

**Cognitive Task Performance and Anxiety Across Menstrual Phases:  
Understanding Through the Cross-Gender Identity Lens**

*Project submitted for partial fulfilment of the degree of*

MASTERS OF ARTS  
IN  
PSYCHOLOGY



THAPAR INSTITUTE  
OF ENGINEERING & TECHNOLOGY  
(Deemed to be University)

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## CERTIFICATION

This is to certify that the thesis entitled, 'Cognitive Task Performance and Anxiety Across Menstrual Phases: Understanding Through the Cross-Gender Identity Lens' is being submitted in partial fulfillment of requirements for the award of the degree of Master of Arts in Psychology, presented in the Thapar School of Liberal Arts & Sciences, Thapar Institute of Engineering and Technology, Patiala is a Bonafide work carried out under the supervision of Dr. Santha Kumari, Professor & Program Chair, Thapar School of Liberal Arts & Sciences, Thapar Institute of Engineering and Technology, Patiala and that no part of this project has been submitted for the award of any other degree.



(RHYTHM)

This is to certify that the above statement by the student concerned is correct and true to the best of my knowledge.



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## CANDIDATE'S DECLARATION

I hereby declare that the work presented in this thesis entitled, 'Cognitive Task Performance and Anxiety Across Menstrual Phases: Understanding Through the Cross-Gender Identity Lens' submitted in partial fulfillment of requirements for the award of the degree of Master of Arts in Psychology, presented in the Thapar School of Liberal Arts & Sciences, Thapar Institute of Engineering and Technology, Patiala, is an authentic record of my work carried out under the supervision and guidance of Dr. Santha Kumari, Professor & Program Chair, Thapar School of Liberal Arts & Sciences, Thapar Institute of Engineering and Technology, Patiala and refers other researchers' work which is duly listed in the reference section.

The matter embodied in this thesis has not formed the basis for awarding any other degree at this or any other university.

Date- 20.05.2025

Place- Patiala, Punjab



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This is to certify that the above statement by the student concerned is correct, valid, and accurate to the best of my knowledge.



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## DECLARATION

I, Rhythm (862302043), a student of M.A. Psychology (2023-2025), Thapar School of Liberal Arts & Sciences, Thapar Institute of Engineering and Technology, Patiala, have completed the project entitled, to investigate the ‘Cognitive Task Performance and Anxiety Across Menstrual Phases: Understanding Through the Cross-Gender Identity Lens.’

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## ABSTRACT

The study aims to explore the impact of cross gender identity and menstrual cycle phase (luteal and menstrual) on cognitive task performance and anxiety across females aged 18-26 years from northern urban Indian region. The study makes use of three cognitive performance tasks, namely, Spatial Ability Task from the General Ability Test Battery, Stroop Task and Wisconsin Card Sorting Task. State Trait Anxiety Inventory is also utilized to understand anxiety levels across menstrual phases. The study focuses on the differences across menstrual phases (luteal vs menstrual) and cross gender identity scores (low vs high) and how they interact with cognitive task performance and anxiety levels. Findings of the study presents significant difference in all the cognitive tasks across menstrual phases with generally better performance in menstrual phase than luteal. But cross gender identity scores did not present a statistically significant interaction with performance on cognitive tasks across menstrual phases. Anxiety levels also differ across phases of menstrual cycle. However, there is no significant interaction with cross gender identity scores across different menstrual phases. These findings point towards the fact that hormonal variations do play a major role in assessing cognitive performance and helps us understand the emotional state of females. These findings can be helpful in educational and occupational sectors. Further to expand this study with cross gender identity, incorporation of hormonal assays with larger sample can help develop more concrete results as compared to the questionnaire used in this study.

Keywords: Menstrual Cycle, Cross-Gender Identity, Cognitive task performance, Anxiety, Executive Functioning, Spatial Ability, Hormonal Fluctuations.

# CHAPTER 1

## INTRODUCTION

Women undergo a myriad of changes throughout their lives. Some of these changes are often dismissed by saying ‘it’s just hormones’ but these hormones regulate much of emotional, psychological and physical spheres of their lives. Menstruation is linked with reproduction but it’s effect on the body goes beyond that. It plays a critical role in shaping attention, emotional regulation, memory and many other functions. The feeling females may experience where some days their mind is razor sharp, productive and functions efficiently while on some days there is this feeling of dullness, less productivity and efficiency. This is related to hormonal changes due to menstruation. Before we try to understand more about it, we should be clear about menstruation, its phases and what each phase entails.

### 1.1 The Menstrual Cycle

The female human body experiences flux and reflux of hormonal changes each month like a cycle. This cycle ensures a healthy body and proper functioning of the reproductive system. It is known as the Menstrual cycle where each part is accounted by certain hormonal fluctuations, leading to a lot of physiological and psychological changes.

The menstrual cycle marks its beginning with the start of your period or when you menstruate. It is the process when the egg inside the uterus isn’t fertile and the lining begins to shed. This cycle is of crucial importance when it comes to reproductive health and pregnancy. Absence or irregularity indicates various issues related to reproductive system and health like PCOS, pituitary or thyroid gland-based disease however mere absence is a big indicator of pregnancy. A typical cycle lasts between 24 to 35 days and is divided into 4 main parts.

## 1.2 Menstrual Cycle and Hormonal Changes

The *menstrual phase* (1-5 day) starts when you start bleeding indicating the beginning of your menstrual cycle. In this phase the lining of the uterus sheds containing blood, mucus and some cells from the lining.

The second stage, also known as, the *follicular phase* (5-18 day) begins right after menstruation. In this phase the lining of the uterus starts to thicken due to changing hormonal levels causing follicles to grow on the surface of ovaries. Only one of these follicles will grow up to become an egg which may not get fertilized later.

The third stage is the *Ovulation stage* when the mature egg is released from the ovaries to the uterus. This usually happens a week or two before the beginning of the menstrual cycle.

At last, there is the *luteal phase* where the egg has travelled from the ovaries to the uterus through the fallopian tube. The uterine lining begins to thicken and if the egg doesn't mature this lining begins to shed indicating presence of a period and absence of pregnancy.

In a general sense the first two stages are collectively known as the menstrual phase while the last two are the luteal phase. Women experience premenstrual syndrome (PMS) if they do not get pregnant and experience the following symptoms- Bloating, Tenderness or pain in breasts, Mood changes, weight gain, headache, food craving, etc.

The menstrual cycle is not a rigid cycle where everything is fixed. The interplay and fluctuations of hormones can lead to differences in each cycle, that is, for the days it goes on to the way a female experiences them.

In the menstrual phase levels of *estrogen and progesterone* are at its lowest. As the egg passes and signals the uterine lining to grow again, estrogen starts to rise.

In follicular stage, the pituitary gland produces a hormone called *follicle stimulating hormone (FSH)* which tells the ovaries to prepare an egg for ovulation. Production of estrogen continues here and is at its peak, this is when signal goes to the brain about this dramatic increase and *Luteinizing hormone (LH)* is released. This spike signals the egg about its released from the ovaries and to the uterus to mature, ovulation begins and soon after its estrogen levels begin to drop. After this the progesterone levels begin to rise which causes the uterine lining to stop thickening and prepare for a fertilized egg. Progesterone peak and then drops if pregnancy doesn't take place leading to PMS. Drop in both estrogen and progesterone cause menstruation. Studies have consistently showed impact of hormonal changes especially due to menstruation and how it can impact our performance. A recent study showed that cognitive performance in females fluctuates throughout the menstrual cycle, with better cognitive scores during the menstruation and poorer performance in the luteal phase (F. Ronca, 2024).

### **1.3 Sex vs Gender**

World Health Organization (WHO) defines gender as socially constructed roles, activities and behaviours that deemed fit for a male or female. While Male and Female are a way of defining sex (a biological construct- something you are born with), Masculine and Feminine is the way to refer a person's gender. Characteristics of a person's gender vary based on the sociocultural set up whereas sex-based characteristics remain comparatively constant.

There lies a difference in sex and gender but they are often seen as used synonymously. In the most basic sense, sex refers to chromosomes and genitalia and gender is based on social constructs, ascribes roles and is conventionally used as masculine or feminine (Frohard-Dourlent, 2017). Therefore, sex is a poor proxy for gender barring they have different

meanings and using that interchangeably can cause confusion like sex precedes and dictates gender (Bittner & Goodyear-Grant, 2017)

## **1.4 Cross Gender Identity**

We now know that sex and gender are different where gender is social construct which can change based on various factors like sociocultural factors. The American Psychological Association (APA) refers to this as '*Sex Role*' which can be explained as, the behaviours and attitudes typically linked to a particular sex, as defined by societal norms, are known as sex roles. These roles arise from a combination of biological factors and social influences.

However, individuals vary significantly in how strongly they display behaviours traditionally associated with their assigned sex.

In terms of this study the term cross gender identity in females can be operationalised as traits, responsibility and interests that differ from traditional norms. This identity is developed by an individual based on their own self-identity, wishes and internal sense. This can also differ from their assigned sex.

In light of this traditional females can be feminine, masculine feminine with more emphasis on their masculine side. Now this can be due to factors like personal choice, sociocultural environment, upbringing or hormonal factors. A study found that females who adopt higher degree of masculine identity have significantly higher levels of testosterone than feminine sex typed females (Baucom, 1985)

## **1.5 Cross Gender Traits and Behaviour**

Traits are particular characteristics that set individual apart. Cross Gender traits or Gender Variant Expression refers to exhibiting an individual's behaviour and attitudes a little or lot different than the prescribed gender norms. It can be seen in preference of tasks, appearance

and expression of thought. This can be due to an individual's nature (surrounding and upbringing) or nurture (due to biological factors and hormonal levels). However, adopting these cross-gender traits in normal when it comes to developing gender identity in children because it helps them develop their own gender identity, one with which they can conform with comfortably as an adult.

## **1.6 Cognitive Task Performance**

Cognitive tasks play a vital role in psychology as they require involvement of a lot of mental processes like attention, perception, decision making and problem solving. Performance on these tasks can be understood on the basis of-

- *Individual Characteristic* which includes Cognitive Capacities (working memory, general intelligence), Emotional Influences (mood, stress levels) and Biological as well as Gender related factor (Hormonal changes, which play a major part in this study)
- *Task Characteristics* which focus on the Complexity (need for extensive mental processes and control), Time Constraints (puts more cognitive load) and Task Type (like spatial or verbal task)
- *Environmental Context* which encompasses of Surroundings (silent spaces allow for better performances), Social Dynamics (task done alone or not) and Physical State (since cognitive task require a lot of focus, a person should likely not be in a fatigued or sleep like state for optimum performance).

## **1.7 Spatial Ability**

Spatial ability is a crucial skill that helps us navigate on a daily basis. It consists of mental rotation which involves 2 and 3 Dimensional objects (like the spatial ability task from

General Ability Test Battery) and Spatial Perception which allows us for understanding the orientation of one's own body (Martens and Antonenko, 2012). Spatial ability encompasses of skills that help us visualize and manipulate objects around us and due to this reason, it is also known as Visuo-spatial ability. It requires a great deal of cognitive capacity and processing to deal with mental rotations, spatial visualization and spatial perception.

MacIntyre et al. (2024) presented that other than threat perception, hormonal fluctuations in the body (like during menstrual cycle) modulate performance in spatial ability tasks due to heightened emotional states.

Spatial Ability is an important skill in almost every domain of work like architecture, medicine, engineering and an important asset in our day-to-day life navigation.

## **1.8 Executive Functioning**

According to Cleveland Clinic, executive functions are skill that us manage our day by planning. Problem solving and adaptation. These skills develop throughout life with experience but decline with age due to decrease in cognitive processing with age. Executive Functioning involves-

- *Working Memory*- It has limited capacity and store information temporarily. It is quickly manipulated and used based on requirement. Reasoning and comprehension as some complex tasks it is greatly involved in.
- *Cognitive Flexibility*- It deals with adaptation and adjustment to present circumstances. It can take in all the necessary information and pivot mentally to obtain the required or desired results. It puts on high cognitive load on an individual and it often shifts between mental tasks while resolving them simultaneously. People with high cognitive flexibility can think out of the box and can overcome mental rigidity.

- *Inhibition Control*- As the name suggests, it helps an individual control inhibitions or impulses or sudden urges to do something without thinking of consequences. It makes sure a person thinks before they act. During the follicular phase of the menstrual cycle, women tend to show less inhibition control due to elevated estrogen and dopamine.

## **1.9 Anxiety**

- Anxiety is a normal response to stress but if prolonged, it can turn into a mental health disorder. Some of its symptoms include- excessive worry, fear, rapid heartbeat, sweating, dizziness, changes in sleep and eating patterns. Even though both men and women suffer from anxiety, research points towards the fact that women are more prone to it.
- Anxiety plays a prominent role during menstrual cycle that females due to changes in the hormonal balance and are greatly noticeable for someone who suffers from premenstrual syndrome (PMS).
- During the menstrual phase (follicular and ovulatory), estrogen eventually peaks with low levels of progesterone. This allows an individual to have lower anxiety, stable mood, have emotional balance and eventually move towards confidence and sociability. But as we move towards the Luteal phase with lower levels of estrogen, peak of progesterone which suddenly plummets, there is onset of PMS leading to anxiety, tension, mood swings and difficulty in concentration.

## CHAPTER – 2

### REVIEW OF LITERATURE

Over a long period of time interaction between menstrual cycle and cognitive performance is being done. Literature exists and ranges for many years.

#### **2.1 Menstrual Cycle and Cognitive Functioning**

The impact of hormonal changes especially during the menstrual cycle and its impact of performance is well studied topic and show consistent impact on each other. A study showed that cognitive performance in females do fluctuate throughout menstruation with comparatively better scores during the menstrual phase as compared to luteal phase (A Ronca et al., 2014)

Menstruation brings in subtle hormonal fluctuations which can be seen through emotional reactions and cognitive functioning. A 2022 study by Le and Thomas focuses on the role of all the hormones involved in the menstrual cycle since previous research focused massively on just the role of estrogen. Both estrogen and progesterone impact our cognitive process and brain regions including hippocampus and the prefrontal cortex. However, both play different roles. Estrogen is involved in verbal memory and is at its peak during the follicular phase while progesterone which is at its peak during the luteal phase that counteract some of estrogen's impact.

#### **2.2 Sex and Task Performance**

One of the most controversial research topics due to its nature, effect and varied results due to its implications in social science, education, psychology, etc, is the understanding of cognitive abilities based on sex differences. Most reviews do state that there is not much

difference in general abilities and intelligence of males and females or those with higher masculine and feminine traits as compared to their biological traits (Nyborg, 2015). However, there may exist a difference when it comes to specific cognitive abilities (Nisbett, 2012). Women tend to do better on verbal fluency and grammar-based tasks (Halpern & Lamay, 2000) while men are often better at spatial tasks especially, mental rotation tasks (Voyer, Voyer & Bryden, 1995).

### **2.3 Cross Gender Identity and Cognitive Task Performance**

Nash (1979) proposed the sex-role mediation hypothesis, which focused on the idea that sex differences in cognitive abilities happen due to variation on sex-role differences. This means that those who associate more with masculine traits may perform better on spatial ability tasks whereas those who perform better on verbal tasks may associate more with feminine traits. Extensive research is done to understand the relationship between masculinity and spatial ability. A meta-analysis by Reilly and Neumann (2013) did present robust data with associations between masculinity and mental rotation tasks for both males and females. However less data is available to study the relationship between femininity and verbal tasks. However, with the current times, gender has become a much more fluid concept. Gender is a much talked about topic but due to individual differences, it can lead to controversial results. So merely relying in Nash's hypothesis is not enough and further exploration in this is important.

### **2.4 Menstrual Cycle, Gender Identity and Task Performance**

A study partially supported the idea that gender identity can affect cognitive abilities in ways that align with typical characteristics of the opposite gender. A study by Kennen et al (1992) by using trail making test of Halstead Reitan Neuropsychological Battery found that performance of females was better in the menstrual and follicular period as compared to that

in luteal phase. Studies have focused on studying the executive functioning using various test but not much literature exists for Wisconsin Card Sorting Task (WCST) which is employed in this study.

Berfield et al. (1986) explored how sex roles and EEG patterns influence spatial abilities. Results showed a negative relationship between spatial performance and masculinity which is contradictory to the conventional belief that masculinity improves these skills. The results from their EEG study showed differences in brain lateralization are more associated with sex roles than biological sex, pointing towards the idea that there is significant role of socialization and personal experience in shaping spatial abilities.

A study focused on effect of menstruation on cognitive and day to day tasks. The results concluded that menstrual phase does play a role in diminishing performance in cognitive tasks.

## **2.5 Menstrual Cycle and Cognitive Strategies**

Hormonal alterations, especially those involving estrogen and progesterone, have been observed to cause fluctuations in cognitive strategies throughout the menstrual cycle. When progesterone and estrogen levels are high, women tend to exhibit better spatial skills during luteal phase. This is because estrogen interacts with hippocampus which plays a major role in spatial memory and navigation leading better cognitive processes (Scheuringer & Pletzer, 2017)

On the other hand, in the follicular period, estrogen and progesterone are lower which may favour masculine trait associated females with better spatial performance. During this time women lean towards egocentric tactics, that is, depending on self-referential cues. A study showed that men frequently make use of egocentric tactics which are less affected by hormones leading to better performance in spatial tasks (Filippove et al., 2021).

Because of this, women may use cognitive methods during the follicular period that are more similar to those commonly seen in men, most likely as a result of the low hormonal modulation of spatial processing.

These findings underscore the role of hormonal variation in shaping cognitive strategies, demonstrating that cognitive performance is not static but rather influenced by the dynamic hormonal changes throughout the menstrual cycle. This insight has implications for understanding sex differences in cognition and highlights the importance of considering hormonal states in studies of cognitive performance.

## **2.6 Menstrual Cycle, Anxiety and Cross Gender Identity**

The female body experiences plethora of hormonal changes throughout their lives. The menstrual cycle is of 25-28 days and a lot fluctuations happen throughout that time making some phases more prone to anxiety (Handy et al., 2021). The premenstrual phase, where progesterone levels increase and then immediately drop induces high anxiety-like symptoms. This imbalance of hormones leads to mood disturbances, particularly anxiety and many females also experience premenstrual syndrome (PMS) during this time.

Also, evidence suggests that those with higher level of masculine traits due to biological factors (that is, those with higher testosterone levels) may experience less anxiety and mood disturbances (Berenbaum & Beltz, 2016).

## CHAPTER - 3

### RESEARCH GAP

#### 3.1 Research Gap

Menstrual cycle and cognitive performance are of major interest in research and studied over the years. However, while extensive research on cognitive task performance across the menstrual cycle phases (luteal and menstrual phases), these studies predominantly focus on females and males, that is, biological determinants without acknowledging the chief traits a person may constitute (which maybe dominant towards the opposite of their birth gender). There is limited research exploring cross-gender identity as a factor influencing cognitive task performance. A blind eye is often turned towards this. They usually experience different hormonal shifts and undergo different psychological and social impacts. Even though they are perceived as females and experience the same things, their perception and experience maybe different.

Therefore, this research is more inclusive by exploring performance of females across menstrual phases but based on their cross-gender identity scores obtained. For this study cognitive tasks, namely, the Wisconsin Card Sorting Task, GATB- Spatial Ability Task and Stroop tasks are put to use. Also, we will try to understand the difference in anxiety levels across high and low cross gender identity across in their luteal and menstrual phase.

This study aims to fulfil the above-mentioned gaps.

## **3.2 Objectives**

1. To study the variation in cognitive task performance across different menstrual phases
2. To study the effect of cross gender identity on cognitive task performance across different menstrual phases.
3. To study the effect of cross gender identity of anxiety levels across different menstrual phases.

## **3.3 Rationale**

Cognitive performance across the menstrual cycle has long been a topic of interest, with existing research primarily examining performance fluctuations during different phases, particularly the luteal and menstrual phases. However, much of this body of work has focused predominantly on binary biological sex (i.e., male and female), often overlooking the influence of gender identity and expression on psychological and physiological processes.

Individuals who identify with cross-gender traits—those whose gender expression or identity diverges from their assigned sex at birth—may experience the menstrual cycle differently due to unique psychological, hormonal, and social influences. This omission in research creates a gap while understanding individual differences which is essential for more inclusive and nuanced research.

To address this gap, current study tries to document changes in cognitive performance across menstrual and luteal phases by considering their cross-gender identity scores obtained.

Cognitive tasks such as the Wisconsin Card Sorting Task, the GATB-Spatial Ability Task, and the Stroop Task will be used to assess cognitive flexibility, spatial reasoning, and attentional control, respectively. Additionally, anxiety levels will be examined across

menstrual phases (luteal and menstrual) in relation to high and low cross-gender identity profiles.

Integration of gender identity, hormonal fluctuations, anxiety levels and task performance is crucial for this study aiming to enrich understanding of interaction of gender identity and biological processes on cognitive outcomes.

### **3.4 Hypotheses**

The present study aims to understand the impact of menstrual phases (menstrual vs luteal) and cross gender identity (low vs high) on cognitive task performance and anxiety. Based on the objective of this study and the present literature the following hypothesis can be formulated:

- Cognitive tasks are sensitive to hormonal fluctuations due to continuous rise and drop of estrogen and progesterone levels in females. Spatial ability tasks and Stroop task require cognitive manipulation of information, a skill highly influenced by hormonal fluctuations. From this, it can be hypothesised-

**H1:** There will be a significant difference in cognitive task performance across menstrual phases (luteal and menstrual) on the following tasks:

- GATB-Spatial Ability Task
- Stroop Task

- Wisconsin card sorting task is a popular neuropsychological test used to assess executive functioning which is again highly influenced by hormonal changes as seen in the menstrual phases (luteal and menstrual) of females. Luteal phase, characterized by increased progesterone levels leading to decreased cognitive control while Menstrual phase stabilizes estrogen which supports cognitive control and functioning. From this we can hypothesise:

**H2:** There will be a significant difference in cognitive task performance across menstrual phases (luteal and menstrual) on the following dimensions of Wisconsin Card Sorting Task:

- Total Trials
  - Total Errors
  - Preservative Responses
  - Preservative Errors
- 
- Anxiety is prone to hormonal fluctuations with increased levels in luteal phase due to sudden drop in estrogen and progesterone levels. When hormones comparatively stabilize in menstrual phase, anxiety reduces. From this we can hypothesise:

**H3:** There will be a significant difference in anxiety levels across the menstrual phases (luteal and menstrual).

- Cross gender identity may moderate the effects on cognitive tasks especially those which require spatial reasoning and cognitive flexibility. Those with higher cross gender identity scores present more masculine traits characterised with better cognitive performance due to higher testosterone levels. However, hormonal changes in females during menstruation may have a different effect. From this we can hypothesise:

**H4:** There will be a significant interaction effect between Menstrual phases (Luteal and Menstrual phase) and cross gender identity scores (Low and High) on cognitive performance on the following tasks:

- GATB-Spatial Ability Task
- Stroop Task
- Cross gender identity may moderate the effects on cognitive tasks especially those which require spatial reasoning, cognitive flexibility and manipulation. Those with higher cross gender identity scores present more masculine traits which may present to them as an advantage in cognitive tasks due to higher testosterone levels. However, hormonal changes in females during menstruation may have a different effect. From this we can hypothesise:

**H5:** There will be a significant interaction effect between Menstrual phases (Luteal and Menstrual phase) and cross gender identity scores (Low and High) on cognitive performance of the following dimensions of Wisconsin Card Sorting Task:

- Total Trials
- Total Errors

- Preservative Responses
- Preservative Errors
  
- Sudden hormonal shifts are associated with anxiety and can potentially be moderated by cross gender identity traits. Those with higher cross gender identity scores may exhibit comparative less anxiety levels due to testosterone's buffering effect. From this we can hypothesise:

**H6:** There will be a significant interaction effect between Menstrual phase (Luteal and Menstrual) and cross gender identity scores (Low and High) on anxiety levels.

## CHAPTER - 4

### METHODOLOGY

#### 4.1 Sample

38 female participants from urban Indian population. Participants were selected based on specific inclusion criteria. Eligible participants include women with regular menstrual cycle between the age group 18-26 (mean age = 22.74) were included. They were not on any oral contraception from the last 6 months and were not suffering from any hormonal issues like PCOS or Endometriosis. The sample was collected particularly from Punjab and convenience sampling was used in this study. This approach was chosen due to ease of access to the target population and resource constraints

#### 4.2 Design

This study uses both Within Subject Design and Between Subject Design. Within subject is employed while studying the cognitive performance across menstrual and luteal phases.

Between subject is used to study comparisons across cross gender identity groups.

##### Independent Variables-

- Menstrual Cycle phase (Luteal and Menstrual)
- Cross Gender Identity Scores

##### Dependent Variable-

- GATB- Spatial Ability task
- Wisconsin Card Sorting task

- Stroop Task
- Anxiety Level

### **4.3 Tools Used**

For this study the following tools were used of-

#### 1. Menstrual Cycle Questionnaire

It is a small form with 5 items to enquire about the current menstrual cycle phase of the individual. It was used twice, once during the menstrual phase and then in the luteal phase as well. It includes items like- are you currently menstruating? How long do your periods last, etc.

#### 2. Cross Gender Identity Questionnaire

Blanchard and Blanchard cross gender identity scale for females was used. It comprises 20 items and assesses the degree to which an individual identifies with the gender different from their birth assigned gender. Overall, this tool is designed to measure gender identity for those who were assigned females at birth.

#### 3. 3-Dimensional Space Perception Subtest of GATB (General Aptitude Test Battery)

The test comprises 40 illustrations of flat or 2-D sheets marked with dotted lines, indicating where they can be folded, rolled, or bent. For each item, participants are tasked with identifying the option that best represents how the given object would look after undergoing these transformations. Successful performance requires the ability to mentally visualize and rotate a two-dimensional shape into its three-dimensional counterpart. Participants are scored based on the number of correct answers completed within the six-minute time frame, with a maximum score of 40, where each correct response earns one point.

#### 4. Wisconsin Card Sorting Task

The Wisconsin Card Sorting Test (WCST), developed by David A. Grant and Esta A. Berg in 1948, is widely recognized as a measure of executive functioning. It evaluates an individual's ability to adopt and maintain an effective problem-solving strategy in response to changing stimuli to achieve a future goal. During the test, participants must match response cards to one of four key cards without being told the matching rule. Multiple scoring parameters are assessed in the WCST, including the number of trials completed, total correct responses, total errors, perseverative responses and errors, and non-perseverative errors, among others. The test has strong inter-scorer reliability for 11 of its scoring components, with coefficients ranging from 0.895 to 1.000, except for the "Learning to Learn" score, which showed a lower reliability ( $r = 0.658$ ). In terms of validity, the WCST has shown solid construct validity (Axelrod et al., 1992). Furthermore, the overall reliability of the instrument is excellent, with a Cronbach's alpha of 0.930 (Miranda et al., 2020).

#### 5. Stroop task

The Stroop Task is an assessment method used to measure selective attention, cognitive control, and processing speed. In this, there are 2 conditions, namely congruent and incongruent which go on for 40 trials. In this study colour Stroop was used where a colour name (like RED) is presented with an ink colour similar or different from the text. In the congruent condition the ink colour and the text are the same, for instance, RED text with RED ink. In the incongruent conditions the ink colour and text are different, for instance, RED text with GREEN ink. Only 4 colours are used in this, those are, Red, Blue, Yellow and Green. The Stroop effect (slower response time or more errors in the incongruent condition) is considered an indicator of executive functioning.

## 6. State Trait Anxiety Inventory (STAI)

It was developed by Spielberger and colleagues as a self-report tool to understand anxiety. It has 40 items, divided in half by 2 types, namely, State and trait anxiety.

State Anxiety is the short-term emotional condition and individual feels that is like situational worry or nervousness.

Trait Anxiety is long term emotional experience. This worried and nervous nature is inherent or innate to the individual.

### **4.4 Procedure**

The participants were first contacted to take part in the study. Then they consented to participate in the study. They were briefed about the study and instructed about the overall study however instructions were given before each experiment. They first had to fill in a menstrual cycle questionnaire which would tell us about the phase of their menstrual cycle. Participants in the study were counterbalanced, that is, sequences of people in menstrual and luteal phases were alternated. Then they were instructed to fill in the Cross-gender identity questionnaire. Then they were instructed to fill in a Self evaluation questionnaire which was the State Trait Anxiety Inventory (STAI). Cognitive task performance took place after the forms were filled. Participants performed the following tasks in random order- Wisconsin Card Sorting task, GATB- Spatial Ability Task and Stroop Task. Before their tasks were conducted the participants were clearly instructed how to do these. These tasks were also counterbalanced in each phase. Same procedure was followed for both luteal and menstrual phases with a 15–20-day gap between the two. Instructions were repeated each time. All the collected information was kept strictly confidential.

## **4.5 Statistical Analysis**

Data was handled in an organized manner using Microsoft excel which was later used for analysis. For the analysis part, Statistical Package for Social Sciences (SPSS) was used. In order to make sense of the data obtain we conducted Descriptive Statistics to understand difference in performance based on low or high cross gender identity scores. Repeated Measure ANOVA was conducted to understand the interaction between menstrual phases (Menstrual and Luteal phase) and Cross gender identity scores (Low and high) on different cognitive performance tasks (WCST, Stroop task and GATB). We also used Repeated measure ANOVA to understand the interaction between menstrual phases (Menstrual and Luteal phase) and Cross gender identity scores (Low and high) on Anxiety levels.

## CHAPTER - 5

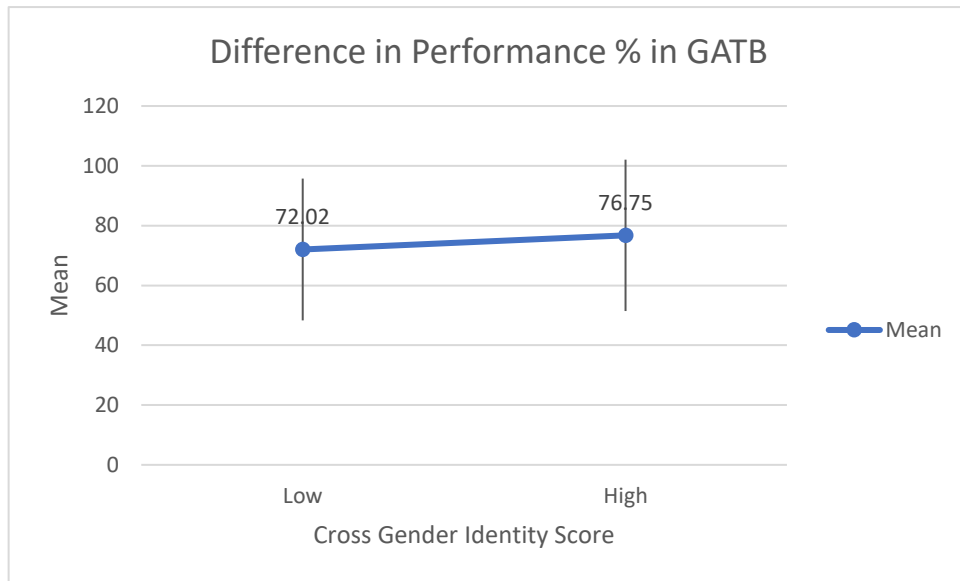
### RESULTS

Based on the present study statistical analysis was conducted and following data was obtained.

**Table 1-** Descriptives Statistics for Low and high scoring cross gender identity groups based on performance percentage in GATB (spatial ability task)

Performance %	CGI Score	N	Mean	Std. Deviation
	Low	19	72.02	23.71
	High	19	76.75	25.31

*Table 1 depicts that subjects with high cross gender identity scores have better percentage of improvement as compared to that of low cross gender identity scores based on the means. Mean for the low group is 72.02 with a 23.71 standard deviation while mean and standard deviation for the high group is 76.75 and 25.31 respectively.*



**Figure 1-** Difference in performance percentage in GATB task presenting improvement of performance in high scored cross gender identity group.

**Table 2-** Repeated Measure ANOVA Summary table for GATB

Source	Mean Square	F	Significance
Menstrual Phase	5853.80	30.422	0.000
CGI Score*Menstrual Phase	31.592	0.164	0.688

*Table 2 is a repeated measure ANOVA for GATB – spatial ability task. It depicts significant difference in performance between the menstrual phases whereas no interaction between menstrual phase and Cross gender identity scores.*

**Table 3-** Descriptives Statistics for Low and high scoring cross gender identity groups based on performance percentage in Stroop task.

Performance %	CGI Score	N	Mean	Std. Deviation
	Low	19	4.71	175.55
	High	19	-4.76	92.67

Table 3 depicts that subjects with low cross gender identity scores have better percentage of improvement as compared to that of high cross gender identity scores based on the means. Mean for the low group is 4.71 with a 175.55 standard deviation while mean and standard deviation for the high group is -4.76 and 92.67 respectively.

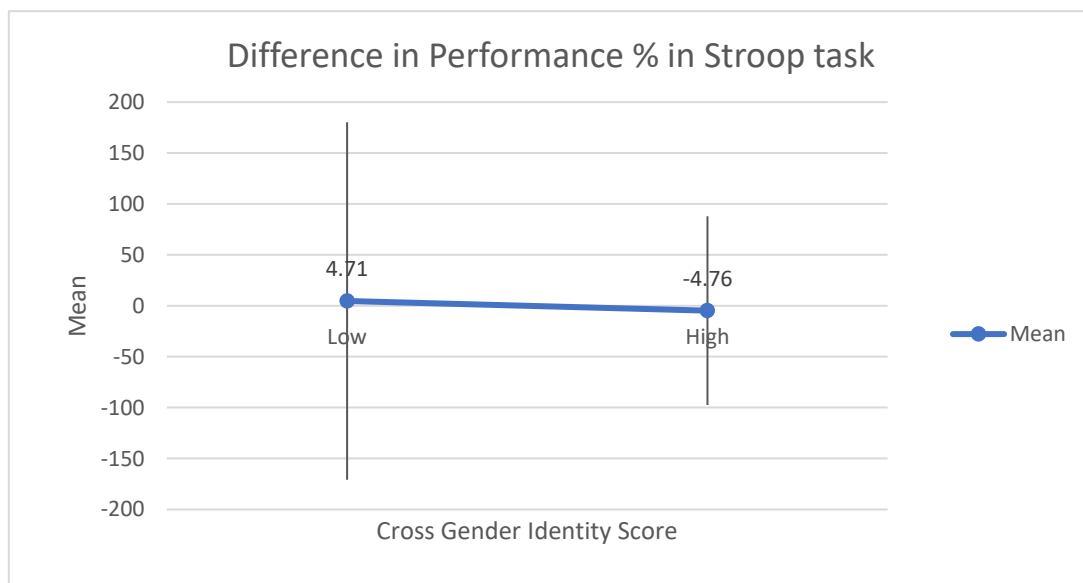


Figure 2- Difference in performance percentage in Stroop task presenting improvement of performance in low scored cross gender identity group.

**Table 4-** Repeated Measure ANOVA Summary table for Stroop task

Source	Mean Square	F	Significance
Menstrual Phase	222589.066	14.187	0.001
CGI Score*Menstrual Phase	30922.224	1.971	0.169

*Table 4 is a repeated measure ANOVA for Stroop task. It depicts significant difference in performance between the menstrual phases whereas no interaction between menstrual phase and Cross gender identity scores.*

**Table 5 -** Descriptives Statistics for Low and high scoring cross gender identity groups based on performance percentage in Trials of WCST

Performance %	CGI Score	N	Mean	Std. Deviation
	Low	19	46.17	21.79
	High	19	41.53	14.18

*Table 5 depicts that subjects with low cross gender identity scores have better percentage of improvement as compared to that of high cross gender identity scores based on the means. Mean for the low group is 46.17 with a 21.79 standard deviation while mean and standard deviation for the high group is 41.53 and 14.18 respectively.*

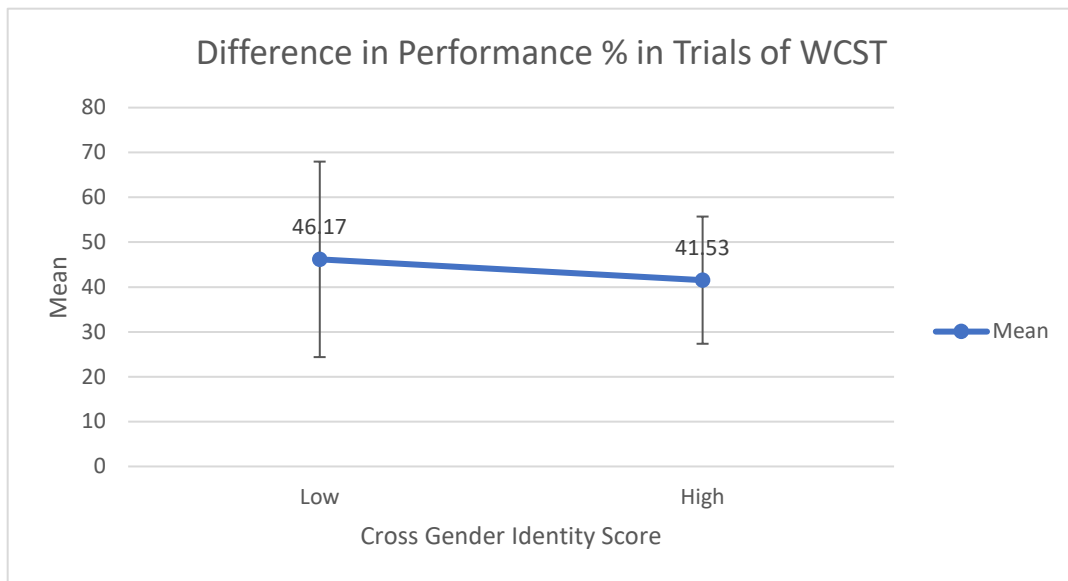


Figure 3- Difference in performance percentage in Trials of WCST presenting improvement of performance in low scored cross gender identity group.

**Table 6-** Repeated Measure ANOVA Summary table for Trials of WCST

Source	Mean Square	F	Significance
Menstrual Phase	1330.58	8.451	0.006
CGI Score*Menstrual Phase	189.47	1.203	0.280

*Table 6 is a repeated measure ANOVA for Trials of WCST. It depicts significant difference in performance between the menstrual phases whereas no interaction between menstrual phase and Cross gender identity scores*

**Table 7** - Descriptives Statistics for Low and high scoring cross gender identity groups based on performance percentage of Errors in WCST

Performance %	CGI Score	N	Mean	Std. Deviation
	Low	19	-21.21	20.80
	High	19	-23.71	19.36

Table 7 depicts that subjects with low cross gender identity scores have better percentage of improvement as compared to that of high cross gender identity scores based on the means. Mean for the low group is -21.21 with a 20.80 standard deviation while mean and standard deviation for the high group is -23.71 and 19.36 respectively.

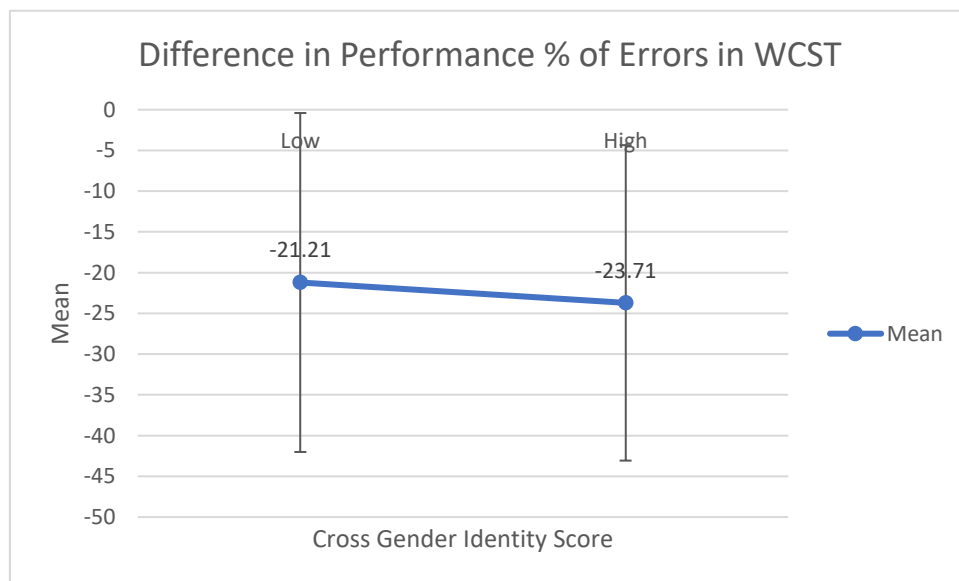


Figure 4- Difference in performance percentage of Errors in WCST presenting improvement of performance in low scored cross gender identity group.

**Table 8-** Repeated Measure ANOVA Summary table for Errors in WCST

Source	Mean Square	F	Significance
Menstrual Phase	500.33	9.797	0.003
CGI Score*Menstrual Phase	4.750	0.093	0.762

*Table 8 is a repeated measure ANOVA for Trails of WCST. It depicts significant difference in performance between the menstrual phases whereas no interaction between menstrual phase and Cross gender identity scores*

**Table 9-** Repeated Measure ANOVA Summary table for Perseverative responses in WCST

Source	Mean Square	F	Significance
Menstrual Phase	90.645	7.645	0.009
CGI Score*Menstrual Phase	20.013	1.688	0.202

*Table 9 is a repeated measure ANOVA for Perseverative responses in WCST. It depicts significant difference in performance between the menstrual phases whereas no interaction between menstrual phase and Cross gender identity scores*

**Table 10-** Repeated Measure ANOVA Summary table for Perseverative errors in WCST

Source	Mean Square	F	Significance
Menstrual Phase	59.07	8.09	0.007
CGI Score*Menstrual Phase	12.65	1.73	0.196

*Table 10 is a repeated measure ANOVA for Perseverative responses in WCST. It depicts significant difference in performance between the menstrual phases whereas no interaction between menstrual phase and Cross gender identity scores.*

**Table 11-** Repeated Measure ANOVA Summary table for Anxiety across phases based on CGI Scores

Source	Mean Square	F	Significance
Menstrual Phase	2478.37	22.315	0.000
CGI Score*Menstrual Phase	30.316	0.273	0.605

*Table 11 is a repeated measure ANOVA for Anxiety levels across phases and based on CGI scores. It depicts significant difference in anxiety levels between the menstrual phases whereas it presents no interaction between menstrual phase and Cross gender identity scores.*

## CHAPTER - 6

### DISCUSSION

The purpose of the study was to understand the interaction of cross gender identity and menstrual phases on anxiety levels and cognitive task performance in females between the age of 18-26. This study focused on the luteal and the menstrual phases of the menstrual cycle where the first 4-5 days were considered under the menstrual phase while the last 7-10 days were considered the luteal phase. To understand cognitive performance Stroop task, Spatial ability task from the General Ability Test Battery (GATB) and Wisconsin Card Sorting test was used. The State Trait Anxiety Inventory (STAI) was put to use to understand anxiety level across different menstrual phases. Blanchard and Blanchard's Cross Gender Identity Questionnaire was put to use to divide the sample in low and high Cross Gender Identity scores. Based on the questionnaire, those with low score presented typical feminine traits and those with high score exhibited masculine traits as well.

The findings of the study revealed significant difference across menstrual phases in cognitive tasks where females generally performed better in the menstrual phase. This indicates that hormonal fluctuations do play a major role in cognitive processes. These findings align with existing literature (Ronca et al., 2024 & Le & Thomas, 2022) which demonstrated that due to relatively stable estrogen and progesterone levels in the start of menstruation lead to optimal performance during the menstrual phase of the menstrual cycle.

When it comes to the findings of interaction effect of menstrual phases and cross gender identity score levels, no statistically significant result was produced. This points towards the fact that menstrual phases independently influence performance on cognition-based tasks and the degree of cross gender identity doesn't play a role or influences performance. However, these findings were inconsistent with that of Nash (1979) and Reilly & Neumann (201) who

focused on the idea that individuals with higher masculine traits may perform better on spatial ability tasks due to greater testosterone influence. But the present study was not able to gather significant evidence to support this hypothesis with menstrual cycle interaction.

In Spatial Ability Task from GATB, the results indicated the participants with high cross gender identity scores performed slightly better, although the interaction effect was insignificant. These findings somewhat align with a 1985 study by Baucom et al. who suggested that higher testosterone levels in females with masculine traits may have an advantage in spatial tasks. Nevertheless, insignificant interaction suggests that menstrual phases may exert more prominent effect on spatial task performance than degree of cross gender identity scores alone.

When it comes to the Stroop task, results indicated significant main effect with better performance in menstrual phase. Interestingly, participants with low cross gender identity scores produced better performance which slightly diverges from the existing literature by Reilly & Neumann (2013) which pointed towards the fact that higher testosterone in females with masculine traits would have an advantage at cognitive tasks. However, this discrepancy can be due to the nature of the Stroop task which requires more executive control and cognitive flexibility than spatial reasoning. As suggested by Pletzer & Steinbeisser (2017), it is plausible the heightened levels of estrogen levels in menstrual phase may facilitate executive functioning.

The last cognitive task was the Wisconsin Card Sorting Task (WCST) where participants in menstrual phase performed better with less trials taken to complete the task along with comparatively less errors. However, the lack of interaction between menstrual phases and degree of cross gender identity score indicate that hormonal fluctuations may overshadow any potential effect of cross gender identity scores on this task. These findings do align with

previous research which suggested that progesterone levels can impair cognitive flexibility (Solis-Ortiz et al. 2004). The perseverative responses and perseverative errors dimensions of WCST also do not present significant interaction among cross gender identity scores and menstrual phases. However, there is a difference in performance across menstrual phases, once again indicating influence of hormonal changes on task performance.

Anxiety in both the menstrual phases were assessed by State Trait Anxiety Inventory and there was a significant difference in overall anxiety levels across menstrual phases with high anxiety in luteal phase. This coincides with existing literature (Handy et al., 2021) that linked luteal phase with heightened anxiety due to drop of estrogen and progesterone levels before the start of the next menstrual cycle. However, no significant interaction was found between cross gender identity scores and menstrual phases, pointing towards the fact that hormonal fluctuations do increase anxiety levels but the degree of cross gender identity may not influence the relationship substantially.

## CHAPTER - 7

### CONCLUSION, IMPLICATION, LIMITATIONS AND SCOPE FOR FUTURE RESEARCH

#### 7.1 Conclusion

From this study we can conclude that cognitive task performance to study spatial performance and executive functioning along with anxiety levels are sensitive to hormonal fluctuations over the menstrual cycle. This leads to generally better performance in the menstrual phase. Also, higher anxiety levels in the luteal phase point towards the fact that the sudden drop in estrogen and progesterone may contribute to anxiety just before the beginning of the menstrual cycle.

This study wanted to exam the interaction between menstrual cycle phases and degree of cross gender identity (low vs high) to understand the impact of traits on performance. However, this study could not successfully conclude this.

Nevertheless, further exploration of this study with larger sample and lab testing of hormonal assays to get concrete results of cross gender identity differences based on hormonal differences could produce desirable results. The help of technologies like fMRI or EEG will provide direct evidence for neural basis for hormone effect on cognition.

#### 7.2 Limitations

1. The *sample size* of the study was limited or small which may restrict the results of this study and hence produce difficulty in the generalizability of this study.
2. This study did not include *hormonal assays* to quantify progesterone, estrogen and testosterone levels which could provide more precise insight in hormonal influences than

using a questionnaire to divide group of people in high or low degree of cross gender identity levels.

3. The study solely focused on the age group of 18-26 from Urban region of north India. Such *single population* limits the diversity of the sample.

4. The study use *convenience sampling* which can cause biases and limit the external validity of this study.

5. *Self-Report Measures* were used in this study to measure anxiety and cross gender identity scores which are prone to biases and social desirability.

### **7.3 Future Implications and Scope for Future Research**

1. *Inclusion of Hormonal Assays* where we can measure hormonal levels and get results qualifiable can contribute to a more comprehensive understanding of the cognitive fluctuation the basis of hormones.

2. A *Longitudinal Approach* where one can track cognitive performance and anxiety across multiple menstrual cycles can produce more robust findings.

3. The study can make use of *diverse population* with broader age range, cultural backgrounds and gender identities to get more generalizable insights.

4. Opting for *random sampling* can reduce bias of the study which may intervene due to convenience sampling.

5. Interventions can be developed to mitigate cognitive and emotional fluctuation that hinder optimum performance of females with practical implications in workplace and educational settings.

## CHAPTER – 8

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**APPENDIX- A**  
**INFORMED CONSENT**

Greetings,

I am Rhythm and currently pursuing MA Psychology from Thapar Institute of Engineering and Technology, Patiala. I am approaching you regarding my Master's Dissertation which is an essential part of my degree. My study pertains to understanding variations in human performance on specific tasks due to hormonal changes and your traits. Your participation will not be associated with any physical or psychological risk or harm.

The experiment would require 30-40 minutes of your time and I will also contact you for Phase 2 of the study in a few days.

The results of the study will be presented as part of my final viva and may contribute to scientific literature but your data won't be relived to anyone and will stay anonymous. Only grouped data will be used for the study.

If you wish to withdraw from this study at any point, you are free to do so.

If you have any questions, feel free to contact me at [rrhythm\\_ma23@thapar.edu](mailto:rrhythm_ma23@thapar.edu)

I, \_\_\_\_\_ (Full Name), understand that my participation in this study is voluntary and that I may refuse to participate or withdraw from it at any point without any penalty.

\_\_\_\_\_ (Signature of Participant)

\_\_\_\_\_ (Date)

## **APPENDIX B**

### **Menstrual Status Questionnaire**

1. Your Full Name- \_\_\_\_\_
2. Your Age (in years) \_\_\_\_\_
3. Average Length of your Menstrual Cycle (in days) \_\_\_\_\_
4. Are you currently Menstruating? \_\_\_\_\_
5. Number of days since the beginning of your previous/last Menstrual Period or Date of  
your previous/last Menstrual Period \_\_\_\_\_
6. Are you currently using any oral contraceptives? \_\_\_\_\_

## APPENDIX C

### Blanchard and Blanchard Cross gender identity scale for Females

In the following you will find a number of questions concerning your childhood and youth-hood preferences ,desires and feelings .

Read carefully the given answers and choose your answer .

Put a Tick mark( ✓ ) against the answer you choose

NAME :

SEX:

NO. OF YEARS OF EDUCATION :

DATE OF BIRTH :

DATE:

---

1) Between the ages of 6 and 12 , did you prefer

a) to play with boys

d) not to play with other children

b) to play with girls

e) don't remember

c) didn't make any difference

2) Between the ages of 6 and 12 ,did you

a) prefer boy's games and toys (football,soldier etc)

b) to play with girl's games and toys ( dolls ,sewing etc )

c) like / dislike both equally

d) had no opportunity to play games or with toys

- 3) In childhood, were you very interested in the work of a garage mechanic? Was this
- a) prior to age 6
  - b) between ages 6 and 12
  - c) probably in both periods
  - d) do not remember that i was very interested in the work of garage mechanic
- 4) Between ages 6 and 14 ,which did you like more ,romantic stories or adventure stories
- a) Liked romantic stories more
  - b) Liked adventure stories more
  - c) it did not make any difference
- 5) Between the ages 6 and 12 ,did you like to do jobs or chores which are usually done by men ?
- a) yes
  - b) no
  - c) don't remember
- 6) Between the ages of 13 and 16 ,did you like to do jobs or chores which are usually done by men ?
- a) yes
  - b) no
  - c) don't remember
- 7) Between the ages 6 and 12 when you read a story did you imagine that you were
- a) the male in the story (cowboy ,detective ,soldier etc )
  - b) the female in the story (the girl being saved ,etc )
  - c) the male sometimes and the female other times
  - d) neither the male nor the female
  - e) did not read stories

8) In childhood or at puberty ,did you like mechanics magazines? Was this

a)between the ages 6 and 12

b)between the ages 12 and 14

c)probably in both periods

d) do not remember that i like mechanic magazines

9) Between the ages 6 and 12 ,did you sometimes imagine yourself as being the courageous leader of others ?

a)yes

b)no

c) unsure

10) Between the ages 6 and 12 ,did you wish you had been born a boy instead of a girl ?

a)often

b)occasionally

c)never

11) Between the ages 13 and 16 , did you wish you had been born a boy instead of a girl ?

a)often

b)occasionally

c)never

12) Since the age of 17 ,have you wished you had been born a boy instead of a girl

a)often

b)occasionally

c)never

13) Do you think your appearance is

a) Very feminine

b)feminine

c)a little masculine

d)quite masculine

14) Between the ages 6 and 12, did you sometimes imagine, in your fantasies, yourself physically defending someone against a monster, dangerous animal or evil people?

- a) Prior to age 6
- b) Between ages 6 and 12
- c) probably in both periods
- d) do not remember such fantasies

15) In your childhood fantasies did you sometimes wish you could go hunting big game? was this

- a) prior to age 6
- b) between age 6 and 12
- c) probably in both periods
- d) do not remember such fantasies

16) In childhood, did you wish you could become very strong physically? was this

- a) prior to age 6
- b) between age 6 and 12
- c) probably in both periods
- d) do not remember the desire to become very strongly physically

17) In childhood was there ever a period in which you wished you would, when adult, become a dressmaker or dress designer? was this

- a) Prior to age 6
- b) Between ages 6 and 12
- c) probably in both periods
- d) do not remember having this desire

18) In childhood fantasies did you sometimes imagine yourself driving a racing car? was this

- a) prior to age 6
- b) between ages 6 and 12
- c) probably in both periods
- d) do not remember having this fantasy

19) In childhood ,did you ever wish to become a dancer ?was his

a)prior to age 6

c)probably in both periods

b)between ages 6 and 12

d)do not remember having this desire

20) In childhood did you ever wish to become a pilot ,or did you fantasize yourself being a pilot? Was this

a)prior to age 6

c)probably in both periods

b)between ages 6 and 12

d)do not remember having this desire