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THE EFFECT OF HORMONES ON STRESS AND MEMORY PROCESSES: A STUDY OF PTSD

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ABSTRACT

Studies have found that women are more than twice as likely as men to develop posttraumatic stress disorder (PTSD) following a trauma. To investigate this finding further, this study was designed to explore how hormonal variations in the menstrual cycle may affect the occurrence of intrusive memories and avoidance behaviors, two central features of PTSD. Women (n=30) were recruited into three experimental groups: naturally cycling women in the luteal phase, naturally cycling women in the follicular phase, and women on hormonal contraceptives. A comparison group of men (n=10) was also included in this study. All participants were asked to view a 10-minute clip from a film, which acted as an emotional stressor and an analogue traumatic event. Heart rate, diastolic blood pressure, and distress from the intrusive memories were also measured, along with the frequency of intrusive memories and avoidance behaviors following the film trauma. Primary results show that women on hormonal contraceptives experience significantly fewer intrusive memories following the film than naturally cycling women. In addition, women on hormonal contraceptives exhibited a decrease in diastolic blood pressure in response to the film whereas the other three experimental groups showed an increase in diastolic blood pressure. These results suggest that hormonal contraceptives may have a protective effect against extreme stress responses caused by menstrual cycle hormone variations, and may protect against the development of PTSD symptoms.

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Chapter 1

Introduction

Posttraumatic stress disorder (PTSD) is a psychiatric disorder that can develop in response to a severe trauma. Four clusters of symptoms characterize PTSD: re-experiencing, avoidance, hyper-arousal, and negative emotional states (APA, 2013). The re-experiencing symptoms primarily involve reliving the trauma through spontaneous, uncontrollable, and vivid flashbacks to the event. These experiences are known as intrusive memories. The avoidance symptom cluster includes any measure taken to avoid thoughts or situations that remind the individual of the trauma, such as avoiding certain locations, people, or events. Hyper-arousal refers to symptoms such as hyper-vigilance, trouble sleeping, difficulty concentrating, uneasiness, and increases in physical arousal. Finally, the negative emotional state cluster includes symptoms such as persistent self-blame and a negatively distorted view of oneself and the world (APA, 2013). The presence of all of these symptom clusters is needed in order to diagnose PTSD in an individual.

PTSD is frequently associated with the military and its returning soldiers. However, military veterans are not the only men and women who suffer from PTSD. Posttraumatic stress disorder is caused by a variety of traumas, including motor vehicle accidents, natural disasters, and sexual assault. It is estimated that 7.8% of Americans (24.5 million) will suffer from PTSD in their lifetimes (Kessler et al., 2005). In fact, it is estimated that 51% of women and 61% of men will experience at least one traumatic event that could potentially result in PTSD in his or her lifetime (Kessler et al., 2005). However, while men are more likely to experience traumatic events, research studies have found that women are more than twice as likely to develop PTSD

following such an event (9.7% to 3.6% (women to men); King, Vogt, & King, 2004; Kessler et al., 2005). These findings have led researchers to question why women are more prone to developing PTSD than men.

Previous research has explored several explanations as to the cause of this gender difference in PTSD prevalence rates. One explanation is that men and women experience different types of trauma with women experiencing more assaultive violence (Bresalau et al. 1999). Another theory is that certain trauma events have a different meaning to women than men and that these gender-specific post-trauma attributions have more effect on the gender difference than trauma exposure (Freedman 2002). An additional study explored women's inclination toward self-blame and how this may attribute to the gender difference (Tolin & Foa, 2006). More recently, studies have examined differences in fear response between the genders. One study proposes that women may be more vulnerable to PTSD due to heightened fear responses (Inslicht et al., 2012). However, none of these proposed mechanisms is sufficient to account for the magnitude of the gender discrepancy found in PTSD development following a trauma.

Researchers are now considering the possibility of unique male and female biology in elucidating this disproportion of PTSD development between the sexes. Because intrusive memories are a central feature of PTSD, among the proposed mechanisms accounting for the sex difference in PTSD development is the potential differences in male and female memory consolidation following the trauma. Considerable evidence suggests that high levels of stress-hormones, such as cortisol released during stressful events, play an important role on lasting memory and may facilitate memory over-consolidation (McGaugh, 2004). This memory over-consolidation, due to excess cortisol, is thought to create more strongly encoded memories. This intensified encoding may lead to a greater occurrence of memory intrusions following a trauma. Previous studies have implied that the menstrual cycle may also play an important role in this stress-related memory over-consolidation (Feree & Cahill, 2009; Bryant et al., 2011; Feree,

Kamat, & Cahill, 2011; Ertman, Adreano and Cahill, 2011; Felmingham, Fong and Bryant; 2012). This pilot study aims to further examine the interaction between the menstrual cycle status and emotional memory consolidation.

Previous research has indicated that women who are in the luteal phase of the menstrual cycle during a traumatic event are at a greater risk of experiencing intrusive memories than those in the follicular phase (Bryant et al., 2011). The luteal phase is the latter half of the menstrual cycle, which starts with ovulation and ends with either menstruation or pregnancy. The primary hormone involved with the luteal phase is progesterone. There is an elevated level of progesterone during the luteal phase, which is likely to be a contributing factor in the increased level of memory intrusions for these women following a trauma. The excess progesterone during the luteal phase can bind to glucocorticoid receptors, facilitating an increase in cortisol released during a stressful or traumatic event (Kanjantie & Phillips, 2006; Kudielka & Kirschbaum, 2005; Aletmus et al., 1997; Bryant et al., 2011). Furthermore, studies have shown that increases in cortisol levels enhance emotional memory and improve long-term recall of emotionally arousing material (Buchanan & Lovallo, 2001; Wolf, 2009). This positive association among progesterone, cortisol, and memory intrusions following a stressor has been found in both laboratory (Feree & Cahill, 2009; Feree, Kamat, and Cahill, 2011) and hospital settings (Bryant et al., 2011).

Hormonal contraceptives, which serve to diminish naturally occurring peaks in progesterone during the mid-luteal phase, may decrease intrusive memories following trauma (Feree, Wheeler, and Cahill, 2012), thus potentially mitigating the association between the menstrual phase and stress related memory over-consolidation. Findings have indicated that hormonal contraceptives decrease the level of cortisol released following a stressor (Kirschbaum et al 1999; Kudielka and Kirschbaum, 2005) and can result in inhibited recall of emotional material in a laboratory setting (Nielson et al., 2011). Additionally, women on hormonal

contraceptives have been found to have fewer re-experiencing symptoms following a sexual assault compared to naturally cycling women (Feree, Wheeler, and Cahill, 2012).

While the aforementioned research has made great strides in potentially explaining the gender discrepancy in PTSD development, the topic necessitates further replication and exploration. The current literature has a few key limitations. First, the studies mentioned have only examined memory intrusions over a 48-hour period following the stressor (Flemingham, Fong & Bryant, 2012; Ferree & Cahill, 2009; Ferree, Kamat & Cahill, 2011). Furthermore, all studies examining the relationship between the menstrual cycle and intrusive memories thus far have relied solely on retrospective estimates of intrusions (Ferree & Cahill, 2009; Ferree, Kamat & Cahill, 2011). Real-time recording of intrusions has not been introduced into a study involving the menstrual cycle as of this time. This study, however, will rely on real-time recording of intrusions rather than retrospective reporting. The methodology used in this study will allow for a more accurate and detailed account of intrusive memories than the studies previously mentioned.

Another significant limitation in explaining the gender differences in PTSD using the research outlined above is that re-experiencing is only one cluster of symptoms needed to diagnose PTSD. Whether hormone variation affects the development of the other three symptom clusters of PTSD remains unknown. However, researchers have theorized that re-experiencing symptoms should evoke avoidant behavior in PTSD patients (Foa, Zinberg, and Rothbaum, 1992; Taylor, 1998). Empirically supporting this theory, one study found that the re-experiencing symptoms in female rape victims explained the majority of their avoidance behaviors as well (Feuer, Nishith & Resick, 2005). However, this link between re-experiencing and avoidance symptoms needs further exploration. In fact, avoidance behavior remains unexamined in relation to hormonal variation across the menstrual cycle phase. This is most likely due to the difficulty in measuring avoidant behaviors in a laboratory setting.

The remaining two clusters of symptoms needed to make a complete PTSD diagnosis are hyper-arousal and a negative mood state. Hyper-arousal, which involves increased physiological and psychological arousal lasting over an extended period, is thought to facilitate PTSD development (Yehuda & LeDoux, 2007; Pole, 2007). Hyper-arousal in response to stress is typically measured by changes in blood pressure, heart rate, breathing rate, and sweat production (Cacioppo 1994; Wolf, 2008; De Kloet et al., 2005). Previous research has found a relationship between the PTSD symptom clusters of hyper-arousal and re-experiencing as well. This particular research indicates that higher levels of physiological arousal, including hyperventilation, blood pressure and heart rate, in response to a stressor are related to increased intrusions (Resnick, 1997; Hopwood & Bryant, 2006; Nixon & Bryant, 2005).

Whether the hyper-arousal symptom cluster is affected by hormonal variation in the menstrual cycle is highly debated and inconsistent. Some research suggests that women in the luteal phase have modulated autonomic arousal (Sun et al., 2012) while other studies have found no significant difference in autonomic arousal between the follicular and luteal phase (Strauss, Schultheiss, & Cohen, 1983). Additionally, the effect of hormonal contraceptives on physiological arousal has not yet been explored (Kanjantie & Phillips, 2006). Therefore, exploring how the menstrual cycle and hormonal contraceptives affect hyper-arousal may be crucial in fully understanding the gender discrepancy in PTSD.

This pilot study aims to explore the relationships between analogues to each PTSD symptom cluster and the hormonal status of participants. First, this study aims to replicate prior findings that the luteal phase of the menstrual cycle is associated with more intrusive memories than the follicular phase. In addition, this study aims to replicate findings that women on hormonal contraceptives will have fewer intrusive memories than naturally cycling women, given that hormonal contraceptives keep estrogen and progesterone at consistently low levels (Feree, Wheeler, and Cahill, 2012). It is expected that women in the luteal phase will have significantly

more intrusions as compared to women in the follicular phase, women on hormonal contraceptives, and men. It is also expected that women on hormonal contraceptives will experience significantly less intrusive memories compared to naturally cycling women across the menstrual cycle, but will still differ significantly from the number of intrusions experienced by the comparison group of men.

The second aim of this study is to explore the differences in physiological and psychological response to a laboratory stressor across the menstrual cycle and among women on hormonal contraceptives. Previous research regarding physiological responses across the menstrual cycle has been inconsistent, potentially due to seriously limited validity of women's self-reported menstrual cycle phase (Hampson & Young, 2008). However, with the use of hormonal assays, this study will be able to accurately place female participants in the correct cycle phase. This will allow for better examination of any potential differences in physiological response between naturally cycling women (follicular and luteal phases) and women on hormonal contraceptives.

Given that there is excess cortisol circulating in women in the luteal phase of the menstrual cycle (Kanjantie & Phillips, 2006; Kudielka & Kirschbaum, 2005; Aletmus et al., 1997; Bryant et al., 2011), it is expected that these women will also exhibit heightened physiological response to a stressor when compared to women in the follicular phase, women on hormonal contraceptives, and men. This heightened response will be measured by more extreme changes in diastolic blood pressure and heart rate during the laboratory stressor. It is also predicted that women on hormonal contraceptives will have a more dulled physiological response due to their stability of progesterone levels compared to naturally cycling women. Similar to physiological response, it is predicted that naturally cycling women in the luteal phase of the menstrual cycle will have the strongest psychological response to the film stressor followed by women in the follicular phase. A stronger psychological response in this case refers to a greater

endorsement of negative affect traits. It is also predicted that women on hormonal contraceptives will experience a more dull psychological responses compared to naturally cycling women, endorsing fewer feelings of negative affect following the film.

Finally, this study aims to examine differences in avoidance symptoms across the menstrual cycle following the laboratory stressor. The study will also explore differences in avoidance symptoms in women taking hormonal contraceptives and men. Although avoidance is a major symptom cluster in PTSD, it has not been examined across the menstrual cycle thus far. It is predicted that women in the luteal phase will have more instances of avoidance behavior due to the link between re-experiencing and avoidance symptom clusters, and therefore, it is also hypothesized that women on hormonal contraceptives will exhibit fewer avoidance behaviors than naturally cycling women.

Chapter 2

Methods

Participants:

Participants for this study were recruited from the Pennsylvania State University's psychology department "subject pool" at University Park during the 2013 spring semester. Participants were recruited in roughly equal numbers to one of four experimental groups: naturally-cycling women in the follicular phase of the menstrual cycle (n=9), naturally-cycling women in the luteal phase of the menstrual cycle (n=11), women on hormonal contraceptives (n=10), and a comparison group of men (n=10). Following a mass screening discerning sex, trauma history, and contraceptive use, a total of 40 participants were run through the research design. Any individuals who screened positively for PTSD by scoring a 15 or greater on the Posttraumatic Diagnostic Scale (PDS; Sheeran and Zimmerman, 2002) were excluded from recruitment and participating in the study, so as not to trigger any existing symptoms. Women reporting endocrine disorders or repeated irregular cycles were excluded from the study. Additionally, any individual who reported having experienced sexual assault on the Traumatic Life Events Questionnaire (Kubany, Leisen, Kaplan, Watson, Haynes, et al., 2000) was excluded from the study due to the relevant content displayed in the laboratory stressor. The TLEQ was used to assess participants' history of trauma. Trauma frequency and degree of distress from the trauma was analyzed on a participant-to-participant basis to determine if the participant should be excluded from the study.

Recruitment:

Based on the data collected from the mass screening, eligible participants were emailed and given the basic study information. Women were also asked to report cycle regularity, cycle length, and the date of their last menstrual cycle. Women on hormonal contraceptives and men were scheduled into the lab when convenient.

Naturally cycling women interested in participating were asked to notify the lab via email on the first day of their cycles, at which time they could be appropriately scheduled into the follicular or luteal experimental groups. Women scheduled into the follicular phase condition were brought into the lab between days 1 and 4 of the menstrual cycle, while women in the luteal phase were brought into the lab between days 22 and 27, depending on individual cycle lengths.

To determine when the luteal phase participants would reach peak progesterone levels, the guidelines established by Hampson and Young (2008) were followed. These guidelines specify that the duration of the luteal phase is 13-15 days. To find the day of ovulation, the length of the luteal phase (13-15 days) was subtracted from the participant's reported cycle length, typically 28-30 days. The participant was then scheduled 7-10 days after this calculated ovulation date, which is the time when progesterone should be at its maximum (Holmes & Bourne, 2008).

Procedure:

Participants presented to the Relationships and Stress Research lab for an initial one-hour appointment. After giving consent to participate, all female participants were asked to provide one 2mL saliva sample. The sample was collected using the 'passive drool' method and frozen for analysis. The samples were then assayed, at a later date, for both estradiol and progestin to verify the participant's self reported phase of the menstrual cycle. The analyses also detected any hormonal elevation in women using hormonal contraceptives.

All participants were then administered a series of questionnaires and scales prior to viewing a laboratory film stressor. While participants completed these forms, baseline heart rate

and diastolic blood pressure were assessed. Readings were taken every 2 minutes until at least five successful baseline readings were recorded. Several pre-film measures were taken in order to acclimate the participant to the monitor and to ensure accuracy of the readings.

After completing the initial questionnaires, participants were asked to view a 10-minute clip from the Gaspar Noe movie entitled "Irreversible," which acted as an emotional stressor, or an analogue traumatic event. Physiological measures continued to be taken at two-minute intervals during this 10-minute film stressor and for six minutes following the stressor while the participant completed two additional scales.

After all the scales were completed and the final physiological measure was taken, participants were instructed to record any spontaneous intrusive recollections concerning the film for one (n=20) or two weeks (n=20) depending on the given condition. Participants in the one-week condition were instructed to return to the lab the following week for a brief 20-minute avoidance interview. This interview assessed the participant's emotional and behavioral avoidance of content related to the film stressor. Participants in the two-week condition continued recording any intrusive memories for an additional week.

Measures:

Trauma film paradigm

This study used the trauma film paradigm methodology (Lazarus et al., 1965; Lazarus, Opton, 1964; Lazarus & Alfert, 1964) as an emotional stressor. This method has been demonstrated to induce analogue PTSD-like symptoms in participants for up to a week following the viewing of the film (Holmes & Bourne, 2008). The film paradigm methodology involves watching a clip that closely simulates a real-life traumatic event. This event must depict "actual or threatened death or serious injury to the body or self" as outlined by APA criteria (1994) (Holmes & Bourne, 2008). The film paradigm methodology also requires that the film evoke a stress response (Folkins et al, 1968; Holmes et al, 2004; Holmes & Bourne, 2008) and produce

re-experiencing symptoms as a result of this induced stress (Holmes & Bourne, 2008; Butler, Wells & Dewick, 1995; Horowitz, 1975).

This film paradigm methodology has been used several times to study emotional memory and intrusions (Feree & Cahill, 2009; Feree, Camat, & Cahill, 2011;Verwoerd et. al, 2009; Nixon et. al, 2009; Laposa & Alden, 2008; Holmes & Bourne, 2008; Nixon, Nehmy, & Seymour, 2007; Butler, Wells & Dewick, 1995; Horowitz, 1975). In addition, two studies have used this film methodology in studying hormonal variation and its affects on intrusive memories (Feree & Cahill, 2009; Feree, Camat, & Cahill, 2011). Both studies found that women in luteal phase of the menstrual cycle experienced an increased number of intrusions following the trauma film. However, these studies were only conducted over a 48-hour period and relied on retrospective recall of intrusions.

The film paradigm used in the study is a 10-minute clip from the movie "Irreversible" by Gaspar Noe. The film depicted a real-life traumatic event involving both physical and sexual assault. This particular film has been used in previous studies and has been validated as a stressor, producing intrusive memories for a week following the initial viewing (Nixon, Nehmy, & Seymour, 2007; Nixon et. al, 2009; Nixon et. al, 2009).

Memory Diary: After leaving the initial one hour lab session, participants were asked to record any intrusive memories that occurred over a one or two week period, depending on the experimental condition. Participants were provided with both a paper and electronic diary to record intrusions. The cover of the paper diary included a detailed definition of intrusive memories (a spontaneous thought, image or dream) and instructions on how to input the intrusions onto the electronic diary. Each page within the diary contained identical questions concerning the content and context of each intrusion and the degree of distress it caused the participant. The paper version of the diary was given to the participants to ensure that the intrusions were recorded in a timely manner so that details of the intrusion were not lost. Previous

trauma film literature has considered the paper diary the most effective way to record accurate intrusions (Holmes & Bourne, 2008). The participants were instructed to copy any intrusions recorded in the paper diary to the electronic diary, either daily or as was convenient. The electronic diary was a posted survey on Psychdata.com. The survey contained the same questions that were asked in the paper diary. If the participant had an intrusion of the film while Internet access was available, the participant could forgo the paper diary step and enter the intrusion straight onto the electronic diary. Each entry into the electronic diary was coded with the participant's ID number so that the intrusion could be associated with the correct experimental condition. The frequency of intrusions as well as the content of each intrusion was analyzed.

Biological measures:

Salivary assays: Female participants were asked to provide one 2 mL sample of saliva so that estrogen and progesterone levels could be determined. Participants were asked not to eat or drink 30 minutes prior to the lab session. However, if a participant did not comply with this request, the sample was taken at the end of the study. To ensure the sample was not contaminated with food, participants rinsed out their mouths with water before the sample was collected. The sample was collected using the 'passive drool' technique. The saliva sample was labeled with the participant's number, the date, and the collector's initials and then placed in a -40 degrees C freezer for storage (Hampson & Young, 2008). After all the female saliva samples were collected, they were assayed for estrogen and progesterone, both of which have been validated as indicators of menstrual cycle phase (Ellison, 1993; Hofman, 2001; Gandara, LeResche & Mancl, 2007). These assays were used to confirm participants' self-reported menstrual cycle phase. The assays also assessed elevated hormonal levels in women on hormonal contraceptives.

Physiological measures:

Blood pressure and heart rate: Blood pressure and heart rate were measured simultaneously on the clinically validated Omron 10 SERIES upper arm blood pressure monitor

(Coleman et. al, 2008). The Omron monitor was used to take blood pressure and heart rate every 2 minutes with five readings before the film, five readings during the film, and two to three readings after the film. Multiple baseline readings were taken while the participants filled out the self-reported questionnaires to habituate the participant to the monitor and to ensure accurate baseline readings. Blood pressure and heart rates were averaged across baseline and post-film readings, respectively. The film blood pressures and heart rates were analyzed carefully to identify trends and/or peaks.

Health and Demographic Questionnaire: Participants were asked to fill out a form containing both health and demographic related questions. All participants were asked to report race, age, height and weight. Height and weight were reported so that BMIs could be calculated. Participants were asked about their smoking habits, as well as any history of endocrine disorders or psychotropic drug use. All participants were also asked the timing of different events associated with puberty such as age of body hair, blemish, and growth spurts. Female participants were additionally asked to answer gynecological questions concerning menstrual period regularity, prior pregnancies, the use of contraceptives, and the use of hormone replacement therapy.

The *Beck Depression Inventory* (BDI-II; Beck, Steer, & Brown, 1996) was used to assess baseline depression in participants. The BDI-II consists of 21 groups of questions that describe how the person has felt over the past two weeks. This scale assesses emotions such as sadness, self-dislike, worthlessness, and suicidal thoughts. The BDI-II scores each group of questions on a 0-3 scale. Zero signifies that person does not have the feeling listed and a three indicates a high intensity of that particular feeling. Therefore, a higher overall BDI-II score indicates a higher level of baseline depression. BDI-II total scores were assigned to participants by summing the (0-3) ratings for each of the 21 questions.

State-Trait Anxiety Inventory (STAI-I; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) was used to assess the participant's characteristic anxiety level, how they generally feel (trait) or how they feel in a given moment or following a specific event (state). The STAI-I is an anxiety inventory based on a 4-point Likert scale (0-3). The trait subscale lists a series of 20 statements that the participant either agrees with not at all, somewhat so, moderately so, or very much so. The trait subscale lists statements such as, "I feel pleasant", "I lack self-confidence", and "I am content." STAI-I state subscale was administered to participants immediately before and after viewing the film stressor. The state anxiety inventory also uses a 4-point Likert scale (not at all, somewhat so, moderately so, or very much so) to address a series of 20 questions. This set includes questions such as, "I feel calm", "I am jittery", and "I feel at ease." STAI-I scores were assigned to participants through the use of syntax software.

The *Traumatic Life Events Questionnaire* (TLEQ; Kubany, Leisen, Kaplan, Watson, Haynes, et al., 2000) was used to assess participants' history of trauma. The TLEQ consists of 22 specified traumas including natural disasters, motor vehicle accidents, sudden death of a loved one, and physical and sexual assault. For each trauma, it asks the frequency of the event, whether the event caused a sense of fear, helplessness or horror, and if the event caused serious injury. The last question on the list asks the participant to indicate which trauma was most distressing. Participants indicating sexual assault on this scale were excluded from the study so that prior exposure would not affect the results.

The *PTSD Checklist, Civilian Version* (PCL-C; Weathers, Litz, Herman, Huska, & Keane, 1993) was used to further investigate participants' most distressing trauma indicated on the TLEQ. The PCL-C measures all seventeen diagnostic criteria for PTSD listed in the DSM IV (APA, 1994). The PCL-C consists of a series of 17 questions pertaining to the past month. Participants answered these questions on a 5-point Likert scale from 1 (not at all) to 5

(extremely). Participants were given a score on the PCL-C by summing the answers to the seventeen questions.

The *Positive and Negative Affect Schedule: PANAS-X* (Watson & Clark, 1994) is a 60-item measure of positive and negative affect. This scale was given to participants following the film stressor to gauge their individual reactions. The affective states assessed include: fear, sadness, guilt, hostility, shyness, fatigue, surprise, joviality, self-assurance, attentiveness, and serenity. Each of these affective states was assessed through multiple emotions on the 60-item list. For example, the sadness affective state included the items "sad," "blue," "downhearted," "alone," and "lonely." Each item was scored on a 5-point Likert scale from 1 (very slightly, or not at all) to 5 (extremely). Participants were asked to fill out the scale based on current feelings, rather than over the past week as indicated on the original PANAS-X.

The *Analogue Avoidance Symptom Interview* is a study-constructed semi-structured 11-question interview used to assess emotional and behavioral avoidance of content related to the film stressor. The interview occurred one week after the initial lab session and lasted approximately 15 minutes. One of the four main symptom clusters of PTSD is avoidance. The APA defines avoidance as "efforts to avoid thoughts, feelings, or conversations associated with the trauma," or "efforts to avoid activities, places, or people that arouse recollections of the trauma," which explain emotional and behavioral avoidance respectively (2000). The interview targeted both types of avoidance with several questions each. Emotional avoidance was targeted through the following questions: "have you actively made efforts to avoid thinking or having feelings about the film clip you saw," "have you avoided discussing the film clip with anyone," and "have you been finding ways to distract yourself from thinking about the images or content of the film."

To measure behavioral avoidance, the following questions were asked: "have you actively made efforts to avoid activities, situations, or places that remind you of the film clip,

"after viewing this film did you change any of your normal routines" "after viewing the film, did you find yourself avoiding sexual contact," "have you changed anything to increase your sense of safety--for example, avoiding dark alleys, reduced drinking habits or, walking across campus with a friend," and "have you avoided any form of media such as television shows, movies or newscasts that discuss similar topics." Interviews were analyzed both by number of avoidance characteristics and by content of the avoidance. A full list of the questions asked during the Analogue Avoidance Symptom Interview can be found in Appendix A.

Chapter 3

Results

After receiving the results of the progesterone and estrogen saliva assays, ten participants were excluded from the data analyses because their hormone levels fell outside of the expected range for their given experimental group. The final sample size consisted of thirty participants. The results of this study are based on the data collected from naturally cycling women in the follicular phase (n=13), naturally cycling women in the luteal phase (n=4), women on hormonal contraceptives (n=3), and men (n=10). Twenty-one participants identified themselves as White (70%), two as Black (6.7%), three as Asian (10 %), one as Hispanic (3.3%), and three as mixed race (10%). The mean age of female participants was 19.25 (*S.E.* = 0.228) and the mean age of male participants was 19 (*S.E.* = 0.298).

Group differences in the experience of intrusions

The seventh day of the intrusion recordings were excluded from the data analysis due to the varying times in which the participants stopped recording on this final day of the week. The mean number of intrusions over the six days following the film stressor for all participants (n=30) is 2.10 (*S.E.*=0.277) with 95% confidence that the true population mean is between 1.53 and 2.67 for number of intrusions experienced in the six days following the film. The number of intrusions ranges from 0 to 6 with a standard deviation of 1.52. The distribution of intrusions during the six days following the film stressor had a skewness value of 0.582 (*S.E.*=0.427). Using the rule of thumb that any skewness value falling within +/- 2*SE skewness is acceptable; this skewness value does not violate the assumption of the proposed test. This suggests that the distribution has a mildly positive skew. The kurtotic value for this distribution is 0.071 (*S.E.*=0.833) indicating a

very slight platykurtic quality to it. Based on the Shapiro-Wilk test (w=0.916, p<0.05), however, the distribution of intrusions violates the assumptions of normality.

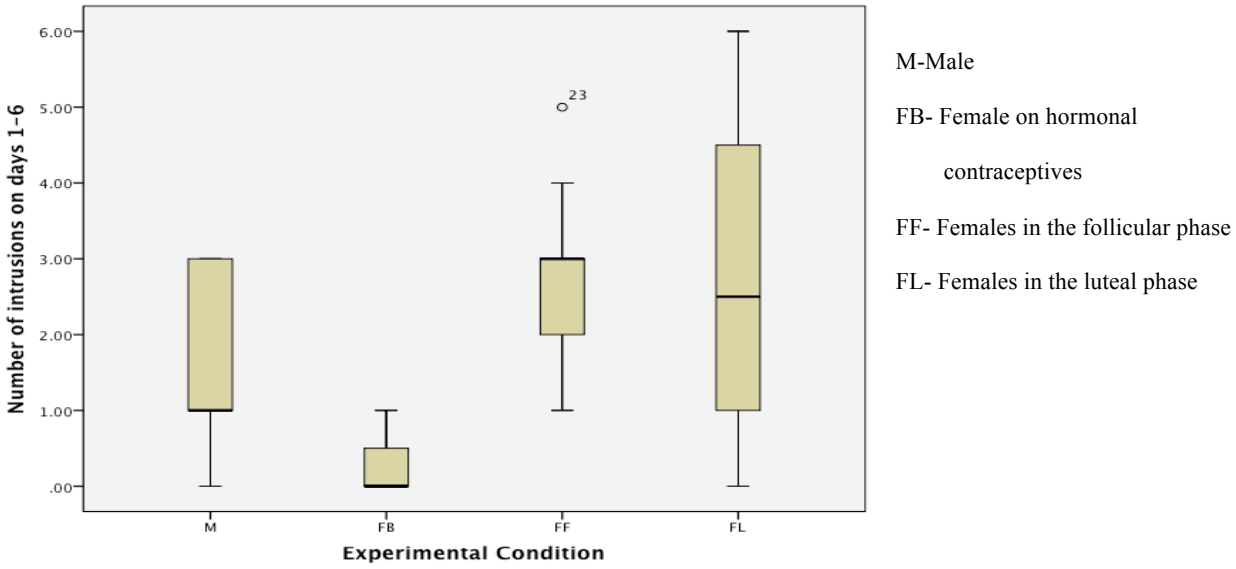
Descriptive statistics were performed separately for each experimental group for number of intrusions experienced in the six days following the film stressor. The mean number of intrusions for men (n=10) was 1.60 (*S.E.*=0.340) with 95% confidence that the true population mean among men is between 0.831 and 2.37. The number of intrusions ranges from 0 to 3 with a standard deviation of 1.07. The distribution of intrusions among men during the six days following the film stressor had a skewness value of 0.349 (*S.E.*=0.687). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the test. This value indicates a slight positive skew. The kurtotic value for the distribution of intrusions following the film stressor for men is -1.274 (*S.E.*=1.334), signifying a platykurtic distribution. Based on the Shapiro-Wilk test (w=0.826, p<. 05), the distribution of intrusions violates the assumptions of normality.

The mean number of intrusions experienced for women on hormonal contraceptives (n=3) in the six days following the film stressor was 0.333 (*S.E.*=0.333) with 95% confidence that the true population mean among women on hormonal contraceptives is between -1.10 and 1.77. The number of intrusions ranges from 0 to 1 with a standard deviation of 0.58. The distribution of intrusions among women on hormonal contraceptives during the six days following the film stressor had a skewness of 1.732 (*S.E.*=1.225). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the proposed test. This skewness value indicated a positive skew. Due to size of the sample, kurtotic values could not be estimated for this experimental group. Based on the Shapiro-Wilk test (w=0.750, p<. 05), the distribution of intrusions for women on hormonal contraceptives violates the assumptions of normality.

The mean number of intrusions experienced for naturally cycling women in the follicular phase (n=13) during the six days following the film stressor was 2.69 (*S.E.*=0.347) with a 95% confidence that the true population mean among women in the follicular phase is between 1.94 and 3.45. The number of intrusions ranges from 1 to 5 with a standard deviation of 1.25. The distribution of intrusions among women in the follicular phase during the six days following the film stressor had a skewness of 0.086 (*S.E.*=0.616). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the proposed test. This value indicates a very slight positive skew. The kurtotic value for the distribution of intrusions for women in the follicular phase is -.584 (*S.E.*=1.191), again indicating a slight platykurtic distribution. Based on the Shapiro-Wilk test (w=0.915, p>.05), the distribution of intrusions does not violate the assumptions of normality for women in the follicular phase.

The mean number of intrusions experienced for naturally cycling women in the luteal phase (n=4) during the six days following the film stressor was 2.75 (*S.E.*=1.25) with 95% confidence that the true population mean among women in the luteal phase is between -1.22 and 6.73. The number of intrusions ranges from 0 to 6 with a standard deviation of 2.50. The distribution of intrusions among women in the luteal phase during the six days following the film stressor had a skewness value of 0.560 (*S.E.*=1.014). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the test. This value indicates a mildly positive skew. The kurtotic value for the distribution of intrusions for women in the luteal phase is 0.928 (*S.E.*=2.619) signifying a nearly mesokurtic distribution. Based on the Shapiro-Wilk test (w=0.982, p>.05), the distribution of intrusions does not violate the assumptions of normality.

Figure 1-1. Group differences in the experience of intrusions.



A one-way Analysis of Variance statistical test (ANOVA) was performed to determine if there was a significant difference in the number of intrusions experienced during the six days following the film stressor across the four experimental groups (men, women on hormonal contraceptives, naturally cycling women in the follicular phase, and naturally cycling women in the luteal phase). The one-way ANOVA showed a significant difference between the experimental groups for number of intrusions experienced ($F(3,26) = 3.23$; $p = 0.039$). A Post Hoc LSD statistical test was conducted to determine which experimental groups were causing this significant difference in the number of intrusions in the six days following the film trauma. The LSD Post Hoc test showed that women on hormonal contraceptives experienced significantly fewer intrusions than both natural cycling women in the follicular phase ($p=0.012$) and naturally cycling women in the luteal phase ($p=0.029$).

Group differences in the experience of distress

The degree of distress each intrusion caused the participant, on a scale from 0 (no distress) to 5 (severe distress), was also analyzed. The average amount of distress caused by intrusions for all participants (n=30) was 2.15 (*S.E.*=0.197) with 95% confidence that the true

population mean for distress is between 1.75 and 2.55. The average amount of distress experienced by participants ranges from 0 to 4.00 with a standard deviation of 1.08. The distribution of average distress caused by each intrusion among all participants had a skewness value of -0.338 (*S.E.*=0.427). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the test. This value indicates a mildly negative skew. The kurtotic value for the distribution of average distress among all participants is -0.076 (*S.E.*=0.833), displaying a platykurtic distribution. Based on the Shapiro-Wilk test (w=0.927, $p<.05$), the distribution of average distress violates the assumptions of normality.

The average amount of distress reported by men following the intrusions was 1.55 (*S.E.*=0.244) with 95% confidence that the true population mean among men for distress is between 0.999 and 2.10. The average amount of distress experienced by men ranges from 0 to 2.50 with a standard deviation of 0.77. The distribution of average distress caused by each intrusion among men had a skewness value of -0.831 (*S.E.*=0.687). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the proposed test. This value indicates a negative skew. The kurtotic value for the distribution of average distress among men is 0.124 (*S.E.*=1.334), platykurtic distribution. Based on the Shapiro-Wilk test (w=0.899, $p>.05$), the distribution of average distress among men does not violate the assumptions of normality.

The average amount of distress reported by women on hormonal contraceptives following the intrusions was 1.50 (*S.E.*=0.764) with 95% confidence that the true population mean among women on hormonal contraceptives for distress is between -1.79 and 4.79. The average amount of distress experienced by women on hormonal contraceptives ranges from 0 to 2.50 with a standard deviation of 1.32. The distribution of average distress caused by each intrusion among women on hormonal contraceptives had a skewness value of -1.458 (*S.E.*=1.23). This skewness value is within +/- 2*SE of skewness and therefore does not violate the

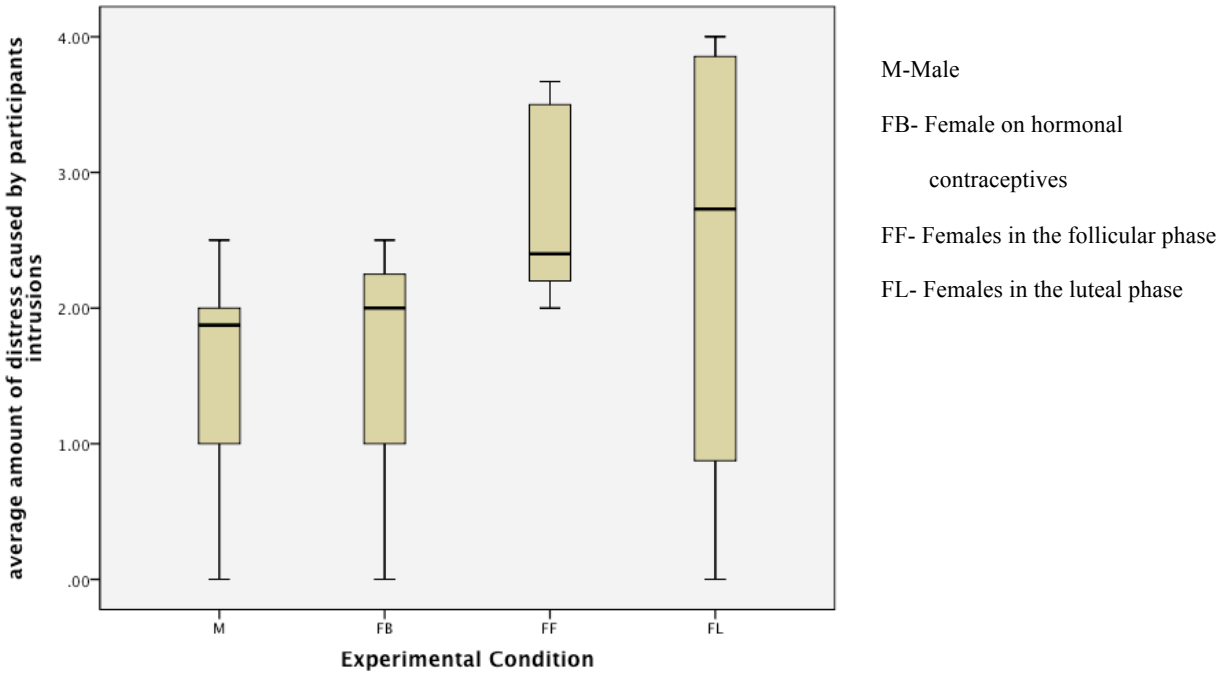
assumption of the test. This value indicates a negative skew. Again, due to size of the sample, kurtotic values could not be estimated for this experimental group. Based on the Shapiro-Wilk test (w=0.893, p>.05), the distribution of average distress for women on hormonal contraceptives does not violate the assumptions of normality.

The average amount of distress reported by naturally cycling women in the follicular phase following the intrusions was 2.70 (*S.E.*=0.190) with 95% confidence that the true population mean among women in the follicular phase for distress is between 2.28 and 3.11. The average amount of distress experienced by women in the follicular phase ranges from 2 to 3.67 with a standard deviation of 0.685. The distribution of average distress caused by each intrusion among women in the follicular phase had a skewness value of 0.449 (*S.E.*=0.616). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the proposed test. This value indicates a slightly positive skew. The kurtotic distribution of average distress among women in the follicular phase is platykurtic with a value of -1.826 (*S.E.*=1.191). Based on the Shapiro-Wilk test (w=0.812, p>.05), the distribution of average distress among women in the follicular phase does not violate the assumptions of normality.

The average amount of distress reported by naturally cycling women in the luteal phase following the intrusions was 2.37 (*S.E.*=0.933) with 95% confidence that the true population mean among women in the follicular phase for distress is between -0.61 and 5.34. The average amount of distress experienced by women in the luteal phase ranges from 0 to 4.00 with a standard deviation of 1.87. The distribution of average distress caused by each intrusion among women in the luteal phase had a skewness value of -.682 (*S.E.*=1.014). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the proposed test. This value indicates a slightly negative skew. The kurtotic value for the distribution of average distress among women in the luteal phase is -2.012 (*S.E.*=2.619), again platykurtic. Based on the

Shapiro-Wilk test (w=0.905, p>.05), the distribution of average distress among women in the luteal phase does not violate the assumptions of normality.

Figure 1-2. Group differences in the experience of distress.



A one-way Analysis of Variance statistical test (ANOVA) was performed to determine if there was a significant difference in the average amount of distress experienced following an intrusion across the four experimental groups. The one-way ANOVA showed a significant difference between the experimental groups for average amount of distressed caused by intrusions ($F(3,26) = 3.11$; $p = 0.044$). The Post Hoc LSD statistical test indicates that the significant difference in the average amount of distressed caused by intrusions is due to men having significantly lower levels of distress compared to naturally cycling women in the follicular phase (p=0.01).

Group differences in change in diastolic blood pressure

Diastolic blood pressure and heart was analyzed to assess participants' physiological reaction to the film. Average change in diastolic blood pressure was determined by subtracting

the average pre-film diastolic blood pressure from the average post film diastolic blood pressure The average change in diastolic blood pressure for all participants (n=30) was 0.79 (*S.E.*=0.959) with 95% confidence that the true population mean for change in diastolic blood pressure lies between -1.18 and 2.75. The change in average diastolic blood pressure ranges from -11 to 9 with a standard deviation of 5.26. The distribution of average change in diastolic blood pressure among all participants had a skewness value of -.511 (*S.E.*=0.427). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the test. This value indicates a slightly negative skew. The kurtotic value for the distribution of average change in diastolic blood pressure among all the participants is -0.375 (*S.E.*=0.833). Based on the Shapiro-Wilk test (w=0.952, p>.05), the distribution of average change in diastolic blood pressure among all participants does not violate the assumptions of normality.

The mean average change in diastolic blood pressure for men was 1.95 (*S.E.*=1.529) with 95% confidence that the true population mean for change in diastolic blood pressure lies between -1.50 and 5.41. The change in average diastolic blood pressure ranges from -7 to 8 with a standard deviation of 4.83. The distribution of average change in diastolic blood pressure among men had a skewness of -.270 (*S.E.*=0.687). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the proposed test. This value indicates a slightly negative skew. The kurtotic value for the distribution of average change in diastolic blood pressure among men is -0.660 (*S.E.*=1.334). Based on the Shapiro-Wilk test (w=0.965, p>.05), the distribution of average change in diastolic blood pressure among men does not violate the assumptions of normality.

The mean average change in diastolic blood pressure for women on hormonal contraceptives was -5.48 (*S.E.*=4.470) with 95% confidence that the true population mean for change in diastolic blood pressure lies between -24.71 and 13.76. The change in average diastolic blood pressure ranges from -11 to 3 with a standard deviation of 7.74. The distribution of average

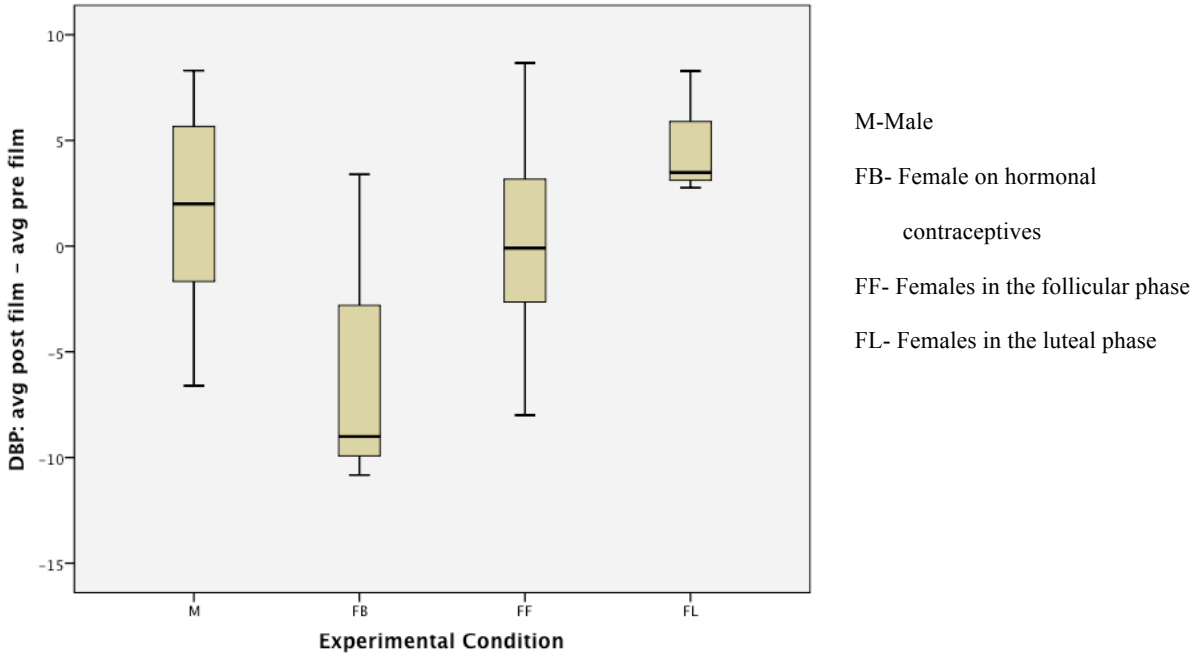
change in diastolic blood pressure among women on hormonal contraceptives had a skewness of 1.623 (*S.E.*=1.225). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the proposed test. This value indicates a positive skew. Due to size of the sample, kurtotic values could not be estimated for this experimental group. Based on the Shapiro-Wilk test (w=0.845, p>.05), the distribution of average change in diastolic blood pressure among women on hormonal contraceptives does not violate the assumptions of normality.

The mean average change in diastolic blood pressure for naturally women in the follicular phase was 0.19 (*S.E.*=1.291) with 95% confidence that the true population mean for change in diastolic blood pressure lies between -2.62 and 3.01. The change in average diastolic blood pressure ranges from -8 to 9 with a standard deviation of 4.66. The distribution of average change in diastolic blood pressure among naturally cycling women in the follicular phase had a skewness of -.051 (*S.E.*=0.616). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the proposed test. This value indicates a very slight negative skew. The kurtotic value for the distribution of average change in diastolic blood pressure among women in the luteal phase is -0.426 (*S.E.*=1.19). Based on the Shapiro-Wilk test (w=0.979, p>.05), the distribution of average change in diastolic blood pressure among women in the follicular phase does not violate the assumptions of normality.

The mean average change in diastolic blood pressure for naturally women in the luteal phase was 4.50 (*S.E.*=1.272) with a95% confidence that the true population mean for change in diastolic blood pressure lies between 0.46 and 8.55. The change in average diastolic blood pressure ranges from 3 to 8 with a standard deviation of 2.54. The distribution of average change in diastolic blood pressure among naturally cycling women in the luteal phase had a skewness of 1.890 (*S.E.*=1.014). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the proposed test. This value indicates a positive skew. The kurtotic value for the distribution of average change in diastolic blood pressure among women in the

luteal phase is 3.681 (*S.E.*=2.619). Based on the Shapiro-Wilk test (w=0.744, p<.05), the distribution of average change in diastolic blood pressure among women in the luteal phase does violate the assumptions of normality.

Figure 1-3. Group differences in change in diastolic blood pressure.



A one-way Analysis of Variance statistical test (ANOVA) was performed to determine if there was a significant difference in the average change in diastolic blood pressure before and after the film stressor across the four experimental groups. The one-way ANOVA showed there was no significant difference between the experimental groups for average change in diastolic blood pressure ($F(3,26) = 2.718$; $p = 0.065$). However, the p-value is small enough to indicate a trend in the data. The Post Hoc LSD statistical test indicates that there is a significant difference between women on hormonal contraceptives and both men (p=0.28) and naturally cycling women in the luteal phase (p=0.012). These significant differences, according to the Post Hoc LSD, are caused by women on hormonal contraceptives exhibiting an overall decrease in diastolic blood pressure unlike the other three experimental groups that displayed an overall

increase in diastolic blood pressure. No significant effects were seen when analyzing change in heart rate during the film stressor.

Group differences in the experience of positive and negative affect

Next, positive and negative affects of the participants following the film trauma were analyzed. The average endorsements of positive and negative affects were scored on a scale from 1 (very slightly, or not at all) to 5 (extremely). The mean average endorsement of positive affect for all participants was 1.87 (*S.E.*= 0.102) with 95% confidence that the true population mean for endorsement of positive affect lies between 1.66 and 2.08. The endorsement of positive affect for all participants ranges from 1 to 3 with a standard deviation of 0.56. The mean average endorsement of negative affect for all participants was 2.21 (*S.E.*= 0.125) with 95% confidence that the true population mean for endorsement of negative affect lies between 1.96 and 2.46. The endorsement of negative affect for all participants ranges from 1 to 3 with a standard deviation of 0.682.

Descriptive statistics were also performed for each experimental group for the average endorsement of positive and negative affect. The average endorsement of positive affect following the film stressor for men was 1.97 (*S.E.*=0.198) with 95% confidence that the true population mean for endorsement of positive affect lies between 1.52 and 2.42. The endorsement of positive affect for men ranges from 1 to 3 with a standard deviation of 0.627. The mean average endorsement of negative affect for men was 1.94 (*S.E.*= 0.215) with a 95% confidence that the true population mean for endorsement of negative affect lies between 1.93 and 1.95. The endorsement of negative affect for men ranges from 1 to 3 with a standard deviation of 0.679.

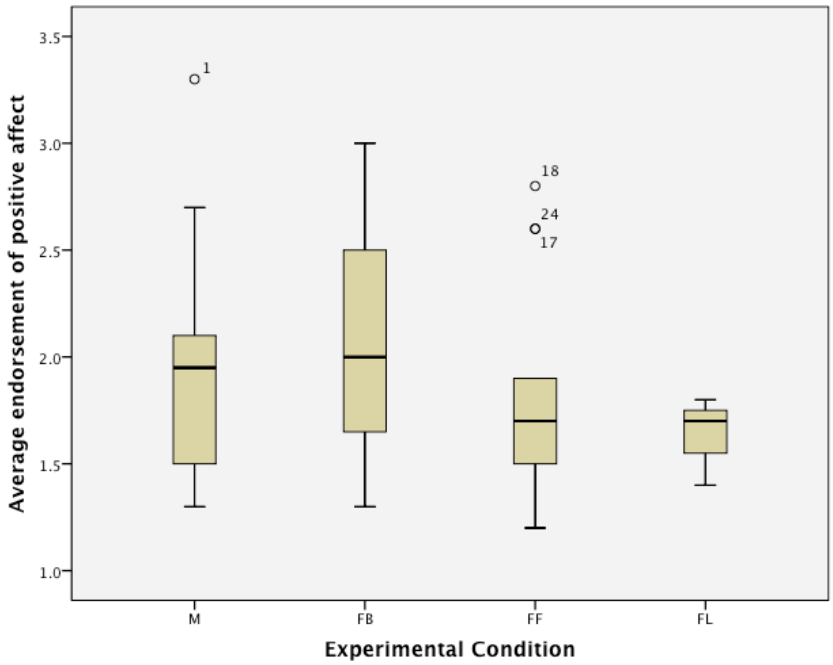
The average endorsement of positive affect following the film stressor for women on hormonal contraceptives was 2.10 (*S.E.*=0.493) with a 95% confidence that the true population mean for endorsement of positive affect lies between -0.02 and 4.22. The endorsement of positive affect for women on hormonal contraceptives ranges from 1 to 3 with a standard

deviation of 0.852. The mean average endorsement of negative affect for women on hormonal contraceptives was 2.53 (*S.E.*= 0.426) with a 95% confidence that the true population mean for endorsement of negative affect lies between 0.70 and 4.36. The endorsement of negative affect for women on hormonal contraceptives ranges from 2 to 3 with a standard deviation of 0.737.

The average endorsement of positive affect following the film stressor for natural cycling women in the follicular phase was 1.81 (*S.E.*=0.159) with a 95% confidence that the true population mean for endorsement of positive affect lies between 1.48 and 2.13. The endorsement of positive affect for women in the follicular phase ranges from 1 to 3 with a standard deviation of 0.539. The mean average endorsement of negative affect for women in the follicular phase was 2.39 (*S.E.*= 0.180) with a 95% confidence that the true population mean for endorsement of negative affect lies between 2.00 and 2.78. The endorsement of negative affect for women in the follicular phase ranges from 1 to 3 with a standard deviation of 0.647.

The average endorsement of positive affect following the film stressor for natural cycling women in the luteal phase was 1.65 (*S.E.*=0.087) with a 95% confidence that the true population mean for endorsement of positive affect lies between 1.37 and 1.93. The endorsement of positive affect for women in the luteal phase ranges from 1 to 2 with a standard deviation of 0.173. The mean average endorsement of negative affect for women in the luteal phase was 2.05 (*S.E.*= 0.371) with a 95% confidence that the true population mean for endorsement of negative affect lies between 0.87 and 3.23. The endorsement of negative affect for women in the luteal phase ranges from 1 to 3 with a standard deviation of 0.742.

Figure 1-4. Group differences in the experience of positive affect.



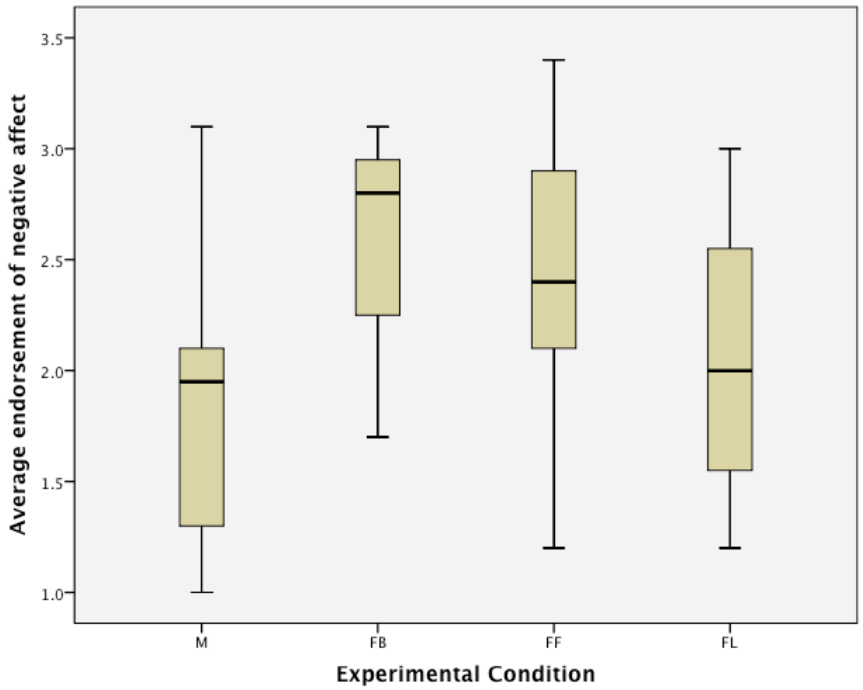
M-Male

FB- Female on hormonal contraceptives

FF- Females in the follicular phase

FL- Females in the luteal phase

Figure 1-5. Group differences in the experience of positive and negative affect.



A one-way Analysis of Variance statistical test (ANOVA) was performed to determine if there was a significant difference in the average endorsement of positive affect following the film stressor across the four experimental groups. The one-way ANOVA showed there was no significant difference between the experimental groups for average endorsement of positive affect ($F(3,26) = 0.508$; $p = 0.680$). One-way Analysis of Variance statistical test (ANOVA) was also performed to determine if there was a significant difference in the average endorsement of negative affect following the film stressor across the four experimental groups. The one-way ANOVA showed there was no significant difference between the experimental groups for average endorsement of negative affect ($F(3,26) = 1.148$; $p = 0.349$).

Group differences in avoidance behavior

Half of the original participants recorded intrusions for one week and were then asked to return to the lab for an analogue avoidance symptom interview. Of the sample of participants included in the data analysis (n=30), 14 participants completed the avoidance interview including five men, one woman on hormonal contraceptives, seven naturally cycling women in the follicular phase, and one naturally cycling woman in the luteal phase of the menstrual cycle. This subset of participants (n=13) was analyzed to determine if there was a difference in avoidance behaviors across the four experimental groups.

To perform this analysis, naturally cycling women, in both the luteal and follicular phase, were combined and compared to men when analyzing differences in avoidance behaviors. Women on hormonal contraceptives were not included in this analysis because the final sample only consisted of one woman on hormonal contraceptives who participated in the avoidance section on the study.

The average number of endorsed avoidance behaviors for men and naturally cycling women (n=13) was 3.92 (*S.E.*=0.780) with 95% confidence that the true population mean for avoidance behaviors lies between 2.22 and 25.62. The number of endorsed avoidance behaviors

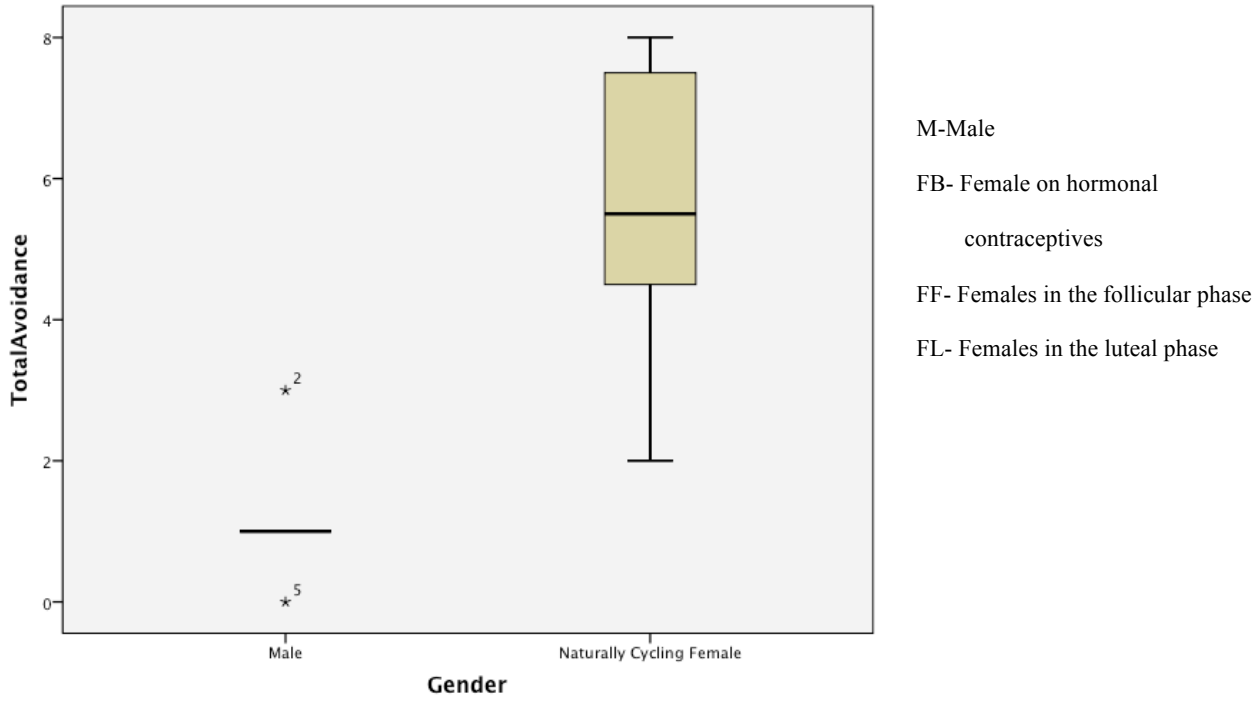
ranges from 0 to 8 with a standard deviation of 2.813. The distribution of average number of avoidance behaviors among men and naturally cycling women had a skewness value of 0.146 (*S.E.*=0.616). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the proposed test. This value indicates a slightly positive skew. The kurtotic value for the distribution of average number of avoidance behaviors among men and naturally cycling women is -1.429 (*S.E.*=1.191). Based on the Shapiro-Wilk test (w=0.922, p>.05), the distribution of average number of avoidance behaviors among men and naturally cycling women does not violate the assumptions of normality.

The average number of avoidance behaviors for men was 1.20 (*S.E.*=0.490) with 95% confidence that the true population mean for average number of avoidance behaviors among men lies between -0.16 and 2.56. The average number of avoidance behaviors among men ranges from 0 to 3 with a standard deviation of 1.095. The distribution of average number of avoidance behaviors among men had a skewness of 1.293 (*S.E.*=0.913). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the proposed test. This value indicates a positive skew. The kurtotic value for the distribution of average number of avoidance behaviors among men is 2.917 (*S.E.*=2.00). Based on the Shapiro-Wilk test (w=0.828, p>.05), the distribution of average number of avoidance behaviors among men does not violate the assumptions of normality.

The average number of avoidance behaviors for naturally cycling women was 5.63 (*S.E.*=0.730) with 95% confidence that the true population mean for average number of avoidance behaviors among men lies between 3.90 and 7.35. The average number of avoidance behaviors among naturally cycling women ranges from 2 to 8 with a standard deviation of 2.066. The distribution of average number of avoidance behaviors among naturally cycling women had a skewness of -.496 (*S.E.*=0.752). This skewness value is within +/- 2*SE of skewness and therefore does not violate the assumption of the proposed test. This value indicates a positive

skew. The kurtotic value for the distribution of average number of avoidance behaviors among men is -.247 (*S.E.*=1.481). Based on the Shapiro-Wilk test (*w*=0.941, p>.05), the distribution of average number of avoidance behaviors among naturally cycling women does not violate the assumptions of normality.

Figure 1-6. Group differences in avoidance behavior.



A one-way Analysis of Variance statistical test (ANOVA) was performed to determine if there was a significant difference in the average number of endorsed avoidance behaviors between men and naturally cycling women. The one-way ANOVA showed there was significant difference between the two groups for average number of endorsed avoidance behaviors ($F(1,11) = 19.113$; $p = 0.001$), with naturally cycling women reporting significantly more avoidance behaviors than men.

Chapter 4

Discussion

The first aim of this study was to replicate prior findings that the luteal phase of the menstrual cycle is associated with more intrusive memories than the follicular phase, due to hormonal variation in circulating levels of progesterone. While there was no significant difference found between naturally cycling women in the luteal phase and follicular phases in the number of intrusive memories experienced, there was a significant difference found for number of intrusions that naturally cycling women in general had, relative to women on hormonal contraceptives.

Previous research has found that women in the luteal phase tend to experience a greater number of intrusions than women in the follicular phase in response to a stressor (Feree & Cahill, 2009; Feree, Kamat, and Cahill, 2011; Bryant et al., 2011). This study was unable to replicate this finding, possibly due to a small sample size. However, this study does corroborate previous research that hormonal contraceptives may mitigate the association between the menstrual cycle phase and stress related memory over-consolidation—resulting in fewer memory intrusions experienced by women on hormonal contraceptives (Feree, Wheeler, and Cahill, 2012). This significant difference in the number of memory intrusions experienced between naturally cycling women and women on hormonal contraceptives suggests that hormonal contraceptives may protect against the variations in stress response caused by the menstrual cycle and may also protect against the development of intrusive memories following a trauma.

In addition to examining the frequency of intrusive memories across the experimental groups, this study also determined the amount of distress each intrusion caused the participant. A

significant effect was found for the amount of distress caused by intrusions across the experimental groups. This significant difference was primarily caused because men had significantly less distress from intrusions than women in the follicular phase. The pattern of distress showed that naturally cycling women in the follicular phase experienced the most distress from intrusions, closely followed by naturally cycling women in luteal phase. Women on hormonal contraceptives and men experienced a lower degree of distress, with women on hormonal contraceptives experiencing slightly more distress than men. This pattern may indicate that naturally cycling women not only experienced more intrusive memories, but that they may also be more distressed by the intrusions. This increased level of distress could possibly suggest that the intrusions are more vivid for naturally cycling women. This increased clarity in intrusions would support previous findings that higher levels of progesterone, and in turn cortisol, facilitate a stronger encoding of emotional memories.

The second goal of this study was to explore the differences in physiological and psychological response to a film stressor across the four experimental groups. While previous research regarding physiological responsivity across the menstrual cycle has been inconsistent, this study hypothesized that women in the luteal phase would experience a heightened physiological response, evidenced by an increase in diastolic blood pressure, given that there is excess cortisol circulating in women during the luteal phase of the menstrual cycle (Kanjantie & Phillips, 2006; Kudielka & Kirschbaum, 2005; Aletmus et al., 1997; Bryant et al., 2011). Additionally, it was hypothesized that women on hormonal contraceptives would have a dulled physiological response compared to naturally cycling women due to stabilized, low levels of progesterone, and therefore associated lower levels of circulating cortisol (Feree, Wheeler, and Cahill, 2012). Physiologically, the results did not show a significant difference in average change in diastolic blood pressure or in heart rate across the experimental groups; however, the results did display an interesting trend across conditions. The pattern in the data showed that women in

the luteal phase did exhibit the greatest increase in diastolic blood pressure as a result of the film; however, this difference was not significant assuming a 95% confidence level. In addition, while men and both groups of naturally cycling women exhibited overall increases in diastolic blood pressure throughout the film stressor, women on hormonal contraceptives experienced a decrease in diastolic blood pressure over the course of the film stressor. This decrease in diastolic blood pressure is an unusual response under stress. Normally, blood pressure increases under stress because the sympathetic nervous system, which is programed to respond to stress, increases heart rate and blood pressure, and widens the bronchial passages to increase respiratory rate (Jansen et al., 1995). Therefore, it is unclear why women on hormonal contraceptives experienced a decrease in diastolic blood pressure under the film stressor. This relationship needs to be further investigated. This decrease in diastolic blood pressure experienced by women on hormonal contraceptives may suggest that hormonal contraceptives dull physiological stress responses, potentially also resulting in decreased emotional memory consolidation.

In terms of psychological response to the film stressor, positive and negative affects were analyzed. While there was no significant difference among the groups for average endorsement of positive or negative affect, interesting patterns in the data were identified. It was predicted that naturally cycling women in the luteal phase would have the greatest endorsement of negative affect followed by women in the follicular phase. It was also hypothesized that women on hormonal contraceptives would endorse fewer negative affective qualities than naturally cycling women. Contrary to the hypotheses, the results show that women on hormonal contraceptives had the strongest endorsement of both negative and positive affect. However, this occurrence may be due to chance, given the small sample size included in these analyses. Interestingly, men endorsed positive affect more strongly than negative affect. Since this positive affect score is self-reported, it is possible that the men endorsed positive affect more strongly to show they were unaffected by the stressor or to avoid being viewed as weak.

Finally, this study hypothesized that women in the luteal phase would exhibit more instances of avoidance behavior than women in the follicular phase due to the link between re-experiencing and avoidance symptom clusters. Additionally, it was predicted that women on hormonal contraceptives would have the fewest occurrences of avoidance behavior also due to this link of intrusive memories and avoidance behaviors. Unfortunately, these hypotheses could not be directly tested due to a small final sample size that included only one woman on hormonal contraceptives in the avoidance condition. There was a significant difference, however, between men and naturally cycling women for number of avoidance behaviors. This significant difference may be caused by a number of factors. First, these women may have been significantly more aware of being alone at night or more aware of certain situations to avoid because they identified more closely with victim in the film who was also a woman. Another possible explanation for this significant difference in avoidance behaviors between naturally cycling women and men may be that men are less comfortable with admitting avoidance or fear of certain people or situations. These men may have had more avoidance behaviors than they were willing to admit.

Several factors potentially limit the findings of this study. Limitations to this study may stem from external validity issues, the sample of participants used, or the way in which the variables were operationalized. First, one limiting factor of the study may be the small sample size. Although forty participants were recruited in equal number across the four experimental groups, the saliva assays regrouped certain participants into unexpected conditions and eliminated other participants from the study entirely. This resulted in the study having an uneven distribution of participants across experimental conditions. Due to a small sample size, this pilot study had insufficient statistical power to detect potential differences across groups, which may have contributed to many of its null findings. Further, this limiting factor affects the generalizability of the study results.

The way in which the independent and dependent variables were operationalized may also be considered a study limitation. For instance, a limiting factor could be the means by which the dependent variable data was collected for this study. The results of this study were primarily based on self-reported measures, excluding physiological response and progesterone levels. Although this study improves upon previous research, which employed retrospective recall of intrusions, by collecting intrusions in real-time, participant compliance could be an issue in this study. Participants were expected to record any intrusive memory related to the film in the online diary as soon as it occurred; however, the number of intrusions each participant experienced may be underrepresented in the data if participants did not comply with this expectation.

Another dependent variable measurement that is potentially limiting is the analogue avoidance symptom interview, which has not yet been validated as a way of collecting avoidance behavior data. This interview was created specifically for this study to try to better understand the relationship between the occurrence of intrusive memories and avoidance behavior. This measure is crucial to the study because there is limited empirical data validating the presumed phenomenology of PTSD, and the way that re-experiencing and avoidance symptoms interact. Avoidance behavior (aside from cognitive thought suppression) has not been measured in response to analogue trauma given the difficulty of simulating avoidance in a laboratory setting.

In light of these limitations, it is suggested that future research in this area recruit a greater sample size that more evenly distributes women across the menstrual cycle. Also, as this study has established a somewhat low relationship between self-reported and biologically validated menstrual phase, future research is encouraged to use salivary assays as a means of making cycle determinations. Future researchers may also consider utilizing a community sample, given the limited generalizability and somewhat homogeneous characteristics associated with an undergraduate university population.

In spite of the limitations discussed, this study has several important implications for PTSD research. First, this study supports the findings of Feree, Wheeler, and Cahill (2012) that indicate that hormonal contraceptives may decrease the occurrence of intrusive memories following a trauma. In addition, this study provides evidence that higher levels of progesterone and cortisol, seen in naturally cycling women, may be linked to memory over-consolidation and therefore, may result in an increased number of intrusive memories in response to trauma.

Most importantly, this research study suggests that hormonal contraceptives may have a protective effect against the variations in stress response informed by menstrual cycle hormonal variability and may protect against the development of PTSD symptoms. However, more research needs to be conducted to extend this to PTSD.

Appendix A

Analogue Avoidance Symptom Interview

We are curious about your reaction to the film clip that you saw during your last visit to the lab. Specifically, we are interested in your thoughts and behavior both immediately after viewing the clip, and during the week following.

1. Have you actively made efforts to avoid thinking or having feelings about the film clip you saw?

2. Have you actively made efforts to avoid activities, situations, or places that remind you of the film clip?

3. Have you changed any aspect of your routine so that memories of this clip can be avoided?

4. After viewing this film did you change any of your normal routines? For instance did you become more conscious/fearful of walking alone at night?

5. Did you change anything to increase your sense of safety? For example avoiding dark alleys, reduced drinking habits or, walking across campus with a friend?

6. After viewing the film, did you find yourself avoiding sexual contact?

7. Has your sense of safety declined since viewing the film? Have you felt more aware of your gender, physique, strength etc.?

8. Have you discussed the content of the film with anyone?
    a. If so, did you find it hard to discuss?
    b. Did you avoid talking about it again after this initial conversation?

9. Have you avoided any form of media such as television shows, movies or newscasts that discuss similar topics that the film displayed?

10. Have you been finding ways to distract yourself from thinking about the images or content of the film? If so, how?

11. Have you experienced any decrease in feelings of happiness or love since viewing the film?

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Association Memberships/Activities

- Masters of Business Administration Association (MBAA)
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- Schreyer Honors College Student Council Member
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Professional Experience

Bristol-Myers Squibb **Plainsboro, NJ**

Global Procurement Business Analyst *1/12 - 6/12*

- Calculated price savings between branded and private label glassware products for over 300 items in company stockrooms to aid in the development of a more cost effective sourcing strategy.

- Analyzed competitive pricing for lab equipment and identified 21% savings opportunity.

- Categorized annual lab equipment budget to aid in Strategic Sourcing Council objectives.

- Analyzed annual pricing proposals for capital lab equipment to identify new areas of negotiation and potential savings.

- Utilized SAP and BI/BEx databases to pull spend information to discover market trends and supplement procurement strategies, which led to reductions in unnecessary spending.

Schreyer Honors College, Penn State University **University Park, PA**
Gateway Orientation Lead Mentor *1/13 - 9/13*

- Planned and restructured a one day Gateway Orientation to build a stronger and more unified Honors College community.

- Communicated and collaborated with all SHC staff members to successfully plan the event.

- Managed 220 new Gateway students and supervised 12 gateway mentors, delegating and overseeing execution of team tasks.

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- Partnered with the recruitment and selection team to conduct statistical analysis of admissions data to help determine number of acceptance offers for the class of 2017.

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