Research Proposal: Estrogen Levels Effects on Sex-Dimorphic Skills and Mood

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Abstract

Sex-dimorphic skills are skills that, on average, one sex outperforms the other on. Verbal tasks and fine motor tasks are considered female-favoring tasks, while mathematical reasoning and spatial tasks are considered male-favoring tasks. Studies have suggested a correlation between prenatal androgens and sex-dimorphic patterns. More evidence suggests that normal androgen fluctuation, such as that which occurs in the female menstrual cycle, can also have minor effects on performance on dimorphic skills during adulthood.

While studies show improvement or decline in performance on female-favoring tasks in correlation of androgen fluctuation, finding suggesting that not all woman in fact excel at female-favoring tasks. The ratio of women excelling at women-favoring tasks: men-favoring tasks is 79:21. Therefore, only about 80% of women present as better at female-favoring tasks than male-favoring tasks.

Other research suggests that androgen levels during the menstrual cycle also affect emotions. During the menstrual cycle, the luteal phase, marked by heightened estrogen, has been connected to heightened emotional state.

Because of these things, the question I will be investigating in this study is, do the minority of women who excel at male-dominated tasks respond differently to estrogen fluctuation during the menstrual cycle?

For a long time, it has been thought that males and females have not only physical but also cognitive differences. Evidence of cognitive differences exists. An example of these differences are sex-dimorphic skills. Sex-dimorphic skills are skills that, on average, one sex outperforms the other on. An example of this is that, on average, women score higher than men on verbal tasks and fine motor tasks, whereas men score higher than women on mathematical reasoning and spatial tasks. Verbal tasks and fine motor tasks are considered female-favoring tasks, while mathematical reasoning and spatial tasks are considered male-favoring tasks.

Studies have suggested a correlation between prenatal androgens and sex-dimorphic patterns. More evidence suggests that androgens do not only affect early disposition to sex-dimorphic skills but can also have minor affects on performance on dimorphic skills during normal fluctuations in adulthood. For example, as women’s testosterone levels decline throughout the day, so do spatial skills. As men’s testosterone levels decline throughout the day, spatial skills improve (Sanders 2002).

Levels of androgens: estrogen, progesterone, and testosterone change throughout the female menstrual cycle. It has been shown that performance of sex-dimorphic tasks, but not sex-neutral tasks, change with estrogen across the menstrual cycle. Studies show improved performance on female-favoring tasks during high estrogen phases (preovulatory and mid-luteal phases) and improved performance on male-favoring tasks during low estrogen phases (menses) (Hampsen 1990).

While studies show improvement or decline in performance on female-favoring tasks, finding suggesting that not all woman in fact excel at female-favoring tasks. The ratio of women excelling at women-favoring tasks: men-favoring tasks is 79:21. Therefore, only about 80% of women present as better at female-favoring tasks than male-favoring tasks. The same is true for men; men excelling at male-favoring tasks: female-favoring tasks is 83:17. Again, only about 80% of men score higher on male-favoring tasks than female-favoring tasks.

Because of this variation in the general population, I would like to investigate the minority: the 20% of woman that excel at male-favoring tasks. The majority of woman (the 80% that excel at female-favoring tasks) improve at female-favoring tasks during high estrogen phases. I am curious if the minority shows less improvement or no improvement in female-favoring tasks when estrogen levels rise.

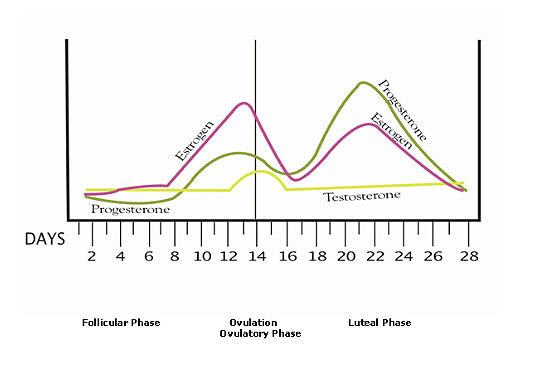


Figure 1: Normal hormone level changes throughout a woman’s menstrual cycle.

Other research suggests that androgen levels during the menstrual cycle also affect emotions. During the menstrual cycle, the luteal phase, marked by heightened estrogen (see Figure 1) has been connected to heightened emotional state. In a study it was demonstrated negative feelings, including depression, tension, fatigue, irritability, and physical discomfort, peak during late luteal phase, (Sanders, 1983). The hypothalamus and hippocampus, which are emotional centers of the brain, house estrogen receptors, which could indicate its role in emotions (Farage, 2008). In another study, estrogen was administered to postmenopausal women and it was found that when blood estrogen levels matched those of the late follicular phase (estrogen’s highest peak), emotional response to psychologically stressful events was remarkably exaggerated (Maki, 2007). Further, in a study on rabbits, rats, and cat electrical stimulation of the hippocampus increased progesterone formation in the ovary (Kawakami, 1966). While this experiment was not conducted on humans, it indicated possible correlation between androgens and activity in the emotional centers of the brain.

Because of this I would like to investigate whether there is a significant difference in self-reported mood between the times when estrogen levels are highest and lowest during the menstrual cycle (see Table 1). I would also like to investigate if women with significantly less or no mood changes are predominantly woman who excels at male-favoring tasks.

As a culmination, I will be investigation 1) changes in sex-dimorphic tasks and mood in correlation to peak estrogen levels during the female menstrual cycle and 2) if there is a correlation between changes in task performance and changes in mood and whether a woman excels at female-favored tasks or male-favored tasks.

To measure this, the experimental group will include women with regular menstrual cycles, lasting between 25-35 days, who are not using oral hormonal contraceptives and have not been for at least 3 months will be used. These women will be given tests when estrogen levels are expected to be highest and lowest throughout the cycle (see table 1).

Table 1: Phases during the menstrual cycle when estrogen levels are highest and lowest. These are to be considered estrogen significant points.

|  |  |
| --- | --- |
| **Highest estrogen** | **Lowest estrogen** |
| Pre-ovulation | Early follicular |

In order to measure sex-dimorphic skills, women will be tested on verbal tasks, fine motor tasks, mathematical reasoning, and spatial tasks during the two estrogen significant times. Each woman will only do this during one cycle to prevent bias that could come from testing improvement from repeated test taking. The difference between scores on female-favoring tasks and male-favoring tasks will be calculated for each participate like so: (verbal task)+(fine motor task)-(mathematical reasoning)-(spatial reasoning). T-test will be run with this data set to find outliers that could be considered better at male-favoring tasks than female-favoring tasks. The goal of this is to identify woman as part of the majority (80% that excel at female-favoring tasks) or as part of the minority (80% that excels at the female-favoring tasks).

In order to demonstrate whether or not there is a significant difference in performance at each sex-dimorphic task at the two estrogen-significant points in the menstrual cycle, one-way ANOVA will be run comparing the data sets. How this will be done is shown in table 2.

Table 2: AVONA layout for each data set. This will be done separately for scores on verbal task, fine motor task, mathematical reasoning, and spatial reasoning.

|  |  |
| --- | --- |
| **Early follicular** | **Pre-ovulation** |
| Participant 1 | Participant 1 |
| Participant 2 | Participant 2 |
| Participant 3 | Participant 3 |
| Ect. | Ect. |

In order to determine if there is a significant difference between females who excel at female-favoring tasks and females who excel at male-favoring tasks, the difference between scores will be calculated like so: (Pre-ovulation)-(Early follicular) for each task. For each task t-test will be run to determine any outliers. Outliers will be compared to the group of women previously determined to be part of the minority that excels at male-favoring tasks.

Mood surveys will also be given at the two estrogen significant times. They will include numerical rating of emotional state as well as numerical rating for emotional response to day-to-day activities. By including both of these it will make it easier to differentiate between changes in emotional state caused by outside life stresses and changes in emotions towards normal activities in correlation to altered hormone levels. In order to determine if there was a significant improvement or decline in mood between phases I will run one-way ANOVA as shown in table 3.

Table 3: Example of how one-way ANOVA will be conducted to compare mood scores during early follicular phase and pre-ovulation phase.

|  |  |
| --- | --- |
| **Mood scores in early follicular phase** | **Mood scores in pre-ovulation phase** |
| Participant 1 | Participant 1 |
| Participant 2 | Participant 2 |
| Etc. | Etc. |

In order to determine if there is a correlation between mood fluctuation and whether a woman excels at female-favoring tasks or male-favoring tasks, the difference between scores will again be taken like so: Mood score (Pre-ovulation)-(Early follicular). T-test will be run to determine if there are outliers who have significantly greater or less mood fluctuation than the average. Outliers will be compared to women who were determined to be part of the minority that excels at male-favoring tasks.

In correspondence to research I have found,

1. I expect to find significant improvement in female-favoring tasks when estrogen levels are highest, during pre-ovulation phase compared to early follicular phase.
2. I do not except to find that woman who had significantly less or no performance improvement to be predominantly women who are part of the minority who excel at male-favored tasks.
3. I expect to find a significant decline in mood when estrogen levels are highest, during pre-ovulation phase compared to early follicular phase.
4. I do not expect to find that women with less or no mood fluctuation to be predominantly woman who are part of the minority that excel at male-favoring tasks.

Work Cited

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Budget

1. Compensation for hours spent:

|  |  |
| --- | --- |
| **Activity** | **Estimated hours spent** |
| Constructing mood surveys and skill tests | 20 |
| Recruiting participants | 10 |
| Distributing surveys and tests | 30 |
| Inputting data collected | 5 |
| Performing statistical analysis | 15 |
| Analyzing results and drawing conclusions | 10 |
| **Total** | **90** |

Estimated cost: $1,100

1. Cost associated with compensating participants and renting space:

Estimated cost: $2,000

1. Cost associated with materials (paper, ink, pens):

Estimated cost: $200

**Total estimated cost: $3,300**