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The influence of menstrual cycle phase on threat recognition

Melanie Lynn Beaussart

THE INFLUENCE OF MENSTRUAL CYCLE PHASE ON THREAT RECOGNITION

A Thesis

Presented to the

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In Partial Fulfillment

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by

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ABSTRACT

The aim of this study was to assess the relationship between women's perception of different types of threats and the menstrual cycle. It was hypothesized that due to evolved anti-rape adaptations, ovulating women would have an increased affective response to threatening stimuli and that this reaction would cause a decrease in the time it takes for a woman to respond to that threat, especially if the scenario involves rape. Participants listened to audio vignettes that depicted situations of sexual, physical, and social threats with the instructions to indicate at which point they felt threatened and wanted to leave. Immediately following each vignette the participants rated their emotional and stress responses using the SAM Manikin. Although we found evidence that ovulatory status was related to how quickly women responded to situations that involved threats of rape, we could not attribute this to women's affective response to the stimuli.

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TABLE OF CONTENTS

CHAPTER ONE

EVOLUTIONARY PSYCHOLOGY AND MATING

The negative ramifications of sexual assault can include physical violence, psychological distress, unwanted offspring, and sexually transmitted disease, all of which extract a high cost in adaptive fitness. On the other hand, strict attunement to events predicative of sexual assault is highly consumptive of time and energy. Given the small window of time when conception is possible, it might be counterproductive to continuously maintain such a state of cognitive hypervigilance. Only during the time of ovulation, when a woman is most likely to conceive if inseminated, would the benefits of such increased vigilance and other rape avoidance strategies be likely to outweigh the physical and behavioral costs. Therefore, any adaptive mechanisms to decrease the chances of forced copulation might be expected to operate selectively, becoming more active during ovulation to prevent rape and less active at other times to save resources.

Adaptionism

The unifying theme behind evolutionary approaches to explaining social behavior is describing how the process of evolution through natural selection has shaped the way individuals relate to others. The proponents of this approach believe that certain aspects of social and cognitive psychology can be explained by examining the processes of natural selection and the conditions of our ancestral past that would have influenced our species' adaptive fitness. Adaptations are traits or behaviors that enable an organism to cope with environmental pressures. Such adaptations were "designed" by natural selection to give individuals who possessed them a heritable advantage over individuals who did not possess them in the evolutionary past (Williams, 1966).

Adaptations have a seemingly purposeful design that is unlikely to have arisen by pure chance; in fact, the very improbability (non-random functionality) of such traits is the best evidence for the role of natural selection in the first place. Thus, in attempting to decide whether a trait is a proper adaptation - as opposed to a random side effect of some other features of the organism - one of the key

criteria is the unlikely nature of that trait. Adaptations are unlikely to arise to by chance because of their complexity and their transparent relationship to the organism's fitness. In this thesis, I argue for the existence of a specific cognitive adaptation in human females that reduces the possibility of rape during the time of maximum pregnancy risk. Our argument, that the predicted patterns of behavior represent a true adaptation, rests precisely on the improbability of these patterns occurring by chance alone.

Adaptionism in Psychology

Within this framework, adaptive behavior is facilitated by the evolution of domain-specific psychological mechanisms (Tooby & Cosmides, 1992). These adaptations, which are driven by natural selection, are mechanisms that function via "decision rules" which are evoked by environmental cues. These adaptations produce specific perceptions or behavioral reactions which enable immediate decision making to adaptively relevant material that effectively solved recurrent problems over the course of our evolutionary history (Schaller, Park & Kenrick, 2006).

Sexual Selection

Though Darwin is most famously known for his theory of natural selection, his theory of sexual selection (Darwin, 1871) provides another potential mechanism for the evolution of human behaviors. Sexual selection theory asserts that, within any given species, one sex (in the case of humans, females) invest more in parenting and therefore has a lower reproductive ceiling (and lower variability) than the other. The number of mates a male can attract is closely tied to his reproductive success, whereas this factor is significantly less important to the overall reproductive success for females due to the prolonged gestation and lactation that is associated with each birth. Whether a woman has sex with 10 partners or is in a monogamous relationship with only one man, she will still usually only give birth to a single child a year. For this reason, the reproductive profit from attaining numerous mates appears to be much higher for males than for females (Symons, 1979). Females are therefore more restricted in how many offspring they can raise and consequentially should be more selective when choosing a mate. This phenomenon results in competition by the less

discriminating sex for the attention and mating rights of the more discriminating; in humans this translates to males competing for female attention.

Mating Strategies

The force of differential parental investments leads to crucial differences in the mating strategies of women versus men. Wilson (1978), for example, suggests that human males have evolved a more aggressive, capricious, and undiscriminating mating style than human females. Under this assumption, males are expected to be forceful in their pursuit of females in order to mate with them and pursue "mate quantity". Sometimes this takes the form of sexual coercion — i.e., rape. In contrast, given the intense reproductive cost coupled with the risk of sub-par male parental investment, females are likely to be more discriminating and may actively avoid mating with poor quality males. Wilson (1975) also contends that females are expected to resist the aggression of males in order to pursue "mate quality", and this has led some researchers to predict the existence of evolved adaptations to counter the forceful sexual advances of men.

Reproductive Fitness Cost of Rape

Reproductive fitness or the number of descendents that a woman has over time, can be substantially impaired by the cost of rape. To start, sexual assault resulting in conception is costly because it limits a woman's reproductive choices as to the timing of pregnancy and the identity of the reproductive partner. In addition, Ellis and Walsh (1997) and Chavanne and Gallup (1998) argue that if a woman conceives as a result of a sexual assault, it is unlikely that the perpetrator will contribute to raising the child. It may also be more difficult for the woman to find or keep a marital partner, as described by Thornhill and Thornhill (1983). Therefore, the victimized woman could incur a large cost to her ability to raise any current children as well as decreasing the likelihood of successfully rearing future children. Similarly, Bellis and Baker (1990) argue that if the woman has a reproductive partner when the sexual assault occurs and she conceives from the sexual assault, it may appear that she has been unfaithful to her partner, increasing her risk of being assaulted by him. Bellis and Baker further contend that once the child is born, it is unlikely that her partner

will dedicate as much of his resources towards a child that is not his, or he may neglect or abuse the child.

However, even if a woman does not conceive from a sexual assault involving intercourse, a woman who is raped may incur many costs to her general fitness over and above the costs that would be associated with an unwanted pregnancy resulting from consensual relations (Daly, 1978). Subsequently then, if sexual assault does result in reduced female adaptive fitness then this would set the stage for protective anti-rape adaptations (Thornhill & Palmer, 2000).

Examples of Anti-Rape Adaptations (Non-Cyclic)

Defensive adaptations can involve both psychological and social mechanisms designed to prevent rape from occurring. For instance, Pawson and Banks (1993) showed that women in their reproductive years are more anxious of being attacked outside their house and they tend to fear sexual assault more than women who were out of their reproductive years and more likely to fear burglary. One way for a young woman to subjugate this fear would be to mate with a male who will then protect her. Wilson and Mesnick (1997) offered the "Bodyguard Hypothesis" which

suggests that in primate species where unattached females are vulnerable to male aggression, females may try to mate with a high status male to obtain protection against other males. As a result human females might prefer to mate with strong protective men, especially in environments of high perceived sexual threat. Consistent with this theory women often perceive less risk of violence in public spaces when they are accompanied by a man (Valentine, 1989). Furthermore, human females may have preferences for bodily characteristics that are indices of a man's ability to protect them and their offspring from other men (Geary, Vigil & Byrd-Craven, 2004).

The "Bodyguard Hypothesis" may even extend to family members and not just mates. Some research suggests that the company of a male relative living within the proximity reduces the probability of a female family member being raped (Figueredo et al., 2001). One possibility is that a would-be rapist fears threats to his own well-being because of possible retribution by the sexual assault victim's relatives.

Likewise, women might also use alliances with other females to reduce the risk of rape. Research has shown that single females in the absence of social bonds with

other females are more vulnerable to violence from males (Perry, 1997; Smuts, 1992). An effective counter strategy in female-bonded societies is to use female-female coalitions to deter male violence (Brereton, 1995; Sterck, Watts & van Schaik, 1997). This suggests that there is an adaptive benefit for females to be social because it increases their ability to resist male aggression (Mesnick, 1997).

Though these ideas are compelling, to date there has been relatively little experimental work to investigate psychological mechanisms specific to anti-rape adaptations. Perhaps the first research to investigate psychological anti-rape adaptations was Thornhill and Thornhill (1990). They argued that the emotional trauma of rape functions to direct women's attention to the social and environmental variables that resulted in the rape, in order to steer clear of those conditions in the future. To support their hypothesis, they offered evidence that victims of sexual assault who are of reproductive age show more intense emotional distress than victims who have a decreased chance of any further reproductive success, such as menopausal women. This finding occurs even if physical violence is not used during the rape and is particularly pronounced in acts

of penile/vaginal penetration as opposed to oral or anal penetration. This suggest that some of the psychological consequences a woman may experience from a sexual assault act as a means of motivating her to avoid similar conditions in the future.

Cyclic Anti-Rape Adaptations

This thesis proposes an additional adaptation that serves the purpose of rape avoidance, namely, heightened vigilance to sexual threat at the time of peak risk, i.e., during the ovulatory phase of the menstrual cycle. Before considering this hypothesis in more detail, it will be helpful to provide some general background on the menstrual cycle and its influence on perception and cognition.

CHAPTER TWO

THE MENSTRUAL CYCLE

The Menstrual Cycle - General Background

Despite the fact that human females are receptive to sexual contact throughout the menstrual cycle, the risk of pregnancy is not constant during the entire cycle. Ovulation requires the coordination of several endocrine glands including the hypothalamus, pituitary, thyroid, adrenal glands, and the ovary. The first part of this cycle is the follicular phase during which the follicle stimulating hormone (FSH) stimulates the ovaries and a dominant ovarian follicle emerges around days 5-7 of the cycle. The luteinising hormone (LH) levels are low but rising, while progesterone levels remain low during this phase. Next is the ovulatory phase at around days 10-15, that is characterized by a strong hormonal flow during which estrogen reaches its highest levels. This results in the amplification of progesterone and a large surge in LH, which precipitates the release of an egg from the ovary into the fallopian tube.

The release of the egg is the start of the period of conception opportunity, which lasts approximately twenty-

four hours (Ferin, Jewelewicz & Warren, 1993). However, because sperm can live up to five days in a woman's reproductive tract (Baker & Bellis, 1993), a woman could theoretically conceive from sperm collected up to five days before ovulation. Thus, there is a window of opportunity lasting as long as 5 or 6 days when a woman can become pregnant during a given menstrual cycle.

Origin of the Menstrual Cycle

Only human females and great apes have a true menstrual cycle, whereas other placental mammals experience estrus. Though these two cycles are regulated by the same system of glands and utilize essentially the same hormones, a major difference is that animals that have estrous cycles are only sexually receptive during the ovulatory phase of the cycle and reabsorb the endometrium if conception does not occur during that cycle. In contrast, animals that have menstrual cycles shed the endometrium through menstrual bleeding. They are also considered to have a concealed ovulation since they are theoretically receptive to sexual activity regardless of which phase they are in during the cycle.

Over the years, there have been many theories about the necessity for human menstruation, from a spiritual explanation of punishment by the gods to the practical explanation that it has a cleansing utility. But one of the most convincing arguments is by Barbara Strassmann (1996), who claims that menstruation is metabolically less costly to the woman than maintaining the uterus in a continuously prepared state for implantation. She shows that during ovulation the metabolic rate of women increases by almost 10% over the metabolic rates during the follicular phase. Over the span of twelve months this could mean approximately eighteen days of energy are saved. She suggests that the menstrual cycle helps reduce the cost involved in reproduction and that this energy conservation will promote female fitness in any environment in which there may be limited resources.

The Menstrual Cycle and Mate Selection

In recent years, researchers have begun to study the effects of reproductively relevant cues on behavior and mate preference at different points of the female reproductive cycle. Research exploring patterns of ovulation and mate selection offers some of the most

convincing evidence for the evolution of cognitive adaptations (Gangestad, Thornhill & Garver-Apgar, 2005a). Penton-Voak and Perret (2000) found that females rate highly masculine faces as more attractive during the fertile week than at other points in the menstrual cycle. Researchers have also shown that preferences for more masculine sounding voices increase toward high fertility days (Feinberg et al., 2006; Puts, 2006). Thornhill and Gangestad (1999) observed that the scent of facially symmetric males, which they contend is a sign of good genetics, was rated by the participants in the study as more attractive and sexually interesting than was the smell of the less facially symmetric males. Importantly, this was only true just before peak ovulation. These results are consistent with the hypothesis that females have evolved a heightened sensitivity to certain cues of men's reproductive fitness during ovulation.

Researchers have explored the function of certain environmental cues such as a woman's relationship status (Pillsworth, Haselton & Buss, 2004), her partner's fluctuating asymmetry (Gangestad, Thornhill & Garver-Apgar, 2005b), and the major histocompatibility complex of romantic couples (Garver-Apgar, Gangestad, Thornhill,

Miller & Olp, 2006) on women's desire for extra-pair sexual liaisons. All of those factors influenced the perceived attractiveness for extra-pair copulation, especially during ovulation. Baker and Bellis (1990) found that women were more likely to have an affair or engage in sexual intercourse with someone other than their partner when they were ovulating. The researchers also found that these women were less likely to use birth control during extra-pair copulations than when having sex with their long-term mates.

The Menstrual Cycle and Cognition

As evolution has presented men and women with different environmental challenges, their responses to the pressures of sexual selection have, of necessity, been different as well. Specifically, women have been shown to demonstrate many responses which fluctuate over the course of their menstrual cycles. The complexity of the menstrual cycle system makes it unlikely that any one neuroactive chemical is completely responsible for these effects, but changes in the levels of particular neuroactive hormones could certainly alter or influence cognitive functioning in various ways.

Many researchers have found predictable changes in cognition, sensory perception, sexual behavior, and mate preferences during the time of high fertility risk. Perhaps the most obvious way to investigate whether changes in cognition are associated with fluctuations in hormone levels is to observe whether cognitive task performance changes in association with hormone levels during different phases of the menstrual cycle. Some research indicates that sensory acuity increases during ovulation. For instance, women are better at recognizing smells (Brand, 2001; Pol, Hijman, Baaré, van Eekelen & van Ree, 2000) and show greater sensitivity to pheromones during ovulation (Vierling & Rock, 1967).

One study by Macrae, Alnwick, Milne & Schloerscheidt (2002) demonstrated that women's attentiveness to stereotypical characteristics of masculinity varies with menstrual phase. The researchers asked participants to classify a set of facial photographs as male or female. They found that during ovulation women were faster at identifying male faces then at other times during the cycle. However, the ability to categorize female faces did not vary as a function of menstrual phase. In the second part of their study, women performed a task in which they

were to identify whether a series of words were masculine or feminine when primed with pictures of men, women, or random patterns. The findings from this experiment were that ovulating women were significantly faster at matching masculine words when primed with a male's picture than feminine words when primed with a female's picture or when items were mismatched, while non-ovulating women showed no significant difference between the two types of words. They concluded that women's greater attentiveness to cues of masculinity during ovulation is related to their enhanced aptitude to classify stereotypic signals of mating relevant items.

CHAPTER THREE

EVIDENCE FOR CYCLICAL RAPE AVOIDANCE

Is it reasonable to postulate the existence of complex anti-rape mechanisms that motivate women to avoid sexual assault? There is no direct neurobiological evidence to support the existence of unique brain mechanisms that specialize in rape avoidance. However, the hormonal surges surrounding ovulation may affect mental processes that are critical for the normal, everyday perception of environmental cues and the calculation of appropriate behavior. Considering the tremendous fluctuation of hormones across the menstrual cycle, it is reasonable to assume that cognitive abilities might vary over the course of that cycle. For this reason and from an adaptationist perspective, we might expect that some of that variation might relate to pregnancy risk and rape avoidance, even if women are not knowingly aware of it. In particular, it is likely that hormones affect the input systems, perhaps by regulating the acuity, sensitivity and efficiency of the sensory system; as well as the integrative systems, i.e. by affecting motivation and attention to cues predictive of sexual threat.

The hormonal changes that occur throughout the menstrual cycle could also trigger physical changes related to the ability to cope with sexual threat. For example, Petralia and Gallup (2002) theorized that the ability of a female to physically resist a potential rape would fluctuate in relation to her phase of the menstrual cycle. To test their predictions, they had 192 female participants take a test of handgrip strength. Then the women were read essays that depicted either a woman walking to her car late at night while being followed by a stranger (the rape scenario), or a woman walking to her car with the sun shining and music playing (the happy scenario); a second handgrip strength test was performed immediately afterward. To determine menstrual cycle phase they asked women questions about their menstrual cycle pattern and gave each women a urinary test for luteinising hormone (LH) to detect the onset of ovulation. The researchers categorized each participant into one of four menstrual cycle phases: Menstrual, postmenstrual, ovulatory, and premenstrual. The researchers showed that handgrip strength was significantly stronger after the rape essay, but only for women in the ovulatory phase of their menstrual cycle. There was no effect on those women who were in another

phase of the menstrual cycle or using hormonal contraceptives. Importantly, the women who were in the ovulatory phase and who were also given the happy essay did not display improved handgrip strength. Petralia and Gallup (2002) concluded that evolution favored an ability to physically resist attempts of forced copulation that were most active relative to risk of conception.

Rape Avoidance Behavior

A few studies have investigated anti-rape defenses that entail the reduction or modification of behaviors that might increase the chances of a female being sexually assaulted. Chavanne and Gallup (1998) suggest that selective pressure arising from the risk of rape may have caused mechanisms to evolve that modify females' behavior over the menstrual cycle. The researchers asked 40 undergraduate female students to rate the risk of sexual assault was involved in 18 everyday behaviors (e.g., ''go to the library'', ''walk in a dimly lit area'', etc.). Then they asked 300 women to signify which of the 18 activities they had done within the last 24 hours. Then the researchers collected information about the participant's menstrual cycle. As in the Petralia and Gallup study

(2002), the researchers categorized participants as either be in menstrual (days 1-5), postmenstrual (days 6-12), ovulatory (days 13-17), and premenstrual (days 18-28) phase of the menstrual cycle. They were then given a risk-taking score that was calculated by adding all activities that the participants said they had done, weighted by its supposed riskiness as determined in the first part of the study. Chavanne and Gallup found that those women who were in the ovulation phase of the menstrual cycle performed fewer risky activities compared to women at other phases. This effect was not found for women using hormonal forms of birth control. The authors conclude that females modify their behavior during ovulation in a way that reduces the risk of sexual assault.

One problem with Chavanne and Gallup's study is that their risk-taking measure confounds activity level with risk exposure. In other words, those women who said that they had engaged in several of the seemingly low-risk activities were given the same score as those women who said that they had one or two or the more risky activities. Thus, a woman who engaged in one rather dangerous activity such as walking alone through a dark alley, would be given the same score as a woman who did many seemingly less

dangerous activities (such as riding her bike and studying with friends). This makes it difficult to determine if the reduced scores for ovulating women were actually due to a reduction in risk taking or to an overall reduction in activity levels.

To rectify these limitations Bröder and Hohmann (2003) replicated the findings of Chavanne and Gallup with a more wide-ranging list of activities and a tighter definition of risk taking events. As in the Chavanne and Gallup study, these researchers asked students to rate the risk of sexual assault for 20 risky and 20 non-risky behaviors, and then using a longitudinal design, they recorded the occurrence of risky and non-risky behaviors at four points during the subject's menstrual cycles: Menstrual (days 1-5), postmenstrual (days 6-12), ovulatory (days 13-17), and premenstrual (days 18-28). This new methodology demonstrated stronger results by confirming that women participate in risky activities less regularly throughout the ovulatory phase than during the other phases of the menstrual cycle. However, there was no evident change for participants in non-risky activities.

Cognitive Bias Toward Threat Perception of Sexual Assault as a Function of Ovulation

The behavioral changes described above are presumably accompanied and probably driven by changes in cognition that bias women to attend to threat. Provost and Vernon (2004) study looked for such cognitive biases and found evidence that a woman's risk aversion to sexual assault was highest around ovulation. In their study, 70 undergraduate students completed an Implicit Associations Test which measured cognitive biases for associating the concepts of man and woman with the concept of safety. They found that women showed greater resistance to associating safety and maleness during ovulation.

To understand this relationship, Garver-Apgar, Gangestad, & Simpson (2007) asked women to view videotaped interviews of men and rate each man's propensity to be sexually coercive. A sample of 169 normally cycling women watched interviews that had been videotaped of several different men who were strangers to the participants. The women were then told to rate each man on numerous factors that were then summed into a single coerciveness scale. Then the women's menstrual cycle phase was estimated. The researchers found that ovulating women perceived the men in

the videos as more sexually coercive than non-ovulating women.

The Garver-Apgar et al. study had participants view videos of strangers. Research has demonstrated that women, despite having a greater actual risk of rape by someone that is known to them (Kilpatrick, Edmunds & Seymour, 1992), tend to show more fear of stranger rape (Thornhill & Thornhill, 1990). This has guided some to suggest that stranger rape by outgroup males was a greater adaptive problem for women than rape from ingroup males. Which lead some researchers to hypothesize that women should be most strongly prejudiced against members of the outgroup, especially at times when they are more likely to get pregnant.

To test this idea, Navarrete, Fessler, and Fleischman, (2009), using a variation of the Implicit Attitude Test (IAT) and a self-report scale, measured Caucasian women's implicit and explicit attitudes toward outgroup members. Then, the women were told to rate the pictures of ingroup (Caucasian) and the outgroup (African-American) males for physical properties that were associated with the "scariness" of the individual. Finally, using information gathered about the participant's menstrual cycle history,

they evaluated each woman's ovulatory status. Using this information, Navarrete et al. found that outgroup bias and fear of outgroup males was closely related to women's menstrual cycle phase such that the closer a woman was to ovulation the more likely she was to show prejudices against outgroup men.

McDonald, Asher, Kerr & Navarrete (2011) elaborated on those findings. While the previous study used solely Caucasian participants, this study looked at both Caucasian and African-American ovulating women. The results confirmed that both groups of women were more likely to associate negative words with males of the other ethnicity. The authors theorize that women evolved protective responses to the possibility of rape by men from invading groups. These findings of ingroup/outgroup biases are alleged to be the outcome of evolved cognitive abilities to that help focus women's attention on avoiding sexual assault. These results add to the growing body of research showing that women do indeed appear to have cognitive abilities, biases, or mechanisms involved in avoiding the risk of rape.

It can be concluded from the results of these studies, that much like other sensory threshold changes that occur across the menstrual cycle, thresholds for detecting cues of threat and sexual coerciveness are reduced as women nears ovulation. Such changes in risk assessment could have a significant effect on a woman's chance of being sexually assaulted (Meadows, Jaycox, Stafford, Hembree & Foa, 1995). Researchers have hypothesized that women may show substantial individual differences in their ability to recognize threat signals and that those with the poorest ability to recognize threat may be the most likely to be victimized (Wilson, Calhoun & Bernat, 1999). They studied rape narratives from 44 female assault victims, 19 from an assessment study for recent assault victims and 25 from a treatment study of chronic assault-related posttraumatic stress disorder. All of the women had been raped, some once, others multiple times. Two raters, who did not know the women's victimization histories, rated the narratives for threat recognition - that is, degree of apparent attention to potential danger or their perception of the threat of rape. They found that women in the repeated rape

group showed poorer threat recognition than women in the single rape group.

Meadows, Jaycox, Orsilla, and Foa (1997) assessed whether these group differences were related to individual differences in recognizing potential danger cues associated with sexual assault. In their study, 115 male and female college students responded to 11 scenarios, each divided into 8 to 11 segments that increased in threat intensity as the scenario went along. Respondents indicated at which point during the interaction they became uncomfortable and would prefer to leave the situation. They found that respondents with sexual assault histories opted to leave the threatening scenarios much later than respondents without sexual assault histories; these differences were still substantial even after controlling for post traumatic stress symptoms. Thus, suggesting that the results are not due to the trauma of being raped but rather are characteristics of the individuals who were sexually assaulted. These results were supported by Marx and colleagues (Marx, Calhoun, Wilson & Meyerson, 2001), who conducted an evaluation study of a sexual revictimization treatment program with women who reported at least one episode of adult or adolescent sexual victimization. Eight

weeks after the treatment, women with poorer threat perception abilities had reported more instances of sexual revictimization. This suggests that threat perception is an important anti-rape defense.

Other research has examined how factors related to threat-based of arousal influenced women's ability to respond to threats of sexual assault (Wilson, Calhoun & Bernat, 1999). In this study, participants were comprised of both survivors of sexual assault and those with no history of sexual violence or abuse. The results showed that survivors of multiple sexual assaults exhibited much longer decision latencies in signaling that an audiotape rape scenario should be halted than either women who had a single incident of sexual abuse or women who were never victims of sexual abuse. Women with higher-arousal symptoms of posttraumatic stress disorder (PTSD) showed decision latencies times comparable to those of non-victims, while women of repeated sexual assault who also had lowered arousal symptoms of PTSD had an increase in response times. Further examination of the results showed that women with higher decision latency had lower reported emotional arousal, suggesting a lack of aversive arousal due to an inability to recognize the threatening stimuli in

the audio. It can be argued that the arousal to threatening stimuli is crucial for an individual's survival, since it is the trigger for adaptive behaviors to evade threats to a person's wellbeing (Calder, Lawrence & Young, 2001). Such shortfalls in threat perception might stop women from reacting to threats that would normally elicit an autonomic nervous system response and trigger avoidance behaviors (Soler-Baillo, Marx & Sloan, 2005).

Risk perceptions and individual differences in behavior suggest that the cyclic behavioral changes reported by Chavanne & Gallup (1998) and Bröder & Hohmann (2003) might be mediated by temporary shifts in sensitivity to sexual threat cues over the course of the ovarian cycle. However, while several of the studies described above provide evidence regarding the link between threat perception and rape, there are none that assess whether threat perception itself varies systematically over the menstrual cycle. This is a key connection because threat perception is a likely mediator of behavioral changes that could reduce the likelihood of sexual assault.

Hypothesis

Though many of the aforementioned studies have examined how certain variables are associated with rape and menstrual phase, none of them tested whether their results were specific to sexual assault or a generalized response to any threat. It is possible that threat perception can show interpretation and behavioral differences mediated by what kind of threat is being presented in addition to the affective reaction to it. Therefore, the purpose of this study is two-fold. First, this study aims to measure changes in women's recognition of different kinds of threats over the course of the menstrual cycle. In particular, ovulating women are expected to show significantly greater arousal to an audiotape vignette that depicts the threat of sexual assault and will respond more quickly to that threat compared to women who are not ovulating. Second, if this is an evolved response that functions as an anti-rape defense, i.e., if it is an "adaptation" in the technical sense described earlier, then this heightened response should occur only to vignettes specifically related to sexual assault, not to those related to non-sexual (e.g., physical or social) threats.

CHAPTER FOUR

METHODS

Participants

In this study 188 female students of California State University, San Bernardino between the age of 18 and 37 (*SD*=5.65) volunteered to participate in a study on "women's perception of threat" in exchange for extra credit in one of their psychology classes. Not all of the participants scores were included in the statistical analysis: 11 of the participants' scores were removed from analysis due to reporting an irregular menstrual cycle longer than 32 days, 7 participants were removed due to technical errors with the computer program, and 8 were removed because they were currently pregnant. This left a final N of 162. The participants were divided into three groups based on their menstrual cycle phase: (1) The ovulatory group, consisting of women with a regular 26-32 day menstrual cycle who are currently in the ovulatory phase of that cycle (n=40); (2) the non-ovulatory group, consisting of women with a regular 26-32 day menstrual cycle who are currently not in the ovulatory phase of that cycle (n=69); (3) and the control group, consisting of women who do not have regular

menstrual cycles due to hormonal contraceptives (n=53). Of the participants, 21 said they were married and 141 were currently unmarried. In addition, there were 40 European Americans, 33 African Americans, 75 Hispanic Americans, 5 Asian Americans, 3 Native Americans, 3 Indians, and 3 people of other ethnic identity.

Design

There were two independent variables in this experiment. The between-subjects independent variable is stage of the menstrual cycle (ovulatory, non-ovulatory, and control). The within-subjects independent variable is the type of implied threat (social, sexual, physical, happy, and neutral). The dependent variables are (1) the emotional/arousal response to an audiotape vignette as measured by the SAM (Self-Assess Manikin, Bradley & Lang, 1994) and (2) the latency to stop the audiotape vignette in response to the participant's recognition of potential harm.

Measures

Demographic

Participants completed a computer-based questionnaire about their birth-control practices, brief gynecological history, and current medications. In the demographic section, biographical information such as age and ethnicity was collected (see Appendix B).

Menstrual Cycle Questionnaire (MCQ)

The Menstrual Cycle Questionnaire (MCQ) is a modified version of the Reproductive Health Survey from the National Institute for Environmental Health (see Appendix B). The MCQ asks questions about the woman's menstrual cycle such as average length of bleeding and menstrual health history. From this information the McIntosh method (McIntosh, Matthews, Crocker, Broom & Cox, 1980) was used to determine participant's current menstrual phase. This method uses a set of mathematical equations to predict the most likely day of the LH surge, and hence the time of ovulation, solely from knowledge of the average length and variability of the participant's cycle. The formula used to calculate the first day of the ovulatory phase is 0.770 x (average days of cycle length) - 7.685 - 1.96 x (0.432 x range of

cycle length + 0.694). The formula used to calculate the last day of the ovulatory phase is 0.770 x (average days of cycle length) - 7.685 + 1.96 x (0.432 x range of cycle length + 0.694). These formulas will be used to determine the onset of ovulation; the other two phases can then be calculated by exclusion. Previous research has tested this method and found that it predicted the day of ovulation with 95% accuracy (Lenton, Landgren, Sexton & Harper, 1984).

Self-Assessment Manikin

Subjective emotional responses to the stimulus will be collected using the 9-point valence (pleasantness) and arousal scales of the SAM, a nonverbal pictorial assessment tool that directly measures the pleasure, arousal, and dominance associated with a person's affective reaction to a wide variety of stimuli. Responses on the valence dimension range from one ("extremely happy, pleased, satisfied, content, hopeful") to 9 ("extremely unhappy, annoyed, unsatisfied, melancholic, despaired, bored''). Responses on the arousal dimension range from one ("extremely relaxed, calm, sluggish, dull, sleepy, unaroused") to 9 ("extremely stimulated, excited, frenzied, jittery, wide-awake, aroused"). Previous research has

demonstrated that the valence and arousal dimensions reliably co-vary with physiological reactions associated with emotional response (e.g., skin conductance response, heart rate), suggesting that the SAM is a valid measure of emotional responding (Bradley, Greenwald, Petry & Lang, 1992; Lang, Greenwald, Bradley & Hamm, 1993). Correlations of .937 for emotional and .938 for arousal were found between ratings generated by SAM and the galvanic skin response (Phan et al., 2003). Upon termination of each the five auditory stimuli (vignettes) and prior to the next vignette, the participants were instructed to rate their affective experience to the vignette using the emotional and arousal dimensions of the SAM.

Trauma Symptom Checklist-40 (TSC-40)

The TSC-40 was used to evaluate symptomatology in adults associated with childhood or adult traumatic experiences. This 40-item questionnaire uses a four-point rating scale from 0 ("never") to 3("often") to obtain a TSC-40 total score ranging from 0 to 120 (see Appendix B). The TSC-40 is composed of six subscales measuring anxiety, depression, dissociation, sexual abuse trauma, sexual problems, and sleep disturbance. The TSC-40 requires approximately 10-15 minutes to complete and was scored by

the computer. Studies using the TSC-40 indicate that it is valid and reliable, with alphas for the full scale averaging between 0.89 and 0.91 (Briere, 1996; Elliott & Briere, 1992).

Decision Latency

The participants heard five three-minute audiotape narratives illustrating various types of threat scenarios. They were instructed to click on the left mouse button to indicate when they felt threatened and would wish to leave the situation if they were actually experiencing that situation in the real world. The decision latency measure used in this study was adapted from a similar measure used by Marx and Gross (1995). Decision latency was operationalized by Marx and Gross as the time it takes the participants to press the mouse button (in the Marx and Gross study, a keyboard button) to stop the audio in response to a perceived threat. Decision latency is intended to measure risk recognition i.e., the sooner a participant presses the button the more quickly she recognizes the threat. Latencies were recorded in seconds using a reaction time program activated at the start of the vignette. The auditory stimuli (vignette) was played via

the computer through a set of headphones worn by the participants.

Auditory Stimuli

All vignettes were taken directly or adapted from the Petralia and Gallup (2002) study demonstrating changes in handgrip strength as a function of menstrual cycle and can be found in Appendix A. The sexual assault vignette, which depicts a woman walking to her car late at night as she is pursued by a strange man, and the happy vignette, which portray a woman walking to her car on a bright sunny day with other people in the vicinity are the exact stories from Petralia and Gallup. Both the social threat vignette, which tells of a woman confronted at her car by her ex-boyfriend and his new girlfriend after she has fallen in the mud, and the non-sexual physical threat vignette, which depicts a woman walking to her car late at night while being pursued by a pack of wild dogs were written for the purpose of this study. A fifth vignette was created by removing all cues of threats from the sexual assault scenario, thereby making a neutral vignette. All of the vignettes are essentially the same story with modifications in theme that did not substantially affect the length of the audio. The audio was recorded by a professional male

voice-actor, who keep a constant even vocal inflection across all the vignettes.

Procedure

Subjects were run in groups of two to four at a time. After arriving at the laboratory and after giving informed consent, participants were seated in a dimly lit room in front of a PC. A computer mouse was placed in front of them, headphones were fitted, and they were asked to follow the instructions that they would read on the screen.

Participants were told that they would be listening to several audiotape vignettes and to imagine what their thoughts and feelings would be if they were the women experiencing each situation. They were also told that if the events in the vignette appeared threatening, they should click the mouse button to indicate the point at which they would choose to leave that situation. Participants were informed that they would hear the entire dialog regardless of when they clicked the mouse.

Following each vignette, participants were instructed to rate their affective response to that vignette using the SAM measure described above. The participants were then asked to close their eyes, relax, and clear their mind for

a few moments, and then to click the mouse to start playing the next audio sample whenever they were ready. The same process was repeated for all the vignettes which were presented in a randomized order. After their final recovery period, the computer guided the participants through the demographic questions, menstrual cycle questionnaire, and the TSC-40. Then the participants were debriefed and the experiment was complete.

CHAPTER FIVE

RESULTS

Differences in Response Rates to Stimuli

Participants were asked to click on the mouse button when they felt that they would want to leave the situation. It is reasonable and consistent with past literature to assume that this occurred when participants detected threat in the vignette. Table 1 shows the breakdown of the responders and non-responders for each threat scenario and menstrual cycle group. First, because previous research suggests that women with higher levels of trauma symptoms are less likely to respond to threatening situations, TSC-40 scores were analyzed. First, Cronbach's alphas were calculated to determine the internal consistency of the TSC-40 and for each of the six subscales. The TSC-40 on the whole was internally reliable (α = .88). The coefficient alphas for the subscales were as follows: Anxiety (α = .63), Depression (α = .68), Dissociation (α = .70), Sexual Abuse Trauma Index(SATI) (α = .59), Sexual Problems (α = .73), and Sleep Disturbance (α = .69). The preceding values are comparable to those reported by Briere (1996).

A series of independent samples t-tests (table 2) were conducted to determine if there was a difference between responders and non-responders in their scores on the TSC-40 and its subscales. The only significant difference amongst these factors was that women who responded to the socially threatening situation (M = 4.08, SD = 3.80) were more likely to have increased sexual dysfunction scores on the TSC-40, $t(168) = -2.61$, $p = .01$ $d = -0.40$. Given the large number of tests carried out, this single significant difference is likely to be a Type I error.

Pearson product correlations were calculated to evaluate the strength of the relationship between the TSC-40 scores of the decision latency times for those who responded to the threat scenarios. As table 3 shows, there is no relationship between the TSC-40 or any of its subscales and the time it took participants to indicate that they felt threatened by the audio they were listening to. Because of this and the fact that the TCS-40 was intended primarily to identify issues with non-responders, no further analysis using the TSC-40 or its subscales were conducted.

T-tests were then conducted to see if there were differences in the mean affective rating scores for

responders versus non-responders using the SAM Manikin (table 4). Both the sexual and social threats showed differences in the mean response rating for the emotional valence of the SAM Manikin, $t(155) = 2.20$, $p = .03$ and $t(155) = 2.33$, $p = .02$, respectively. Women who responded to either threat felt more emotional distress than those who did not respond (Cohen's of $d = .35$ and $d = .37$), showing that the emotional reaction to the stimuli had a large effect on responding rates. Only the social threat response rate was related to the stress response ratings, $t(155) = -1.98$, $p = .05$, Cohen's $d = .32$, showing that a stronger anxiety response to the social threat stimuli increased the likelihood that a person would indicate that they would leave the situation.

Because the TSC and the SAM Manikin did not show consistent results among respondents and non-respondents, a series of Pearson chi-squared tests were conducted for menstrual cycle group, demographic factors such as ethnicity, education, being in a current sexual relationship, and sexual preference, in addition to an independent sample t-tests for age, to see if any of the these variables influenced the decision to respond or not respond to threatening scenarios. There was no significant

age difference between responders and non-responders and in addition, responding was equally distributed in all demographic factors of the sample including menstrual cycle group (See table 5). If response rate is unaffected by factors shown to affect response latency and that would be expected to influence threat detection, it may be that response rates do not provide a valid measure of threat detection. For example, some women may not have responded to the threat because they had interpreted the instructions differently or simply paid less attention to the stories and task. Our independent variables would not be expected to affect response rate in this case.

Decision Latency and Menstrual Cycle Group

A series of one-way ANOVAs were conducted across threat stimuli to examine differences in decision latency across the MCG (non-ovulating, ovulating, and control) groups. Table 6 shows the number of respondents and mean response times in seconds per menstrual cycle group for each threat scenarios. Key assumptions were checked before the ANOVAs were run. There was evidence in support of the assumptions of normality, homogeneity of variance, covariance matrices, linearity, and multicolinearity.

Scatterplots of MCG and decision latency times for each threat scenario indicated normal distributions and the Levene's Test for Equality of Variances were all $p > .05$. There were no within cell univariate outliers detected.

There was no significant difference between MCG and response times in any of the threat scenarios with the exception of the sexual threat vignette. The results of the ANOVAs are displayed in table 7. The analysis specifically showed that for the sexual threat scenario there was a significant effect of MCG on the decision latency time, $F(2,78) = 3.01$, $p = .055$, $\eta^2 = .07$.

Post hoc comparisons using planned t-tests indicated that the mean time in seconds for the Ovulating group ($M = 62.39$, $SD = 17.80$) was significantly lower than the Non-Ovulating ($M = 79$, $SD = 26.88$), $t(49.77) = 2.78$, $p < .01$, and the Control groups ($M = 75.84$, $SD = 25.86$), $t(44) = -1.98$, $p < .05$, indicating that women who were ovulating were faster at responding to the sexual threat scenario than the other groups. There was no significant difference between response times for the sexual assault threat for the Control versus Non-Ovulating groups ($t[60] = .51$, $p > .05$, ns).

Taken together these results suggest that the only scenario that showed a difference between the groups' response times was the sexual threat scenario. Women that were currently in the ovulating phase of the menstrual cycle were faster to respond that they would leave the sexually threatening situation than women who were not ovulating or who were taking hormones (Figure 4). This was true only for the sexual threat scenario and not for any of the other scenarios (Figure 5 & 6).

Emotional and Stress Response to Stimuli

Though not all of the participants responded to the stimuli, all of the participants rated their emotional and stress response to the stimuli that they had just listened to by using the SAM Manikin. Therefore, participants' responses on SAM Manikin provide a manipulation check for the effectiveness of the different threats, i.e., people should respond differently to the happy and neutral vignettes that to the threat vignettes on the SAM.

The emotional and stress response scores from the SAM Manikin were analyzed in separate 1-way ANOVAs with Threat Scenario (Sexual, Social, Physical, Happy, Neutral) as the within-subjects factor. Mauchly's test for sphericity

indicated that this assumption was not met (W = .708, df = 9, $p < .001$ for the emotional response and W = .731, df = 9, $p < .001$ for the stress response), so the Huynh-Feldt correction was applied. Based on the corrected degrees of freedom, the main effect of change in threat scenario was significant for both the emotional response (F[3.44, 633.62] = 677.87, $p < .001$, $\eta^2 = .79$) and for the stress response (F[3.44, 625.24] = 384.62, $p < .001$, $\eta^2 = .68$).

Post-hoc comparisons were performed using the Bonferroni adjustment for multiple comparisons and as indicated in table 8, the SAM Manikin was effective in measuring the changes in participants' emotional responses to the different scenarios. In particular, threatening situations elicited more sadness than the happy or neutral scenarios. Figure 7 shows that the sexual assault (M = 2.49, SD = .10), social threat (M = 2.5, SD = .10), and physical threat (M = 2.62, SD = .10) scenarios were all given significantly lower emotional response scores indicating an increased level of distress compared to the happy scenario (M = 8.00, SD = .10) and the neutral scenario (M = 4.91, SD = .08).

Post-hoc comparisons were also performed to determine the usefulness of the SAM Manikin at measuring the stress response to the different threat scenarios. As seen in figure 8, the sexual assault (M = 7.79, SD = 1.58), social threat (M = 5.97, SD = 2.02), and physical threat (M = 7.45, SD = 1.67) scenarios were all given significantly higher stress response scores indicating an increased level of anxiety compared to the happy scenario (M = 1.83, SD = 1.64) and the neutral scenario (M = 4.87, SD = 1.88). Table 9 shows the results of the pairwise comparisons.

Overall, these results demonstrated that the SAM Manikin is a valid measure of emotional and stress response to the threatening scenarios. To determine whether the SAM ratings were affected by menstrual phase, another series of ANOVAs was performed using emotional valence as the dependent variable in one series and stress valence as the dependent variable in the other, with the menstrual cycle group as the independent variable in both analyses. There were no significant differences between the reported emotional or stress response for any of the stimuli over the different menstrual groups. As shown in table 10, all probability values were $p > .25$

CHAPTER SIX

DISCUSSION

In this study we measured changes in women's recognition of threat over the course of the menstrual cycle. In particular, by asking women to listen to several audiotape vignettes that depict different types of threats, we explored variations in threat response time and the affective reactions of the women to each threat, with the intention of understanding how the menstrual cycle might influence these measures. Our ultimate goal was to assess the viability of variations in threat perception as an evolved anti-rape adaptation. Therefore, we hypothesized that ovulating women, due to increased pregnancy risk, would be faster in reacting to test situations that involve sexual threats. Indeed, we found that ovulatory status was related to how quickly women responded to situations that involved threat of rape. However, there was no apparent effect of menstrual cycle phase on women's affective response to the different scenarios.

Decision Latency Response Times

Researchers have theorized that women have evolved psychological mechanisms that produce behaviors and cognitive biases that help them to avoid sexual assault. Over the years, a mounting body of evidence to support this hypothesis has been found (for a review see McKibbin & Shackelford, 2011). In the present study, threat perception was assumed to be an integral component of anti-rape adaptations. Women listened to audio that had a progressing level of impending harm. At the start of the audio the threat was vaguely implied; however, by the end of the vignette the subject was in the midst of a full on assault (see Appendix A for audio dialog). Figure 1 shows the distribution of response time to the sexual threat scenarios, pooled over menstrual phases. Women who were ovulating indicated that they would leave the situation, on average, around the 62 second mark. It is at this point in the audio where the possible rapist is first made known to the participant. In comparison, women who were either in the non-ovulatory or the control group indicated that they would leave around the 75 to 79 seconds marks or the point in the audio at which the possible rapist has now begun to

follow the woman. Notably, the intensity of the threatening cues is very different at these two points in the narratives. This disparity illustrates the extent of influence that ovulation has on reproductively relevant self-preservatory behavior. While responding too rashly at the onset of a potential threat may carry some costs, waiting until a vigorous response is inevitably required to defend oneself against a sexual assault would seem far more costly overall. Importantly, these effects of the menstrual cycle phase were specific to the sexual assault scenario and did not generalize to physical or social threats.

Affective Response to Threat

Though many studies have examined variables associated with the objective perception of threat, little is known about how people's affective responses influence the cognitive choice of whether to respond or not respond to that threat. Emotions can help establish the priority that cognitive processing systems assign to different events in our environment (Ellsworth, Scherer, Davidson, Scherer & Goldsmith, 2003). From an evolutionary perspective, it can be argued that the emotional response to threatening

stimuli is crucial for an individual's survival, since it is the trigger for adaptive behaviors to evade threats to a person's wellbeing (Lennox, Jacob, Calder, Lupson & Bullmore, 2004). Contrary to our prediction however, ovulating women did not show a stronger emotional or stress response to any of the threatening scenarios on the SAM Manikin. This is somewhat surprising in light of the fact that ovulating women did respond more quickly to the sexual threat scenarios, indicating more rapid threat detection during ovulation. One possibility is that the increase in the response speed occurred below the level of consciousness and did not require any change in conscious emotional reactions to occur. Another possibility is that any enhanced emotional responding was short-lived and had dissipated by the time the participant was completing the SAM.

Alternate Explanation of Results

It is, however, possible that an explanation of women's quicker response to threat is that women are simply faster in their reaction to all stimuli while ovulating. Though some research shows that this may be the case. In particular, to audio stimuli (Nene & Pazare, 2010; Yadav,

Tandon & Vaney, 2003) the difference in response times in other studies is mere milliseconds. In this study the mean difference in response times between the menstrual cycle phases were several seconds, a much larger difference. Moreover, the fact that ovulating women only increased reaction time to the sexual threat scenario argues against this explanation.

Another possible explanation is that the variation in performance can be explained by certain cognitive differences associated with cyclic mood disorders such as premenstrual syndrome (PMS) or premenstrual dysphoric disorder (PDD) (Davydov, Shapiro & Goldstein, 2004). If the participants were suffering from PMS or PDD, then their reactions times might be faster during the ovulatory phase than during the non-ovulatory phase, as has been shown in some other studies (Man, MacMillan, Scott & Young, 1999). However, this would not explain why only response times to the sexual assault scenario were affected by the menstrual cycle phase; there was no difference between the menstrual cycle group and the control group who were taking hormones.

In sum, it is unlikely that any social science model other than the evolutionary account could predict an effect of menstrual cycle phase on the response times for the

sexual threat scenario alone. Other accounts could explain an overall increase in vigilance or response speed, but not the restriction to sexual threat.

Confounding Variables

Unlike other studies (Marx, Calhoun, Wilson & Meyerson, 2001; Meadows, Jaycox, Stafford, Hembree & Foa, 1995; Soler-Baillo, Marx & Sloan, 2005; Wilson, Calhoun & Bernat, 1999), we did not find that psychological variables (i.e., depression, anxiety, PTSD, or sexual dysfunction) were significantly correlated with response latency. Correlational analyses examining the relationship between psychological variables theorized to be related to response times and perceptions of risk failed to produce consistent findings across vignettes. When the psychological variables associated with trauma were examined in relation to response accuracy we found that only social threat was influenced by the symptoms of sleep disorders.

This raises the question of whether non-responders actually failed to detect any threat, or whether they failed to respond for some other reason such as inattention to the task. While the social threat scenario was the least to be responded to it also had a mean affective

ratings score of just slightly above neutral, which could imply that the scenario of being humiliated by an ex-boyfriend was not that threatening to most women. This was not the case for the sexual and physical threats however. Women rated these vignettes as having a strongly negative affective reaction and thus it seems unreasonable that they would not find the thought of being accosted by a strange man or attacked by a pack of wild dogs threatening enough to want to stop.

In this study, data of reaction times to the audio were not collected after the audio stopped. Therefore, if a woman waited until the very last moment to respond when the situation had reached its apex of she may have missed her opportunity to be counted as a respondent. However, this seems unlikely to account for the large volume of non-responders in the threat situations. Response latencies to all the threat scenarios have normal distributions that are symmetric and have bell-shaped density curves with a single peak. As Figures 1 to 3 show, most responders indicated that they would leave the situation approximately in the middle of the audio with no indication that there was any increase in responses toward the end. Based on this, one would expect only a small number of non-responders in each

condition. However, there were actually more non-responders than responders in the non-sexual threat scenarios, far more than would have been predicted based on the distribution of response latencies.

Another possible confound is that unlike other studies that explore threat perception of rape, the audio in this study never explicitly stated any sexual behavior at all. However, it could be assumed that most participants would accurately predict that a strange man following them to their car would lead to rape since most women anticipate that a physical attack from a male in any form would potentially lead to sexual assault (Hilinski, 2009).

Future Research

The questions about this study easily lend themselves to improve future research in this area. First, the SAM Manikin showed that not all of the audio threats induced a sufficient level of emotional response to be consciously reacted to. Second, the sexual threat lacked any actual sexual content and therefore that manipulation might be strengthened. Lastly, in this study the measure of decision latency ended at the moment of the most extreme level of threat. Thus future research should include audio scenes

that occur after the point greatest threat intensity. In addition, to more accurately determine the relationship of the menstrual cycle and threat perception, it would be useful for future research to include some form of physical ovulation verification.

Conclusion

Because of the reproductive fitness costs that are associated with sexual assault, it is reasonable to expect that women have adaptive psychological mechanisms that are specific to rape avoidance. Researchers have established that during ovulation when conception risk are high, women exhibit an increased strength when they feel threatened (Petralia & Gallup, 2002), increased suspicion of males (Garver-Apgar, et al., 2007; McDonald, et al., 2011; Navarette, et al., 2009), and a decrease in risky behavior (Bröder & Hohmann, 2003; Chavanne & Gallup, 1998). These effects are theorized to be the by-product of a complex psychological system that works to guard a woman's reproductive choice by influencing her cognitive and behavioral reactions to situations in order to decrease the possibility of rape (McKibbin, Shackelford, Miner, Bates & Liddle, 2011). But what those studies did not

differentiate was if this bias was specifically targeted toward rape or if it was a general response to any threat. In this study we wanted to test this distinction and therefore evaluated how ovulation impacted the perception of other types of threats in addition to sexual threats. What is novel about this study is the discovery that for ovulating women response time is faster only if the situation specifically includes rape and not any other type of threat. This result adds to the existing body of evidence regarding the psychological mechanisms that motivate anti-rape behaviors.

APPENDIX A

AUDIO VIGNETTES

Sexual Assault Threat - 134 seconds

As she leaves the psychology building she realizes that it is much later than she thought and that the campus seems empty. It is a long walk out to her car. On this dark night, the dim glow of the outside lights seems to disappear before it reaches the ground. She remembers that the moon should be almost full but as she looks up to find the large silver globe her eyes are met with a blanket of cloudy darkness. ''No wonder it is so dark tonight,'' she thinks to herself as she begins the trek to her car.

She doesn't like walking alone this late at night but she's tired so without thinking she takes the short cut through the pine trees. In the shadow of the trees, she must watch where she places her feet otherwise she may trip on the large tangled roots beneath her. She hears a noise, perhaps another footstep, but in the darkness she cannot discern what it is. A chilling gust of wind strikes and causes her to tighten her coat and quicken her step. She hears something else. What was that? Was it somebody else or just the wind?

Now the parking lot is just ahead, all that she has to do is cross the barren campus green. As the wind picks up she hears another noise and looks back. She sees the

silhouette of a tall man emerging from the pine trees and the sight of him startles her. Again, she quickens her pace.

At the edge of the vacant parking lot she pauses and looks for her car. Happy with the sight of her car she reaches into her coat pocket for her keys and finds that they are not there. They must be in her purse and as she begins to feel around for them in her large bag she notices that strange man again, he is staring at her intensely and appears to be headed directly towards her. At her car she places her handbag on the hood and peers into it, but in the darkness nothing is visible. She now feels he is closing in on her as frantically searches for her keys. Finally, her fingers make contact with her keys and she pulls them out of her purse. As she inserts the key into her car door she feels his cold hand on her shoulder . . .

Petralia, S. M. & Gallup, G. G. (2002). Effects of a sexual assault scenario on handgrip strength across the menstrual cycle. *Evolution and Human Behavior, 23*(1), 3-10.

Social Threat - 169 seconds

As she leaves the psychology building she realizes that it is much later than she thought and that the campus seems empty. It is a long walk out to her car. On this dark night, the dim glow of the outside lights seems to disappear before it reaches the ground. She remembers that the moon should be almost full but as she looks up to find the large silver globe her eyes are met with a blanket of cloudy darkness. "No wonder it is so dark tonight," she thinks to herself as she begins the trek to her car.

It's late and she's tired so without thinking she takes the short cut through the pine trees. In the shadow of the trees though she is careful, she slips and stumbles into a bush near the walkway. She is unhurt, however the foolish blunder has messed up her hair and gotten wet mud from the recent rains all down the front of her coat and pants. Given her ruined appearance, she is glad that the campus appears to be deserted. As she resumes her trek towards her car, she hears the sound of voices being carried on the breeze and worries that someone will see her in such disarray. Before she leaves the cover of the trees, she sees that the parking lot is almost empty with only a few cars left but as the wind picks up it becomes

clear that the voices she heard earlier are coming from a man and woman up ahead laughing and talking.

Now the parking lot is just ahead, unfortunately the people she heard talking are standing next to a car just a few spaces over from hers and she realizes that she will be in full view of them as she approaches her car. She runs her hands through her hair in a failed attempt to tame the mess then crosses her arms tightly hoping to cover the worst of the mud stains and quickens her pace across the parking lot.

As she nears her car, she realizes to her horror that she knows the man and woman who are talking; it is her ex-boyfriend and his new pretty and fashionable girlfriend, the last two people on earth she'd want to run into looking like she does. She quickly reaches into her coat pocket for her keys and finds that they are not there. They must be in her purse and as she begins to feel around for them in her large bag she notices that her ex and his girlfriend have stopped talking and they appear to be looking directly at her. She places her handbag on the hood of her car and peers into it, but in the darkness nothing is visible.

She can hear that their conversation, has resumed, and decidedly unflattering comments are being made about her

appearance. She is mortified. She feels their eyes upon her and frantically searches for her keys. Finally, her fingers make contact with her keys and she pulls them out of her purse. As she inserts the key into her car door she hears the words "pathetic loser" accompanied by a snickering laughter . . .

Developed by - Beaussart, M. L., 2011

Physical Threat Non-Sexual - 144 seconds

As she leaves the psychology building she realizes that it is much later than she thought and that the campus seems empty. It is a long walk out to her car. On this dark night, the dim glow of the outside lights seems to disappear before it reaches the ground. She hears the sound of barking nearby, one perhaps or even a couple of dogs are somewhere in the vicinity. She remembers that the moon should be almost full but as she looks up to find the large silver globe her eyes are met with a blanket of cloudy darkness. "No wonder it is so dark tonight," she thinks to herself as she begins the trek to her car.

It's late and she's tired so without thinking she takes the short cut through the pine trees. In the shadow of the trees, she must watch where she places her feet otherwise she may trip on the large tangled roots beneath her. She hears a noise, the howling and woofing of more than a few dogs, but in the darkness she cannot detect where they are. A chilling gust of wind strikes and causes her to tighten her coat and quicken her step. She hears something else. What was that? Was it a noise or just the wind? It's the sound of rustling leaves on the side of her.

Now the parking lot is just ahead, all that she has to do is cross the deserted campus green. As the wind picks up she hears another noise and looks back and sees the silhouettes of several large dogs emerging from the pine trees and the sight of them startles her. Again, she quickens her pace.

At the edge of the vacant parking lot she pauses and looks for her car. Happy with the sight of her car she reaches into her coat pocket for her keys and finds that they are not there. They must be in her purse and as she begins to feel around for them in her large bag she notices that the dogs are growling and appear to be headed directly towards her. At her car she places her handbag on the hood and peers into it, but in the darkness nothing is visible looking up she sees the dogs running toward her in full stride. She anxiously searches for her keys hearing the rapid barking getting louder finally, her fingers make contact with her keys and she pulls them out of her purse. As she inserts the key into her car door she feels one pulling on her coat.

Developed by - Beaussart, M. L., 2011

Positive Passage - 124 seconds

As she leaves the psychology building she realizes that it is much earlier than she thought and that at this time of day the campus is full of life. On this dazzling day, the brightness of the sun engulfs her as it beats down on the sidewalk beneath her feet. As she looks up at the cloudless sky the intensity of the sun makes her squint and she remembers that the weather forecasters had predicted a flawless day. "For once the weatherman was right," she thinks to herself as she begins the trek to her car.

It is early and she is happy to be free on such a glorious day so she decides to take the long route through the pine trees. In the shadow of the trees, her eyes take a moment to adjust and she must watch where she places her feet, otherwise she may trip on the large tangled roots beneath her. She hears a noise and looks up to see two squirrels chasing each other. A cool sweet breeze whispers through this small forest and she savors the relief it brings from the intensity of this afternoon's heat.

Now the parking lot is just ahead and all that she has to do is cross the crowded campus green. Today there are many students out playing Frisbee and soaking up the summer sun. She slows her pace and savors being outdoors on a day

like today. She sees the silhouette of a tall man emerge in front of her and then watches as its owner dives for a football. Again, she slows her pace to enjoy the moment.

At the edge of the full parking lot she pauses and looks for her car. Usually it would bother her to have to search for her vehicle, but on this splendid day she is happy to wander aimlessly through the sea of automobiles looking for her own. After a while she spots her car and reaches in her pocket for her keys. As she opens her car door she feels a blast of heat coming from the interior. She immediately rolls down the windows and slides back the sunroof. She starts her car, adjusts the stereo, and as she pulls out of the parking lot those nearby can hear her music blasting.

Petralia, S. M. & Gallup, G. G. (2002). Effects of a sexual assault scenario on handgrip strength across the menstrual cycle. *Evolution and Human Behavior, 23*(1), 3-10.

Neutral Scenario - 97 seconds

As she leaves the psychology building she realizes that it is much later than she thought and that the campus seems empty. It is a long walk out to her car. On this dark night, the dim glow of the outside lights seems to disappear before it reaches the ground. She remembers that the moon should be almost. She begins the trek to her car.

She doesn't like walking alone this late at night but she's tired so without thinking she takes the short cut through the pine trees. In the shadow of the trees, she must watch where she places her feet otherwise she may trip on the large tangled roots beneath her.

Now the parking lot is just ahead, all that she has to do is cross the barren campus green. The wind picks up. Again, she quickens her pace.

At the edge of the vacant parking lot she pauses and looks for her car. It is parked between two of the few remaining vehicles, a beat-up old pick-up truck and one of those family vans. Happy with the sight of her car she reaches into her coat pocket for her keys and finds that they are not there. They must be in her purse and as she begins to feel around for them in her large bag she places her handbag on the hood and peers into it, but in the

darkness nothing is visible. Finally, her fingers make contact with her keys and she pulls them out of her purse.

Developed by - Beaussart, M. L., 2011

APPENDIX B

MEASURES

Personal History, (Beaussart,2011)

How old are you? I am years old.

What is your ethnic background?

Your employment status?

What is your households yearly income?

What is your marital status?

If you are not married do you have a regular sexual partner?

Menstrual Cycle Questionnaire (MCQ) (Beaussart,2011)

1.Are you currently using contraception or a method of family planning to prevent pregnancy?

2. What is the main method of birth control that you are using now?

Pill (oral contraceptive)
Injection
Implant
IUD
Condom
Diaphragm
Withdrawal
Rhythm
Jelly, cream or foam
Other
None

3. Have you ever used the pill or the hormone patch for birth control?

If Yes, when did you last take the pill? (month/year)

4. Have you ever used Depo-Provera for birth control?

If Yes, when was your last injection? (month/year)

5. Have you ever used Norplant for birth control?

If Yes, when was your last Norplant removed? (month/year)

6. Have you ever used an IUD for birth control?

If Yes, when was your last IUD removed? (month/year)

7. Are you currently pregnant?

8. Are you currently breastfeeding?

9. Have you had a hysterectomy or your ovaries removed?

10. Have you gone through menopause or the change of life?

11. How old were you when you started your period?

12. Do you still have menstrual periods?

Menstrual Cycle

13. What was the date of your last period? (month/day/year)

13b. How sure are you of when you had your last period?

14. How would you describe your menstrual cycle pattern most of the time?

15. How long does your menstrual cycle last?

15b. On average, how many days after your last period has stopped is the fertile or ovulatory phase of your menstrual cycle?

Other Health Factors

16. Are you taking any medicines now? Yes No

If yes, what medicines?

17. Do you have any health problems (hearing loss, asthma, diabetes, seizures, etc.)?

If yes, what problems?

18. Have you ever had any of the following infections, diseases or operations?

Pelvic inflammatory disease (e.g. infection in Fallopian tubes or ovaries)

Chlamydia infection

Gonorrhea

Other sexually transmissible infections

Endometriosis

Ovarian cysts

Fibroma in the uterus (fibroids)

Operations on the uterus, tubes, ovaries or cervix

Cervical dysplasia

Thyroid disease

Fertility Problems

TSC-40 (Elliott & Briere, 1992)

How often have you experienced each of the following in the last two months? 0 = Never 3 = Often

1. Headaches
2. Insomnia (trouble getting to sleep)
3. Weight loss (without dieting)
4. Stomach problems
5. Sexual problems
6. Feeling isolated from others
7. "Flashbacks" (sudden, vivid, distracting memories)
8. Restless sleep
9. Low sex drive
10. Anxiety attacks
11. Sexual overactivity
12. Loneliness
13. Nightmares
14. "Spacing out" (going away in your mind)
15. Sadness
16. Dizziness
17. Not feeling satisfied with your sex life
18. Trouble controlling your temper
19. Waking up early and can't get back to sleep
20. Uncontrollable crying
21. Fear of men
22. Not feeling rested in the morning
23. Having sex that you didn't enjoy
24. Trouble getting along with others
25. Memory problems
26. Desire to physically hurt yourself
27. Fear of women
28. Waking up in the middle of the night
29. Bad thoughts or feelings during sex
30. Passing out
31. Feeling that things are "unreal"
32. Unnecessary or over-frequent washing
33. Feelings of inferiority
34. Feeling tense all the time
35. Being confused about your sexual feelings
36. Desire to physically hurt others
37. Feelings of guilt

38. Feelings that you are not always in your body
39. Having trouble breathing
40. Sexual feelings when you shouldn't have them

Elliott, D. M. & Briere, J. (1992). Sexual abuse trauma among professional women: validating the Trauma Symptom Checklist-40 (TSC-40). *Child Abuse & Neglect, 16*(3), 391-398.

APPENDIX C

TABLES

Table 1. Respondents Per MCG and Threat

Number of respondents per menstrual cycle group for the Sexual, Social, and Physical threat scenarios.

Threat Scenario	MCG	Response	No Response
Sexual Threat	Non-Ovulatory	35	34
	Ovulatory	19	21
	Hormones	27	26
	Total	81	81
Social Threat	Non-Ovulatory	17	52
	Ovulatory	15	25
	Hormones	22	31
	Total	54	108
Physical Threat	Non-Ovulatory	36	33
	Ovulatory	19	21
	Hormones	24	29
	Total	79	83

Table 2. TSC Scores and Response Rate

TSC Subscale scores for respondents versus non-respondents for sexual, social, and physical threat scenarios.

	Sexual		Social		Physical	
	Respns	No Respns	Respns	No Respns	Respns	No Respns
TSC-40 Total	24.55	26.06	27.18	24.15	25.00	25.78
	(14.76)	(12.35)	(13.96)	(13.45)	(13.71)	(13.62)
Dissociation	4.30	4.53	4.55	4.34	4.67	4.21
	(3.45)	(2.89)	(3.29)	(3.14)	(3.31)	(3.03)
Anxiety	5.11	5.47	5.58	5.13	5.35	5.27
	(3.18)	(3.56)	(3.51)	(3.30)	(3.39)	(3.34)
Depression	5.97	5.83	6.10	5.80	5.87	5.97
	(4.05)	(3.54)	(3.76)	(3.83)	(3.80)	(3.82)
SATI	3.32	3.59	3.81	3.27	3.73	3.22
	(2.95)	(2.89)	(3.04)	(2.84)	(2.93)	(2.88)
Sleep	5.93	6.08	6.32	5.84	5.63	6.41
	(3.86)	(3.54)	(3.70)	(3.70)	(3.75)	(3.62)
Sexual	3.20	3.22	4.08**	2.77	3.52	2.91
	(3.54)	(2.99)	(3.80)	(2.89)	(3.48)	(3.07)

Note. Asterisks indicate a significant difference between the cell in which it is shown and the cell on its immediate right. **=$p<.01$ $df=81.43$. Standard deviations appear in parentheses below the mean.

Table 3. TSC Correlations with Threat Response

Correlation results for TSC-40 with subscale scores and response time for the sexual, social, and physical threat scenarios.

	Sexual	Social	Physical
TSC-40 SUM	-.031	-.184	.027
Dissociation	-.088	-.110	-.045
Anxiety	.179	.157	-.032
Depression	.056	.008	.006
SATI	.024	-.022	-.050
Sleep	.087	.023	.013
Sexual	.029	-.060	-.017

Note. All correlations were statistically non-significant $p > .16$.

Table 4. Response Rate and Affective Reaction

Mean scores for respondents versus non-respondents emotional and stress responses on the SAM Manikin for the sexual, social, and physical threat scenarios.

	Sexual Threat		Social Threat		Physical Threat	
	Respns	No Respns	Respns	No Respns	Respns	No Respns
Emotional	2.31*	2.75	2.17**	2.70	2.63	2.71
	(1.23)	(1.28)	(1.07)	(1.47)	(1.18)	(1.46)
Stress	8.06	7.73	6.53*	5.89	7.68	7.47
	(1.47)	(1.24)	(1.68)	(2.00)	(1.28)	(1.62)

Note. * =p<.05. ** =p<.01. Lower scores on the emotional valence indicate and increased distress response. Lower scores on the stress valence indicate a decrease anxious response. Standard deviations appear in parentheses below the mean.

Table 5. MCG and Demographic Factors of Responders

Results of statistical tests comparing responders versus non-responders based on menstrual cycle group and demographic factors for the Sexual, Social, and Physical threat scenarios.

	Sexual			Social			Physical		
Variable	X^2	*df*	Sig	X^2	*df*	Sig	X^2	*df*	Sig
Menstrl	.13	2	.94	5.00	2	.08	.48	2	.79
Married	2.56	3	.46	3.27[b]	3	.35	3.99[g]	3	.26
Partner	1.17	2	.56	.93[c]	2	.63	1.29[h]	2	.53
Sex Pref	.00[a]	2	1.0	2.84[d]	2	.24	4.00	2	.14
Ethnic	.24	11	.57	14.5	11	.21	6.69[i]	11	.82
Edu	1.04	2	.59	2.13[f]	2	.35	.33[j]	2	.98
	T	*df*	Sig	*t*	*df*	Sig	*t*	*df*	Sig
Age	-1.11	160	.27	.71	160	.48	.23	159	.82

Note: Superscript letters are for the following; a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is 1.00. b. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 2.04. c. 2 cells (33.3%) have expected count less than 5. The minimum expected count is .33. d. 3 cells (50.0%) have expected count less than 5. The minimum expected count is .68. e. 17 cells (70.8%) have expected count less than 5. The minimum expected count is .34. f. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 1.36. g. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 2.94. h. 2 cells (33.3%)have expected count less than 5. The minimum expected count is .46. i. 16 cells (66.7%) have expected count less than 5. The minimum expected count is .49. j. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 1.96.

Table 6. Number of Respondents and Non-Respondents as a Function of Threat and MCG

Number of respondents and mean response times in seconds per menstrual cycle group for each of the Sexual, Social, and Physical threat scenarios.

		N Responders	*M* Response Time	*SD*
Sexual	Non-Ovulatory	35	79.27	26.88
	Ovulatory	19	62.28	17.80
	Hormones	27	75.84	25.85
	Total	81	74.14	25.33
Social	Non-Ovulatory	17	107.51	33.85
	Ovulatory	15	112.80	31.26
	Hormones	22	114.10	32.03
	Total	54	111.66	31.92
Physical	Non-Ovulatory	36	97.36	30.92
	Ovulatory	19	79.17	32.60
	Hormones	24	88.29	31.62
	Total	79	90.23	31.99

Table 7. Decision Latency Times as a Function of MCG

Results of ANOVAs for differences in decision latency times for menstrual cycle group per threat situation.

		df	*F*	Sig.
Sexual Threat	Between Groups	2	3.01	.055
	Within Groups	78		
	Total	80		
Social Threat	Between Groups	2	.21	.81
	Within Groups	51		
	Total	53		
Physical Threat	Between Groups	2	2.13	.17
	Within Groups	76		
	Total	78		

Table 8. Post Hoc Comparison for Emotional Response

Bonferroni comparisons of emotional responses to different threat scenarios.

Threat Scenario	Comparison	M Response Diff	Std. Error	95% Confidence Interval for Difference(a)	
				Lower	Upper
Sexual	Social	.04	.12	-.30	.39
	Physical	- .11	.10	-.41	.18
	Happy	-5.42*	.16	-5.88	-4.97
	Neutral	-2.35*	.12	-2.70	-2.00
Social	Sexual	- .04	.12	-.39	.30
	Physical	- .15	.13	-.52	.21
	Happy	-5.46*	.16	-5.92	-5.01
	Neutral	-2.40*	.13	-2.77	-2.02
Physical	Sexual	.11	.10	-.18	.41
	Social	.15	.13	-.21	.52
	Happy	-5.31*	.15	-5.76	-4.87
	Neutral	-2.24*	.12	-2.60	-1.88
Happy	Sexual	5.42*	.16	4.97	5.88
	Social	5.46*	.16	5.01	5.92
	Physical	5.31*	.15	4.87	5.76
	Neutral	3.06*	.13	2.69	3.44
Neutral	Sexual	2.35*	.12	2.00	2.70
	Social	2.40*	.13	2.02	2.77
	Physical	2.24*	.12	1.88	2.60
	Happy	-3.06*	.13	-3.44	-2.69

Note: * $p < 0.01$

Table 9. Post Hoc Comparison for Stress Response

Bonferroni comparison for stress response as a function of threat scenario.

Threat Scenario	Comparison	M Response Diff	Std. Error	95% Confidence Interval for Difference(a)	
				Lower	Upper
Sexual	Social	1.80(*)	.16	1.35	2.26
	Physical	.35	.13	-.03	.75
	Happy	5.94(*)	.20	5.36	6.52
	Neutral	2.89(*)	.16	2.41	3.37
Social	Sexual	-1.80(*)	.16	-2.27	-1.35
	Physical	-1.45(*)	.16	-1.91	-.98
	Happy	4.13(*)	.21	3.51	4.75
	Neutral	1.08(*)	.20	.49	1.67
Physical	Sexual	-.35	.13	-.75	.03
	Social	1.45(*)	.16	.98	1.91
	Happy	5.58(*)	.20	4.99	6.18
	Neutral	2.53(*)	.17	2.03	3.04
Happy	Sexual	-5.94(*)	.20	-6.52	-5.36
	Social	-4.13(*)	.21	-4.75	-3.51
	Physical	-5.58(*)	.20	-6.18	-4.99
	Neutral	-3.04(*)	.17	-3.55	-2.54
Neutral	Sexual	-2.89(*)	.16	-3.37	-2.41
	Social	-1.08(*)	.20	-1.67	-.49
	Physical	-2.53(*)	.17	-3.04	-2.03
	Happy	3.04(*)	.17	2.54	3.55

Note: * $p < 0.01$

Table 10. Affective Reaction Per MCG

Results of ANOVAs for differences in emotional and stress response per menstrual cycle group for each threat situation.

		Affective Response			Stress Response		
Threat	Groups	*F*	*df*	Sig.	*F*	*df*	Sig.
Sexual	Between	.04	2	.96	.107	2	.90
	Within		159			159	
	Total		161			161	
Social	Between	1.33	2	.27	.152	2	.86
	Within		159			159	
	Total		161			161	
Physical	Between	.86	2	.43	.176	2	.84
	Within		159			159	
	Total		161			161	

Note: There were no significant differences between menstrual cycle group and emotional response to the stimuli, all p values >.25.

APPENDIX D

FIGURES

Figure 1. Response Time for Sexual Threat

Histogram for response times to sexual threat scenario.

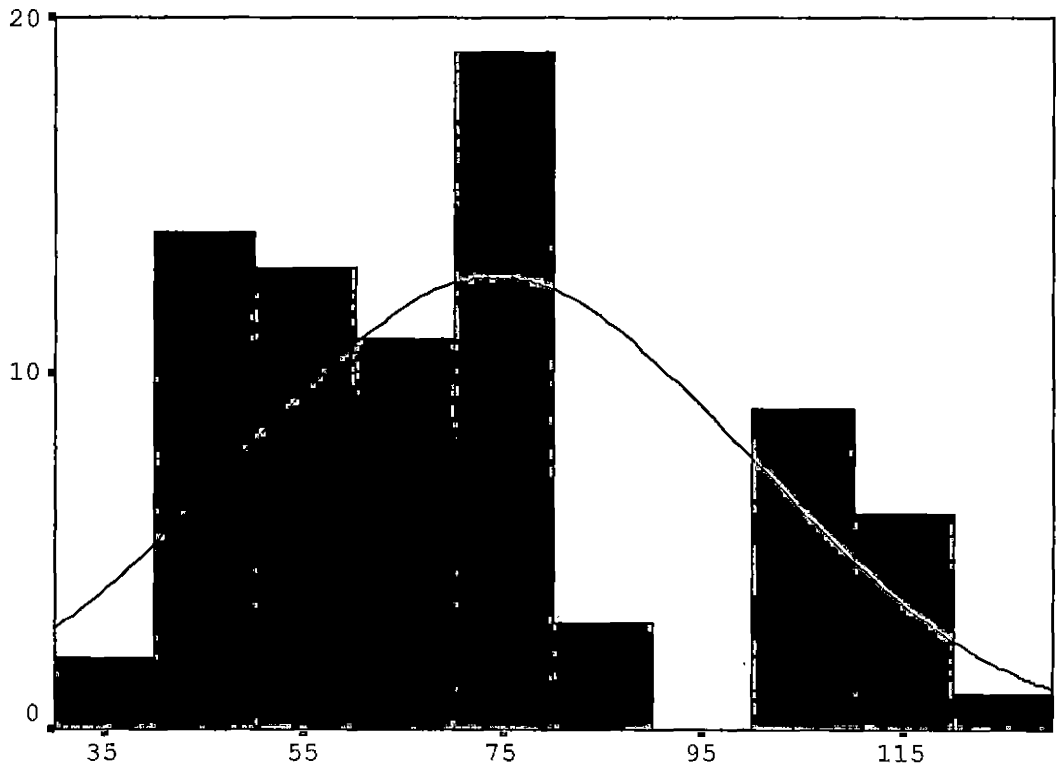
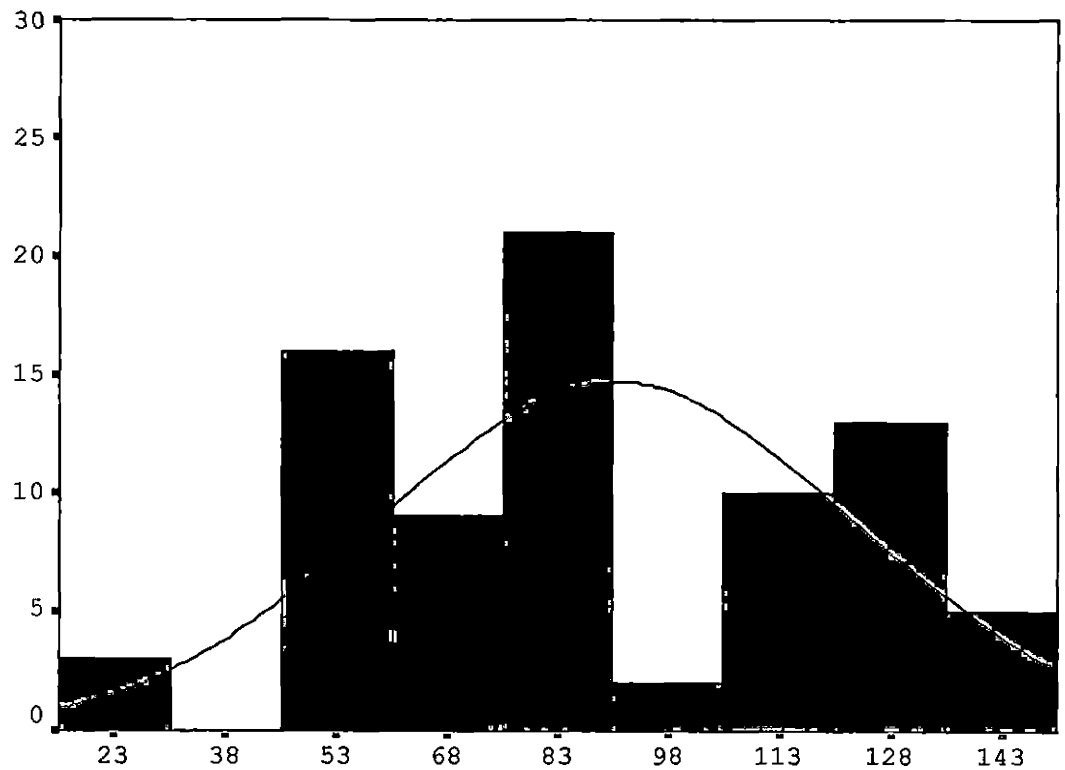


Figure 2. Response Time for Physical Threat

Histogram for response times to physical threat scenario.



Decision latency times for physical threat (seconds)

Figure 3. Response Time for Social Threat

Histogram for response times to social threat scenario.

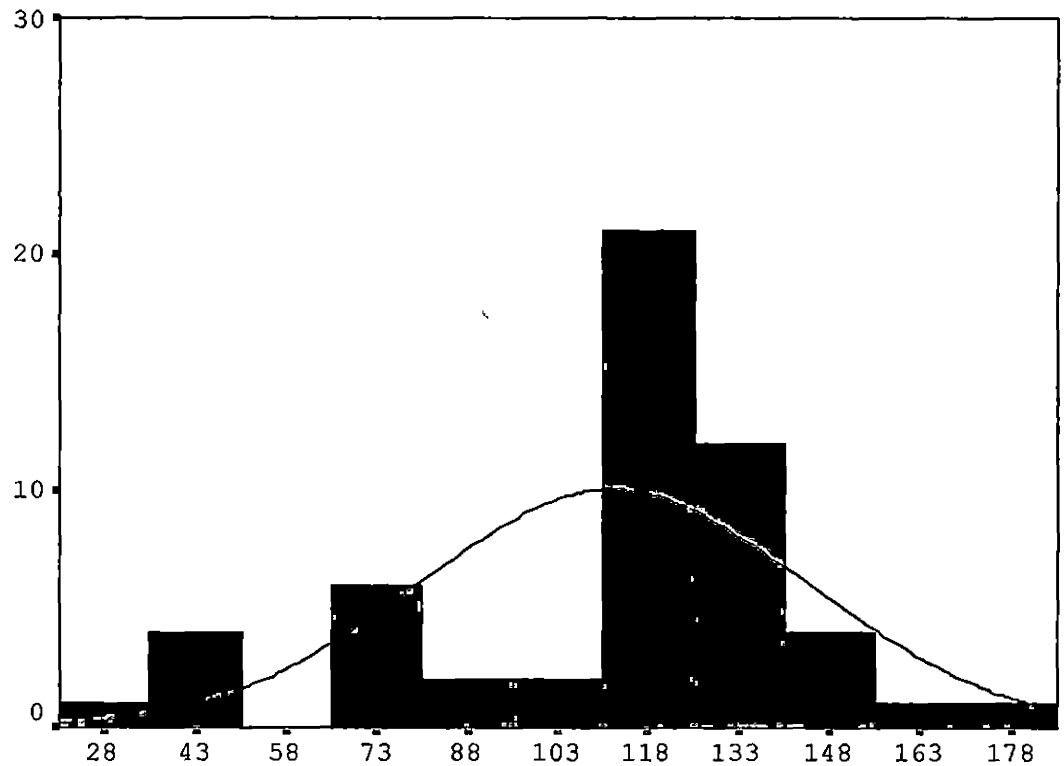


Figure 4. Decision Latency for Sexual Threat

Error bar graph of mean decision latency response scores indicate the 95% confidence interval for the sexual threat scenario.

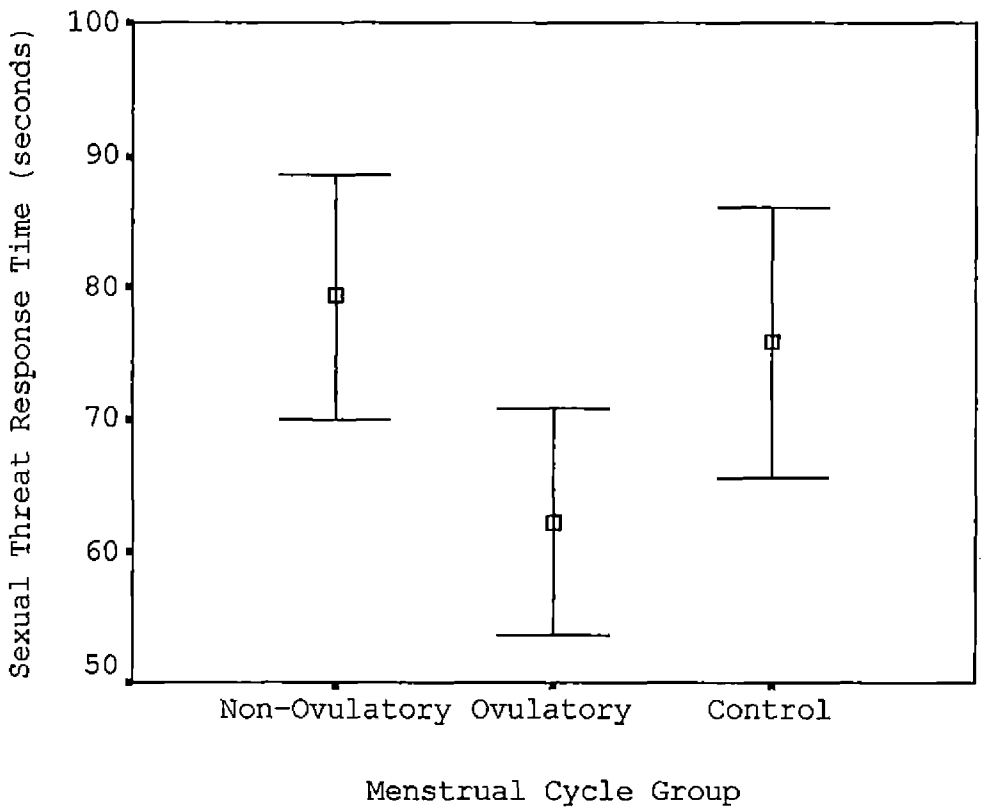


Figure 5. Decision Latency for Social Threat

Error bar graph of mean decision latency response scores indicates the 95% confidence interval for the social threat scenario.

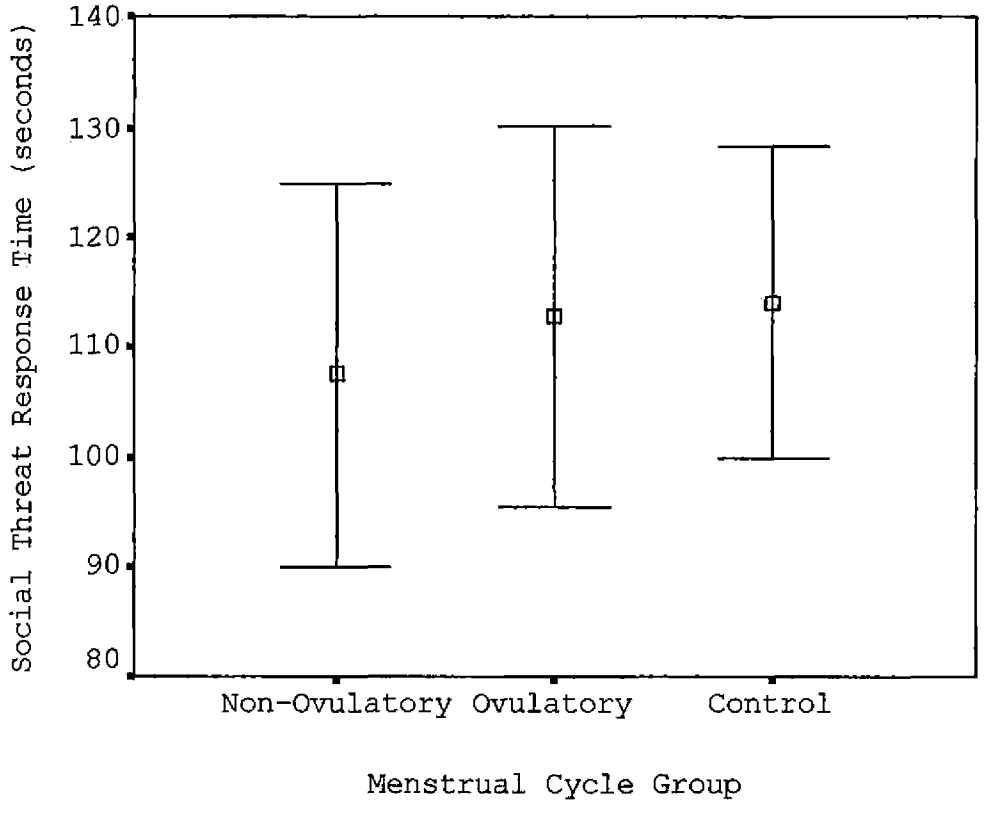


Figure 6. Decision Latency for Physical Threat

Error bar graph of mean decision latency response scores indicate the 95% confidence interval for the physical threat scenario.

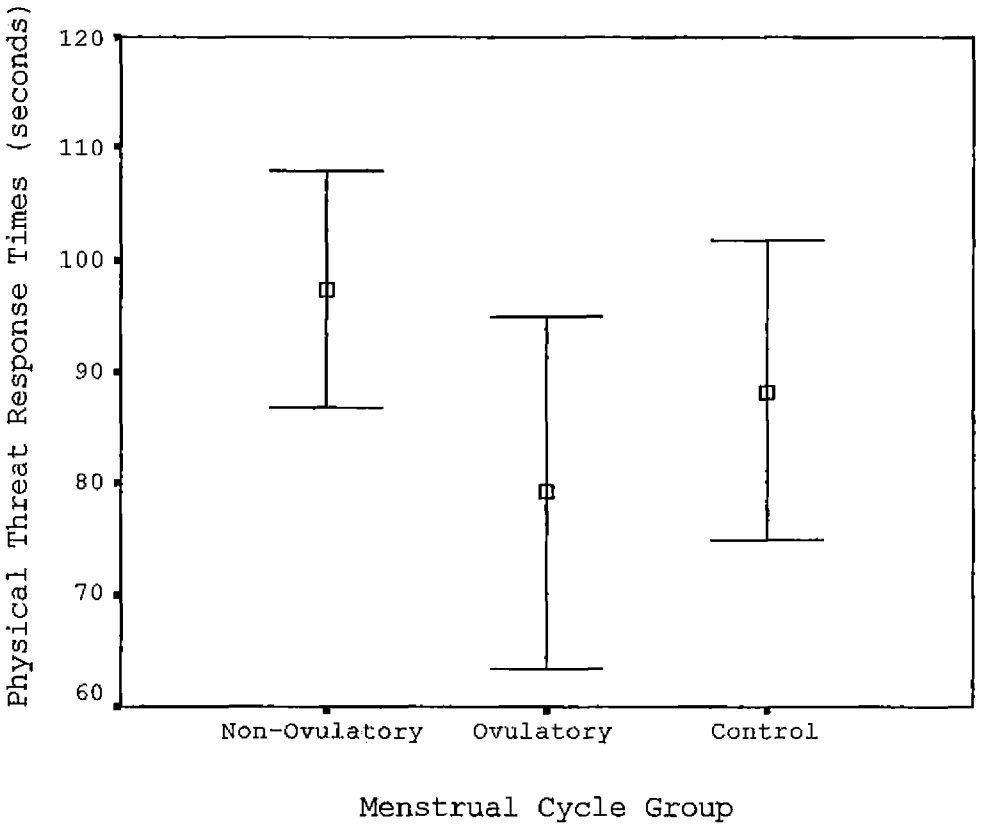
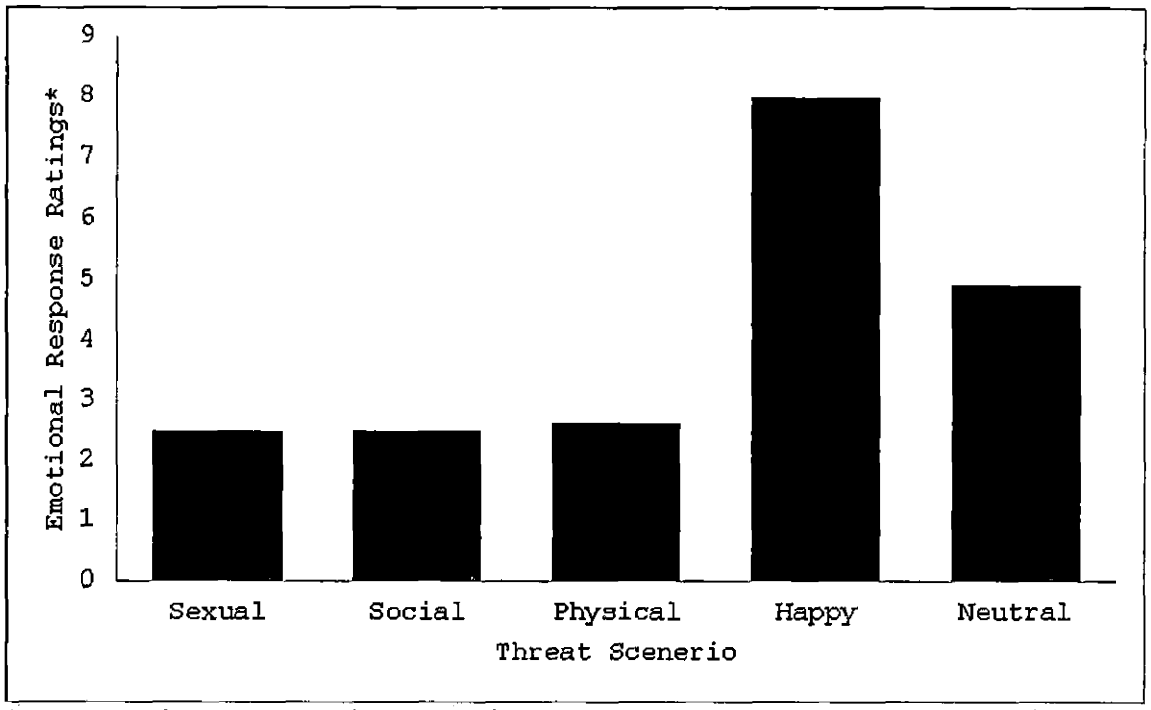


Figure 7. Emotional Response to Threat

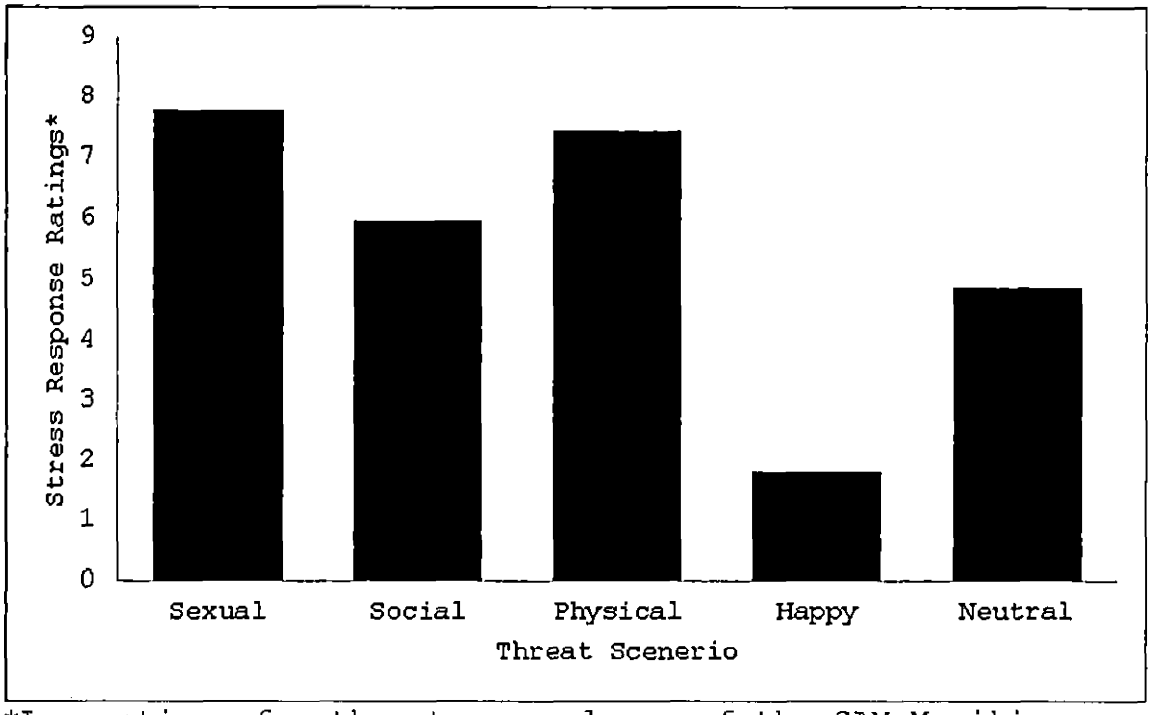
Mean emotional response ratings on the SAM Manikin per threat scenario.



*Low ratings for the emotional valence of the SAM Manikin indicate that the audio elicited feelings of sadness in the participant while a high score indicates a happy response.

Figure 8. Stress Response to Threat

Mean stress response ratings on the Sam Manikin per threat scenario.



*Low ratings for the stress valence of the SAM Manikin indicate that the audio elicited feelings of calm in the participant while high scores indicate an anxious response.

APPENDIX E

INSTITUTIONAL REVIEW BOARD

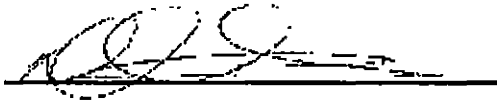
Human Subjects Review Board
Department of Psychology
California State University,
San Bernardino

PI:	Clapper, John & Beaussart, Melanie
From:	Donna Garcia
Project Title:	The influence of Mentrual Cycle Phase on Threat Recognition
Project ID:	H-11WI-27
Date:	Tuesday, April 19, 2011

Disposition: Expedited Review

Your IRB proposal is approved. This approval is valid until 4/19/2012.

Good luck with your research!



Donna M. Garcia, Chair
Psychology IRB Sub-Committee

CALIFORNIA STATE UNIVERSITY
SAN BERNARDINO

College of Social and Behavioral Sciences
Department of Psychology

Informed Consent

This study in which you are being asked to participate is designed to investigate the correlates of dream perception. This study is being conducted by Dr. John Clapp, Professor of Psychology, California State University, San Bernardino. This study has been approved by the Institutional Review Board, California State University, San Bernardino.

PURPOSE: This study aims to measure variables that impact a woman's perception of the childbearing situation.
DESCRIPTION: Participation will involve listening to 3 audio vignettes intended to evaluate your ability to recognize if the content of the audio is personally or physically threatening. We will also be gathering information about your menstruation history and asking you to fill out measures to screen any previous psychological issues. When you complete the audio task and surveys, you will receive a debriefing statement describing the study in more detail. For your participation you will receive 3 points of extra credit for the class of your choice, pending your instructor's approval.
PARTICIPATION: Your participation in this study is entirely voluntary. You are free to withdraw your participation at any time during the study, or refuse to answer any specific question, without penalty or withdrawal of benefits to which you are otherwise entitled.
CONFIDENTIALITY OF DATA: Code numbers will be used to identify participants and no identifiers are saved from the subjects' testing during each session on the computer therefore anonymity is guaranteed. As no identifying information will be collected, your name cannot be connected with your responses and hence your data will remain completely anonymous.
DURATION: This experiment will take approximately 60 to 70 minutes to complete.
RISKS: Due to the sensitive nature of the subject and the presentation of suggestive audio stimuli, there may be psychological stress imposed on the participants in this study. This stress however is minimal and methods have been put into place to reduce the possibility of any psychological harm.
BENEFITS: There are no direct benefits to you as a participant other than extra credit for one of your psychology courses.
CONTACT: If you have questions at any time about the study, you may contact Dr. John Clapp, jclapp@csusb.edu or call 909.537.3843. If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact the Human Subjects office at California State University, San Bernardino (909) 537-7588.
RESULTS: Results from this study will be available from Dr. John Clapp jclapp@csusb.edu after May, 2012.
IRB APPROVED: This study has been approved by the Department of Psychology Institutional Review Board Sub-Committee of the California State University, San Bernardino, and a copy of the official Psychology IRB stamp of approval should appear on this consent form. The University requires that you give your consent before participating in this study.

"I acknowledge that I have been informed of and that I understand the nature and purpose of this study and I freely consent to participate. I also acknowledge that I am at least 18 years of age."

Participant's X _____

Date: _____

CALIFORNIA STATE UNIVERSITY SAN BERNARDINO
PSYCHOLOGY INSTITUTIONAL REVIEW BOARD SUB-COMMITTEE
APPROVED 11/19/11 NOT AFTER 11/19/12
REF# H-11-27 CHAIR _____

REFERENCES

Baker, R. R. & Bellis, M. A. (1993). Human sperm competition: ejaculate adjustment by males and the function of masturbation. *Animal Behaviour, 46*(5), 861-885.

Bellis, M. A. & Baker, R. R. (1990). Do females promote sperm competition? Data for humans. *Animal Behaviour, 40*(5), 997-999.

Bradley, M. M., Greenwald, M. K., Petry, M. C. & Lang, P. J. (1992). Remembering pictures: pleasure and arousal in memory. *Journal of Experimental Psychology. Learning, Memory, and Cognition, 18*(2), 379-390.

Brand, G. (2001). Sex differences in human olfaction: Between evidence and enigma. *The Quarterly Journal of Experimental Psychology: Section B, 54*(3), 259-270.

Brereton, A. R. (1995). Coercion-defense hypothesis: the evolution of primate sociality. *Folia Primatologica, 64*, 207-214.

Briere, J. (1996). Psychometric review of the Trauma Symptom Checklist-40. In B. H. Stamm (Ed.), *Measurement of stress, trauma, and adaptation.* Lutherville, MD: Sidran Press.

Bröder, A. & Hohmann, N. (2003). Variations in risk taking behavior over the menstrual cycle: An improved replication. *Evolution and Human Behavior, 24*(6), 391-398.

Calder, A. J., Lawrence, A. D. & Young, A. W. (2001). Neuropsychology of fear and loathing. *Nature Reviews. Neuroscience, 2*(5), 352-363.

Chavanne, T. J. & Gallup Jr, G. G. (1998). Variation in risk taking behavior among female college students as a function of the menstrual cycle. *Evolution and Human Behavior, 19*(1), 27-32.

Daly, M. (1978). The cost of mating. *The American Naturalist, 112*(986), 771-774.

Darwin, C. R. (1871). *The Descent of man and selection in relation to sex*. London, England: John Murray.

Davydov, D. M., Shapiro, D. & Goldstein, I. B. (2004). Moods in everyday situations: Effects of menstrual cycle, work, and personality. *Journal of Psychosomatic Research, 56*(1), 27-33.

Elliott, D. M. & Briere, J. (1992). Sexual abuse trauma among professional women: validating the Trauma Symptom Checklist-40 (TSC-40). *Child Abuse & Neglect, 16*(3), 391-398.

Ellis, L. & Walsh, A. (1997). Gene-based evolutionary theories in criminology. *Criminology, 35*(2), 229-276.

Ellsworth, P. C., Scherer, K. R., Davidson, R. J., Scherer, K. R. & Goldsmith, H. H. (2003). Appraisal processes in emotion. In *Handbook of affective sciences*. (pp. 572-595): New York, NY, US: Oxford University Press.

Feinberg, D. R., Jones, B. C., Moore, F. R., Debruine, L. M., Cornwell, R. E., Hillier, S. G., et al. (2006). Menstrual cycle, trait estrogen level, and masculinity preferences in the human voice. *Hormones and Behavior, 49*, 215-222.

Ferin, M., Jewelewicz, R. & Warren, M. P. (1993). *The menstrual cycle: Physiology, reproductive disorders, and infertility*: New York, NY, US: Oxford University Press.

Figueredo, A. J., Corral-Verdugo, V., Frías-Armenta, M., Bachar, K. J., White, J., McNeill, P. L., et al. (2001). Blood, solidarity, status, and honor: The sexual balance of power and spousal abuse in Sonora, Mexico. *Evolution and Human Behavior, 22*(5), 295-328.

Gangestad, S. W., Thornhill, R. & Garver-Apgar, C. E. (2005a). Adaptations to ovulation: Implications for

sexual and social behavior. *Current Directions in Psychological Science, 14*(6), 312-316.

Gangestad, S. W., Thornhill, R. & Garver-Apgar, C. E. (2005b). Women's sexual interests across the ovulatory cycle depend on primary partner developmental instability. *Proceedings: Biological Sciences, 272*(1576), 2023-2027.

Garver-Apgar, C. E., Gangestad, S. W. & Simpson, J. A. (2007). Women's perceptions of men's sexual coerciveness change across the menstrual cycle. *Acta Psychologica Sinica, 39*(3), 536-540.

Garver-Apgar, C. E., Gangestad, S. W., Thornhill, R., Miller, R. D. & Olp, J. J. (2006). Major histocompatibility complex alleles, sexual responsivity, and unfaithfulness in romantic couples. *Psychological Science, 17*(10), 830-835.

Geary, D. C., Vigil, J. & Byrd-Craven, J. (2004). Evolution of human mate choice. *The Journal of Sex Research, 41*(1), 27-43.

Hilinski, C. (2009). Fear of crime among college students: A test of the shadow of sexual assault hypothesis. *American Journal of Criminal Justice, 34*(1), 84-102.

Kilpatrick, D. G., Edmunds, C. & Seymour, A. (1992). *Rape in America*. Arlington, VA: National Victim Center.

Lang, P. J., Greenwald, M. K., Bradley, M. M. & Hamm, A. O. (1993). Looking at pictures: affective, facial, visceral, and behavioral reactions. *Psychophysiology, 30*(3), 261-273.

Lennox, B. R., Jacob, R., Calder, A. J., Lupson, V. & Bullmore, E. T. (2004). Behavioural and neurocognitive responses to sad facial affect are attenuated in patients with mania. *Psychological Medicine, 34*(05), 795-802.

Lenton, E. A., Landgren, B. M., Sexton, L. & Harper, R. (1984). Normal variation in the length of the follicular phase of the menstrual cycle: effect of chronological age. *BJOG: An International Journal of Obstetrics & Gynaecology, 91*(7), 681-684.

Macrae, C. N., Alnwick, K. A., Milne, A. B. & Schloerscheidt, A. M. (2002). Person perception across the menstrual cycle: Hormonal influences on social-cognitive functioning. *Psychological Science, 13*(6), 532-536.

Man, M. S., MacMillan, I., Scott, J. & Young, A. H. (1999). Mood, neuropsychological function and cognitions in

premenstrual dysphoric disorder. *Psychological Medicine: A Journal of Research in Psychiatry and the Allied Sciences, 29*(3), 727-733.

Marx, B. P., Calhoun, K. S., Wilson, A. E. & Meyerson, L. A. (2001). Sexual revictimization prevention: an outcome evaluation. *Journal of Consulting and Clinical Psychology, 69*(1), 25-32.

McIntosh, J. E., Matthews, C. D., Crocker, J. M., Broom, T. J. & Cox, L. W. (1980). Predicting the luteinizing hormone surge: relationship between the duration of the follicular and luteal phases and the length of the human menstrual cycle. *Fertility and Sterility, 34*(2), 125-130.

McKibbin, W., Shackelford, T., Miner, E., Bates, V. & Liddle, J. (2011). Individual differences in women's rape avoidance behaviors. *Archives of Sexual Behavior, 40*(2), 343-349.

Meadows, E. A., Jaycox, L. H., Orsilla, S. M. & Foa, E. B. (1997). *The impact of assault on risk recognition in ambiguous situations.* Paper presented at the Association for Advancement of Behavior Therapy, Miami Beach, FL.

Meadows, E. A., Jaycox, L. H., Stafford, J., Hembree, E. & Foa, E. B. (1995). *Recognition of risk in revictimized women*. Paper presented at the Association for the Advancement of Behavior Therapy, Washington, DC.

Mesnick, S. L. (1997). Sexual alliances: Evidence and evolutionary implications. *Feminism and evolutionary biology*, 207-257.

Navarrete, C. D., Fessler, D. M. T., Fleischman, D. S. & Geyer, J. (2009). Race bias tracks conception risk across the menstrual cycle. *Psychological Science, 20*(6), 661-665.

Nene, A. S. & Pazare, P. A. (2010). A study of auditory reaction time in different phases of the normal menstrual cycle. *Indian Journal Physiologic Pharmacology, 54*(4), 386-390.

Pawson, E. & Banks, G. (1993). Rape and fear in a New Zealand city. *Area, 25*(1), 55-63.

Penton-Voak, I. S. & Perrett, D. I. (2000). Female preference for male faces changes cyclically-Further evidence. *Evolution and Human Behavior, 21*(1), 39-48.

Perry, S. (1997). Male-female social relationships in wild white-faced capuchins(Cebus capucinus). *Behaviour, 134*, 477-510.

Petralia, S. M. & Gallup, G. G. (2002). Effects of a sexual assault scenario on handgrip strength across the menstrual cycle. *Evolution and Human Behavior, 23*(1), 3-10.

Phan, K. L., Taylor, S. F., Welsh, R. C., Decker, L. R., Noll, D. C., Nichols, T. E., et al. (2003). Activation of the medial prefrontal cortex and extended amygdala by individual ratings of emotional arousal: a fMRI study. *Biological Psychiatry, 53*(3), 211-215.

Pillsworth, E. G., Haselton, M. G. & Buss, D. M. (2004). Ovulatory shifts in female sexual desire. *The Journal of Sex Research, 41*(1), 55-66.

Pol, H. E. H., Hijman, R., Baaré, W. F. C., van Eekelen, S. & van Ree, J. M. (2000). Odor Discrimination and Task Duration in Young and Older Adults. *Chemical Senses, 25*, 461-464.

Provost, M. P. & Vernon, Q. L. (2004). *Evidence for a cognitive bias promoting rape vigilance.* Paper presented at the Human Behavior and Evolution Society, Berlin, Germany.

Puts, D. A. (2006). Cyclic variation in women's preferences for masculine traits: Potential hormonal causes. *Human Nature, 17*(1), 114-127.

Schaller, M., Park, J. H. & Kenrick, D. T. (2006). Human evolution and social cognition. In R. I. M. Dunbar & L. Barrett (Eds.), *Oxford Handbook of Evolutionary Psychology*. Oxford, England: Oxford University Press.

Smuts, B. (1992). Male aggression against women: An evolutionary perspective. *Human Nature, 3*(1), 1-44.

Soler-Baillo, J. M., Marx, B. P. & Sloan, D. M. (2005). The psychophysiological correlates of risk recognition among victims and non-victims of sexual assault. *Behaviour Research and Therapy, 43*(2), 169-181.

Sterck, E. H. M., Watts, D. P. & van Schaik, C. P. (1997). The evolution of female social relationships in nonhuman primates. *Behavioral Ecology and Sociobiology, 41*(5), 291-309.

Strassmann, B. I. (1996). The evolution of endometrial cycles and menstruation. *Quarterly Review of Biology, 71*(2), 181-220.

Symons, D. (1979). The evolution of human sexuality. In: New York: Oxford University Press.

Thornhill, N. W. & Thornhill, R. (1990). An evolutionary analysis of psychological pain following rape: II. The effects of stranger, friend, and family-member offenders. *Ethology and Sociobiology, 11*(3), 177-193.

Thornhill, R. & Gangestad, S. W. (1999). The scent of symmetry: a human sex pheromone that signals fitness. *Evolution and Human Behavior, 20*, 175-201.

Thornhill, R. & Palmer, C. (2000). The Natural History of Rape: Biological Basis of Social Coercion: MIT.

Thornhill, R. & Thornhill, N. W. (1983). Human rape: an evolutionary analysis. *Ethology and Sociobiology, 4*(1), 37–173.

Tooby, J. & Cosmides, L. (1992). The psychological foundations of culture. In J. H. Barkow, L. Cosmides & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 19-136). New York, NY, US: Oxford University Press.

Valentine, G. (1989). The geography of women's fear. *Area, 21*(4), 385-390.

Vierling, J. S. & Rock, J. (1967). Variations in olfactory sensitivity to exaltolide during the menstrual cycle. *Journal of Applied Physiology, 22*(2), 311-315.

Williams, G. C. (1966). *Adaptation and natural selection.* Princeton, NJ: Princeton University Press.

Wilson, A. E., Calhoun, K. S. & Bernat, J. A. (1999). Risk recognition and trauma-related symptoms among sexually

revictimized women. *Journal of Consulting and Clinical Psychology, 67*(5), 705-710.

Wilson, E. O. (1975). *Sociobiology: the new synthesis.* Cambridge, MA: Belknap Press of Harvard University Press.

Wilson, E. O. (1978). *On human nature.* Cambridge, MA: Harvard University Press Cambridge.

Wilson, M. & Mesnick, S. L. (1997). *An empirical test of the bodyguard hypothesis.* London, England: Chapman & Hall.

Yadav, A., Tandon, O. P. & Vaney, N. (2003). Long latency auditory evoked responses in ovulatory and anovulatory menstrual cycle. *Indian Journal Physiologic Pharmacology, 47*(2), 179-184.