128-electrode sensor net. Two groups of subjects, one consists of 19 displaying the extraversion trait and the other 20 subjects displaying ambiverts trait. Students with neuropsychological problems and introverts are excluded as a trait controlled. Participants completed a visual oddball task by pushed button'1' or '2' is see standard (O) or target (X) stimuli respectively. The amplitude and latency of P300 and N200 was observed and determined. The results obtained was analyzed using Mann Whitney test and the Wilcoxon test measured from nine electrode sites. Mann Whitney test revealed that there is no significant difference for amplitude and latency between ambivert and extravert because less electrodes demonstrated the differences between those personalities. However, Wilcoxon Test that used to discriminate the standard and target within personalities has determined that extravert showed more significant differences for amplitude and latency of N200 and P300. However, Chi Square test has proved that there is no association between the significant electrode and the ERP components. The future work may required better explanation of neural processing using different paradigm and methodologies to prove that ambivert has different neural correlate than extravert.

CHAPTER 1

INTRODUCTION

1.1 Study background

Personality is one of crucial factor in an individual to be perceived. It shows the pattern of behaviour, cognition and emotion of an individual (Michel & Smith, 2004) and it is made up of three important components: traits, characteristics adaptations and life stories (Mc Adams & Pals, 2006). People tend to go through lives categorizing the people they encounter in their lives. This tendency of classifying people makes a great deal of sense in social context because it is a universal human characteristic to impose an order on complex situations. The recurring patterns may be discriminate as complex as the human itself.

Here are some attempts from psychologist in defining the personalities which it is the collective perceptions, emotions, cognitions, motivations, and actions of the individual that interact with various environmental situations (Patrick & Léon-Carrión, 2001). Besides that, personality is the psychological forces that make people uniquely themselves (Friedman & Schustack, 2006) and it reflects the various styles of behaviour that different organisms habitually imitate (Rychlak, 1981).

The science of the brain of each personality suggested there are differences in nature and how they react towards stimuli might be differ as well between personalities (Yuan, 2011). These behavioral findings have been reinforced by a number of neuroimaging studies (Teplan, 2002; Woodman, 2010; De Young et al., 2010).

1.1.1 Personality Variance

Five factor model is a fundamental of human personality theories. It is a hierarchical organization of personality traits which is basically composed of five basic dimensions, Extraversion, Agreeableness, Neuroticism, and Openness to Experience. The conceptions and theories has been used and applicable across cultures especially among personality psychologist (McCrae & John, 1990).

One of the element of infamous Five Factor model is the extroversion factor which was coined by Eysenck in 1967. Later it became an essential indicator in categorizing people. Extroversion is an attitude of a person to be upbeat and optimistic and enjoying social contacts. Many studies have shown that extraversion is associated with subjective well beings and personal happiness (Yuan, 2011). Extroverts experience less cortical arousal than introverts from a given stimulus and therefore seek out more intense social experiences (Eysencks, 1970). According to BAS/BIS (behavioural approach/inhibition system) theory that was proposed by Jeffrey Gray (1970) postulates that extravert to be more sensitive to signals of reward and different from introvert, who are more susceptible to punishment. Thus, extroversion individuals were reported more pleasant affects in everyday life compared to non extraverts (Costa and McRae, 1980).

Furthermore, students drawing from college for academic reasons tend to be extroverts. They also seek diversion in daily routine; enjoy explicit sexual and aggressive humour, more active sexually, in terms of frequency and different partners as well as more suggestible as introverts (Pervin & Cervone, 2010). According to Eysencks theory of individual differences, extraverts reported more often to choose location in library that provided external stimulations, took more

study breaks, prefer higher level of noise and for more socializing opportunities while studying. In psychopathology and behaviour change, Eysenks construed that criminals and antisocial persons tend to have high neuroticism, high extraversion, and high psychotism scores. Such individuals show weak learning of social norms (Pervin & Cervone, 2010).

Instead of extravert and ambivert type of personality, there is ambivert which fall more or less between extrovert and introvert where most people are within in this range. Ambiverts love to keep in touch with people but in turn they get exhausted if too much time is spent around them. They can do things alone, but this also can lead them dispiriting if they lived that way for whole day. Furthermore, ambiverts very passionate in the things they interested in by which they enjoy breadth of influence and knowledge as their processing information done both internally and externally (Marshall, 2014).

As for neurobiological basis, in accord of Canli et al. (2002), they observed that, the brain response to pleasant pictures increased with extroversion in a number of cortical and subcortical regions, including the temporal lobe, amygdale and basal ganglia in a series of functional MRI studies. On top of that, neurobiological evidence suggests that extraversion is associated with the corticolimbic-dopaminergic system, which is critical for incentive and reward motivation (Depue & Collins, 1999).

Yuan et al. (2011) suggested that if extraverts are truly susceptible to unpleasant events then ambiverts are, they should exhibit less Event Related Potential differentiation between unpleasant and neutral conditions. This would be specifying the case for N2 and P3 components which indexes of early visual

processing. Therefore the measurement and analysis of occipital P1 and the frontal N1 components to examine whether extraversion modulated the early processing of stimulus features and whether this potential modulation varied depending on the emotional valence intensity of the stimuli is needed.

Therefore, electrophysiological indices of brain activity, such as event-related potentials (ERPs) are the suitable method to observe the neuronal changes between personalities as they directly measures brain responses to discrete stimuli.

1.2 Significance of the study

The personality theory that is adapted in this study is the Five Factor Model (FFM) along with numerous studies that have replicated the inventories in categorizing people (Wright et al., 2006; De Young et al., 2010; Yuan et al., 2011). The main focus study is about extroversion personality trait. Many studies have used the comparison between extravert and introvert, the researcher intend to compare the signatures and physiological between extrovert and ambivert of the neurobiological basis through the ERP technique.

This study focuses on the N200 and P300 ERP components which appear to be closely associated with the cognitive processes of perception and selective attention (Woodman, 2010). The differences in its amplitude and the latency in each component based on personalities may indicate the different cognitive process of each personalities.

It has been many theories that support each statement or against it. As an individual has unique and exclusively characteristics which make they are distinctly from the others, it is hard for scientist to classify or categorize each person in the same way they could apprehend.

Important key to remember, having high scores in a particular personality domain do not indicate an equally high overall personality profile, because different traits are needed for different tasks, often at different periods in life. As traits do not change much throughout our lives, we should try to do things that are complimented by our traits. Having an insight about which of our personality traits that are strong or weak can help us to choose a more rewarding career, job, task or profession, as well as provide a deeper understanding of ourselves.

In this study, the introvert group is not being focused as we are interested in extravert and ambivert traits. Therefore, the major goal of the present study was to investigate extraversion-related differences in central processing mechanisms associated with either stimulus analysis or response organization. Thus the ambiverts should as s control group in the subjects as ambivert represents the major of human population (Gergiev et al, 2014) with the ambivert category can be computed as ±1standard deviation of the mean value (Cohen & Schmidt, 1979; Luciano et al, 2004). Moreover, a lot have been done on extroversion and introversion but less information on the ambivert.

By choosing the undergraduate subjects from medical background the social and neurobiological factor cannot be determined as a whole. Medical students have better education level thus they have better neural cognitive processing compared to other groups. They are the best subjects to be taken because medical students have a stable personality as it is has higher correlation with their academic achievement (Hoschl and Kozeny, 1997 & Lievens, 2002). Thus, their cognitive level is easily observed and a good data can be obtained.

1.3 Objectives of study

1.3.1 General objective

To identify the differences of neuronal activity between extravert and ambivert trait of personality in a selected group of medical student undergraduates.

1.3.2 Specific objectives

1. To determine differences of amplitude and latency of N200 ERP component between extravert and ambivert trait of personality from visual stimuli.
2. To determine the differences of amplitude and latency of P300 ERP component between extravert and ambivert trait of personality from visual stimuli.

1.3.3 Null hypotheses

1. There is no significant difference in the amplitudes and latencies of N200 between extravert and ambivert.
2. There is no significant difference in the amplitudes and latencies of P300 between extravert and ambivert.

CHAPTER 2

LITERATURE REVIEW

2.1 Individual differences in personality

Personalities psychology often describes the individual differences in behaviour, emotion, and cognition through the taxonomies of personality traits which the traits is believed remained stable for life between 25 to 30 years old (Sheperd, 2007). The personality scarcely being discussed from the aspect of neuroscience research because personality is a psychological aspect that is hardly be tested by empirical basis. Hence, personality is emerging as a subdiscipline focused on testing and refining neurobiological theories of personality in therm of neuroscience aspect. Since the personality a reflection of response towards variety of eliciting stimuli, thus the tendencies are posited to arise from the regularities in the functioning of relevant brain mechanisms (De Young et al., 2010).

From the big five theoretical model, extraversion and neuroticism is the best traits to understand the underlying mechanisms as these two traits are the core manifestation in personality of responses towards reward and sensitivity towards punishment and threat (Clark & Watson, 2008), whereby extraverts respond more strongly to positive emotional stimuli (Depue and Collins, 1999) while the introvert more sensitive to punishment (Yuan et al., 2011). Thus the linear approach are not suitable to look for the differences between introversion and extraversion, as their external stimuli may not be reciprocal (Georgiev et al., 2014).

2.2 Neuropsychology test

Assessing Personality through Big Five Theories

The big –five model is a hierarchical organization of personality trait in term of five basic dimensions: Extraversion, agreeableness, conscientiousness, neurocitism and openness to experience (McCrae, 1991). From the early personality and trait theories (Eysenck, 1967) through contemporary social science (Canli, 2004) there is continues search for physiological. People tend to classify themselves approximately to five dimensions of individual differences. Hence, the big five theories represent significant development in personality psychology for these three reasons as outlined by Briggs (1989), First, the five factor model provides a compelling framework for building personality measures that seek to represent the domain of individual difference terms broadly and systematically. Secondly, it enables researchers to locate myriad constructs and measures in the field within a meaningful conceptual space, enhancing our ability to compare and contrast different constructs and promising to bring clarity and order to an enterprise. Third, the model suggests that the five basic dimensions should merit special attention in continuing search for mechanisms underlying individual differences in personality. The elements composed of Five factor model can be observed from figure 2.2.

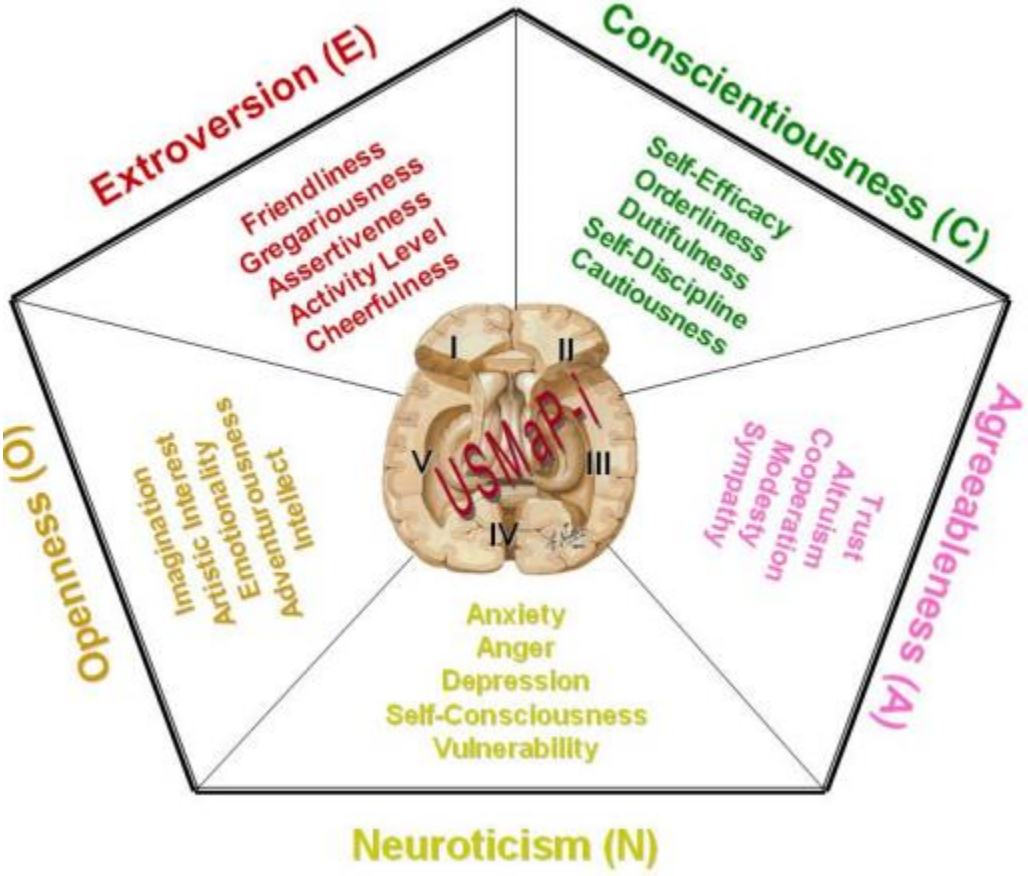

Figure 2.2 : The big five characteristics (Yusoff et al., 2006).

The prominent findings of correlation extroversion to the neurobiological are positive correlation with neural activity in dopaminergically innervated, reward sensitive regions, including the ventral striatum, amygdale, and medial prefrontal cortices (Depue and Collins, 1999).

2.3 Event Related Potential (ERP)

Event-related potentials are a general class of electrical brain potentials that are embedded in the electroencephalogram and that display a stable time relationship to a definable sensory, cognitive, or motor event. ERPs consist of a series of peaks and troughs that are referred to as ERP components . The naming of these components often reflects their polarity (P for positive, N for negative voltage) and their order of occurrence (e.g., P1 is usually the first negative component) or typical timing in milliseconds after the event (e.g., P300). Apart from their polarity and latency, ERP components can be characterized in terms of their general scalp distribution. The relationship between the voltage distribution observed over the scalp and the brain regions giving rise to this pattern is by no means transparent (Nieuwenhuis and De Rover, 2014). In terms of its neurophysiology, EEG and averaged ERP's are measuring electrical potentials produced by the ion flow of extracellular fluid across cell membranes and the connection of neurons through neurotransmitter (Woodman, 2010) as shown in Figure 2.3.

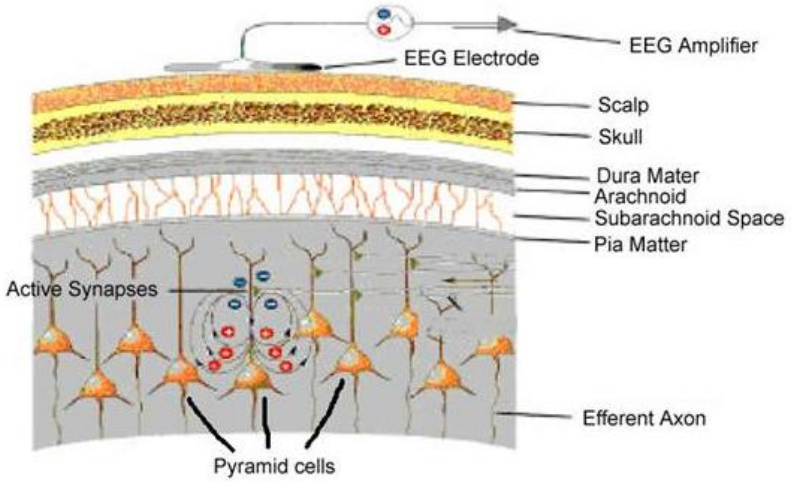

Figure 2.3: the EEG electrode recording the activity of the synapse in the cerebral cortex.

Event related potential (ERP) can monitor brain electrical activity with high precision in term of milliseconds due to their high temporal resolution. Due to the precise temporal resolution of electrophysiological recordings, the ERP technique has proven particularly valuable for testing theories of perception and attention (Woodman, 2010). It is able to observe the different electrophysiological components that represent the various cognitive stages needed to achieve a normal performance in healthy subjects. While in contrary the subjects with cognitive deficits, cognitive ERPs can identify the electrophysiological components that represent the onset dysfunction, therefore infer the impaired cognitive stages (Rugg and Coles, 1995).

The ERP task most frequently used to elicit the P300 is the oddball task, where the subjects are confronted with a train of repeated ‘standard frequent stimuli and a few deviant rare stimuli (target stimuli) in which the participants need to detect the deviant stimuli as quickly and as accurately as possible (usually by pressing button or by mental counting during visual oddball task). In order to investigate neurophysiological marker in major psychiatric disorders a significant reduction or prolongation of P300 amplitude and latency can be conclusive to several psychiatric illnesses.

The ERP recorded during the oddball task reflects brain activities underlying various cognitive functions such as attention and working memory. A positive ERP component of P300 is considered to reflect context updating due to renewal of the representation of current environment within working memory.

2.3.1 N200 and P300

N200 is an ERP component that is recorded over anterior scalp sites particularly that peaks 200 to 350 ms after stimulus onset and characterized bilateral temporal negative deflection (Folstein & Van Petten, 2008).

Certain oddball detection test suggested that N200 is typically evoked before the motor response, signifying its link to the cognitive processes of stimulus identification and distinction (Hofman, 1990; Folstein & Van Petten, 2008).

According Patel and Azzam (2005), sub area of N200 is divided into three parts: In repetitive stimulus presentation, the *N2a* is an anterior cortical distribution evoked by either conscious attention to, or ignoring of, a deviating stimulus; the *N2b* is a negativity of central cortical distribution seen only during conscious stimulus attention; the *N2c* arises frontally and centrally during classification tasks. Previous research suggested that the deflection of N200 reflect executive cognitive control functions and also has been used in a study of language (Kaan, 2007 & Du et al., 2014).

On the other hand, the P300 can be defines as long lasting positive ERP components that occur between 300 and 700 ms (Verleger, 1988),), 280-1000ms (Johnson, 1993), 250-900 ms (Patel & Azzam, 2005) after the onset stimulation and associated with a decisional "response-related stage", indexing diverse functions such as memory updating or cognitive closure mechanisms (Verleger, 1988), indexing brain activity that is resulted from a change in the organisms neural representation of the stimulus (Polich, 1989) and occurs only if subject engaging in a task detecting deviant stimuli (Picton, 1992).

P300 latency can be used to measure the stimulus classification speed as it indexing the processing time required before response generation. P300 latency is also sensitive temporal measure in neural activity provide the fundamental of processes of attention allocation and immediate memory.

P300 amplitude can be a means to measure CNS activity that reflects the processing of incoming information that integrate into memory representation and context of stimulus occurs. The quality of the information is being processes determine the variation in amplitude of P300 (Polich & Herbst, 2000).

Moreover, based on the studies throughout the information processing stream, a number of early and late neuroelectric features appears to be abnormal in various psychiatric populations often reported finding of P300 abnormalities. The averaged P300 amplitude was smaller and latency was larger for the more difficult task (Jung, 2011).

In fact, the amplitude of the P300 is thought to index memory processes and allocation of attention resources and the latency of the P300 seem to be linked to the stimulus classification speed, independent of behavioural response times. Altered P300 values are logical findings in certain pathological situations such as cognitive disinhibition, short term memory and attention that was caused by dysfunction of the frontal lobes (Campanella et al., 2012)

According to Campanella et al. (2012), many studies have provided evidence for the relevance of the P300, as a biological marker of the pathophysiological mechanism. A reduction in P300 construed as a state marker of depression such as biological marker that is altered during the disease but that stabilizes after clinical remission (Karaaslan et al., 2003); A trait marker of schizophrenia such as biological

parameter that is altered during and after the disease (Mathalon et al., 1993) and a vulnerability marker of alcoholism such as biological variable that is altered before the emergence of the disease (high risk children of alcoholic parents).

These markers could be used to help diagnosis as prognostic elements or to assists and choosing the best treatment for psychiatric disorders therefore these markers can improve the early detection of illness in which facilitate more effective and targeted interventions.

Besides that, good P300 reading for latency needs a good inter-stimulus interval (ISI) effects. The task and ISI for example under 2.5s condition has a clear impact on P300 morphology as the oddball paradigm has shown typical ERP component compared to single stimulus condition produce minimal amplitude (Struber & Polich, 2002).

The task given on oddball paradigm offered fundamental data for the theoretical interpretation of P300 as indexing memory-updating operations, with component amplitude reflecting the amount of attentional resources for given task. The deviant stimuli produce large P300 amplitude due to immediate memory for the old stimulus has decayed and renew by the neural events that occur upon the new target stimulus (Squires et al., 1976; Duncan-Johnson and Donchin, 1977). However, according to Gonsalvez and Polich (2002), the target-to-target interval (TTI) also affects P300. The study has found out, number of preceding nontargets (standard target) generally produces stronger effects than ISI and they suggested that TTI determine P300 measure by amplitude increases as TTI increased for both visual and auditory stimuli but the latency in contrast tend to decrease with increase TTI.

Moreover, a more recent study reported the handedness on visual P300 responses has a big effect. The study was more specific than previous study in the field because it covers both left and right handed subjects. A visual oddball was used to recorded from 19 electrodes sites showed a significant difference for both P300 amplitude and latency, ($p<0.05$;$p<0.04$) for central sites (Fz, Cz, Pz) only but not for the rest of the electrodes. Besides that, the right hemisphere is more dominant for cognitive processing of visual information and the right handed demonstrated stronger at the central sites (Eskikurt, Yücesir & İsoglu-Alkac, 2013).

2.3.2 ERP components and its association with cognitive functions

Yuan et al. (2011) suggest that if extraverts are truly vulnerable to unpleasant events than are ambiverts, they should exhibit less ERP differentiation between unpleasant and neutral conditions. This would be specify the case for N2 and P3 components which indexes of early visual processing. Therefore the measurement and analysis of occipital P1 and the frontal N1 components to examine whether extraversion modulated the early processing of stimulus features and whether this potential modulation varied depending on the emotional valence intensity of the stimuli is needed.

A number of studies have investigated the effects of aging on the N2b component and, thus, upon selective information processing as a whole. In one oddball detection study involving the effects of color deviation on N2b elicitation in subjects from age 7 to age 24, increasing age was found to correspond directly to decreases in N2b latency and alterations to the component's physiological generation. This suggests the that optimization of visual and cognitive discrimination processes results from physical maturation (Van Der Stelt, 1998).

According to Key, Dove and Maguire (2005) preoccipital region is a brain area that visual stimuli were reported to elicit the highest N2 amplitudes. Task type, stimulus type such as as written words, pictures of objects or human faces does influence the variation of N2 of visual stimuli. According to study made by Allison et al (1999), they observed that letter strings of recognizable nouns elicited a N2 component at the fourth occipital gyrus near the occipitotemporal sulci by directly place intracranial electrodes to the cortex. However, pictures of complex object, produced an N2 waveforms over the inferior lingual gyrus medially and middle occipital gyrus laterally but not for scrambled pictures. For N2 peaks for face recognition task merely found at the fusiform gyrus and inferior temporal or occipital gyri just lateral to the occipito-temporal on inferior occipital sulci. Thus, it can be concluded that differing distribution tells that N2 peak reflect category-spesific processing (Allison et al, 1999).

N2 is believed as a component that have a timing and distribution that largely due to feedback. N2pc which occurs approximately 200 ms poststimulus and has a scalp distribution which suggest that it might be generated by activity in the ventral visual stream (Woodman, 2010) while Luck and Hillyard (1994) postulates that the N2pc is due to feedback from an attentional control structure, like the pulvinar (or the frontal-eye field).

There is a variant in P3 which is P3a shows to have different scalp distributions with frontal maximum and slightly shorter latency for stimuli in visual. The frontal P3a occurs when a subject is not requires to actively respond to the stimulus or when a novel stimulus is added to the standard 2-stimulus oddball paradigm (Key, Dove & Maguire, 2005).

Moreover, the the ERP reading of personality demonstrate positive relation between introversion and amplitudes of N1, P2 components while the extraverts shows greater N2 amplitude after reward auditory stimuli association, greater N2 amplitude for introvert for the loss of tone, some researchers reported higher amplitude for extraverts (Philipove, 2008) and others greater P300 in introverts (Cahill & Polich 1992) and some reported no difference of P300 amplitude (Lindin et al., 2007). The differences of the ERP consensus by researchers is related to extraversion depend on experimental condition (Georgiev et al., 2014).

Besides that, the importance of attention in mental fatigue cannot be neglected in influencing the ERP components. Attention helps subjects to bias the processing of incoming information so that they can focus on relevant information for current goal and ignore the irrelevant information to achieve those goals. As reported by Boksem, Meijman & Lorist (2005), subjects developed difficulties in to stay alert and maintain the attention in long run so that they could perform at acceptable level which the mental fatigue can be developing from time on task. Thus, increase in beta power resulted from the urge to stay alert. This can be seen from the mountain tension in cranio-facial muscle. The N2b acts and reflect the further processing of relevant information especially a stimuli that need a feedback as a strong evidence that attentional task affected by mental fatigue. When the selective attention deteriorates it can cause subjects to lack of ability to focus their attention on task relevant items and easily distract by irrelevant information. This would cause the missed target can be occurred as well as false alarms can be increased with time on task. A short time on task should be implemented to sustain the good N200 ERP component.

2.4 Neuroanatomical and neurophysiology of personality

Bear in mind that, ambivert is a trait that characterized by both introvert and extravert. Thus it has has higher association with characteristics of introvert and extravert. Buckner (2012) reported that introverts tend to have larger and thicker gray matter in certain areas of the prefrontal cortex, a highly complex brain region associated with abstract thought and decision-making.

On the other hand, extroverts tend to have thinner gray matter in those same prefrontal areas—which hints that introverts tend to devote more neural resources to abstract pondering, while extroverts tend to live in the moment.

On top of that, other scientists measured the cerebral blood flow of introverted extraverted people with positron emission tomography (PET) scans while they thought freely. They found that the introverts had more blood flow in their frontal lobe and anterior thalamus — brain regions involved with recalling events, making plans and solving problems. Extroverts had more blood flow in brain areas involved with interpreting sensory data, including the anterior cingulate gyrus, the temporal lobes and the posterior thalamus (Joseph, 2013). The data suggested that the extroverts' attention focused outwards and the introverts' attention focused inwards.

In accord of Canli et al. (2002), they observed that, the brain response to pleasant pictures increased with extroversion in a number of cortical and subcortical regions, including the temporal lobe, amygdale and basal ganglia in a series of fMRI studies. Neurobiological evidence suggests that extraversion is associated with the corticolimbic-dopaminergic system, which is critical for incentive and reward

motivation (Depue & Collins, 1999), sensitive to reward cues (Pickering & Gray, 2001) and tend to experience positive influence (Lucas & Diener, 2001).

Besides that, selective area of cerebral cortex of healthy young subjects demonstrate that extraverts have a thinner cortical gray matter ribbon in the area of the right inferior PFC and fusiform gyrus compared to introvert (Wright et al., 2006).Other studies found that the right-hemisphere amygdala tends to be larger in extroverts than in introverts, as does the anterior cingulate cortex—except in female extroverts, whose anterior cingulate cortices are apparently smaller than those of female introverts. Since other studies have implicated the anterior cingulate in social error detection, this may point to some underlying (but still incompletely understood) differences in the ways introverts and extroverts process social missteps. Personality differences may have physical effects. Though no one's been able to measure a difference in reaction time between extroverts and introverts, researchers have found that an introvert's premotor cortex tends to process stimuli more quickly than that of an extrovert. Other studies have found that cortical neurons of introverts and extroverts may respond differently to the neurotransmitter chemicals gamma-aminobutyric acid (GABA) and N-methyl D-aspartate (NMDA)—an captivating finding since both GABA and NMDA have both been implicated in anxiety disorders (Thomas, 2013).

According the study made by Fukuda et al. (2012), by using magnetic resonance images (MRI) and the revised NEO Personality Inventory (NEO-PI-R), they found out that subjects with personality trait of less openness have speed up loss of gray matter volume in the right parietal lobule which is responsible for higher cognitive functions such as working memory and creativity compared to those who

have more openness personality trait. They believe the trait of openness is important for preserving gray matter volume and cognitive functions of healthy adults.

A vast research has been made on the study of personality but they scarcely took the ambivert personality as one of the important trait of extroversion in Five Factor Model (FFM). The study made by Georgiev et al. (2014) suggested that ambiversion must not be neglected as the ambiversion has its own EEG reflection in the auditory component. Yet the study did not include visual component hence this study topping up the lack of it.

Besides that, lots of study of extraversion employed emotion as one of the variable because the high correlation between these two (Carretie et al., 2008; Hutcherson et al.,2008 & Yuan et al., 2011) and neural correlates between emotion and ERPs method (Raz et al, 2014), neural correlates of attention with consciousness using ERPs study (Davoodi et al, 2012) as well as perception (Kranzioch et al., 2004). Hence, the present study adopted the extraversion trait with non-emotional stimuli as stated by Carretie et al. (2008), N200 attention is captured only by positive and nonemotional stimuli and P300 component reflect more elaborative, top down which include memory encoding and information (Raz et al. 2014) as well as attention (Polich & Herbst, 2000).

CHAPTER 3

METHODOLOGY

3.1 Research design

This is observational study design using Event Related Potentials (ERP) to compare the visual non-emotional cognitive processing between 2 groups of personality which is extraversion and ambiversion.

3.2 Research Ethic

Ethical approval was sought from the Universiti Sains Malaysia Ethical Committee Board. USM/PPSP@/2013/JKP-65[65.3(4-)].

3.3 Sample and population

40 Undergraduate medical students in Universiti Sains Malaysia, Health Campus. 20 students with ambiversion and 19 students' with extraversion personality trait were recruited based on inclusion and exclusion criteria (see section 3.6).

3.4 Sample size

The sample size selected based on the calculation that has been made using power and sample size program. Independent t-test analysis was used to determine the number required for this study. In a previous study, the response within each subject group was normally distributed with standard deviation 0.36. If the true difference in the experimental and control means is 0.33, we will need to study 20 experimental subjects and 20 control subjects to be able to reject the null hypothesis that the population means of the experimental and control groups are equal with probability

(power) 0.8. The Type I error probability associated with this test of this null hypothesis is 0.05. One subject were excluded due to unresponsiveness of the data ERP recording.

3.5 Location

Magnetoencephalography (MEG) / Event Related Potential (ERP) laboratory of Universiti Sains Malaysia, Health Campus.

3.6 Inclusion and exclusion criteria

- Inclusion criteria: Current undergraduate medical student in School of Medical Science, USM from Year 1 – Year 5.

- Exclusion criteria: Lifetime history of a major medical disorder (neurological, hepatic or cardiovascular), uncorrected visual, history of affective disorder, using psychiatric medication and introversion trait.

3.7 Study procedure

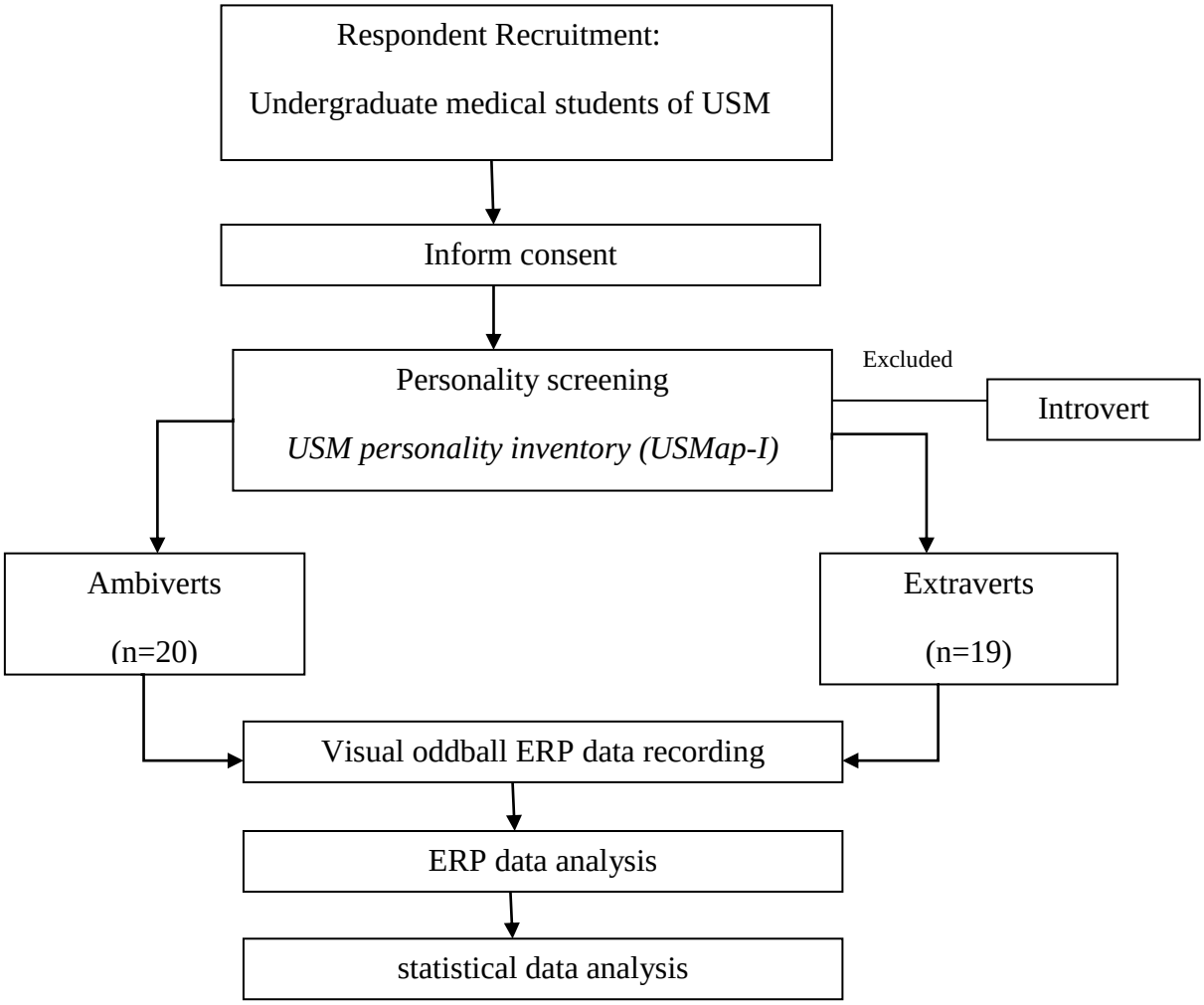

Figure 3.1: The flowchart of study procedure

3.7.2 Personality screening

A list of respondents name with their personality trait was taken from the Principal Investigator (PI) records (Refer to figure 3.2). The classification of the personality trait was based on score obtained from the personality questionnaire, The USM Personality inventory (USMaP-i). This 66-item, non-timed questionnaire, based on the Big-Five personality factors (Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness) identifies Malaysian students personality. The USMaP-i was developed as personality scale that sensitive to the Malaysian cultures and values.

This scale offers behavioral-type questions, with 0-4 rating scales. The extraversions domain score was summed up and divided into high, average and low scores where each one classify the personality trait as below:

Score	Type of Score	Type of Personality
33-48	High score	Extravert
17-32	Average score	Ambivert
0- 16	Lowest score	Introvert

Figure 3.2: The scale use to categorize subjects' personality

USMaP-i of extroversion trait from big five personality theory indicates acceptance internal consistency with Cronbach's alpha 0.802 (Yusoff et al., 2006).