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*by Ikhlas Jenie*

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## Reaction Time in Healthy Female Subjects in Relation to Monthly Sexual Cycle

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### Abstract

To examine whether mental process in female subjects is influenced by monthly sexual cycle. Reaction time (RT) was measured in twenty healthy female undergraduates, who had regular menstrual cycle, normal body mass index and normal hearing function, low anxiety level, and had no color blindness. Simple and choice RT to visual and auditory stimuli were measured using a response velocity measurement device. The RT measurements were done in day 4 of the cycle (menstruation phase) and day 7 (follicular phase) with the randomly assigned time order. Data were analyzed using paired t-test. Visual RT, auditory RT, and choice RT decreased significantly in follicular phase than during menstruation ( $p < 0.05$ ). Mental process in female subjects is influenced by monthly sexual cycle

*Key words:* simple reaction time, choice reaction time, mental process, menstrual cycle, estrogen.

### **Introduction**

Tuttle & Schottelius [1] defined reaction time (RT) as time needed to respond voluntarily to the stimulation of a sense organ. Therefore, RT is also called perception time [2]. With appropriate study design, RT can be used to measure mental process of the brain. However, RT is influenced by several factors, such as age, gender, arousal, fatigue, repetition, anxiety, and stimulus.

Estrogen receptors has been detected widely in the brain, such as the hypothalamus, preoptic area, anterior pituitary, and hippocampus. In series of in vivo experiments, estrogen does contribute to the maturity of the brain. Moreover, estrogen stimulates axonal growth [3] and increases cerebral perfusion [4].

It is reported that RT correlates with circulating estradiol. Moreover, following menopause RT decreases [5]. Woman in reproductive age experiences monthly sexual cycle. It consists of menstruation, follicular phase, and luteal phase. There is hormonal changes during the cycle, particularly estrogen and progesterone. During menstruation, both hormones reach the lowest plasma concentration. Estrogen predominates in the follicular phase, whereas progesterone is prevalent during the luteal phase [6].

As plasma estrogen level changes during monthly sexual cycle, it is questioned whether mental process in female subjects is influenced by monthly sexual cycle. To answer this problem, we had compared RT during menstruation and follicular phase in female undergraduates.

### **Materials and Methods**

This was an observastional, cross-sectional study. The subjects were female students of Faculty of Medicine, Universitas Muhammadiyah Yogyakarta, who 18 to 25 years old and right

handed person with body mass index 18 to 24 kg/m<sup>2</sup>. They must have regular menstrual cycle at least for the last three months. Moreover, they must not have color blindness, hearing impairment, and anxiety based on the results of Ishihara test, hearing function tests (Rinne, Swabbach, and Weber test), and Analog Anxiety Scale (AAS) questionnaire, respectively.

The study subjects signed informed consent. Before the measurement day, they were told for not taking any medicine. RT was measured using a response velocity measurement device, which had been developed by Susanto [7] during his final project in The Faculty of Engineering, Universitas Muhammadiyah Yogyakarta. In this study, RT was measured twice for each subject. First measurement was done during menstruation, i.e. the 3<sup>rd</sup> day after the first day of the menstruation. Second measurement was done in the follicular phase, i.e. the 7<sup>th</sup> day after the last day of the menstruation. Three kinds of RT was measured each time, as following: visual RT, auditory RT, and choice RT between visual and auditory stimuli. For each kind of RT, measurement was done twenty times with 15 seconds-interval. The result for each subject was the average of those measurements. Data was analyzed using paired t-test with SPSS with *p* value < 0.05 was considered significant.

### Results and Discussion

There were 20 female subjects who participated in this study. The subjects' characteristics as summarized in the Table 1 showing that they were young adults and not obese. Moreover, their AAS score was < 150 indicating that they were not in an anxiety state.

Table 1. Subjects' characteristics

Characteristics	Mean	Standard deviation
Age (years)	21.6	1
Body mass index (kg/m <sup>2</sup> )	20.05	1.97
Anxiety score	77	45.3

As showed by Table 2 below, simple visual RT was decreased during follicular phase(191.6 ± 33.3 sec.) than during menstruation phase (210.6 ± 22.4 sec.) ( $p = 0.0001$ ), whereas auditory RT was decreased during follicular phase (199.2 ± 33 sec.) than during menstruation (207.2 ± 31.2 sec.) ( $p = 0.039$ ). Furthermore, choice RT was also decreased during follicular phase (270.2 ± 33.3 sec.) as compared to during menstruation (298.1 ± 33.3 sec.) ( $p = 0.0001$ ).

Table 2. Reaction time during menstruation and proliferative phase

Reaction time (RT)	Menstruation		Follicular phase	
	Mean	St.dev	Mean	St.dev
Visual RT	210.6	22.4	191.6**	33.3
Auditory RT	207.2	31.2	199.2*	33
Choice RT	298.1	33.3	270.2**	33.3

Note. Unit measurement in seconds.

\* =  $p < 0.05$  as compared to menstruation phase. \*\* =  $p < 0.01$  as compared to menstruation phase.

This study shows that simple and choice RT in young adult female subjects is decreased during follicular phase of monthly sexual cycle as compared to during menstruation (RT during follicular phase < menstruation). This result might be related to estrogen level, which is higher during follicular phase than during menstruation.

The result of this study is in line with Patel & Singh [8] who had examined RT in pregnant women. They measured visual RT in 37 women aged 20 to 35 years who were in pregnancy and compared to unpregnant women. They found that visual RT was decreased in pregnant women as compared to unpregnant women. Moreover, the visual RT in 1<sup>st</sup> trimester >

2<sup>nd</sup> trimester > 3<sup>rd</sup> trimester among pregnant women. Patel & Singh [8] argued that these difference can be associated with plasma estrogen level that increase during pregnancy or plasma human chorionic gonadotropin that reach its peak during the 1<sup>st</sup> trimester of pregnancy. Recently, Mehta et al. [9] reported that pregnant women both in the second trimester (n=30) and the third trimester (n=30) did not significantly differ from healthy women in premenstrual phase (n=30). Explaining these results, Mehta et al. [9] argued that neuronal excitability during the second and third trimester of pregnancy was actually being increased by estrogen but otherwise was inhibited by progesterone.

However, the results of our study are not in accordance with of other studies. Kumar et al. [10] had measured visual and auditory RT in 30 girls aged  $21.33 \pm 2.34$  years old, with body mass index  $23.19 \pm 1.18$  kg/m<sup>2</sup>. They reported that both visual and auditory RT during menstruation < follicular phase < luteal phase. Jadhav et al. [11] found that auditory RT was prolonged during luteal phase as compared to follicular phase in 70 female medical students.

These discrepancies among studies that examined the relation of estrogen and human reaction times may reflect complex interaction between estrogen and neurotransmitters in the brain, such as acetylcholine and dopamine. For example, estrogen increases dopamine release in nigrostriatal system but inhibits dopamine uptake [12]. Our study had a limitation for not measure plasma estrogen level.

### **Conclusion**

Reaction time was decreased during follicular phase than during menstruation in young adult female subjects. Thus, mental process in female subjects is influenced by changing in body conditions associated with monthly sexual cycle.

### **Disclosure**

The results of this study was presented as oral paper in APCHI-ERGOFUTURE-PEI-

IAIFI Joint International Conference, Bali, Indonesia, 2014.

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