

EFFECT OF ISLAMIC FASTING ON VISUAL ATTENTION BY EVENT-  
RELATED POTENTIAL ANALYSIS

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*I would like to dedicate this thesis to my beloved wife, father and mother  
for their endless support and encouragement*

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## ABSTRACT

Fasting can the psychological and mental state of a person. Previous studies conducted on evaluating the effects of Islamic fasting on visual spatial attention mechanism found no significant effects; however, the temporal mechanism of brain activities was not investigated in those studies. Thus, in this research we study the effect of Islamic fasting on visual spatial attention through the temporal mechanism of brain activities. This will give us the means to better understand the internal processes of the brain with regard to visual spatial attention. This is done by the process of motivation and emotion using images of food and dynamic facial expression as a realistic source of intervention. There are two major tasks utilized in this study. In the first task, the dot probe method was adopted on 26 participants to investigate the effect of food on visual spatial attention. The second task focused on facial expression using modified Posner method with 40 subjects. Both experiments were conducted before, during and after the month of Ramadan. The reaction time and the event related potential (ERP) components, extracted from recorded EEG during both tasks were measured as the output features of visual attention system. Findings of this study showed that spatial attention is affected by food and facial expression stimuli due to Islamic fasting. Furthermore, the facial expression task showed significant effect of gaze and its interaction with the emotional stimuli. Moreover, according to the findings of the reaction time and ERP analysis, the neural activity showed faster and preference for emotional input rather than gazing input. Besides, the happy facial expression stimuli produce faster results than neutral expression. These results indicated that ERP component coming from the right hemisphere of the brain has more effect than left side. This is consistent with the emotional lateralization concept of emotional processing rather than the valence concept. This is a significant finding since previous researches were not able to resolve these differences.

## ABSTRAK

Puasa dapat mempengaruhi keadaan psikologi dan mental seseorang. Kajian-kajian terdahulu yang mengkaji kesan berpuasa di dalam Islam mendapati tiada kesan ketara puasa terhadap mekanisme penumpuan ruang visual (visual spatial attention) seseorang. Walau bagaimanapun, mekanisma temporal aktiviti-aktiviti otak tidak diselidik dalam kajian-kajian tersebut. Oleh yang demikian, kajian ini melihat kesan berpuasa terhadap penumpuan ruang visual melalui mekanisme temporal aktiviti-aktiviti otak. Ini dilakukan melalui proses motivasi dan emosi menggunakan imej-imej makanan dan ekspresi wajah yang dinamik sebagai sumber intervensi yang realistik. Kajian ini akan membolehkan kita memahami dengan lebih jelas tentang proses dalaman otak dalam penumpuan visual ruangan. Terdapat dua tugas utama yang dijalankan dalam kajian ini. Dalam tugas pertama, tugas titik-siasatan (dot-probe) yang melibatkan 26 subjek dilaksanakan untuk melihat kesan makanan terhadap penumpuan ruang visual. Tugas kedua yang melibatkan 40 subjek memberi tumpuan kepada ekspresi wajah melalui kaedah Posner yang diubahsuai. Kedua-dua eksperimen dijalankan sebelum, semasa dan selepas bulan Ramadan. Komponen-komponen masa tindak balas dan potensi berasaskan peristiwa (ERP) yang diekstrak daripada rekod EEG semasa kedua-dua tugas itu dinilai sebagai ciri-ciri keluaran system penumpuan visual. Hasil kajian ini menunjukkan bahawa penumpuan ruangan dipengaruhi oleh makanan dan rangsangan ekspresi wajah semasa berpuasa. Tambahan pula, tugas ekspresi wajah menunjukkan kesan ketara renungan dan interaksinya dengan rangsangan emosi. Merujuk kepada hasil analisis masa tindak balas dan ERP, aktiviti neural adalah lebih cepat dan menunjukkan keutamaan terhadap input emosi berbanding input renungan. Selain itu, rangsangan ekspresi wajah gembira menghasilkan keputusan yang lebih cepat berbanding ekspresi neutral. Hasil-hasil ini menunjukkan bahawa komponen ERP yang berasal dari hemisfera kanan otak mempunyai kesan yang lebih berbanding hemisfera kiri otak. Ini adalah selaras dengan konsep pemprosesan emosi lateral berbanding dengan konsep valens. Ini merupakan penemuan penting kerana kajian-kajian terdahulu gagal menyelesaikan perbezaan ini.

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## LIST OF ABBREVIATIONS

ERP	-	Event Related Potential
RT	-	Reaction Time
MRT	-	Movement Reaction Time
CFF	-	Critical Flicker Fusion
EEG	-	Electroencephalogram
LED	-	Light Emitting Diodes
SOA	-	Stimulus Onset Asynchrony
HDL	-	High Density Lipoprotein
VLDL	-	Very Low Density Lipoprotein
VAS	-	Visual Analog Scale
FCR	-	Fasting And Calorie Restriction
QOL	-	Quality Of Life
fMRI	-	Functional Magnetic Resonance Imaging
MEG	-	Magnetoencephalography
MPFC	-	Medial Prefrontal Cortex
ADAN	-	Anterior Directing Attention Negativity
SSRIs	-	Selective Serotonin Reuptake Inhibitors
rTMS	-	Transcranial Magnetic Stimulation
EOG	-	Electrooculogram
IFCN	-	International Federation of Clinical Neurophysiology
ESS	-	Epworth Sleepiness Scale
Spearman's rho	-	Spearman's rank correlation coefficient
DRT	-	Difference of Reaction Time
DETR	-	Difference of Emotional Reaction Time
DDA	-	Difference of Deficit Arousal
DMF	-	Difference of Mood Factor
IOR	-	Inhibition of return
LPP	-	Late positive potential

**LIST OF SYMBOLS**

Ag	-	Silver
AgCl	-	Silver chloride
Ms	-	Milliseconds
Kg	-	Kilograms
Kcal	-	Kilocalories
K $\Omega$	-	Kilo ohms
Hz	-	Hertz
$\mu$ v	-	Micro volts
Min	-	Minute

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Background of Religious Fasting

In history, people with variety of cultures and different religions have inscribed the significance of fasting in life. There are several references about fasting in different literatures such as Quran, bible, the Torah, pagan writing, and in Ancient Greeks manuscripts. According to Fredricks (2013) fasting was a kind of rehearsal and practice in the ancient schools, which made by the mystery religions and teachers from Greece, Egypt, and Rome.

There are main periods of time in Buddhist calendar acknowledged as the fasting days. For instance, they mentioned three long months such as the first fifteen days of the first, fifth, and ninth months, also the six fasting days of eight, fourteenth, fifteenth, also twenty fourth, twenty ninth, and thirtieth. They believed that the monks did not supposed to eat after the meal at noon (Ch'en, 2015).

In another religion, the Hinduism takes in many types of fasts. According to devotion of their favourite deity some of the people do fasting on convinced days of a month or selected days of a week. For instance, the Shiva's devotees do fasting on Monday; however, the people who honour Vishnu do it on Friday or Saturday. Furthermore, the Hindus fast in period of religious anniversaries. For instance, in part of northern India, the wives fast for the health and wealth and wellbeing, of their husbands. The wives see the moon with a sieve after sunset and they finish their fasting. There are two causes which the Hindus do abstention or complete fasting such

as a form of medication that they consider fasting supports the body and soul, mind, fostering discipline and self-control. Second, they resist that fasting may help to keep a person free of disease body. Hence, fasting is discretionary as every sincere Hindu household performs it since Hindus consider in purification of mind and body. As considered by Zavasta (2009) fasting in Hinduism is meaning not eating or drinking during particular time otherwise it can mean refraining from certain matters during particular periods.

In Jews religion, fasting has always acknowledged as a part of deep process of soul sanitization. Purity of certainty, God retains a severe accounting of each individual's manners and in the same vein with this record and he metes out justice. Furthermore, to concession and regret, people should vigorously compensate, or make up for their faults. Thus, the main mode of atoning is doing fasting; "YOM KIPPUR" which is the Atonement day is the main fasting day once observant Jews refrain from eating food and drinking for one day. However, Pious Jews, detect extra fast days. Since, Mondays and Thursdays are the days that the Torah reads in the synagoue these are the preferred days for this purpose (Schreiber, 2011).

In Christianity religion, particularly Eastern Orthodoxy and Roman Catholicism a 40-days fast period during Lent, a period of penitence in spring before Easter, a penitential period before Christmas and during Advent, is settled. The severe followers of Greek orthodox Christianity customs do fasting for 180 days each year (Fitzgerald, 2014).

Islam, is the second largest religion with about 1.6 billion followers. The sacred month for Muslims of the world, Ramadan is acknowledged in the ninth lunar month of Islamic calendar. One of the main five pillars of Islam and essential religious responsibility for Muslims is fasting in period of Ramadan which is called Ramadan fasting or Islamic fasting. The healthy adult Muslims are indebted to refrain eating, sexual intercourse and drinking from sunrise to sunset during Ramadan. Although the menstruating women, travelers and sick people have excused for not fasting, they must make up the days miss later. Since, the lunar Islamic calendar is about 11 days shorter than the solar Gregorian calendar, thus, the Ramadan can happen in any season of the

year. Therefore, over a 33-year cycle Ramadan falls on several parts of the seasonal year. This cyclical change intensely influences the sum of daily fasting period that happens in any given site. Furthermore, a location's latitudinal distance from the equator considerably effects daily fasting period. However, the norm of fast period in Ramadan is 12 hours in length, it may take long for 18 hours in Polar Regions in period of summertime (Beshyah *et al.*, 2010; Kettell, 2011).

## 1.2 Research and Gap Analysis on Islamic Fasting

Since 20 years ago, there are several studies which have conducted to find out the effects of Islamic fasting on healthy people. Findings of the studies have displayed differences that may have numerous descriptions. The most important description refers to the difference in the protocols. According to Rocky *et al.* (2004) Ramadan has special effects on many types of biochemical, hormonal parameters, haematological, and behavioral changes.

As remarkable as the human visual and cognitive systems may be, inevitably we are still limited by both bandwidth and processing power. There is a fixed expanse of overall energy available to the brain, and the cost of cortical computation is high. Attention is vital for enhancing the limited sources of systems. Attention as a selective process offers an organism by an optimized depiction of the sensory input. The visual spatial attention as a neuropsychological system which manage the environmental data plays a significant role in people life. For instance, the filtered data via spatial attention from the environment can rise the life chance once the threaten stimuli like poisonous and predatory animals such as spiders, snakes, and sharks can impose bodily harm modulated the spatial attention (Fichtenholtz *et al.*, 2007). Thus, the consequence of this mechanism under the effect of Islamic fasting is projected in this way analyse.

Muslims wakeup early for prayers, eat before sunrise, retire later and devour large meals after the sunset to replace energy and fluid ranks during Ramadan. Hence, it goes to changes in sleep duration, feeding habits, pattern and architecture (Roky *et al.*, 2003; Waterhouse *et al.*, 2009), circadian rhythms (Iraki *et al.*, 1997; Reilly and

Waterhouse, 2007), physiological (Roky *et al.*, 2004), metabolic and endocrine function (Larijani *et al.*, 2003; Leiper *et al.*, 2003; Nomani *et al.*, 1989) following with changes in daytime hydration level, blood glucose rate and body temperature level (Leiper *et al.*, 2003; Monk *et al.*, 1983; Roky *et al.*, 2000a). Several studies, have discussed by facing some contradiction results which have rejected the changes in some factors.

However, for gaining consequences of fasting there are some evidences which have reflected the visual spatial attention.

For instance, Roky *et al.* (2000b), Bahammam *et al.* (2013a) and Tian *et al.* (2011) conducted different studies by utilizing movement reaction time (MRT), critical flicker fusion (CFF) and simple reaction time checked the visual spatial attention, although did not resulted the important consequence due to Fasting effect. It should be deliberated that total of tasks used simple stimuli like dot that was not supported by a high level of physiological validity.

However, through fasting condition (not Islamic fasting), the spatial attention to food as motivational stimuli displayed some changes. Majority of the studies only used food deprivation in different time interval as a non-periodic nutrition regime intended for one or two days (Ahern *et al.*, 2010; Nijs *et al.*, 2010; Werthmann *et al.*, 2013). Inappropriately, the food motivational stimuli effects on spatial attention in period of Islamic fasting was rarely investigated.

On the other hand, several studies have shown the consequence biased food attention by fasting, however the temporal pattern of brain activity less considered because of only utilizing the behavioral data (Reaction time). Moreover, this neural pattern which was biased by Islamic fasting effect intended in visual spatial test never deliberated. It considerable that Islamic fasting can bias the attention in a different way as an intermittent fasting compared to one-day restricted food stimuli.

This different pattern can occur to some causes such as sleep pattern alteration (Bahammam *et al.*, 2013b; Roky *et al.*, 2003) and changing of dehydration level

(Trabelsi *et al.*, 2013; Wilson *et al.*, 2009). Besides, some of the evidences have illustrated the different patterns in intermittent fasting for body's energy system based to adaptation (Stannard, 2011a).

Apart from the motivational stimuli there are some evidences that displays the emotional stimuli can bias the visual attention.

There are several studies that have observed mood enhancement, and psychological health development through the fasting period (Michalsen, 2010). Therapeutic fasting has been performed for a century as a type of safe technique in medical area (Fond *et al.*, 2013; Michalsen *et al.*, 2006a). Furthermore, there are some studies that have been conducted on potential positive influence of adjacent fasting therapy on mood (Fond *et al.*, 2013; Michalsen, 2010).

In the field of Islamic fasting, there some studies conducted focusing on effects of mood changes (Daradkeh, 1992; Farooq *et al.*, 2010). There are several evidences on efficiency of Ramadan on mood enhancement (Chaouachi *et al.*, 2009; Wardah *et al.*, 2013; Daradkeh, 1992).

For example, some of evidences on positive mood proves the positive emotional state like interest, happiness, joy. that provisionally extend an individual's thought-action range (Ochsner, 2014; Wadlinger and Isaacowitz, 2006). Therefore, it endorses the development of attentional attraction and consideration. In the same vein, once the mood rises, it will be high successful social interactions, more income, and a Greater life span that can be delivered subsequently.

hence, it is considered that the positive mood effects on the visual attention. For example, the subjects which were invested into the positive moods, specified increased attentional breadth as exposed via longer visual fixations toward peripheral positive emotional stimuli and further saccade rate under the positive emotional state (Wadlinger and Isaacowitz, 2006). Findings of the test demonstrated that positive moods might extend their emphases to peripheral stimuli through the positive emotional valence. Additionally, according to the previous studies, the positive mood

offers an extend range of spatio-temporal attention, which makes more flexibility, and biases the attention to positive stimulus (Jun *et al.*, 2011; Ochsner, 2014). Thus, although the emotional-spatial stimuli may bias attention under the Islamic fasting consequence, there is no evidence which this bias can consider.

The gazed facial expression may use as a valid ecological emotional-spatial stimulus after selecting food as a motivational stimulus. However, the gazed eye gives the prediction intended for spatial target and facial emotion utilized as emotional triggering stimuli. Hence, it is mentioned that the combined content signal of gazed facial expression may determine the subject's spatial attention and its delivery in environment. Additionally, it might bias emotional state and estimates their potential attentional activity disposition to or beside oneself and other environmental objects (Lerner and Lamb, 2015). In addition, once more realistic stimuli like dynamic gazed facial expression used as spatial emotional, it may consider two gaps.

First, when the cue-target paradigm was utilized through performing the gazed facial expression stimuli, there are some studies have been shown investigation of the relation between emotion and gazed signal. Numerous indications have been exposed the interaction between emotional and gazed stimulus (Hori *et al.*, 2005; Putman *et al.*, 2006). On the other hand, there are several other studies that have been exposed there is no interaction between gaze and facial expression (Fichtenholtz *et al.*, 2007, 2009; Graham *et al.*, 2010).

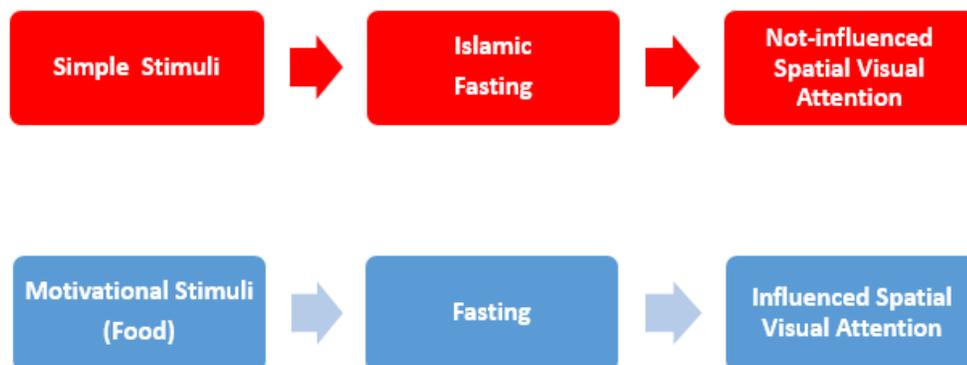
Second is that human brain controls all vigorous functions of the body. Because of the neural brain connection which called corpus callosum albeit and divided into halves (hemispheres)—left hemisphere and the right hemisphere, it performs as a single entity in unison with the other parts of the system (Pietrasanta *et al.*, 2012). The left hemisphere performs its purposes distinctly from that intended for the right hemisphere. The brain lateralization is the idea which two halves of the brain's cerebral cortex perform in different purposes (Lindell, 2013a). The right-hemisphere hypothesis speculates that the right hemisphere is particular for the insight in emotional processing, expression, and experience of emotion, regardless of valence (Perez *et al.*, 2013).

On the other hand, the valence hypothesis assumes that the right hemisphere is particular for negative emotion and which the left hemisphere is specific for the positive emotion. (Berntson, 2011; Mneimne *et al.*, 2010; Perez, 2013).

The changes in facial emotion may possibly tempt emotional state and effect on the spatial attention. Hence, the attention biased is detected via approach-oriented intended for positive facial emotion such as the happy stimuli, and avoidance-oriented intended for negative facial like fearful faces (Rigato *et al.*, 2013). Hence, the fearful facial emotion as a threaten stimuli by both valence hypothesis and right-hemisphere hypothesis must induce the right hemisphere activity. However, there is a debate for the positive facial emotion.

### 1.3 Problem Statement and Gap Analysis

According to the pervious information, there are limited studies which evaluated the effects of Islamic fasting on spatial attention mechanism; however, they have not mentioned any significant effect (BaHammmam *et al.*, 2013a; Roky *et al.*, 2003; Tian *et al.*, 2011).

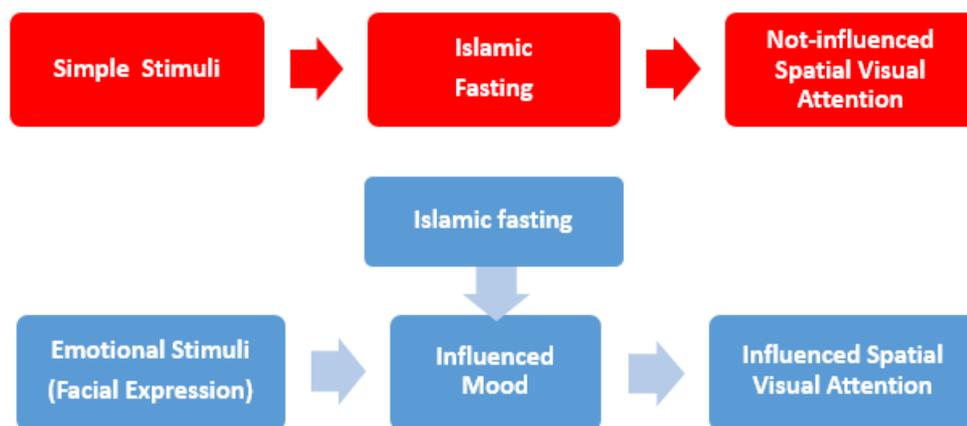


**Figure 1.1** Gap Study Related to Food Stimuli

As it is obvious in Figure 1.1 to evaluate the spatial attention, all of the mentioned experiments were limited to only usage of stimuli with simple geometry

and shape like dot, stars. Furthermore, the output of the conducted tasks was restricted to the reaction time, which did not provide accurate details about the neural mechanism of spatial attention.

On the other hand, according to the information of the Figure 1.1, there are several researches revealed that limited food fasting with non-religious pattern could affect spatial attention when the food images were used as motivational stimuli (Bahammam *et al.*, 2013b; Roky *et al.*, 2000a; Tian *et al.*, 2011). Thus, this study seeks to evaluate the potential of Islamic fasting on changing spatial attention through the application of food images as stimuli. Furthermore, this study aims to evaluate the temporal mechanism of brain activities under such condition as mentioned above since none has been reported. The effect of a person's mood during fasting on spatial attention has not been reported in the literature.



**Figure 1.2** Gap Study Related to Emotional Stimuli

According to the information in Figure 1.2, there are some of the researches reported on the effect of Islamic fasting on alteration of mood level (Chaouachi *et al.*, 2009; Wardah *et al.*, 2013). In addition, there are several previous researches have mentioned about the influence of visual spatial attention for emotional stimuli due to mood alteration (Wadlinger and Isaacowitz, 2006; Jun *et al.*, 2011; Ochsner, 2014). This study aims to investigate the potential of Islamic fasting on visual spatial attention by employing the facial expression as emotional stimuli (facial expression).

According to the discussed information in section 1.2 about the research gap analysis on Islamic fasting in this chapter, the current study will investigate the effect of gaze direction in spatial attention under different facial expression during Ramadan fasting that has not been reported previously. To resolve the ambiguity between valence and right hemisphere theories regarding the processing of emotional content in facial expression, this study will use the Event Related Potential (ERP) method by applying happy facial expression as visual stimuli.

#### **1.4 Objective**

According to the gap and background of the study, the current research seeks to evaluate the effect of Islamic fasting on visual attention. Thus, the following objectives would be discussed in this study:

- 1) To identify the effect of Islamic fasting on visual spatial attention mechanism via
  - Food image as motivational stimuli
  - Facial expression as emotional stimuli.
- 2) To identify the brain temporal pattern for recognizing the processing of food biased attention activity
- 3) To determine the temporal brain activity to make comparison between valence theory, and right hemisphere theory for processing of facial expression.

#### **1.5 Scope of Study**

This study seeks to focus on evaluating the biased spatial visual attentional system by fascinating of food (motivational) and facial gazed expression (emotional) stimuli during period of Islamic fasting. Thus, it tries to assess the effect of Islamic

fasting through repeating three experiments in three particular time periods: (one month before Ramadan, last 3 weeks of Ramadan, and one month after Ramadan).

The effect of food stimuli as the motivational stimuli on visual spatial attention will be issued by the modified version of dot-probe paradigm on a group of 26 voluntary participants (14 male, 12 female) with the mean age of 25.4 years old and standard deviation at 3.7. The participants of the study are selected from students in Universiti Teknologi Malaysia (UTM). The experiment is conducted at the Biomedical Laboratory of Faculty of Electrical Engineering in UTM by recording the electroencephalogram (EEG) data and reaction time of participant during dot-probe test (16:00 to 19:pm). Apart from the visual spatial attention task some of the data collections are proposed to measure cofactors (age, weight-, glucose-, hunger-, thirsty-, dehydration-, food liking level and sleep pattern).

In addition, the gazed facial stimulus as emotional stimuli are applied to evaluate the Ramadan effect on biased visual attention. The biased visual spatial attention is evaluated by a modified version of poser paradigm which is based on dynamic gazed facial expression on a group of 40 (20 male, 20 female) participants with the mean age of 26.2 years old and the standard deviation of 3.1. The EEG and reaction time as the output of attentional task is recorded while some data questionnaires on mood and emotional state were collected beside the task.

In both experimental tasks The EEG acquisition was carried out with The Nihon Kohden Neurofax EEG-9100 Portable Digital EEG Machine and the software was EEG-1000/9000 acquisition program. This device had a 19-channel standard electrode cap with Ag/AgCl electrodes. The distances between the electrodes were constant and this adhered to the IFCN (International Federation of Clinical Neurophysiology) following the 10-20 international system. The positions of the electrodes were FP1, FP2, F7, F8, F3, F4, FZ, T7, T8, C3, C4, CZ, P7, P8, P3, P4, PZ, O1, and O2.

Hence, after collecting data, the ERP components (P1, N1, and P3) as aimed featured extracted from EEG by using the MATLAB, ERPLAB, EEGLAB software

and via repeated measures ANOVA method are analysed statistically by using the SPSS software.

## **1.6 Contribution of Study**

A comprehensive demographic study conducted on 2009 over 232 countries and territories reported that 23% of the global population, or 1.57 billion people, are Muslims. The religious profile of the world is rapidly changing but Islam will grow faster than any other major religions (Miller, 2009). The majority of Muslims participate in Islamic fasting. Thus, the recognition effects of Islamic fasting on human body system can be considered as an important issue. In addition, identifying the alteration of all types of attentional mechanism by the effect of Islamic fasting is significant via the critical role of attentional mechanism to optimize the information from environment and its vital effect on life.

The main contribution of this study is to identify that although the limited studies showed insignificant effect of Islamic fasting, this study investigated Islamic fasting has significant effect on the visual spatial attention. Results of this study approve that attention to the food and the facial expression stimuli has been affected by the Islamic fasting.

When this effect evaluated by food stimuli, different patterns of Islamic fasting from restricted calorie fasting was revealed. This pattern was identified by interaction between food reward system and body's energy system. It prevented from over weighting after Ramadan fasting in contradiction with normal calorie restricted fasting.

Identifying the mechanism of eye gazing and facial expression was another contribution of this study. The interaction pattern between happy facial expression and gaze direction was identified, when biased attentional mechanism by facial expression stimuli elucidated. However, some of the previous studies could not determine that this interaction effect due to lack of accurate task output like mixing between ERP and

behavioral result. On the other hand, this interaction was not evidenced in early stage of visual processing.

Hence, in making comparison between the valance and right hemisphere theories, this study considered that this biased attention has confirmed the right hemisphere theory.

## **1.7 Thesis layout**

The first chapter of this study discussed background of the study by focusing on information about the fasting and its history following by identifying the statement of problem, objective, scope, contribution of the study and thesis layout.

This study will discuss on literatures about fasting and its effects on human body in chapter 2. The main focus of this section is to explain the background of the research about the effects of Islamic fasting on visual attention and cofactors that have potential to influence the spatial attention by its alteration during Islamic fasting period. Furthermore, the studies which have been conducted on Islamic fasting effect on visual attention are discussed in this chapter, and it gives some indirect evidences that the spatial attention may affect by Ramadan fasting when the stimuli included the motivational (food), and emotional content (facial expression). Hence, the mechanism of processing task stimuli (food and facial expression) and related theories to its effect on visual attention are described in this chapter.

The third chapter discusses the methodology of the study. The introduction section explains the methodology for the pilot study, first and second visual spatial attention task in individual parts. After discussion about pilot study in fist part, the second section of methodology is related to effect of Islamic fasting on visual spatial attention by applying food (motivational) stimuli. The third section explains the effect of Islamic fasting on visual spatial attention by applying facial expression (emotional). In addition, participants of the study are clarified in this chapter follows by identifying the materials and, collection and methods of data analysis.

Chapter 4 of this study explains the results and give a discussion on the first experiment, which considered the biased visual attention via food stimuli. In addition, results and discussion about the task on visual spatial attention which influenced by Islamic fasting via applying the facial expression stimuli will be identified in chapter 4 of this study.

The final chapter of this study talks about summary of the results and prepares conclusion of the study. Furthermore, and suggestions based on the results of the study are explained in this chapter.

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