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**Napping in Women with Severe Emotional/Behavioural Premenstrual Symptoms:
Effects on Symptoms and Subsequent Sleeping Patterns**

Lynne J. Lamarche

Thesis submitted to the Faculty of Graduate and Postdoctoral Studies

In partial fulfillment of the requirements for the PhD degree in Clinical Psychology

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“If sleep does not serve an absolute vital function, then it is the greatest evolutionary mistake ever made!”

- Rechtschaffen, 1971

“It was quite revealed to me that the nap is the answer to the world’s individual and collective problems. In the nap we have a non-invasive technique for instant restoration.”

- Moore, 1990

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Curriculum Studiorum

Lynne Julie Lamarche was born on December 15, 1979, in Sudbury, Ontario. She obtained a B.Sc. in Psychology from Queen's University in May, 2002.

Articles

Lamarche, L., Forest, G., & De Koninck, J. (In press). The effect of napping on aggression and sadness among women with significant premenstrual symptoms. Proceedings of the Interim Congress of the World Federation of Sleep Research and Sleep Medicine Societies. (Manuscript published in full)

Wiebe, S., **Lamarche, L.,** Sabourin, C., Lortie-Lussier, M., & De Koninck, J. (Submitted for publication). Dreams of Women with Severe Emotional/Behavioral Premenstrual Symptoms. (Manuscript)

Summary of published work

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Lamarche, L., Forest, G., & De Koninck, J. (2005). The effect of napping on aggression and sadness among women with significant premenstrual symptoms. *Sleep and Biological Rhythms*, 3, A54-A55.

Lamarche, L., Wiebe, S., Crawford, L., & De Koninck, J. (2005). SWS in napping and subsequent nocturnal sleep among women with significant premenstrual symptoms. Abstract published in *Sleep*, 28, A292.

Wiebe, S., **Lamarche, L.,** Lortie-Lussier, M., & De Koninck, J. (2005). Emotional premenstrual symptoms and the emotional content of dream. Abstract published in *Sleep*, 28, A51.

Lamarche, L., Gosselin, A., De Koninck, J., & Campbell, K. (2004). N1 changes in event potentials over time during 36 hours of total sleep deprivation and following recovery sleep. Abstract published in *Sleep*, 27, A161.

Forest, G., **Lamarche, L.,** Grenier, J., Castonguay, M., & De Koninck, J. (2004). Thermal biofeedback and sleep: Limited effects and methodological challenges, Abstract published in *Sleep*, 27, A45.

Lamarche, L.J., Davies, D., MacLean, A.W. (2003). The Effect of Education about the Consequences of Sleep Deprivation and Driving. Abstract published in *Sleep*, 26, A171.

Articles in preparation

Nocturnal Sleep, Daytime Sleepiness, and Napping Among Women with Significant Emotional/Behavioural Premenstrual Symptoms. (In preparation).

Napping in Women with Significant Emotional/Behavioural Premenstrual Symptoms: Effects on Symptoms and Subsequent Sleeping Patterns. (In preparation).

Sleep Disturbance Among Adults with Post-Traumatic Stress Disorder. (In preparation).

Summary

One of the most prominent symptoms of the late-luteal phase of the menstrual cycle is sleep disturbance (Moline, Broch, Zak, & Gross, 2003), and this is particularly noted among women with more severe premenstrual symptoms (Lee, Shaver, Giblin, & Woods, 1990; Mauri, Reid, & MacLean, 1988). In addition, women with more severe symptoms often experience increased daytime sleepiness during the late-luteal phase (Manber & Bootzin, 1997). Past studies have found that a daytime nap is beneficial in the general population, in that it improves subjective alertness, reaction time performance, short term memory performance, vigilance performance (Tietzel & Lack, 2001), and mood (Taub, 1976). The objective of the current study was to investigate the effects of a short mid-afternoon nap during the late-luteal phase of the menstrual cycle on sleepiness, alertness, mood, and cognitive performance among women with severe and minimal emotional/behavioural premenstrual symptoms. The effects of such a nap on subsequent sleeping patterns, was also examined.

Two groups of women were included in this study; 10 women suffering from severe emotional/behavioural premenstrual symptoms and 9 women with minimal to no premenstrual symptoms. After an adaptation nocturnal sleep recording, participants first spent one night during the follicular phase, followed by two nights ('nap condition' and 'no nap condition') during the late-luteal phase sleeping in the laboratory. During the 'nap condition', participants came to the laboratory in the afternoon and attempted to take a mid-afternoon nap scheduled approximately 12 hours following the mid point of their habitual nocturnal sleep, for a maximum duration of 30 minutes. They returned to the laboratory that same night for a nocturnal sleep recording. Measures of sleepiness, alertness, mood, and cognitive performance were completed before and 30 minutes after the napping session, and

the sleepiness, alertness, and mood measures were also administered at every two hours until nocturnal bedtime. The same procedure was repeated for the 'no nap condition', but instead of taking a nap, participants engaged in a quiet activity. The nap and no nap conditions were counterbalanced. Core body temperature was measured continuously during the days and nights of the follicular and late-luteal recordings, using a rectal thermometer.

Results from the study indicated that women with severe emotional/behavioural premenstrual symptoms had more daytime sleepiness and less alertness than women with minimal symptoms, during the late-luteal phase of the cycle. Both groups of women were found to have a more disturbed nocturnal sleep during the late-luteal phase of the cycle compared to the follicular phase. Napping during the late-luteal phase of the menstrual cycle improved sleepiness, alertness, negative and positive mood, as well as some aspects of cognitive performance, with no significant negative effects on subsequent nocturnal sleep, and in some cases even prevented the exacerbation of symptoms. Such improvements were maintained for at least 30 minutes (cognitive performance and intensity of positive mood), 4 hours (alertness and intensity of negative mood), and 6 hours (sleepiness) after napping. In addition, although napping was found to equally benefit women with severe and minimal emotional/behavioural symptoms on most variables, women with severe symptoms had a slightly greater improvement in intensity of negative mood 30 minutes after napping. Women with severe symptoms were therefore found to benefit slightly more from napping during the late-luteal phase of the cycle compared to women with minimal symptoms.

The results of this study demonstrate that a short mid-afternoon nap during the late-luteal phase of the cycle could be used to improve and prevent worsening of emotional and behavioural premenstrual symptoms. This practical and non invasive intervention could not

only provide relief from symptoms on a monthly basis, but may also lead to improvements in family and social domains, mental health, and overall quality of life.

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1.0 Objectives of Present Study

The objective of the present study was to investigate the effects of a short mid-afternoon nap during the late-luteal phase of the menstrual cycle on alertness, sleepiness, mood, and cognitive performance among women with severe and minimal emotional/behavioural premenstrual symptoms. The effects of such a nap on subsequent sleeping patterns were also examined.

2.0 The Menstrual Cycle and Premenstrual Syndrome

2.1 Characteristics of the Menstrual Cycle

The menstrual cycle first develops during puberty and, with the exception of possible absence during pregnancy, lactation or illness, remains present until menopause (Severino & Moline, 1989). Its duration generally ranges from 26 to 32 days (Severino & Moline, 1989), and it is characterized by several phases. The follicular phase consists of the period between the start of menstruation and ovulation, and the luteal phase consists of the period between ovulation and onset of menstruation (Shinohara et al., 2000). The menstrual phase consists of the period from the beginning to the end of menstruation, and the premenstrual phase, also known as the late-luteal phase, consists of the week prior to the menstrual phase (Dennerstein & Burrows, 1979). In most studies in the area of women and sleep, the follicular phase ranges between 3-12 days after onset of menstruation, whereas the late-luteal phase usually ranges between 1-7 days before onset of menstruation. Hormones implicated in the menstrual cycle include luteinizing hormone (LH), follicle stimulating hormone (FSH), oestrogen, and progesterone, levels of which vary during the different phases of the menstrual cycle. More specifically, these hormones are in low concentration during menstruation, while oestrogen and LH levels increase at the end of the follicular phase, just

before ovulation. In addition, a rise in oestrogen and progesterone levels is found in the luteal phase (Driver, Dijk, Werth, Biedermann, & Borbély, 1996).

2.2 Temperature and the Menstrual Cycle

It is well known that a women's core body temperature fluctuates according to the different phases of the menstrual cycle. Generally, there is a small decrease in mean temperature just before the onset of menstruation, which reaches 98°F and persists throughout menstruation. After menstruation, temperature may decrease for a few days, but then increases to above 98°F (Zuck, 1938). This rise can occur in three different patterns: acute, slow and gradual, and step-like (Marshall, 1963). Such an increase in temperature may indicate ovulation, although others suggest that a drop in temperature just before this rise is the marker of ovulation (Davis & Fugo, 1948). Temperature then remains fairly stable until the onset of the next menstruation (Zuck, 1938).

Many studies have compared core body temperature in the luteal and follicular phases of the menstrual cycle. Results from the majority of these studies have indicated that temperature is more elevated in the luteal phase (Baker, Waner, et al., 2001; Chuong, Kim, Takin, & Karacan, 1997; Driver et al., 1996; Kattapong, Fogg, & Eastman, 1995; Nakayama et al., 1997; Shibui et al., 1999). More specifically, studies have noted that the temperature mean (Baker, Driver, Paiker, Rogers, & Mitchell, 2002), mesor (Lee, 1988; Parry, LeVeau, et al., 1997) and minimum (Baker et al., 2002; Parry, LeVeau, et al., 1997) are higher in the luteal phase compared to the follicular phase. However, others fail to find any differences in temperature mean, minimum, or maximum (Nakayama et al., 1992). In addition, some have noted that the amplitude of the temperature rhythm is smaller during the luteal phase compared to the follicular phase (Lee, 1988; Nakayama et al., 1992; Parry, LeVeau, et al.,

1997), whereas others have not observed any difference in temperature amplitude (Wright & Badia, 1999). The difference in body temperature between these phases has been found to be greater at night than during the day, although a significant difference still exists during the day (Shibui et al., 2000). It has been suggested that such an increase in temperature during the luteal phase may be related to a poorer sleep quality at this time (Monroe, 1967).

Theories regarding this heightened temperature during the luteal phase compared to the follicular phase have been proposed. For example, it is postulated that the rise in the level of progesterone is related to the increase in temperature during the late-luteal phase (Southam & Gonzaga, 1965). Others have suggested that it is the result of an increased set point for the core body temperature (Kim & Tokura, 1995). For example, in a study by Kim and Tokura (1995), it was found that participants dressed with thicker clothing in the luteal phase of their cycle compared to the follicular phase. This results in less heat loss from the body to the surroundings, and therefore helps core body temperature reach its set-point value.

It is well known that core body temperature and sleep are closely related. More specifically, the relationship between changes in the slope of body temperature and the initiation of sleep has been examined. For example, in a study by Murphy and Campbell (1997) it was found that, in a disentrained environment consisting of strictly limited behavioural options (i.e. minimal exercise and physical activity, encouraged to eat and sleep whenever they felt the need and to have a nap or major sleep period whenever they felt sleepy), the maximum rate of decline of temperature (MROD) occurred on average 44 minutes before sleep onset. It has therefore been suggested that a sharp decline in core body temperature may prompt the brain to initiate sleep. Results from this study also demonstrated that less time between MROD and sleep onset resulted in more Slow Wave Sleep (SWS) and less time spent awake during the sleep period. Studies have examined the effect of the phase

of the menstrual cycle on the decline in body temperature that takes place at sleep initiation. Findings in this area have been conflicting. Some have reported that the time of the minimum body temperature (Baker, Waner, et al., 2001; Shibui et al., 2000) and the overall temperature rhythm (Lee, 1988; Parry, Mendelson, Duncan, Sack, & Wehr, 1989) are the same in both phases, whereas others have found that the minimum temperature is delayed in the luteal phase (Cagnacci, Soldani, Laughlin, & Yen, 1996; Nakayama et al., 1992), by as much as 90 minutes (Cagnacci et al., 1996). It has been suggested that such a delay is associated with a delay in the nocturnal onset of melatonin secretion (Cagnacci et al., 1996), and that it may be related to symptoms experienced during the luteal phase such as sleepiness and difficulty in waking up (Nakayama et al., 1997).

The above studies have compared temperature differences in the luteal and follicular phases of the menstrual cycle among naturally cycling women. Studies have also examined the effects of oral contraceptives on temperature rhythm. It has been found that body temperature is higher in women using oral contraceptives, and that this difference is most pronounced in the follicular phase, with no significant difference in the luteal phase (Kattapong et al., 1995). In a study by Baker, Waner, et al. (2001), investigating core body temperature across a 24-hour period among a group of naturally cycling women compared to women taking oral contraceptives, it was found that although minimum temperatures of both groups were higher in the luteal phase compared to the follicular phase, women taking oral contraceptives took longer to reach their minimum temperature upon sleep initiation and had less SWS during nocturnal sleep of the luteal phase. In addition, some have found that women taking oral contraceptives have more stage 2 sleep than naturally cycling women (Baker, Mitchell, & Driver, 2001). It is therefore important to control for the use of oral

contraceptives when interpreting results related to temperature changes across the menstrual cycle.

2.3 Premenstrual Syndrome (PMS)

2.3.1 Definitions and prevalence

A variety of symptoms in relation to the different phases of the menstrual cycle may be experienced by women. Although some changes are a normal part of the menstrual cycle, some women experience psychological and somatic symptoms to a more severe degree (Blumenthal & Nadelson, 1988). In 1931, Frank introduced the term 'premenstrual tension' to identify a premenstrual change in negative mood (Dennerstein, Spencer-Gardner, & Burrow, 1984). Because it was later recognized that this condition is characterized by components other than emotional tension, the term 'Premenstrual Syndrome' (PMS) was created by Greene and Dalton, in 1953 (Richardson, 1995).

Although the definition of PMS varies in the literature (Graham & Bancroft, 1993), it is generally characterized by "emotional, behavioural, and physical symptoms that occur in the premenstrual (luteal) phase of the menstrual cycle, with resolution after menses" (Pearlstein & Stone, 1998, p. 577). PMS is classified in the International Classification of Diseases under "pain and other conditions associated with female genital organs and menstrual cycle" (Kahn & Halbreich, 2003). It is recommended by the National Institute of Mental Health (1983) that a diagnosis of PMS be given only when symptoms during the late-luteal phase are 30% more intense than during the follicular phase of the cycle, for a minimum of two consecutive months (Steiner, 2000). Other criteria include that the symptoms decrease with onset of menstruation and remain in remission for at least one week of the follicular phase in most menstrual cycles, and that the symptoms cause some distress

to the individual, or that some level of suffering or impairment in functioning is experienced (Halbreich, 1997). The term PMS is only applied when the symptoms are not due to another disorder (Freeman, 2003). Some reserve the term 'Premenstrual Tension Syndrome (PMTS)' for strictly the emotional and behavioural form of PMS (Haskett & Abplanalp, 1983). In fact, tension is one of the most common symptoms experienced by women with PMS, which mainly consists of irritability, depression, and lethargy (Dalton, 1964).

Although symptoms of PMS always occur during the late-luteal phase, their duration may fluctuate. Many women experience symptoms for only a few days before the onset of menstruation, whereas others experience them for one or two weeks prior to menstruation (Freeman, 2003). Regardless of the duration and timing, it has been suggested that women generally have similar symptoms from one menstrual cycle to another. For example, in a study by Bloch, Schmidt, and Rubinow (1997), it was found that the highest rated symptom of PMS in one cycle was often also found to be the most distressing in other cycles. Consistent with this finding, Metcalf, Braiden, and Livesey (1992) noted that the mean premenstrual tension severity among women with PMS had minimally changed over a period of 8 years. Women seeking treatment for PMS tend to be most significantly affected by it in their twenties to mid-thirties (Freeman, 2003). Often, treatment is not sought (Robinson & Swindle, 2000), and women suffer from this syndrome until menopause (American Psychiatric Association, 1994).

A more severe form of PMS, characterized by negative mood symptoms that cause psychosocial impairment, is often referred to as 'Premenstrual Dysphoric Disorder' (PMDD) (American Psychiatric Association, 2000; Kessel, 2000). PMDD is classified among the major mood disorders in the Diagnostic and Statistical Manual (DSM-IV) (Steiner, 1996). A diagnosis of PMDD requires the occurrence of 5 specified symptoms occurring during the

late-luteal phase, for at least two consecutive cycles (Freeman, 2003). It is important to note that the difference between PMS and PMDD lies within the minimal number of symptoms required for diagnosis and the impairment in functioning (World Health Organization, 1996). An individual can experience PMS without being diagnosed with PMDD (Spangenberg & Venter, 2003), and individuals with severe enough forms of PMS may benefit from the treatment options available for PMDD (Freeman, 2003). Although they are different in some ways, the two terms are sometimes used interchangeably in the literature (Sundström, 1997).

While some studies report PMS prevalence rates as low as 9.8% (Mitchell, Woods, & Lentz, 1991), results from other studies indicate that PMS may not be that uncommon. For example, Hamilton, Parry, Alagna, Blumenthal, and Herz (1984) noted that up to 80% of women experience at least some mood or somatic changes during the late-luteal phase. Other studies find that between 5% (Shaver, 2002) and 25% (Kessel & Coppen, 1963) of women experience premenstrual symptoms to a severe degree. The differences in prevalence rates may be the result of an inconsistent definition of PMS (Corney & Stanton, 1991), as well as the use of prospective and retrospective methods, with prospective methods resulting in lower rates (Sveinsdóttir, Lundman, & Norberg, 2002). Regardless, the number of women suffering from PMS every month is substantial. The occurrence of the more severe form of PMS, PMDD, is less common. Prevalence rates for this disorder, according to the DSM-IV (1994), range between 3-8% of menstruating women (American Psychiatric Association, 1994).

2.3.2 Symptoms of Premenstrual Syndrome

The symptoms experienced by women in the late-luteal phase of the cycle can range considerably. More than 150 symptoms of PMS have been reported by women (Moos,

1968), and include emotional, behavioural, and physical symptoms (Freeman, 2003), as well as cognitive deficits (Clare, 1983). Mood and behavioural symptoms tend to be the most distressing to women with PMS (Freeman, 2003).

Emotional symptoms

In a review of 24 prospective studies of emotional change during the menstrual cycle, irritability, restlessness, anxiety, tension, depression, and increased neurotic conflict were reported by the majority of women during the late-luteal and menstrual phases (Dennerstein & Burrow, 1979). Among women with PMS, negative mood is found to increase 10 to 12 days before menstruation, and tends to peak within one day of onset of menstruation (Metcalf, Livesey, Wells, & Braiden, 1989). It has been suggested that the intensity of negative symptoms is similar to that of psychiatric patients in need of treatment (Van der Ploeg, 1987).

Research examining positive mood, on the other hand, has found that feelings of pleasantness are typically low during the late-luteal phase (Moos et al., 1969). In fact, results from a study by Garron and Shekelle (1973) indicate that positive moods are most often experienced between the end of the menstrual phase and ovulation, and negative moods are generally experienced during the late-luteal and early menstrual phases (May, 1976). Consistent with these findings are the results from a study by Metcalf and Livesey (1995), who observed the distribution of positive mood throughout the menstrual cycle among women with and without PMS. Among women with PMS, positive mood was mostly present preceding ovulation and at the end of the follicular phase (between days 9 to 14 of the cycle), and was mostly absent during the late-luteal and menstrual phases. Among women without PMS, positive mood was distributed evenly throughout the menstrual cycle, with no significant peaks associated with a particular phase.

Behavioural symptoms

Most women experience at least one behavioural symptom during the late-luteal phase of their cycle (Mortola, 1996). Behavioural changes often reported include social withdrawal (Abplanalp, 1983; Collins, 1991; Mortola, Brunswick, & Amsterdam, 2002), changes in work habits, increased tendency to pick fights (Abplanalp, 1983), decreased interest, and appetite changes (Freeman, 2003). Mortola et al. (2002) noted that labile mood with alternative sadness and anger (81%), rejection sensitivity (69%) and crying spells (65%) are common among women with PMS. Sleep disturbance (Dennerstein & Burrow, 1979; Freeman, 2003), insomnia, and fatigue are also noted during the late-luteal phase (Kessel, 2000).

Physical symptoms

Physical symptoms, though less distressing, may include breast tenderness (Dickerson, Mazyck, & Hunter, 2003; Freeman, 2003; Kessel, 2000), headaches, abdominal pain (Dickerson et al., 2003), water retention (Kessel, 2000), backaches, tension, and nausea (Sheldrake & Cormack, 1976). Sheldrake and Cormack (1976) found that 20.8% of their sample of women experienced stomach-aches, 12.1% had backaches, 24.0% had headaches, 11.8% experienced tension, 4.6% had nausea, and 1.5% fainted during the late-luteal phase of the cycle.

Cognitive deficits

Impairment in cognitive functioning during the late-luteal phase of the cycle has been reported among women with somatic and affective PMS symptoms (Diener, Greenstein, & Turnbough, 1992). For example, difficulties with concentration (Kirstein, Rosenberg, & Smith, 1981) and decision making have been noted during the late-luteal phase of the cycle (Rubinow & Roy-Byrne, 1984). Memory (Fryer, Kaspi, Fallon, Moline, & Severino, 1999)

and learning (Keenan, Stern, Janowsky, & Pedersen, 1992), more specifically, may be affected during the late-luteal phase among women with PMS or PMDD. It has been suggested that this impairment may be due to difficulty in encoding information, and that it is unrelated to inattention during the late-luteal phase (Keenan et al., 1992). Impairment in executive functioning has also been noted by a number of studies. For example, results from a study by Brugger, Millicevic, Regard, and Cook (1993) suggest that, during the late-luteal phase, women have more difficulty suppressing task-irrelevant cues during a frontal lobe functioning task (Spangenberg & Venter, 2003). However, others have failed to find impairment in executive functioning (Morgan, Rapkin, D'Elia, Reading, & Goldman, 1996). For example, Matthews and Ryan (1994) found that menstrual cycle phase does not affect sustained attention despite the complaints of difficulty concentrating during the late-luteal phase reported by the women in their study.

Performance with reaction time has also been studied throughout the menstrual cycle. Many of the studies in this area failed to find any differences between phases of the menstrual cycle (Jensen, 1982). For example, in a review conducted by Sommer (1983), it was found that 12 out of 16 studies related to simple or choice reaction time performance did not find any significant changes related to menstrual cycle phase, although one study reported a trend for a longer reaction time during the late-luteal and menstrual phases. Results from studies focusing on higher intellectual performance such as critical thinking and complex solving (Golub, 1976) have also found that it is generally not affected by menstrual cycle phase. However, small declines in nonverbal intelligence (Mohan & Jogi, 1989) and academic performance (Boyle, 1997) during the late-luteal phase have been noted in some studies.

Some researchers have suggested that changes in cognitive performance among women during the late-luteal phase of the cycle may be related to the changes in mood experienced at this time (Mohan, 1976). For example, Eysenck (1986) indicated that tension and anxiety may lead to the development of 'task-irrelevant cognitions', which may impair performance (Matthews & Ryan, 1994), and that feelings of depression may impair memory (Ellis & Ashbrook, 1987). However, others have found that mood changes are not intense enough to affect cognitive performance (Golub, 1976; Matthews & Ryan, 1994).

In summary, findings related to cognitive performance during the different phases of the menstrual cycle are conflicting, although many researchers have found limited evidence for cognitive deficit (Blank, Goldstein, & Chatterjee, 1980; Diener et al., 1992; Klebanov & Ruble, 1994; Sommer, 1983). It has been suggested that although there may be a cognitive slowness in women with more severe premenstrual symptoms, it is not enough to impair objective performance (Resnick, Perry, Parry, Mostofi, & Udell, 1998). Perhaps the discrepancy between subjective and objective findings in some of the studies (Diener et al., 1992) reflects negative attributions related to the late-luteal phase (Morgan et al., 1996), or a tendency for women to perceive the changes in their competence to be greater than they are (Resnick et al., 1998). It is also important to note that the type of cognitive task employed in a study may have an affect on detecting differences in performance across the menstrual cycle (Broverman, Klaiber, Majcher, Shea, & Paul, 1981). For example, Slade and Jenner (1980) found that although cognitive performance did not differ very much between phases of menstrual cycle, the difficulty of the task affected results, with more difficult tasks leading to a worse performance during the late-luteal phase. It has therefore been suggested that impairment in cognitive ability may only be seen with tasks demanding greater cognitive capacity (Diener et al., 1992).

2.3.3 Impact of symptoms

Evidence suggests that the manifestation of PMS can have numerous implications. Women with PMS may experience impairment in functioning in a number of life domains such as occupational, social (Kuczmierczyk, 1989), family, and health (Collins, 1991). Functional impairment is, in fact, one of the necessary criteria for PMDD, and is often also found in women with PMS (Freeman, 2003). In a study by Robinson and Swindle (2000), it was found that 92% of women with PMDD reported that “PMS frequently or always interferes with their functioning in at least one social or occupational life domain” (Robinson & Swindle, 2000, p.764)

Difficulties at work among women with PMS are not uncommon. It has been found that approximately 45% of industrial workers call in sick for at least one day during the late-luteal and menstrual phases of the cycle (Dalton, 1964). More recent studies indicate that PMS causes between 8-16% of women to miss work (Hylan, Sundell, & Judge, 1999). In addition, decreased work productivity has been found among women with PMS (Chawla, Swindle, Long, Kennedy, & Sternfeld, 2002), and work is more severely impaired among women with PMS compared to women without PMS (Hallman, 1986). In fact, in the United States, millions of dollars are lost every year due to the loss of productivity and costs to individual lives and society caused by PMS (Reid & Yen, 1981).

Problems with familial and social roles are also present. The ability to interact with others is reported to be especially affected among women with PMS, as they feel that their temper and mood swings contribute to problems interacting well with others (Collins, 1991). This may eventually lead to problems in interpersonal relationships (Collins, 1991). Impairment in relationships with family members, more specifically, has been found to be related to premenstrual symptoms (Corney & Stanton, 1991). Collins (1991) noted that

women with PMS put a lot of effort into not letting their premenstrual symptoms interfere with their behaviour at work, but tend to release their tension upon arrival at home. Women in this study reported punishing and having arguments with their children frequently during the late-luteal phase, which was followed by feelings of guilt and regret once the symptoms subsided. Collins (1991) also noted that women were less satisfied with their performance as parents, wives, and employees during the late-luteal phase of their cycle. Impairment on a more social level may also be present during the late-luteal phase. For example, Collins (1991) noted that women with PMS often purposely planned vacations during any phase of the menstrual cycle other than the late-luteal phase.

PMS symptoms may also interfere with physical and mental health. For example, some studies have found that women with PMS drink considerably more alcohol compared to women without PMS (Caan et al., 1993), and tend to crave alcohol more during the late-luteal phase compared to other phases of the menstrual cycle (Evans, Foltin, & Fischman, 1999). In addition, a relationship between committed crimes and menstrual phase has been reported. For example, Cooke (1945) found that 84% of all violent crimes in Paris committed by women, occurred during the late-luteal and menstrual phases (Abplanalp, 1985). In fact, a British court accepted PMS as a defence for two murders committed in 1980 (Sveinsdóttir et al., 2002). The percentage of women who have committed suicide during the late-luteal or menstrual phase is also quite high (Dalton, 1964; Mandell & Mandell, 1967). In a study by Stout, Steege, Blazer, and George (1986) it was found that 63% of women at a PMS clinic reported suicidal ideation at some point in their life, and 15% indicated that they had attempted suicide (Chaturvedi, Chandra, Gururaj, Pandian, & Beena, 1995). Similarly, Zacco, Pacillo, Piliago, and Jannone (1960) found that women with PMS tended to be more likely to attempt suicide during the late-luteal phase compared to other phases of the cycle

(Chaturvedi et al., 1995). However, results from studies in this area tend to be conflicting (Clare, 1983).

Studies have also found that Major Depressive Disorder (MDD) and anxiety disorders are more prevalent in women with PMS compared to women without PMS (Roca, Schmidt, & Rubinow, 1999). In fact, Graze, Nee, and Endicott (1990) found that the severity of dysphoria experienced during the late-luteal phase could predict the future development of MDD. Similarly, Hartlage, Arduino, and Gehlert (2001) found that MDD was present within two years of being diagnosed with PMDD in 7 out of 8 women, in contrast to only 3 out of 9 women without PMDD. In this study, women with PMDD were 14 times more likely to develop MDD compared to women without PMDD. It has also been suggested that women who experience depression during the late-luteal phase may be more at risk for developing depression during postpartum or menopause, when hormones are changing intensely (Arpels, 1996).

It is therefore evident that women with severe PMS or PMDD are affected by much more than simply the symptoms of the condition. Overall, their quality of life is impaired (Halbreich, Borestein, Pearlsterin, & Kahn, 2003). In fact, it has been suggested that the impact associated with PMS and PMDD is similar to that of major disorders (Halbreich et al., 2003). And, not only does the individual with the syndrome suffer, but as do the people in her surroundings (Abplanalp, 1983).

2.3.4 Etiological factors

Although the cause of PMS remains unknown, biological, psychosocial, and biopsychosocial hypotheses have been proposed.

Biological hypotheses

Several biological explanations have been suggested for the development of premenstrual symptoms and PMS. While some researchers have indicated that the levels of progesterone, oestrogen, or changes in their ratios are abnormal, evidence suggesting differences between women with and without PMDD/PMS is lacking (Backstrom et al., 1983; Halbreich, Endicott, Goldstein, & Nee, 1986; Rubinow et al., 1988; Rubinow & Schmidt, 1992; Rubinow, Schmidt, & Roca, 1998). It has been found that, in fact, gonadal hormones are normal in women with PMS (Rubinow et al., 1988; Rubinow et al., 1998), and that these women may simply be more sensitive to usual changes in these hormones (Halbriech et al., 1986). Endogenous opiate withdrawal has also been linked with the development of premenstrual symptoms (Facchinetti et al., 1990). Reid and Yen (1981) suggested that women with PMS either have a deficiency in opioids, or that defective feedback sensitivity is related to symptom formation.

Abnormalities in the serotonin neurotransmitter system have been reported to be involved in the development of premenstrual symptoms (Condon, 2001; Halbreich, 2003). More specifically, a sub or super sensitivity of the serotonergic system may be present among women with premenstrual symptoms (Leibenluft, Fiero, & Rubinow, 1994). Such an abnormality may be present both during the entire cycle, and additionally so during the luteal phase (Halbreich & Monacelli, 2004). Other studies have found that women with PMS have a reduced GABA_A receptor sensitivity in the late-luteal phase (Sundström et al., 1998). For example, in a study by Halbreich et al. (1996), it was found that levels of GABA increased from the mid follicular phase to the late-luteal phase among healthy control women, while levels decreased among women with more severe premenstrual symptoms (Halbreich, 2003).

Changes in circadian rhythms have also been found to be related to premenstrual symptoms (Steiner & Born, 2000). For example, it has been noted that the amplitude of temperature rhythm tends to be decreased in the luteal phase compared to the follicular phase among women with PMDD, which may be indicative of a weakened circadian pacemaker, and result in mood fluctuations among vulnerable women (Parry, LeVeau, et al., 1997). This is consistent with other studies finding that a temporary desynchronization is present among women with PMS during the late-luteal phase, as evidenced by sleep problems and daytime sleepiness (Steiner & Born, 2000).

Psychosocial hypotheses

Although biological factors have been found to play a role in the development of PMS, psychological hypotheses have also been proposed. Some have suggested that the attitudes and experiences related to PMS are important (Hardie & McMurray, 1992; Heilburn, Freidberg, Wydra, & Worobow, 1990). Women may have certain expectations or beliefs about menstrual cycle phase changes, which influence their experience of symptoms (Ruble, 1977). For example, in a study by Anson (1999), it was found that women who perceived menstruation negatively had undesirable premenstrual symptoms, whereas the opposite was true for those who viewed it positively. Consistent with this hypothesis, Ruble (1977) found that women who thought they were in their late-luteal phase reported more distressing symptoms, most notably physical symptoms, than women who thought they were in their intermenstrual phase, when in fact, both groups were in the same phase of their menstrual cycle. Whereas some have suggested that socialization leads to expectations and beliefs related to the menstrual cycle (Klebanov & Ruble, 1994), others have suggested that the opposite relationship is true, and that symptoms experienced on a monthly basis influence attitude toward menstruation (Anson, 1999).

The state dependent model of PMS, developed by Rubinow and Schmidt (1989), suggests that the way in which women with PMS perceive daily stressors changes according to menstrual cycle phase (Fontana & Pontari, 1994). More specifically, it has been suggested that women with PMS tend to display difficulty in dealing with environmental stress or additional stress from internal change (Dennerstein et al., 1984). However, it is difficult to know whether stress is the cause or the product of premenstrual symptoms (Dennerstein et al., 1984). Consistent with this interaction between the environment and stress is the finding that women tend to report more severe levels of PMS/PMDD when they are experiencing more stress either at home or at work, whereas less severe symptoms are reported when they are feeling more relaxed, such as during vacation time (Halbreich, 2003).

Biopsychosocial hypotheses

Some theories related to the etiology of premenstrual symptoms are multifaceted, and include the relationship between biological, social, and psychological factors (Walker, 1995). For example, it has been suggested that some women have a predisposition to the development of premenstrual symptoms and syndromes (Halbreich, 2003), as evidenced by a high correlation between mothers and daughters (Kantero & Widholm, 1971). In addition, as discussed above, women with PMS may be more sensitive to hormonal changes that are experienced during this phase of the cycle (Halbreich, 2003). Such biological vulnerabilities may interact with environmental factors and stress that are present at that time (Morse & Dennerstein, 1988), and lead to the development of premenstrual symptoms (Halbreich, 2003). It has been noted that each of these components (hormones, stress and symptoms) can represent both the stimulus and the response at several points in this cycle (Morse & Dennerstein, 1988).

The cognitive model of PMS, developed by Morse and Dennerstein (1986), suggests that the premenstrual changes that occur on a monthly basis can trigger certain negative cognitions that the person has developed over time in relation to the menstrual cycle. Such thoughts and beliefs then create or increase feelings of anxiety, depression, or anger, which may subsequently be expressed in a behaviour that is consistent with these feelings. These behaviours can then lead to other feelings of distress such as guilt about having behaved in a certain way or heightened anxiety and depression. A cycle is therefore present between emotions and thoughts. In addition, these feelings are subsequently linked with the whole experience of the late-luteal phase, which further reinforces the belief that it is an aversive event, and creates the expectation that the next premenstrual experience will be a negative one (Morse & Dennerstein, 1986).

2.3.5 Treatment options

It is evident that the symptoms experienced by women in the late-luteal phase of the cycle can have important consequences (Moos et al., 1969). For this reason, many different treatment options have been suggested. Amongst the most common interventions are; pharmacological and biological treatments, circadian rhythm interventions, psychological treatments, and lifestyle and health interventions.

Pharmacological/Biological treatments

Some of the most common pharmacological treatments consist of psychotropic medication and hormonal interventions. Studies have shown that antidepressants, such as some Serotonin Reuptake Inhibitors (SSRIs) and Tricyclics, are efficacious in decreasing premenstrual symptoms among women with PMS or PMDD, and have minimal side effects (Steiner & Born, 2000). SSRI antidepressants have been found to decrease emotional and

physical symptoms (Kornstein & Halbreich, 2004), as well as improve social and occupational functioning (Freeman, Rickels, Sondheimer, & Polansky, 1999), either when taken continuously throughout the cycle or intermittently during the late-luteal phase (Halbreich, 2003; Kornstein & Halbreich, 2004). It has been, in fact, suggested that SSRI antidepressant treatment should be the first tried among women with moderate to severe PMS or PMDD (Pearlstein, 2004). However, over 33% of women with PMDD do not benefit from this treatment (Halbreich, 2003), and side effects such as sexual dysfunction (Steiner, 2000; Kessel, 2000) and sleep problems may be present (Kessel, 2000).

Anxiolytics such as Alprazolam and Buspirone have also been found to reduce psychological symptoms associated with PMS. However, they tend to be less successful than SSRIs, and dependence as well as other side effects may develop (Steiner & Born, 2000). Progesterone supplementation has been found to decrease symptoms among women with milder forms of PMS, but not with more severe symptoms (Davis & Yonkers, 1997). Some researchers indicate that progesterone is not efficacious in treating premenstrual symptoms (Rubinow et al., 1988), and should not be administered for the psychological symptoms of PMS (Condon, 2001). Oestrogen treatment has also been studied, and results show that it may be effective in treating severe PMS (Magos, Brincat, & Studd, 1986; Smith, Studd, Zamblera, & Holland, 1995; Watson, Studd, Savvas, Garnett, & Baber, 1989).

The effectiveness of ovulation suppression through oral contraceptives has also been studied in relation to premenstrual symptoms. Some have found that they can help reduce physical symptoms, but are less effective in treating psychological symptoms (Graham & Sherwin, 1992; Steiner & Borne, 2000). However, others suggest that side effects may be too undesirable to tolerate (Steiner, 1997), or that PMS symptoms may even worsen (Reid & Yen, 1981). For example, in a study by Freeman, Rickels, Sondheimer, & Polansky (2001) it

was found that 59% of women with PMS reported that oral contraceptives did not help decrease premenstrual symptoms, while 24% of them indicated that their symptoms increased with the use of oral contraceptives, and only 17% reported a decrease in symptoms. In addition, no difference in symptom change was found between the women who were and were not using oral contraceptives. Findings have therefore been quite inconsistent (Kahn & Halbreich, 2001), and it is recommended that oral contraceptive not be used for the treatment of PMS or PMDD (Steiner, 2000). Although ovariectomy with hysterectomy has had some success with reducing premenstrual symptoms (Casper & Hearn, 1990; Casson, Hahn, Van Vugt, & Reid, 1990), this treatment option is not recommended because of its 'extreme nature' (Ross & Steiner, 2003). Ovariectomy has been found to lead to undesirable side-effects in some women (Steiner, 1997). This option should therefore only be given to women with very severe premenstrual symptoms, who have not improved with other treatments (Johnson, 1995).

It is important to note that although many women have tried several different medications, symptoms often return after a few months of treatment (Corney & Stanton, 1991).

Circadian rhythm interventions

Some researchers have suggested that PMS may share some of the same features as depressive disorders (Mackenzie, Wilcox, & Baron, 1986). For this reason, certain treatments for depression have been applied to the PMS population. For example, bright light therapy has been found to significantly reduce depression, irritability, and physical premenstrual symptoms compared to a placebo condition, and these improvements were maintained at 12 months (Parry, 1993). Similarly, Lam et al. (1999) found that 30 minutes of light therapy in the evening for the two weeks during the luteal phase, resulted in a

significant improvement in premenstrual symptoms in women with PMS compared to baseline levels.

Sleep deprivation has also been found to reduce symptoms of depression, and has been studied as a treatment for PMS (Parry et al., 1995). For example, Parry and Wehr (1987) examined the effects of partial and total sleep deprivation on symptoms of women with premenstrual depression. Eighty percent of their sample experienced an improvement in premenstrual symptoms with total sleep deprivation, and the improvement was maintained throughout the late-luteal phase. Partial sleep deprivation in the second half of the night was found to be more effective in improving mood than partial sleep deprivation in the first half of the night. In a similar study by Parry et al. (1995), early and late sleep deprivation were found to equally reduce depressive symptoms after recovery sleep among women with PMDD, and were as effective as total sleep deprivation. Parry et al. (1995) therefore suggested that partial sleep deprivation may be used to reduce premenstrual symptoms. It is suspected that this treatment is effective in reducing symptoms because it resets the circadian rhythm, which may be disturbed among these women due to sleep difficulties (Parry et al., 1995). The advantage of this treatment option is that women do not have to take any form of medication (Leibenluft & Wehr, 1992). However, many women not taking any medication for PMS may not respond well to this treatment because of the unpredictable effects of sleep deprivation (Leibenluft & Wehr, 1992). In addition, depriving oneself of sleep on a monthly basis may not be practical for women, as it can be extremely demanding.

Psychological treatment

Psychological treatments have been successful in reducing premenstrual symptoms. More specifically, the use of cognitive-behavioural therapy (CBT) has been examined, particularly because the development or maintenance of premenstrual symptoms has been

linked with a negative thinking style (Morse & Dennerstein, 1988). CBT has been found to reduce psychological and physical symptoms as well as some aspects of psychosocial functioning (Blake, Salkovskis, Gath, Day, & Garrod, 1998), and tends to be superior to wait list control groups (Rapkin, 2003). In a study by Hunter, Ussher, Browne, Cariss, and Katz (2002), 6 months of CBT was found to be as effective as Fluoxetine, an SSRI antidepressant, in treating PMDD. Although women responded more quickly to the medication, improvements were maintained for a longer period of time with CBT. In general, studies have found that comprehensive CBT tends to be more effective than using only one component of CBT (i.e. restructuring), and that longer interventions are more successful than only a few sessions (Gold & Severino, 1994). However, findings regarding the usefulness of CBT have not been consistent (Pearlstein, 1996). Relaxation, a component of CBT, has been found to be efficacious in reducing emotional and physical premenstrual symptoms (Goodale, Domar, & Benson, 1990), especially severe symptoms (Hamilton & Gallant, 1993). However, conclusions related to its usefulness cannot be drawn, since it is often included as part of a more comprehensive CBT package and rarely on its own (Gold & Severino, 1994).

Lifestyle and health treatment

Changes in lifestyle and health have been suggested as an intervention for premenstrual symptoms. For example, regular exercise may help relieve premenstrual symptoms (Steege, Stout, & Rupp, 1987), and increase the ability to cope with stress (Steege & Blumenthal, 1993). In a study by Steege and Blumenthal (1993), it was found that while both aerobic and anaerobic exercise decreased premenstrual symptoms, aerobic exercise resulted in a better improvement in depressive symptoms. In addition, it has been found that exercising two to three times a week is more effective at reducing tension, depression, and

anger compared to exercising more than four times a week (Cockerill, Lawson, & Nevill, 1995). Similarly, Choi and Salmon (1995) found that a high level of exercise is most effective for reducing symptoms, whereas low levels of exercise and competitive exercising do not lead to such improvements. Despite the potential benefits found in some studies, it has been suggested that exercise and lifestyle management are not effective enough to treat severe PMDD (Steiner, 1995), and that evidence based treatments are lacking (Rapkin, 2003).

Diet management has also been studied in relation to premenstrual symptoms. For example, complex carbohydrates (Wurtman, Brzezinski, Wurtman, & Laferrere, 1989) and calcium supplementation (Thys-Jacobs, Starkey, Bernstein, Tian, & Premenstrual syndrome study group, 1998) have been found to reduce negative affect during the late-luteal phase. However, others have indicated that evidence suggesting that nutritional supplements are superior to placebo is lacking (Rivera-Tovar, Rhodes, Pearlstein, & Frank, 1994; Severino & Moline, 1989), and that more studies need to be conducted before forming any conclusions regarding their effectiveness for the treatment of premenstrual symptoms (Kahn & Halbreich, 2003).

Despite the research related to interventions for premenstrual symptoms conducted thus far, no single treatment has been proven to work consistently for women with PMS (Steiner, 1997). More conservative treatments seem to be most appropriate for women suffering from PMS and who do not meet the criteria for PMDD (Steiner, 1996). However, many women seeking help for premenstrual symptoms are using interventions that are not efficacious (Blumenthal & Nadelson, 1988; Hunter, Swann, & Ussher, 1995).

3.0 Sleep, Menstrual Cycle, and Premenstrual Symptoms

3.1 The Structure of Sleep

It is well known that various stages of sleep are visited throughout the night. After the awake state, stage 1 sleep is usually entered, which is characterized by a low voltage phase with irregular frequency. This is followed by stage 2 sleep, which is characterized by 14 cycles/sec sleep spindles (short bursts of activity of at least 0.5 seconds duration, Rechtschaffen & Kales, 1968) and K-complexes (single high amplitude wave), in a low voltage background (Williams, Hammack, Daly, Dement, & Lubin, 1964). Slow wave sleep (SWS), consisting of stages 3 and 4, may then be entered (Williams et al., 1964), which is described by a delta rhythm with a high amplitude (Morin, 1993). While stage 3 is characterized by 20% to 50% of delta waves in a 30-second epoch, stage 4 is characterized by more than 50% of delta waves (Rechtschaffen & Kales, 1968). After the onset of sleep, most individuals quickly move through this pattern of sleep stages, remain in stage 4 for approximately half an hour, and re-enter stage 3 or stage 2. At this point (70 to 90 minutes after sleep onset, Morin, 1993), rapid eye movement (REM) sleep occurs, which is typically accompanied by dream activity, and characterized by low voltage sharp waves in the brain wave activity, as well as inactivity of certain muscle groups in the body (Williams et al., 1964). During a normal night of sleep this cycle is repeated approximately every 90 to 120 minutes (Williams et al., 1964). A greater percentage of SWS occurs in the first portion of nocturnal sleep, while REM sleep is more present in the last one-third of nocturnal sleep (Broughton, 1989). It has been suggested that SWS is mainly associated with the restoration of physical energy, and REM sleep is associated with cognitive functioning (Morin, 1993).

A model of sleep proposed by Borbély (1986) suggests that the two major regulating factors of sleep are: 1) the amount of time previously spent awake and 2) a circadian process.

According to Borbély (1986), 'Process S' represents the level of sleep propensity during the day, and determines the depth of nocturnal sleep. It increases during the time spent awake and decreases during sleep. 'Process C', on the other hand, does not depend on prior sleep and waking, but corresponds to the circadian rhythm of sleep propensity. This process is important when discussing sleep since it suggests that an internal clock is present which may be responsible for regulating temperature rhythm during sleeping and waking hours (Borbély, 1986). Borbély (1986) suggested that it is the combination of 'Process S' and 'Process C' that represents sleep propensity.

3.2 Sleep and the Menstrual Cycle

Difficulty with sleep has been reported among 42% of healthy middle-aged women (Owens & Matthews, 1998), and may be related to the different phases of the menstrual cycle. More specifically, sleep disturbance during the late-luteal phase of the menstrual cycle is not uncommon (Manber & Bootzin, 1997; Mauri, Reid, & MacLean, 1988). In fact, the most common symptom reported by women with PMS is problems with sleep (Hurt et al., 1992). Some have suggested that some changes in sleeping patterns during the different phases of the menstrual cycle may be related to temperature change (Driver et al., 1996), while others have indicated that it may be related to changes in the melatonin secretion rhythm (Parry, Berga, Kripke, & Gillin, 1990).

Studies have compared the sleep architecture of women during different phases of their menstrual cycle. However, findings on this matter are conflicting. Some studies have noted that although the duration of sleep is longest during the late-luteal phase compared to other phases, participants report that their sleep is more disturbed, and that they feel more restless (Patkai, Johannson, & Post, 1974). Similarly, subjective reports from a study by

Manber and Bootzin (1997) indicated that sleep onset latency (SOL) and number of awakenings after sleep onset were increased, and sleep efficiency and sleep quality were decreased in the luteal phase compared to the follicular phase. Other studies have found a decrease in the amount of SWS (Cluydts & Visser, 1980; Ito et al., 1995), and an increase in stage 1 sleep (Parry et al., 1999) in the luteal phase compared to the follicular phase.

However, some researchers reported that differences in sleep parameters in relation to the phases of the menstrual cycle are minimal (Armitage & Yonkers, 1994). For example, Baker and Driver (2004) found no subjective differences in sleep variables between the mid follicular and late-luteal phase, other than subjective sleep quality, although no difference in subjective ratings of sleep quality and morning vigilance between the luteal and follicular phase were found by Baker, Waner, et al. (2001). Similarly, Driver et al. (1996) did not find any difference between phases in subjective sleep quality, objective total sleep time, sleep efficiency, and SOL. As well, Lee, Shaver, Giblin, and Woods (1990) failed to find any differences between these phases in total sleep time, SOL to stage 1 or stage 2, time spent in various stages, and sleep efficiency.

Findings regarding REM sleep among women in different phases of the menstrual cycle have also been conflicting. For example, Lee et al. (1990) found that the only significant difference between sleep architecture in the different phases of the menstrual cycle is a shorter REM latency during the luteal phase compared to the follicular phase. Results from this study also showed that the percentage of REM sleep did not differ between phases. In a case study by Armitage and Yonkers (1994), it was also found that REM latency was decreased in the luteal phase, but their results indicated that the percentage of REM sleep increased significantly. Such an increase in REM sleep duration may explain the longer, but not necessarily higher sleep quality periods sometimes reported by women in the

luteal phase (Patkai et al., 1974). However, others have found a lower amount of REM sleep (Baker, Driver, Rogers, Paiker, & Mitchell, 1999; Driver et al., 1996; Parry et al., 1999) and a longer REM latency (Parry et al., 1999) in the luteal phase compared to the follicular phase.

Studies have examined the timing of sleep onset in different phases of the menstrual cycle. It has been suggested from past research that the late-luteal and menstrual phases of the cycle are associated with a shift in the sleep-wake cycle. For example, in a study by Shinohara et al. (2000), the timing of sleep onset during the luteal and follicular phases of the menstrual cycle among one participant with PMS was examined. Results showed that sleep onset was advanced after menstruation had begun, but was then progressively delayed shortly after ovulation until the next menstruation. The follicular phase was therefore characterized by a phase advance, whereas the luteal phase was characterized by a phase delay. Studies have examined the effects of a shift in the sleep-wake cycle on performance among healthy individuals. For example, Taub and Berger (1974) observed the effects of shifting sleep time on performance and mood by asking participants to go to bed at their habitual time, 2 and 4 hours later, or 2 and 4 hours in advance, always keeping the amount of sleep constant. Results indicated that mood, calculation, and reaction time on a vigilance task were more impaired in the afternoon following shifted sleep than habitual sleep. More specifically, errors in the last minute of the addition task were higher after delayed sleep (such as in the late-luteal phase of the cycle) compared to advanced sleep. However, mood was lower following the advanced sleep compared to the delayed sleep condition. These researchers suggest that the effects of a sleep shift are associated with the disruption of the sleep-wake circadian rhythm, and that 'behavioural efficiency' is very much related to this circadian rhythm. Lee, McEnany, and Zaffke (2000) also noted a relationship between sleep

disturbance and mood as results from their study indicated that as REM latency increased from the follicular to the luteal phase, the worse mood was during the luteal phase. Mood was also found to be worse with shorter sleep durations, during the luteal phase.

It has been suggested that the sleep disturbances experienced by women with PMS are similar to those found among individuals with depression. However, numerous studies have examined such a relationship, and have concluded that the sleep parameter abnormalities are not the same among the two populations (Chuong et al., 1997; Parry et al., 1989). In fact, it has been found that the depressive symptoms that characterize major depressive episodes are not the same as those experienced by women with severe premenstrual depressive symptoms (Endicott, 1993). It is therefore important to control for mood disorders when interpreting results regarding the effects of the menstrual cycle on sleep (Moline, Broch, Zak, & Gross, 2003). Similarly, research has shown that women with primary dysmenorrhea (“painful uterine cramps, near and during menstruation, that have an impact on personal life and productivity”) (Baker et al., 1999, p. 1013) also experience a disturbed sleeping pattern, which tends to be different from that experienced by women without physical pain (Baker et al., 1999). It is therefore equally important to control for dysmenorrhea when interpreting results regarding the effects of the menstrual cycle on sleep.

3.3 Daytime Sleepiness During the Menstrual Cycle

Such disturbed sleeping patterns among women with PMS can have detrimental effects. One of the most prominent consequences is daytime sleepiness (Shibui et al., 1999). Numerous studies have found an increase in subjective daytime sleepiness during the late-luteal phase. For example, Manber and Bootzin (1997) found a significant correlation between daytime sleepiness and the late-luteal phase of the menstrual cycle. Similarly,

Shibui et al. (2000) examined the diurnal fluctuations of sleep propensity during the luteal and follicular phases of the menstrual cycle among healthy women. Participants in this study were subjected to an ultrashort sleep-wake schedule, consisting of 20 minutes of remaining awake followed by a 10 minute nap. This was repeated continuously for a period of 26 hours, and subjective sleepiness was measured at 30 minute intervals. Results from this study indicated that the level of daytime subjective sleepiness and the number of daytime naps that contained SWS were significantly higher in the luteal phase of the menstrual cycle compared to the follicular phase. According to Shibui et al. (2000), this suggests that there is an increased need for SWS in the luteal phase of the menstrual cycle, and that this is independent from nocturnal sleep. In addition, it has been suggested that as the difference in daily mean body temperature between the follicular and late-luteal phase increases, as does the difference in the amount of SWS during the day between the two phases (Shibui et al., 2000). Such a relationship between SWS and body temperature likely indicates that the SWS regulatory system and the thermoregulatory system may fluctuate across the menstrual cycle (Shibui et al., 2000).

3.4 Severity of Premenstrual Symptoms and Sleep

The conflicting findings in sleep characteristics and architecture during the different phases of the menstrual cycle can be attributed to a number of factors, including small sample sizes and different methodologies from study to study (Baker, Mitchell, et al., 2001). They may also be explained by the fact that some of these studies considered the severity as well as the variety of PMS symptoms experienced by the women in their sample, whereas others did not. It is noted that changes in sleeping patterns during the different phases of the

menstrual cycle may vary depending on symptoms experienced in the late-luteal phase (Driver et al., 1996).

The severity of premenstrual symptoms experienced by women can have an impact on sleep architecture. For example, Lee et al. (1990) examined the sleeping pattern of symptomatic and asymptomatic women during the luteal and follicular phases of the menstrual cycle. Results showed that the symptomatic group had a significantly lower percentage of SWS compared to the asymptomatic group in both phases, and this was slightly more pronounced in the luteal phase. In addition, compared to the asymptomatic group, the symptomatic group had approximately 7-10% more stage 2 sleep during both phases, as well as shorter sleep onset latencies (SOL) during the luteal phase, falling asleep within 5 to 6 minutes from time of lights out. These findings suggest that women who experience more significant premenstrual symptoms may be more sleep deprived than women who experience minimal symptoms (Lee et al., 1990). A smaller amount of REM sleep throughout the menstrual cycle has also been noted among women with moderate to severe premenstrual depression, compared to women with minimal premenstrual mood disturbances (Parry et al., 1989).

Such a relationship between the severity of premenstrual symptoms and sleep disturbance was also found in a study by Mauri et al. (1988), who examined the nature of sleep of three groups of women; women in a non-clinic group who experienced minimal symptoms, women in a non-clinic group who experienced significant symptoms, and women from a PMS clinic who reported significant symptoms. Results from this study indicated that women from the PMS clinic group reported more unpleasant dreams and a lower quality of sleep than the other two groups. These women reported tossing and turning, frequent awakenings, and taking a long time to fall back asleep after an awakening during the night. It

is therefore evident that women who seek help due to significant premenstrual symptoms have more disturbed sleep than women in the general population (Mauri et al., 1988). However, others have failed to find a relationship between the severity of premenstrual symptoms and sleep disturbance (Chuong et al., 1997; Manber & Bootzin, 1997; Parry et al., 1999).

The increase in daytime sleepiness observed in the luteal phase of the menstrual cycle has also been examined in relation to the severity of premenstrual symptoms experienced by women. More specifically, daytime sleepiness (Manber & Bootzin, 1997) and fatigue (Mauri et al., 1988) during the late-luteal phase have been found to be significantly higher in women with more significant symptoms. It has been suggested that such a relationship between the severity of premenstrual symptoms and daytime sleepiness may reflect an underlying need for more sleep among women with significant premenstrual symptoms during the late-luteal phase of their cycle (Manber & Bootzin, 1997). It has also been proposed that an increase in the severity of symptoms may decrease one's ability to effectively deal with such disrupted sleep, or that the increase in daytime sleepiness among women with significant premenstrual symptoms is mediated by unknown biological changes related to the menstrual cycle (Manber & Bootzin, 1997). Consistent with these findings, women with severe PMS tend to experience a significant decline in central nervous system arousal during the late-luteal phase, which is not the case for women without PMS (Asso & Magos (1992). In addition, it has been found that some elements of cognitive performance, such as memory, are slightly worse during the late-luteal phase among women with high premenstrual symptoms compared to the postmenstrual phase, while women with low symptoms perform better during the late-luteal phase (Diener et al., 1992).

In addition to sleep architecture and daytime sleepiness, core body temperature of symptomatic and asymptomatic women has also been compared. For example, Severino et al. (1991) found that women with PMS had significantly higher mean temperatures as well as higher nocturnal minimum temperatures throughout the entire menstrual cycle, compared to women without PMS. However, daytime maximum temperatures and temperature amplitudes were not significantly different among the two groups of women. Parry, LeVeau, et al. (1997) found that temperature mesors were higher in both groups during the luteal phase, but that this was more pronounced in women with PMDD compared to women with minimal premenstrual symptoms. In addition, temperature minimum tends to be earlier throughout the menstrual cycle among women with premenstrual symptoms compared to women with minimal symptoms (Parry et al., 1989).

4.0 Napping

Naps can be defined as a period of sleep lasting no longer than 50% of an individual's average nocturnal sleep (Dinges, Orne, Whitehouse, & Orne, 1987). They appear across species and ages (Broughton & Dinges, 1989), and are an important part of the human circadian rhythm (Lavie, 2001). Naps tend to occur either in response to sleep debt or as a result of the endogenous biphasic sleep wake cycle (Tamaki, Shirota, Hayashi, & Hori, 2000). Evans, Cook, Cohen, Orne, and Orne (1977) identified the existence of two types of nappers: 1) replacement nappers (napping in response to or anticipation of sleep loss) 2) appetitive nappers (napping for reasons other than sleep loss, such as for the pleasure of the activity). Napping is quite common among healthy middle-aged women. In a study by Owens and Matthews (1998), it was found that 37% of women reported napping, and that 54% of these women took a nap two to five times a week or more. The effects of napping

depend on the duration of the nap, the time at which it is taken, and the duration of sleep deprivation before napping (Batéjat & Lagarde, 1999).

4.1 Time of Day

Generally, one's level of alertness is highest during mid-morning, from approximately 9h00 to 11h00, and again in the early evening from approximately 19h00 to 21h00 (Caldwell, 1995). These time periods, referred to as the 'forbidden zones' by Lavie (1986) or 'wake maintenance zones' by Strogatz (1986) (Dinges, 1992), are typically characterized by high levels of energy and performance (Caldwell, 1995). In contrast, the period of lowest alertness tends to occur between 3h00 and 5h00 (Caldwell, 1995). There is also a second period of decreased alertness between 13h00 and 16h00, which is also known as the 'post-lunch dip' (Carskadon, 1989). The post-lunch dip is experienced by people of all ages (Carskadon, 1989), and is considered to be part of the circadian rhythm (Broughton, 1989).

The post-lunch dip has been the focus of numerous studies. Broughton (1975) was the first to offer a proposal to explain its occurrence. According to Broughton, "the major (typically night-time) sleep period together with the afternoon nap zone reflect an endogenous brain rhythm providing a twice daily increase in sleep propensity" (Broughton, 1998, p. 2). Broughton (1975) also noted that the low level of alertness found in the mid-afternoon is approximately 180 degrees out of phase with the minimum level of alertness during the night, thereby giving notion to a 12-hour rhythm for SWS. This is consistent with results from a study by Gagnon and De Koninck (1984), who found that SWS emerges again when sleep is extended. Specifically, it was noted that approximately 12.4 hours separated the first and later onset of SWS pulses. Further support for this finding comes from studies

indicating that afternoon naps compared with morning or evening naps are composed of higher amounts of SWS and lower amounts of REM sleep (Broughton, 1989).

Although these theories explain very well the occurrence of the post-lunch dip, the occurrence of the two wake maintenance zones remains to be clearly explained. A theory explaining the 24-hour sleep-wake propensity process was further proposed by Broughton (1998). Broughton described this theory by referring to Process C (circadian sleep propensity) and Process S (homeostatic sleep propensity), to explain the occurrence of the major nocturnal sleep period, the post-lunch dip, as well as the two wake-maintenance zones. According to Broughton, during the normal night-sleep period, arousal (Process C) is low with a minimum found at approximately 05h00. Arousal then starts to increase and continues to increase throughout the day, reaching its maximum at approximately 21h00. Process S decreases exponentially throughout the night period, and increases exponentially throughout the day. When the increasing Process S is crossed by the increasing arousal process, the afternoon nap zone emerges. The nocturnal period of sleep is explained by a combination of the high Process S and rapidly decreasing arousal. In the morning, the combination of increasing arousal levels and low Process S creates the morning wake-maintenance zone. And, the evening wake-maintenance zone emerges from the increasing arousal levels following the nap zone (Broughton, 1998).

The likelihood of falling asleep at different times of the day has been well studied. For example, Clodoré, Benoit, Foret, and Bouard (1990) examined SOL at 10h00, 12h00, 14h00, 16h00, and 20h00, using the Multiple Sleep Onset Latency Test (MSLT). Results indicated that participants were more likely and took the least amount of time to fall asleep at 14h00, and were least likely and took the most amount of time to fall asleep at 10h00 and

20h00. In addition, sleep occurred more frequently and rapidly at 10h00 than at 20h00, indicating that the morning wake maintenance zone is weaker than the evening zone.

4.2 Effects of Napping on Sleepiness, Alertness, Mood, and Cognitive Performance

Daytime sleepiness can largely impede one's global functioning and lead to numerous accidents (Dinges, 1995). A nap can be beneficial in that it improves alertness/sleepiness (Dinges & Broughton, 1989; Takahashi & Arito, 2000), performance (Takahashi & Arito, 2000), and mood (Dinges & Broughton, 1989; Lumley, Roehrs, Zorick, Lamphere, & Roth, 1986).

4.2.1 Sleepiness/alertness, and cognitive performance

In general, studies have found that a short mid-afternoon nap can decrease sleepiness and fatigue, and increase performance (Hayashi, Chikazawa, & Hori, 2004; Hayashi, Watanabe, & Hori, 1999). Studies examining the effects of napping on performance under conditions of sleep deprivation have generally found that naps are successful at counteracting its effects. In a meta-analysis on efficacy of naps as a countermeasure for fatigue, most results indicated that naps are beneficial for reducing the effects of sleep loss, and that they may even reverse the effects of sleep deprivation (Driskell, 2005). For example, Dinges et al. (1987) found that a 2-hour nap can be beneficial in improving performance or preventing it from worsening after 30, 42, and 54 hours of wakefulness. Studies examining the effects of napping on performance when sleep is not deprived or restricted, have found similar benefits. For example, Hayashi et al. (1999) noted that a 20 minute nap improved subjective sleepiness and performance level, as measured by a logical reasoning task, calculation and auditory vigilance, and self-confidence of task performance, 1 hour after napping. And, the

improvement in sleepiness and auditory vigilance remained present 3 hours after napping. Although fatigue, motivation, and reaction time were not significantly improved after taking a nap compared to not taking a nap, these measures did not worsen.

The effect of the duration of napping on alertness and performance has been studied. In a study by Lumley et al. (1986), the MSLT was used to examine the effect of a 0, 15, 30, 60 and 120 minute nap on alertness after total sleep deprivation. Results showed that napping improved alertness, and alertness increased with nap duration, up to 60 minutes. The 120 minute nap was found to be equally effective at increasing alertness than the 60 minute nap. However, often a nap of a long duration is not possible in work situations. A short nap lasting approximately 30 minutes or less is often more probable (Gillberg et al., 1996). In fact, Taub, Tanguay, and Clarkson (1976) found that a 30 minute nap taken in the late afternoon was equally as effective as a 2 hour nap in improving behavioural efficiency, subjective arousal, and physiological activation. Although studies have found that naps as short as 30 and 90 second naps are not recuperative (Tietzel & Lack, 2002), in general, studies have found that naps of less than 30 minutes either after normal nocturnal sleep (Hayashi et al., 1999; Tamaki et al., 2000, Tanaka et al., 2001) or after a restricted night of sleep (Brooks & Lack, 2006; Gillberg et al., 1996; Horne & Reyner, 1996; Reyner & Horne, 1997; Stampi et al., 1990; Takahashi & Arito, 2000; Tietzel & Lack, 2001; Tietzel & Lack, 2002) improve alertness/sleepiness. More specifically, naps as short as 19.8 (Gillberg et al., 1996), 10.8 (Horne & Reyner, 1996), 10.2 (Takahashi & Arito, 2000), and 10 minutes (Brooks & Lack, 2006; Tietzel & Lack, 2001) can improve alertness/sleepiness and level of performance following restricted nocturnal sleep. These findings are consistent with the suggestion that the benefits of napping are mostly due to sleep itself rather than duration of sleep or sleep architecture (Taub, 1977; Taub, 1979; Taub, Tanguay, & Rosa, 1977).

Some studies even find that short naps may be more beneficial than long naps for some aspects of cognitive performance. For example, Takahashi, Fukuda, and Arito (1998) studied the effects of brief and long daytime naps on alertness. Results showed that subjective alertness increased 30 minutes after the 15-minute nap, and this lasted until at least 3 hours after the nap. After a 45-minute nap, subjective alertness increased only after three hours. Similarly, Tietzel and Lack (2001) found an immediate improvement in subjective and objective alertness as well as cognitive performance, immediately after taking a 10-minute nap, which was maintained for at least an hour after the nap. Although a decline in performance, mood, and alertness was observed immediately following a 30-minute nap, some recovery was shown by the end of testing. More specifically, mood and cognitive performance were improved 35 minutes after the 30-minute nap. It is therefore evident that a brief nap rather than a long nap seems to produce a more immediate improvement in alertness.

With longer sleep duration, there is an increased likelihood of having SWS (Tassi & Muzet, 2000). Much evidence indicates that a relationship between sleep depth during napping and cognitive performance and alertness exists. While some have suggested that the amount of SWS during napping is important for improving alertness (Edinger, Glenn, Bastian, & Marsh, 2000), and reaction time (Taub, 1979), others have noted that SWS does not play a prominent role in the restoration of alertness (Stampi, Mullington, Rivers, Campos, & Broughton, 1990). For example, Stampi et al. (1990) found that a 20 minute nap containing no SWS was more effective than 50 and 80 minute naps containing SWS at improving performance. This is consistent with findings from other studies indicating that even short naps with little or no SWS can have recuperative effects (Gillberg, Kecklund,

Axelsson, & Akerstedt, 1996; Hayashi et al., 1999). Others have suggested that SWS is necessary to improve alertness when sleep loss has occurred (Tamaki et al., 2000).

The delayed improvement in performance and alertness that is sometimes experienced after napping is likely due to sleep inertia. Sleep inertia consists of “a short period of confusion and degraded mood/performance immediately after awakening from sleep” (Naitoh, Kelly, & Babkoff, 1993, p. 110). It is largely influenced by the amount of SWS (Ferrara & De Gennaro, 2000), as well the timing of the nap (Naitoh, 1981), and the duration of wakefulness before the nap (Naitoh & Angus, 1989). Longer naps, such as those of more than 30 minutes, tend to have some sleep inertia as they are more likely to contain SWS (Tassi & Muzet, 2000). For this reason, there should be longer delays between the time participants wake up from their nap and the time of testing. Ferrara, De Gennaro, and Bertini (2000) found that the effects of sleep inertia dissipated after approximately 30 minutes of being awake. Others have found that it lasts minutes to hours, depending on the task (Hofer-Tinguely et al., 2005). It has been suggested that sleep inertia affects pace but not accuracy of a task (Tassi & Muzet, 2000), and that the recovery rate of performance depends on the task administered (Hofer-Tinguely et al., 2005).

Studies have compared such effects of napping to those of resting. For example, in a study by Horne and Reyner (1996), it was found that an afternoon nap of a maximum duration of 15 minutes, after restricting the previous nocturnal sleep to 5 hours, resulted in a reduction in major accidents on a driving simulator as well as a decrease in sleepiness, and performance was significantly better compared to when participants only took a break and did not nap. Similarly, in a study by Hayashi et al., (2004), it was found that a 20 minute mid-afternoon nap led to an improvement in sleepiness, fatigue, and work motivation, and prevented worsening of cognitive performance level and mental fatigue during work 1 hour

after napping, while a simple rest from work resulted in a slight temporary increase in sleepiness. The authors suggested that taking a short nap is more beneficial than simply taking a break from work for decreasing fatigue, and preventing it from exacerbating during additional work. Consistent with these findings, Tamaki et al. (2000) found that a 30 minute early afternoon nap after a normal night's sleep led to decreases in sleepiness and fatigue, while an increase was noted when older adults only rested and did not take a nap. The authors of this study concluded that simply resting leads to a decrease in task performance and an increase in sleepiness and fatigue, while a short afternoon nap improves psychological, behavioural, and physiological arousal.

Most of the studies in this area were conducted in a laboratory environment. However, some have introduced napping to a more natural environment, such as at work. For example, in a study by Takahashi, Nakata, Haratani, Ogawa, and Arito (2004), employees were encouraged to take a 15 minute nap at 12h30 during one work week, and measures of alertness, neurobehavioral performance, and subsequent nocturnal sleep were taken and compared to a week when employees did not nap but simply took a break. Results indicated that subjective alertness during the afternoon decreased throughout the workweek when no nap was taken, while it was maintained at a higher level and improved more at the end of the week when a nap was taken. This suggests that a short nap is more beneficial when sleepiness and fatigue are high, such as at the end of a workweek, even if participants did not restrict their nocturnal sleep. Reaction time was not found to improve in this study however, which is consistent with other studies.

Napping as a countermeasure for sleepiness has been compared to other countermeasures. For example, in a study by De Valck, De Groot, and Cluydts (2003), the effects of a 30 minute nap were compared to that of 300mg slow release caffeine on the

performance of sleep restricted participants on a driving simulator. Results showed that both treatments counteracted sleepiness and improved performance. Although the nap's positive effects were short-term in this study, it is suggested that napping is a good alternative to caffeine as it does not create tolerance with chronic use. Similarly, Bonnet, Gomez, Wirth, and Arand (1995) found that although both prophylactic naps (naps taken at the beginning of sleep loss) and caffeine led to improvements in alertness and performance after sleep deprivation, the effects of caffeine started to wear off after 6 hours, while napping had a longer lasting and more evenly distributed effect.

4.2.2 Mood

In addition to improvements in alertness and cognitive performance, naps have also been found to improve mood (Taub et al., 1976; Taub, 1979). Not only can napping improve mood under conditions of sleep loss (Taub et al., 1976), but it has also been found to improve mood when sleep is not deprived (Taub et al., 1976; Taub, 1977; Taub, 1979). For example, in a study by Taub (1979), a 2 hour napping session in the morning or at night resulted in a significant improvement in positive affective states such as cheerfulness, energetic, and general activation compared to when no nap was taken. Positive and negative mood was improved by napping in a study by Luo and Inoué (2000), who asked participants to nap between 13h00 and 14h00 for 3 consecutive days. More specifically, an increase in joy was noted after napping. And, although to a lesser degree, anger and relaxation also improved within 60 minutes after napping. However, no significant changes were noted in sadness after napping. In addition, Daiss, Bertelson, and Benjamin (1986) noted that a nap of a mean duration of 37.28 minutes resulted in an improvement in anxiety, confusion and fatigue, but as did a resting condition. Dinges et al. (1987) failed to find improvement in

mood after a 2 hour nap, although participants in this study were subjected to 56 hours of sustained wakefulness. The time of day that the nap is taken may also influence mood changes. For example, in a study by Lavie and Weler (1989), it was found that positive mood scores were higher after a nap taken at 15h00 compared to a nap taken at 19h00.

4.3 Effects on Napping on Nocturnal Sleep

The effects of napping on nocturnal sleep architecture have been examined. Evidence from some research indicates that napping has a negative effect on nocturnal sleep, in that it disrupts its quality (Akerstedt, Torsvall, & Gillberg, 1989; Karacan, Williams, Finley, & Hirsch, 1970). For example, some studies have noted a reduction in SWS (Feinberg, Floyd, Bossom-Demitrack, & Katz, 1985; Karacan et al., 1970; Werth, Dijk, Achermann, & Borbély, 1996), total sleep time (TST) (Feinberg et al., 1985; Monk, Buysse, Carrier, Billy, & Rose, 2001), and sleep efficiency (Monk et al., 2001; Werth et al., 1996), as well as increased sleep onset latency (SOL) (Feinberg et al., 1985; Werth et al., 1996), REM latency, and nocturnal awakenings (Feinberg et al., 1985).

These studies, however, report on the effects of a lengthy nap (2 hours), and/or taken in late afternoon and early evening (between 16h00 and 19h00). Evidence from other research indicates that, in fact, people who take naps at other times do not experience any more nocturnal sleep disturbances than people who do not take naps (Lorden, 2003; Pilcher, Michalowski, & Carrigan, 2001). For example, in a study by Karacan et al. (1970), a morning nap of 2 hours (8h00-10h00) did not significantly affect subsequent nocturnal sleep. This is consistent with findings of other studies that suggest that although a nap taken in the late afternoon or early evening can have negative consequences on nocturnal sleep, naps taken in the morning do not have such effects (Karacan et al., 1970).

Studies looking at the effects of an early to mid-afternoon nap also tend to indicate that it does not affect subsequent nocturnal sleep. For example, in a study by Campbell, Murphy, and Stauble (2005), the effects of a 2-hour nap taken from 14h00-16h00 on subsequent nocturnal sleep of older adults was compared to nocturnal sleep following a day that no nap was taken. The only significant difference in nocturnal sleep measures found between the two conditions was SOL, which was 6.3 minutes longer on the day of napping, but still remained in the normal range. Similarly, in a study by Takahashi et al. (2004), a 15 minute nap taken at 12h30 at work during one week did not affect subsequent sleep measures such as sleep latency, sleep onset, total sleep time, time awake after sleep onset, mean activity during sleep, or mean subjective assessment of quality of sleep. These results are consistent with those obtained by Aber and Webb (1986), who examined the effects of a mid-afternoon nap of a maximum duration of one hour in older adults on subsequent nocturnal sleep. In some cases, a short mid-afternoon nap can actually serve to enhance sleep quality. For example, in a study by Tanaka et al. (2001), it was found that a nap taken between 13h00 and 15h00 by older adults, along with moderate intensity exercise, increased sleep quality as indicated by a decrease in wake time after sleep onset and an increase in sleep efficiency. In addition, it was found that this intervention significantly decreased subjective daytime sleepiness and improved mental health.

In summary, little empirical evidence indicates that short daytime naps, less than 2 hours in duration, have a negative affect on subsequent nocturnal sleep (Campbell et al., 2005). On the contrary, considering time of day and nap duration, evidence suggests that a nap of a short duration, during the early to mid-afternoon, may be used to counteract nocturnal sleep disturbance, and does not negatively affect subsequent nocturnal sleep.

Women with more severe premenstrual symptoms tend to have more daytime sleepiness, more intense negative affect, and some cognitive deficits during the late-luteal phase of their cycle. Given the evidence that napping can improve alertness/sleepiness, mood, and cognitive performance without negatively affecting subsequent sleep, it appears that a mid-afternoon nap during the late-luteal phase would be a successful intervention for decreasing such symptoms among these women.

5.0 Present Study

The aim of the present study was to investigate the effects of a mid-afternoon nap on sleepiness, alertness, mood, and cognitive performance during the late-luteal phase of the menstrual cycle, among women with severe emotional/behavioural premenstrual symptoms compared to women who have minimal emotional/behavioural premenstrual symptoms. In addition, the effects of a nap on subsequent sleep architecture, was examined among both groups of women.

This study attempted to bring further contributions to the field of menstrual cycles and sleep. Previous work has examined nocturnal sleep architecture among women during the different phases of the menstrual cycle. Studies have also examined the consequences of disturbed sleep experienced by women with severe premenstrual symptoms (i.e. daytime sleepiness). The present study was an attempt to contribute significantly to our knowledge, being the first to examine the effects of napping on sleepiness, alertness, mood, and cognitive performance among women with severe premenstrual symptoms. It was also the first study to examine the effects of such naps on subsequent sleep architecture among these women.

A first hypothesis tested was that the severity of premenstrual symptoms is related to daytime sleepiness during the late-luteal phase. More specifically, it was predicted that

women with severe emotional/behavioural premenstrual symptoms would have higher scores of sleepiness and lower scores of alertness during the mid-afternoon of the late-luteal phase, compared to women with minimal symptoms.

Based on the presented literature, it was also hypothesized that napping has a beneficial effect on premenstrual symptoms. More specifically, it was predicted that napping would increase positive mood, cognitive performance, and alertness, and decrease sleepiness and negative mood in the hours following napping among women with severe and minimal emotional/behavioural premenstrual symptoms, during the late-luteal phase of their cycle. In addition, based on evidence indicating that women with more severe premenstrual symptoms have more disturbed nocturnal sleep and more daytime sleepiness than women with minimal symptoms, it was hypothesized that the severity of premenstrual symptoms has an effect on the benefits of napping during the late-luteal phase. More specifically, it was predicted that, following napping, women with severe emotional/behavioural premenstrual symptoms would have a greater increase in positive mood, cognitive performance, and alertness, and a greater decrease in sleepiness and negative mood, than women with minimal symptoms.

Finally, based on the presented literature, it was hypothesized that short mid-afternoon naps do not negatively affect subsequent sleeping patterns. More specifically, it was predicted that a mid-afternoon nap, lasting a maximum of 30 minutes during the late-luteal phase of the cycle would not be followed by disturbed nocturnal sleep as evidenced by increased SOL, decreased SWS, lower sleep efficiencies, and increased number of awakenings among women with severe and minimal emotional/behavioural premenstrual symptoms.

Method

1.0 Design

This study consisted of a mixed measures design. Half of the participants had severe emotional/behavioural premenstrual symptoms, while the other half had minimal to no emotional/behavioural premenstrual symptoms. To begin, all participants were asked to come to the sleep laboratory for one nocturnal sleep recording in order to adapt to the laboratory environment, as well as to screen for sleep breathing and movement disorders. Then, participants' sleep was recorded during one night of the follicular phase of their menstrual cycle. Following this, participants' sleep was recorded during one night of the late-luteal phase of their menstrual cycle after which a mid-afternoon nap had been taken in the laboratory, as well as during one night of the late-luteal phase after which no nap had been taken. In some cases, the two nights in the late-luteal phase were recorded during the same menstrual cycle, separated by one day, and were counterbalanced. However, in other cases due to time restraints and the unpredictability of menstrual cycles, the two nights during the late-luteal phase were recorded during different menstrual cycles. Measures of sleepiness, alertness, mood, and cognitive performance were taken immediately before and approximately 30 minutes after the nap and no nap conditions, and measures of alertness, sleepiness, and mood were taken regularly throughout the remainder of the day, at 2-hourly intervals. Please see Appendix A for a summary of the complete design of the study.

2.0 Participants

Advertisements were posted at the University of Ottawa, including the campus health clinic, as well as at a Premenstrual Clinic of the Ottawa-Gatineau region. In addition, an advertisement was placed in the Ottawa Sun newspaper. Approximately 250 women

responded to the advertisements. From these women, 170 came to the laboratory to fill out the initial screening questionnaires to determine inclusion in the study, and 32 women met all criteria for the study. Thirteen women either dropped out of the study or were excluded from the study at various points, for reasons including time constraints (6/13), non ovulatory or irregular cycle (3/13), pregnancy (1/13), leaving the city (1/13), and other (2/13). The final sample consisted of 19 women, between the ages of 20 and 37 years. More specifically, 10 women (mean age 26.7 years) had severe emotional/behavioural premenstrual symptoms, and 9 women (mean age 26.6 years) had minimal to no emotional/behavioural premenstrual symptoms, as measured by the Premenstrual Tension Syndrome Self-Rating Scale (PMTS Self-Rating Scale). Participants were considered to have minimal to no premenstrual symptoms if they obtained a score lower than 8 out of the 32 emotional/behavioural items on the PMTS Self-Rating Scale, and were considered to have severe symptoms if they had a score of 14 or higher. On average, women who qualified for the severe symptoms group scored 24.3 on this scale, while women who qualified for the minimal symptoms group scored 4.6. All subjects remained true to their original categorization during the study.

All participants had regular and ovulating menstrual cycles. None of the participants were pregnant, or had been pregnant within the last year. Participants were not taking psychotropic medication or prescribed medication for their premenstrual symptoms. They were not taking any contraceptive medication, and had not been for at least 4 months prior to the beginning of the study. Participants did not have any history of, or current sleep disorders, or significant health or psychological problems. Participants who were suffering from dysmenorrhoea were excluded from the study. Long (10 hours or more of sleep) and short (6 hours or less of sleep) sleepers, as well as women who went to bed quite late (past 12:30am) and woke up late (past 8:30am) were also excluded from the study. This was done

to ensure that the timing of the nap occurred in the mid-afternoon. All participants had regular sleep/wake patterns.

The majority of the participants in this study (68.4%) were single. English or French was the first language of 63.2% of the sample. Most participants (94.7%) had at least some university or college education, and most were either students (68.4%) or employed (31.6%) at the time of the study. The majority of participants (63.2%) took a nap on a regular basis, while 3 participants from each group reported that they never napped. Most (94.7%) participants reported that they engaged in exercise. In general, the two groups were similar on these dimensions. The majority of participants with severe symptoms (80%) identified themselves as an evening person, while the majority of participant with minimal symptoms (55.6%) identified themselves as a morning person. Four (22.2%) participants with severe symptoms were smokers, three of which were light smokers, and all accepted not to smoke during the study.

Participants were given an information sheet that described the purpose and requirements of the study as well as the potential risks and benefits of participating in the study, and informed consent was obtained from all women (Appendices B and C). A small monetary compensation was given for participation in the study. Participants were informed that they could withdraw from the study at any point, without any consequences. All procedures used in this study were approved by the Ethics Committee of the University of Ottawa, and the treatment of participants was in accordance with the ethical standards of the Canadian and American Psychological Associations.

3.0 Measures

3.1 Measures for Sleep and Nap Recordings and Temperature

Participants slept in a sound proof bedroom, and an attempt was made to keep the temperature in the bedroom between 70° F and 71° F. All sleeping periods were examined using standard polysomnographic measures. For all night and nap recordings, electroencephalogram (EEG), electro-oculogram (EOG), and electromyogram (EMG) measures were taken. More specifically, electrodes were placed at Left Ocular (LOC), left and right positions underneath the chin (EMG), and C3, Fz, Cz, Pz, Oz (EEG) according to the International 10-20 System of electrode placement, with a linked ears montage. During the adaptation nocturnal recording, electrodes were positioned only on C3 and C4 for the EEG signals. In addition, during the adaptation night, two electrodes were placed on the left leg to screen for sleep movement disorders, and oral and nasal airflow was monitored with the use of an airflow sensor respiratory device, to screen for sleep breathing disorders.

The computer program "Eclipse" (Stellate ©) was used to record napping and nocturnal sleep activity. An ambulatory rectal temperature monitoring apparatus and wrist activity recorder was used to measure and record core body temperature at every minute. Digital oral thermometers (Soar, M. E.) were also used to measure oral temperature during the initial phase of the study, as well as throughout the study. Sleep recordings were scored using the Stellate Reviewer program. Twenty-second epochs were scored according to the Standards of Rechtschaffen and Kales (1968). One consecutive minute of stage 1 sleep or the appearance of another stage following stage 1 was considered to be sleep onset.

Nocturnal EEG recording was visually scored by two raters such that 7 out of the 57

nocturnal recordings were scored by both raters. The inter-rater reliability was calculated by comparing agreements of each epoch, and was found to be 91.8%.

3.2 Questionnaires, Scales, and Tests

3.2.1 Sleep and health measures

The General Health Questionnaire (Appendix D) is a self-report measure that assesses participants' general level of health, and was used to screen for significant physical or psychological health problems. The General Sleep Questionnaire (Appendix E) is a self-report measure that assesses one's general sleep quality. The Pittsburgh Sleep Quality Index (PSQI, Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) (Appendix F) is a widely used self-report sleep questionnaire that assesses sleep quality and sleep disturbances during the last month (Smyth, 1999). The Sleep Log (Appendix G) is used to monitor the regularity of sleeping patterns on a daily basis.

3.2.2 Menstrual cycle screeners

Menstrual Cycle Questionnaire

The Menstrual Cycle Questionnaire (Appendix H) gathers information related to the participant's menstrual cycle. More specifically, it includes items related to the regularity of the menstrual cycle, as well as the use of contraceptive medication or medication for premenstrual symptoms. Questions regarding the severity of physical and psychological premenstrual symptoms, as well as the presence of dysmenorrhoea (menstrual pain) are also included.

Premenstrual Tension Syndrome Self-Rating Scale (PMTS Self-Rating Scale)

The PMTS Self-Rating Scale (Appendix I) was published in 1980 by Steiner, Haskett, and Carrol, and includes the essential symptoms of the premenstrual tension syndrome (Steiner et al., 1999). This instrument consists of a total of 36 yes/no answer questions, 32 of which relate to the presence of emotional/behavioural symptoms, and four of which relate to the presence of physical symptoms. The total score of this scale, with 0 being the minimum and 36 being the maximum, indicates the severity of the disturbance in the late-luteal phase of the cycle. In past studies, women with a score of 14 or more during the late-luteal phase and 5 or less during the follicular phase, on the 32 emotional/behavioural items only, have been identified as experiencing significant premenstrual symptoms (Haskett & Abplanalp, 1983). This was the criteria used to identify women with significant symptoms in this study. In order to avoid confusion with the statistical analyses and their interpretations in the current study, the term 'severe symptoms' was employed throughout the thesis instead of 'significant symptoms'. A score of 8 or lower on this scale was used to identify women with minimal to no emotional/behavioral premenstrual symptoms (Haskett & Abplanalp, 1983). The PMTS Self-Rating Scale has been found to be very reliable (Steiner et al., 1999), and has good validity (Steiner et al., 1999).

Morning Form

The Morning Form (Appendix J) consists of a table that allows participants to record their oral temperature every morning at approximately the same time. Participants were provided with a digital oral thermometer, and were asked to record their temperature for approximately 3 weeks to one complete menstrual cycle during the screening period of the study, and most participants continued to record their temperature throughout the study. This

was to ensure that participants had ovulatory cycles, and also helped predict onset of menses based on time of ovulation.

3.2.2 Sleepiness/alertness measures

Stanford Sleepiness Scale (SSS)

The SSS (Appendix K), developed by Hoddes, Dement, and Zarcone in 1972, is used to measure subjective changes in sleepiness over any period of time (Hoddes, Zarcone, Smythe, Phillips, & Dement, 1973). It consists of seven statements (with scores from 1-7), and participants are asked to identify the statement that best describes their current state of sleepiness. A low score is indicative of an alert state, while a high score is indicative of extreme sleepiness. Studies have found that the SSS is a sensitive and reliable measure for levels of sleepiness, and is good for measuring changes with sleep loss and partial recovery (Hoddes et al., 1972).

Subjective Alertness Scale (SAS)

The SAS (Appendix L) is another widely accepted self-report measure of subjective alertness at a particular time. It is a Visual Analog Scale (VAS) (a self-reporting device used to measure subjective phenomena) for alertness that consists of a continuous line or band, with extremely sleepy at one end of the continuum and extremely alert at the other end. Participants are required to indicate their level of alertness, by placing an X on the line at a position which they feel indicates their current level of alertness. A VAS usually consist of a 10cm line (Gift, 1989), however in this study the line was slightly longer, and was subsequently converted to a 10cm line. The measurement from the lowest anchor point of the line (left hand) to the individual's mark on the line is used as the measurement of alertness

(Cline, Herman, Shaw, & Morton, 1992). The VAS has generally been found to have high levels of validity and reliability (McCormack, Horne, & Sheather, 1988).

3.2.3 Cognitive performance measures

Continuous Performance Test (CPT)

The CPT used in this study was developed by Biobehavioral Technologies Incorporated. This computerized test is often used to measure sustained attention (Hsieh et al., 2005). During this test, visual stimuli (four digit numbers) are presented in white on a black background. Participants have to identify when a stimulus appears twice in a row, by lifting their finger from the mouse and pressing back down. Each stimulus appears for a period of 50ms and the inter-stimulus duration (time between response and presentation of next stimulus) is one second. Ninety targets are presented among 360 distracting stimuli. Completion of this task takes approximately 7 to 8 minutes. Several dependent measures are generated from the test including; number of hits (number of correct identifications of the target stimulus), reaction time for hits, number of false alarms (responding when a response is not needed), reaction time for false alarms, as well as the signal detection parameters D' (reflecting the perceptual sensitivity to targets; it is a measure of the participant's ability to discriminate a signal from the background noise) and $Beta$ (reflecting changes in the decision's criterion; it is the tendency to respond too little or too much relative to the actual distribution of the signal) (Conners, Epstein, Angold, & Klaric, 2003; Hsieh et al., 2005). Higher D' values indicate better discrimination between target and non-target stimuli (Conners et al., 2003) as well as better processing capabilities (Hsieh et al., 2005). Lower values of $Beta$ indicate that the individual has responded more often than is necessary or has

a risky responding style (Conners et al., 2003). An unchanged value of *Beta* is therefore optimal. In addition, an increasing number of false alarms is evidence of increased impulsivity (Conners et al., 2003). Overall, studies have found that the CPT has adequate reliability and validity (Campbell, D'Amato, Raggio, & Stephens).

Simple reaction time test (SRTT)

The SRTT is affected by arousal or state of attention, as well as sleepiness (<http://biae.clemson.edu/bpc/bp/Lab/110/reaction.htm>). In this study, it consists of having participants press a response key as quickly as possible when a target stimulus (an asterisk) appears on a computer screen. The stimuli are presented until the participant responds, and inter-stimuli intervals ranging between 1000 and 2500 milliseconds are presented randomly. Ninety stimuli are presented in total, and the task takes approximately 3 minutes to complete. The mean reaction time is noted as the dependent measure. Studies have found that simple reaction time tasks are sensitive to the effects of sleep deprivation (Tilley & Wilkinson, 1984).

3.2.4 Mood measures

Beck Depression Inventory (BDI)

The BDI (Appendix M), developed by Beck, Ward, Mendelson, Mock, and Erbaugh (1961), has become one of the most widely accepted instruments for assessing the severity of depression among individuals diagnosed with depression, and for detecting possible depression among undiagnosed individuals (Piotrowski, Sherry, & Keller, 1985). This questionnaire consists of 21 categories related to signs and symptoms of depression. Each

category includes a description of a behavioural manifestation of depression, and a graded series of four to five self-evaluative statements. Participants are asked to endorse the most characteristic statement for each item relating to how they are feeling on the day that they are completing the measure. The statements reflect different degrees of severity, which is indicated by a score of 0 to 3. The total score, which is obtained by summing the ratings of the 21 items, reflects both the number of symptom categories endorsed as well as the severity of a certain symptom. A score of 0-9 is considered normal or asymptomatic, 10-18 as mild-moderate, 19-29 as moderate-severe, and 30-63 as extremely severe (Beck & Steer, 1993). Beck suggests that a cut-off score of 21 be used for identifying a pure group of depressed patients for research purposes (Beck & Beamesderfer, 1974). Along with the General Health Questionnaire, the BDI was administered to assess for depressive symptoms not related to the late-luteal phase among participants, since depression was an exclusion criteria for the study. The BDI has been found to have reliable psychometric properties (Beck, Steer, & Garbin, 1988; Steer, Beck, & Garrison, 1986).

Nowlis Mood Adjective Checklist (Nowlis MACL)

The Nowlis MACL (Appendix N) was developed by Nowlis in 1965. It is one of the most widely used multiple mood inventories (Howarth & Schokman-Gates, 1981), and is designed specifically to measure mood change. The Nowlis MACL is based on an accessible type of behaviour, which is the tendency for people to apply to mood certain adjectives. This checklist has a broad coverage of different mood states and lists 12 factors, which each have a number of variables. Participants are asked to rate, on a four-point rating scale how much they are feeling each adjective listed, at the moment that they are completing the checklist (Howarth & Schokman-Gates, 1981). This measure has been used as a prototype for many

other mood adjective checklists (Howarth & Schokman-Gates, 1981), and has been used in studies of sleep deprivation (Laties, 1961; Haefner, 1956; Spence, 1957) as well as stress and sleep (De Koninck & Koulack, 1975). Studies have found that it has moderate to high reliability coefficients (Green, 1964; Nowlis & Green, 1964).

4.0 Procedure

4.1 Screening of Participants

Participants who were interested in participating in the study were invited to come to the sleep laboratory to complete a number of questionnaires that were used to determine their inclusion in the study. This included the Menstrual Cycle Questionnaire, the PMTS Self-Rating Scale (twice, once referring to their follicular phase and once referring to their late-luteal phase), the BDI, the General Information Questionnaire, the General Sleep Questionnaire, the PSQI, and the General Health Questionnaire. These questionnaires took approximately 30-45 minutes to complete. Participants who met all requirements for the study were then contacted.

Qualifying participants were then asked to complete a number of measures for approximately one month before any sleep recordings were conducted. Participants were asked to take their oral temperature every morning, approximately 30 minutes upon awakening for three weeks to one month, and complete the Morning Form. This was to ensure that all women had ovulating cycles, which was evidenced by an increase in temperature around the time of ovulation or a dip in temperature before this increase (Marshall, 1963). If participants did not have an ovulatory cycle, they were excluded from the remainder of the study. Participants were also asked to complete the Menstrual Cycle Questionnaire and the PMTS Self-Rating Scale (once during follicular and once during late-

luteal phase) again, during the appropriate phases of their cycle, to confirm regularity of cycle, severity of PMS, and absence of dysmenorrhoea. All women were also asked to complete the Sleep Log daily during this time, to monitor regularity of sleep/wake patterns.

4.2 Napping and Nocturnal Sleep Recordings

Once it was determined that participants had regular and ovulating menstrual cycles, they were asked to spend one night sleeping in the laboratory for adaptation purposes. This night also served the purpose of identifying sleep breathing and movement disorders. None of the participants of this study presented with any symptoms such as apnea or periodic leg movements in sleep. The women were then asked to spend a total of one night during the follicular phase and two nights and 1 napping session during the late-luteal phase sleeping in the laboratory, with the later two nights being counterbalanced. Night sleeping periods were scheduled for the time of the participant's habitual bedtime and wake-time, and participants were asked to arrive at the laboratory approximately one hour before their usual bedtime. Participants wore the rectal thermometer during all nocturnal recordings. They were asked to insert the rectal probe at a depth of approximately 6 inches. For the follicular and late-luteal sleep recordings, participants came to the laboratory the day before or the morning of the recording to pick up the thermometer. They inserted the rectal probe the morning of the nocturnal recordings, and were asked to wear it until the following morning. Participants were allowed to remove the probe for certain activities such as going to the washroom and taking a shower. Two participants from the study (one from each group) refused to wear the rectal thermometer, and instead were asked to take their oral temperature at every hour during the day, and wore a wrist activity recorder during the night. During the study, participants were asked to continue completing the Sleep Log.

4.2.1 Follicular phase nocturnal recording

The follicular nocturnal recording was performed 5 to 9 days after onset of menses (average of 7.26 days after onset of menses). Participants were asked to complete the SSS, SAS, BDI, and PMTS Self-Rating Scale during the mid-afternoon of that day. Upon arrival at the sleep laboratory that evening, electrodes were placed and participants completed the SSS, SAS, and Nowlis Mood Adjective Checklist (Nowlis MACL). Participants were then brought into the bedroom and lights were turned off. Upon awakening in the morning, the electrodes and the rectal thermometer were removed. The SSS, SAS, and Nowlis MACL were completed approximately 30 minutes following awakening.

4.2.2 Late-luteal napping sessions and nocturnal recordings

Nap condition

Participants arrived at the sleep laboratory in the mid-afternoon of a day in the late-luteal phase of their cycle, which consisted of 1 to 6 days before onset of menses (average of 3.44 days before onset of menses), with the exception of one control participant which consisted of approximately 6.5 days before onset of menses. The timing of the late-luteal phase recordings was calculated by counting back 1 to 6 days before the expected start of menstrual bleeding. The expected date of menstrual bleeding was determined based on regularity of the cycle, as well as oral temperature data taken during the cycle. More specifically, 12-16 days (Marshall, 1963) following the determined timing of ovulation was used as an estimate of onset of menstrual bleeding.

The timing of the nap was calculated according to the participant's habitual sleep/wake cycle. More specifically, the nap was scheduled approximately 12 hours after the mid-point of their habitual nocturnal sleep time, because it has been found that the low level

of alertness found in the mid-afternoon is approximately 180 degrees out of phase with the minimum level of alertness during the night (Broughton, 1975). Upon arrival at the laboratory, electrodes were placed and participants completed the PMTS Self-Rating Scale to measure severity of symptoms, and to confirm inclusion in the appropriate group. In addition, participants completed the SSS, SAS, Nowlis MACL, and BDI. Participants also completed the Continuous Performance Test (CPT) and the Simple Reaction Time Task (SRTT). They were then brought into the bedroom to attempt to take a nap. If the participant did not fall asleep (reached the first full minute of stage 1 or appearance of another stage following stage 1) within 40 minutes from the time of lights-off, they were asked to get up. If the participant fell asleep within 40 minutes, they were allotted 30 minutes to sleep. After the napping session, electrodes were removed and the SSS, SAS, Nowlis MACL, CPT, and SRTT were re-administered approximately 30 minutes after wake-up time in the case that the participants slept. If participants did not sleep, they were administered approximately 30 minutes after the time that they got out of bed. The SSS, SAS, and Nowlis MACL were again completed by participants at 2-hourly intervals, throughout the remainder of the day until bed time that night.

Participants then returned to the sleep laboratory that same night for a nocturnal sleep recording. After electrode application, participants completed the SSS, SAS, and Nowlis MACL. Participants were then brought into the bedroom, and lights were turned off. Upon awakening, the electrodes and the rectal thermometer were removed. The SSS, SAS, and Nowlis MACL were completed approximately 30 minutes after awakening.

No nap condition

Participants came to the sleep laboratory on another occasion during their late-luteal phase, which consisted of 1 to 6 days before onset of menses (average of 3.28 days before onset of menses). Participants came to the laboratory at the same time in the afternoon as during the napping condition, but remained awake and performed a quiet activity (i.e. reading, studying) for approximately 40 minutes instead of taking a nap. The same questionnaires and cognitive tests administered during the napping condition were also administered before and after the supposed napping time, and the same sleepiness, alertness, and mood measures were again completed at 2-hourly intervals until bedtime that night. Participants once again returned to the sleep laboratory that night for nocturnal recording, and the same procedures were followed as in the napping condition.

It is important to note that, in the case that participants completed the nap and no nap conditions during the same cycle, at least one day separated the two conditions. In addition, an effort was made to keep the nocturnal sleep times constant for all nocturnal recordings, and participants were asked to keep a regular sleep/wake cycle for at least one week before the last three nocturnal recordings. Participants were asked to refrain from consuming caffeine, drugs, and alcohol during the days of the sleep recordings, and were asked to withdraw from caffeine and nicotine one week prior to any sleep recordings. Participants were asked to refrain from napping outside of the laboratory during the days of the nocturnal recordings.

As part of a follow up study, participants were asked, on a volunteer basis, to continue napping at home during the late-luteal phase of their cycle, for 2 months after their laboratory sleep recordings. They were also asked to complete the SSS, SAS, and Nowlis

MACL before the nap, 30 minutes after the nap, and at 2-hourly intervals throughout the remainder of the day. However, these measures were not received from any of the participants.

Results

1.0 Preliminary Analyses

Before beginning analyses, data were checked for missing values. A total of 60 individual values out of a total of approximately 2800 were missing in the dataset. When possible, missing values were interpolated from the existing values of the participant. If they could not be interpolated and a sequence existed in the data (i.e. repeated measures design), the sequence was continued. In the case that the data could not be interpolated, or not enough data were present for a sequence to be continued, data remained missing and were not included in the analyses. For example, due to technical difficulties with the cognitive performance tasks, in a few cases data was not recorded before or after the nap or no nap condition. In these cases, data could not be interpolated because measures had only been taken at one point in time, and were therefore left as missing data.

All data were also checked for outliers using Mahalanobis distance. Distances that deviated substantially from the average distance were deemed to be outliers. Identified outliers were deleted if their removal resulted in a change in the interpretation of the analyses. If no change resulted from the removal, the original data were used for interpretation of the results. The only exception to this rule was in the case of the analysis for the nap characteristics, as the data for the only participant who did not fall asleep during the napping period was excluded from this analysis. The Huynh-Feldt correction was applied to all ANOVAs, and assumptions were verified for all analyses.

2.0 Prediction 1: Daytime Sleepiness

Women with severe emotional/behavioural premenstrual symptoms have more daytime sleepiness and less alertness than women with minimal symptoms, during the late-luteal phase of the cycle.

2.1 Daytime Sleepiness and Alertness in Late-Luteal and Follicular Phases

Independent t-tests were conducted using the scores of the Stanford Sleepiness Scale (SSS) and Subjective Alertness Scale (SAS) before the napping and no napping conditions during the late-luteal phase and follicular phases, for both groups of women. Results are presented in Figures 1 and 2. Based on the SSS and SAS, women with severe symptoms were more sleepy and less alert during the late-luteal phase compared to women with minimal symptoms, $t(36) = 3.49, p < .005$ and $t(36) = -3.02, p < .01$, respectively. During the follicular phase, there was no significant difference in the level of sleepiness and alertness between the two groups, $t(15) = .69, p = .50$ and $t(10.70) = .22, p = .83$, respectively.

Paired t-tests were conducted for both groups of women to determine whether a difference existed in the level of sleepiness and alertness between the follicular and late-luteal phases of the cycle. Results from the SAS and SSS indicated that women with severe symptoms were significantly less alert and marginally significantly more sleepy during the late-luteal phase compared to the follicular phase, $t(8) = 3.59, p < .01$ and $t(8) = -2.26, p = .05$. For women with minimal symptoms, no significant differences between phases were found for the SSS or SAS, $t(8) = .00, p = 1.00$ and $t(8) = .36, p = .73$, respectively.

Figure 1. Mean Stanford Sleepiness Scale (SSS) score and SD for women with severe and minimal premenstrual symptoms during the follicular and late-luteal phases of the menstrual cycle.

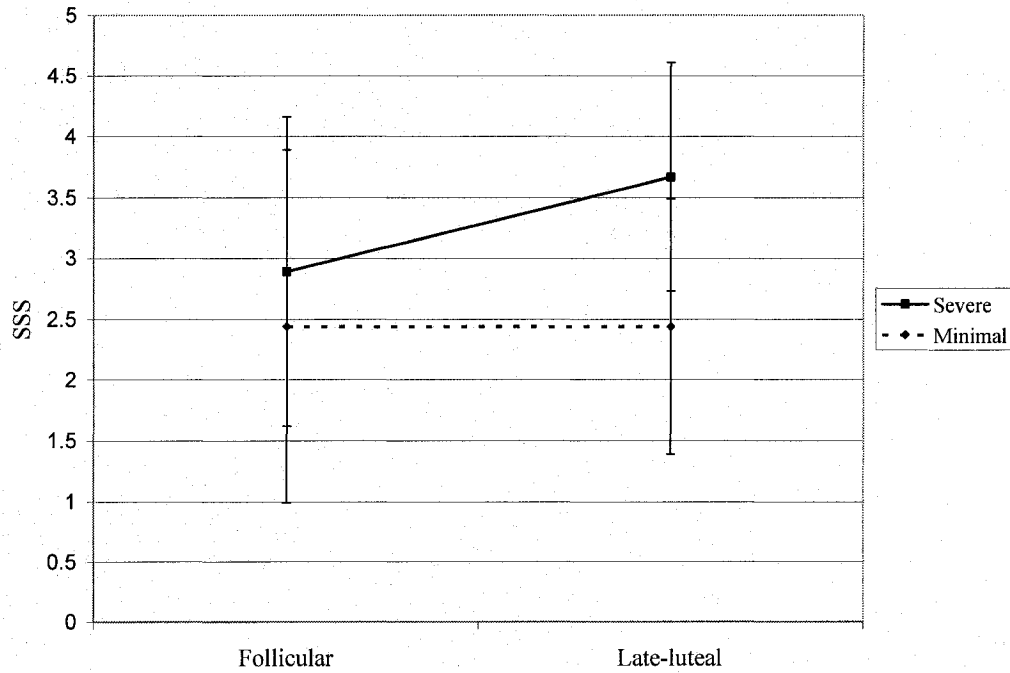
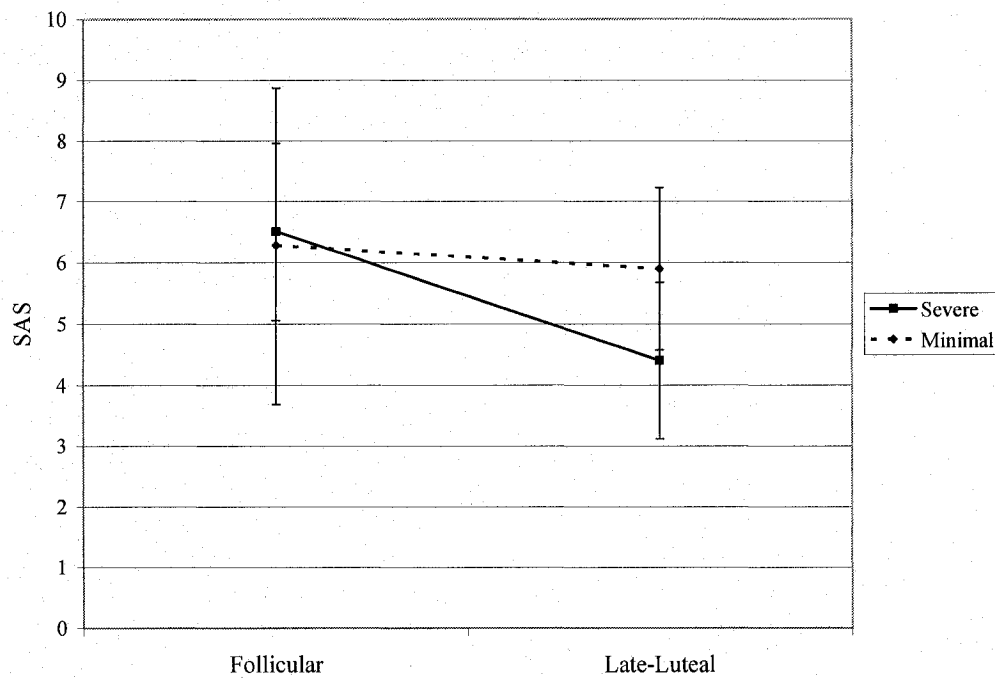


Figure 2. Mean Subjective Alertness Scale (SAS) score and SD for women with severe and minimal premenstrual symptoms during the follicular and late-luteal phases of the menstrual cycle.



2.2 Other Observations

2.2.1 Late-luteal Versus Follicular Nocturnal Sleep Characteristics

A series of 2 (group) X 2 (phase of cycle) mixed ANOVAs were conducted to compare nocturnal sleep characteristics during the late-luteal (nap and no nap conditions) and follicular phases of the cycle, among both groups of women. The following characteristics were examined: sleep onset latency (SOL), percentage of stages 1, 2, SWS and REM sleep, latency to stages 2, SWS and REM sleep, sleep efficiency, number of awakenings, and number of REM periods. The range of Lights Off was 21h26 to 24h20 and the range of Lights On was 5h30 to 8h10. Results are presented in Table 1.

Results indicated that the percentage of stage 1 sleep was significantly lower in the late-luteal nap and no nap phase compared to the follicular phase, $F(1, 17) = 8.35, p < .05, n^2 = .33$ and $F(1, 17) = 11.13, p < .005, n^2 = .40$, respectively. The percentage of SWS was also found to be significantly lower in the late-luteal nap and no nap phase, $F(1, 17) = 5.04, p < .05, n^2 = .23$ and $F(1, 17) = 4.56, p < .05, n^2 = .21$, respectively. In addition, the percentage of stage 2 sleep was significantly greater in the late-luteal nap and no nap phase compared to the follicular phase, $F(1, 17) = 18.22, p < .005, n^2 = .52$ and $F(1, 17) = 22.44, p < .001, n^2 = .57$, respectively. Although both groups of women appeared to have a lower percentage of REM sleep during the late-luteal nap and no nap phase compared to the follicular phase, this was only found to be significant in the no nap condition, $F(1, 17) = 5.37, p < .05, n^2 = .24$. The number of REM periods was found to be greater in the late-luteal no nap condition compared to the follicular phase for both groups of women, $F(1, 17) = 4.76, p < .05, n^2 = .22$, and the latency to REM sleep was found to be marginally significantly shorter in the late-luteal no nap condition compared to the follicular phase for both groups of women, $F(1, 17)$

= 3.96, $p = .06$, $n^2 = .19$. No significant effects or interactions between phase and group were found for any other characteristics.

Table 1

Mean Nocturnal Sleep Characteristics and Standard Deviations (SD) of the Late-Luteal and Follicular Phase for Women with Severe and Minimal Premenstrual Symptoms

	Severe ^a			Minimum ^b		
	Follicular	Late-luteal (Nap)	Late-Luteal (No Nap)	Follicular	Late-luteal (Nap)	Late-luteal (No Nap)
SOL (min)	4.15 (3.40)	12.08 (16.26)	*4.22 (2.08)	*9.20 (7.83)	*13.53 (20.98)	*6.49 (4.18)
% stage 1 [#]	8.04 (2.59)	6.59 (1.81)	6.29 (1.67)	8.59 (1.97)	7.42 (1.23)	7.03 (1.64)
% stage 2 [#]	46.31 (3.29)	51.04 (5.40)	51.81 (4.12)	44.64 (6.14)	50.06 (3.78)	50.47 (5.64)
% SWS [#]	21.79 (5.02)	19.61 (6.63)	20.42 (3.12)	23.78 (5.28)	20.60 (4.65)	20.91 (4.73)
% REM [©]	23.87 (4.53)	22.78 (3.59)	21.45 (3.85)	23.03 (4.54)	21.93 (4.22)	21.61 (3.31)
Lat. stage 2	3.08 (4.80)	1.74 (2.14)	2.72 (2.24)	3.33 (3.35)	2.47 (2.91)	2.60 (2.69)
Lat. SWS	13.22 (6.11)	13.24 (2.94)	12.30 (5.58)	13.31 (5.50)	13.13 (5.03)	19.27 (19.21)
Lat. REM	96.64 (35.79)	91.44 (45.58)	76.72 (25.31)	97.27 (36.36)	71.96 (13.72)	82.61 (32.29)
Total sleep time (min)	426.51 (36.64)	435.05 (35.59)	429.49 (37.29)	418.04 (41.75)	434.93 (33.16)	441.10 (27.70)
Sleep eff.	95.02 (2.78)	94.78 (2.10)	92.56 (6.06)	92.87 (6.70)	96.08 (1.22)	95.49 (2.68)
# Awakenings	21.3 (10.1)	19.00 (9.49)	19.60 (8.04)	17.67 (4.85)	20.11 (6.81)	20.89 (6.45)
# REM periods [©]	4.20 (.79)	4.2 (1.03)	4.50 (.85)	3.78 (.83)	4.56 (.73)	4.56 (.53)

^a $n = 10$, ^b $n = 9$

* Logarithmic transformation applied to data for analyses due to heterogeneity of variances

[#] $p \leq .05$ late-luteal phase (nap and no nap conditions) compared to follicular phase

[©] $p \leq .05$ late-luteal phase (no nap condition) compared to follicular phase

2.2.2 Core Body Temperature

A series of 2 (group) X 2 (phase of cycle) mixed ANOVAs were conducted to compare the core body temperature of women with severe and minimal symptoms, during the follicular and late-luteal phases (nap and no nap condition combined) of the menstrual cycle. Results are presented in Figures 3 to 8. Temperature was recorded for every minute during the day and night of the follicular and late-luteal phases. Temperatures below 36°C and above 40°C were excluded from these analyses, as they likely indicated that the thermometer was momentarily improperly inserted. Rectal temperature data were smoothed by a 5 minute moving average of the 1 minute recordings. The mean, maximum, and minimum temperatures of the days and nights of each phase were then calculated.

Results indicated that both groups of women had a significantly higher mean and maximum daytime temperature during the late-luteal phase compared to the follicular phase, $F(1, 8) = 6.09, p < .05, n^2 = .43$ and $F(1, 8) = 7.23, p < .05, n^2 = .49$, respectively. In addition, both groups of women had a significantly higher mean and maximum nocturnal temperature and a marginally significantly higher minimum nocturnal temperature during the late-luteal phase of the cycle compared to the follicular phase, $F(1, 11) = 11.84, p < .01, n^2 = .52$, $F(1, 11) = 8.84, p < .05, n^2 = .45$ and $F(1, 11) = 3.86, p = .075, n^2 = .26$, respectively. Finally, women with severe symptoms had a significantly higher overall mean nocturnal temperature compared to women with minimal symptoms, $F(1, 11) = 6.66, p < .05, n^2 = .38$.

Figure 3. Mean of the mean daily core body temperature and SD for women with severe and minimal premenstrual symptoms during the follicular and late-luteal phases of the cycle.

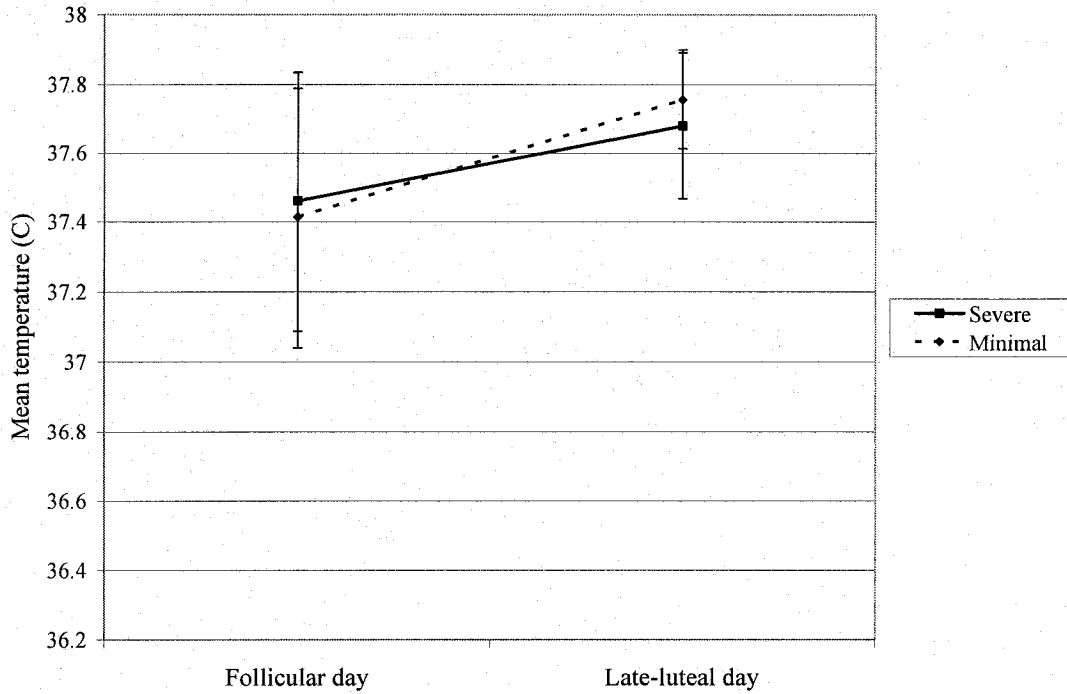


Figure 4. Mean of the mean nocturnal core body temperature and SD for women with severe and minimal premenstrual symptoms during the follicular and late-luteal phases of the cycle.

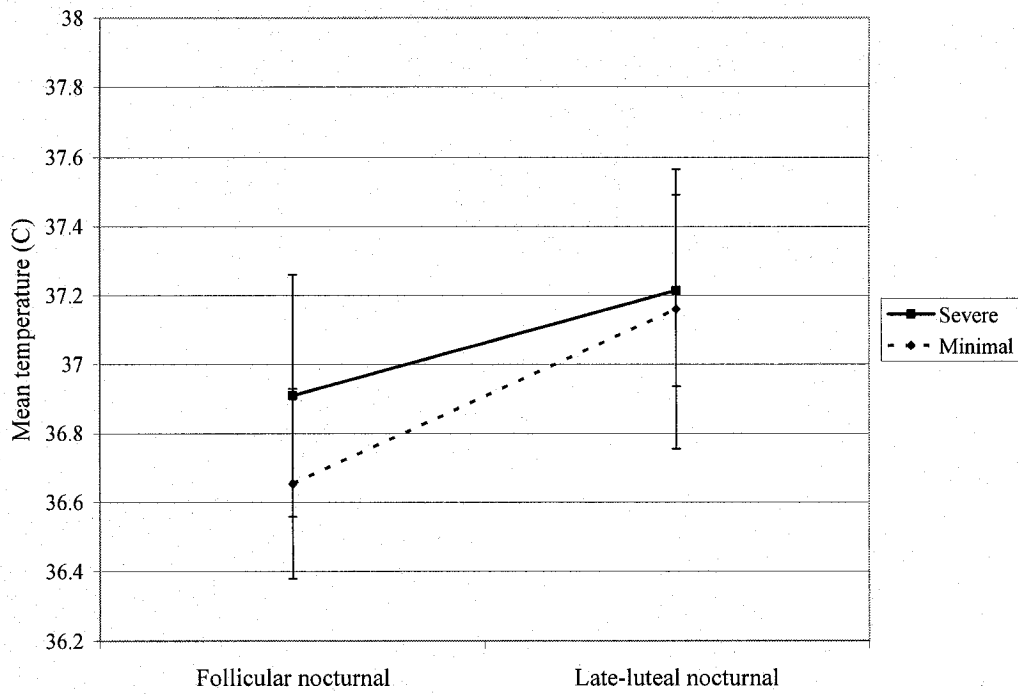


Figure 5. Mean maximum daily core body temperature and SD for women with severe and minimal premenstrual symptoms during the follicular and late-luteal phases of the cycle.

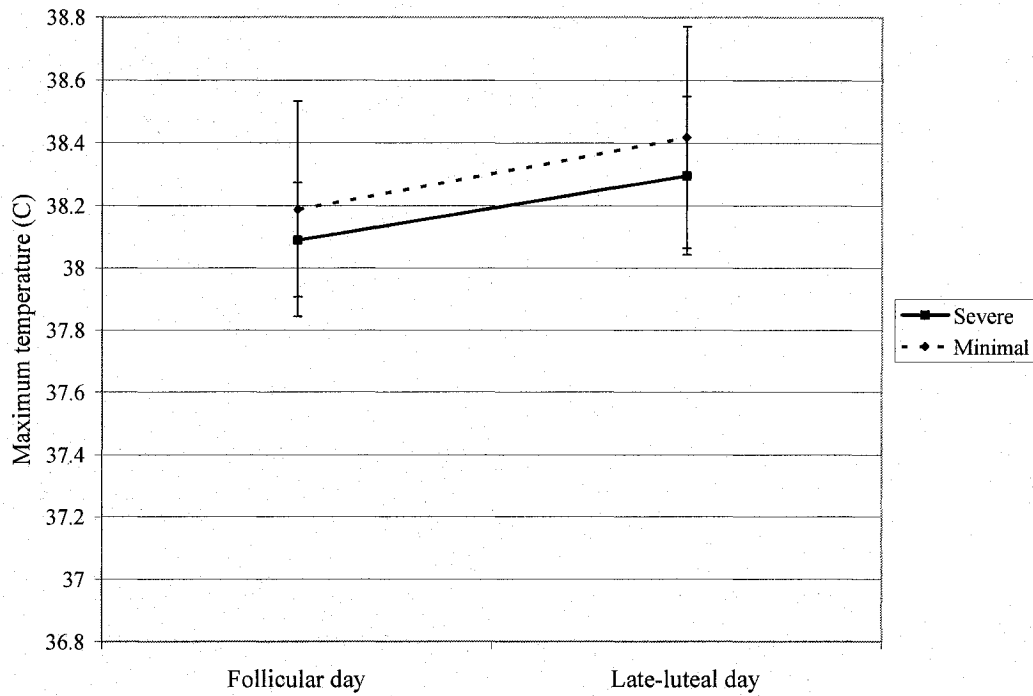


Figure 6. Mean maximum nocturnal core body temperature and SD for women with severe and minimal premenstrual symptoms during the follicular and late-luteal phases of the cycle.

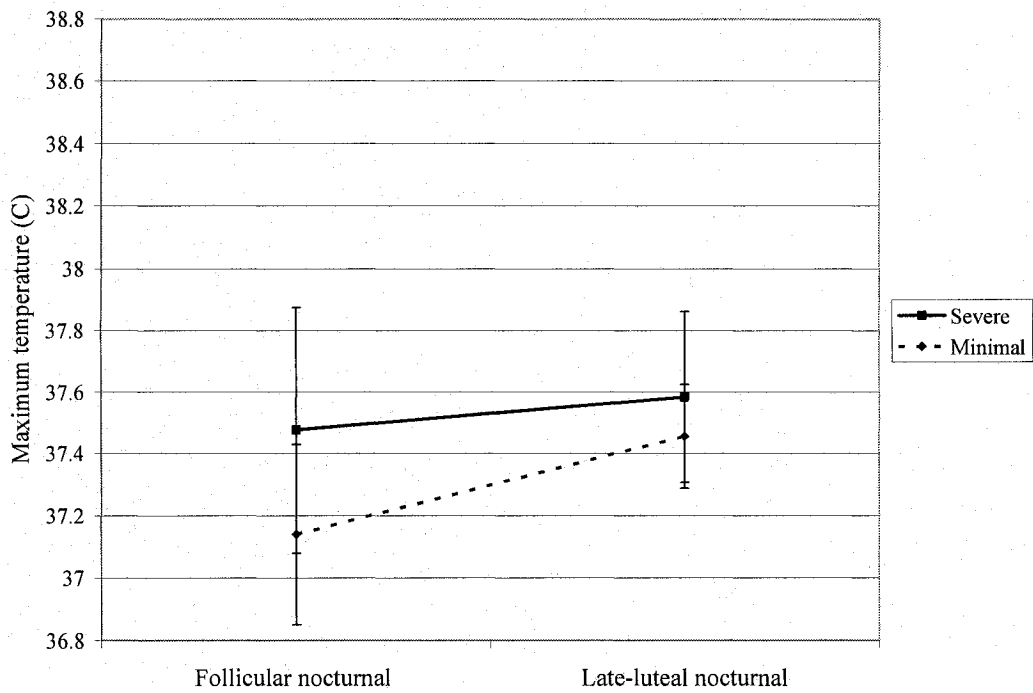


Figure 7. Mean minimum daily core body temperature and SD for women with severe and minimal premenstrual symptoms during the follicular and late-luteal phases of the cycle.

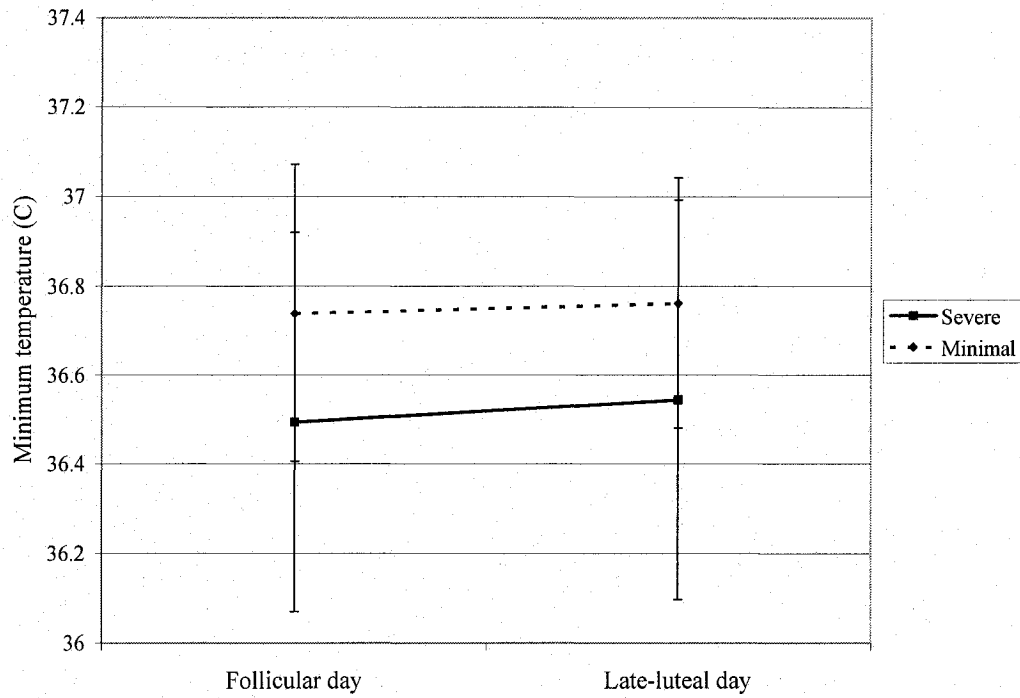
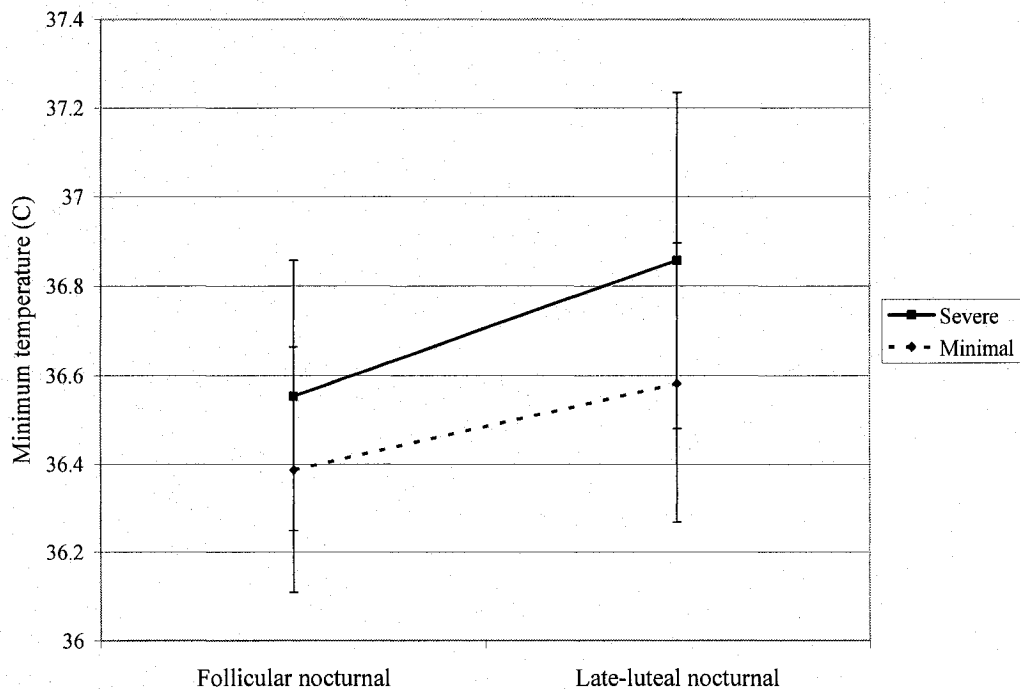


Figure 8. Mean minimum nocturnal core body temperature and SD for women with severe and minimal premenstrual symptoms during the follicular and late-luteal phases of the cycle.



3.0 Prediction 2: Effects of Napping on Sleepiness, Alertness, Mood, and Cognitive

Performance

3.1 Sleepiness and Alertness

Napping will decrease sleepiness and increase alertness in the hours following napping for both groups of women during the late-luteal phase of their cycle, but to a larger extent for women with severe emotional/behavioural premenstrual symptoms.

3.1.1 Effects of napping on sleepiness and alertness

To test this hypothesis, a series of 2 (group) X 6 (time) mixed ANOVAs were conducted to compare sleepiness and alertness scores from the SSS and SAS measures, before and 30 minutes after the nap and no nap conditions, as well as at 2-hourly intervals after the nap and no nap conditions until nocturnal bedtime, among both groups of women. When conducting paired t-tests and trend analyses, a Bonferonni correction was applied and the alpha level was adjusted to .025, since the two groups were analyzed separately. Results are illustrated in Figures 9 to 12.

Nap condition

On the SSS, a significant effect for group was found, indicating that women with severe symptoms were overall significantly more sleepy than women with minimal symptoms, $F(1, 17) = 12.87, p < .005, n^2 = .43$. In addition, a significant effect for time was found, $F(3.87, 65.85) = 14.98, p < .001, n^2 = .47$. More specifically, compared to before napping, women were significantly less sleepy 30 minutes $F(1, 17) = 15.35, p < .01, n^2 = .48$, 2 hours $F(1,17) = 30.69, p < .001, n^2 = .64$, 4 hours $F(1,17) = 15.20, p < .005, n^2 = .47$, and 6 hours after napping, $F(1, 17) = 5.38, p < .05, n^2 = .24$. No significant interaction between

time and group was found, $F(3.87, 65.85) = .62, p = .61, n^2 = .04$. As Figure 9 illustrates, the most significant trend for both groups of women was a quadratic trend, indicating that after napping, a decrease in sleepiness was found during the afternoon with a progressive increase in the evening, culminating at nocturnal bedtime, $F(1,9) = 44.11, p < .001, n^2 = .83$ and $F(1, 8) = 34.87, p < .001, n^2 = .81$, respectively. As seen in Figure 9, sleepiness started to increase slightly earlier in the evening for women with minimal symptoms compared to women with severe symptoms.

On the SAS, a marginally significant effect for group was found, suggesting that women with severe symptoms were overall significantly less alert than women with minimal symptoms, $F(1,17) = 3.67, p = .07, n^2 = .18$. In addition, a significant effect for time was found $F(4.06, 69.09) = 6.24, p < .001, n^2 = .27$. More specifically, compared to before napping, women were significantly more alert 30 minutes $F(1, 17) = 12.55, p < .005, n^2 = .43$, 2 hours $F(1, 17) = 15.30, p < .005, n^2 = .47$, and 4 hours $F(1,17) = 6.67, p < .025, n^2 = .28$ after napping. No significant interaction between time and group was found, $F(4.06, 69.09) = .43, p = .79, n^2 = .03$. As Figure 10 illustrates, the most significant trend for both groups of women was a quadratic trend, $F(1,9) = 21.66, p < .005, n^2 = .71$ and $F(1, 8) = 5.26, p = .05, n^2 = .40$ (marginally significant), indicating that after napping, an increase in alertness was found in the afternoon with a progressive decrease in the evening, culminating at nocturnal bedtime. As seen in Figure 10, the level of alertness for women with severe symptoms started to decrease slightly earlier (late afternoon) compared to women with minimal symptoms (early evening).

Figure 9. Mean Stanford Sleepiness Scale (SSS) score and SD for women with severe and minimal premenstrual symptoms before and 30 minutes after the nap condition, as well as at 2-hourly intervals after napping until bedtime.

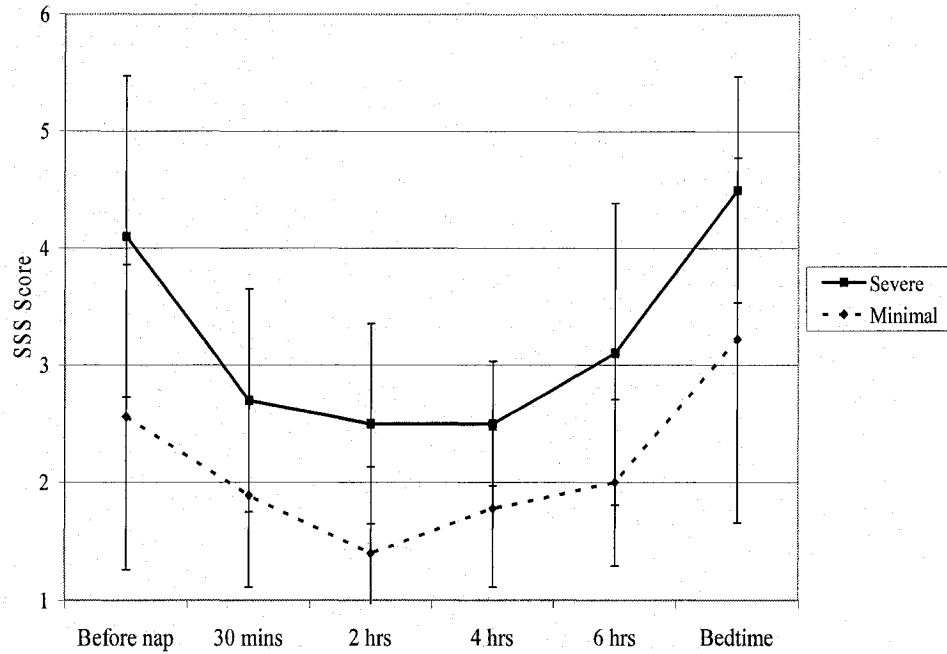
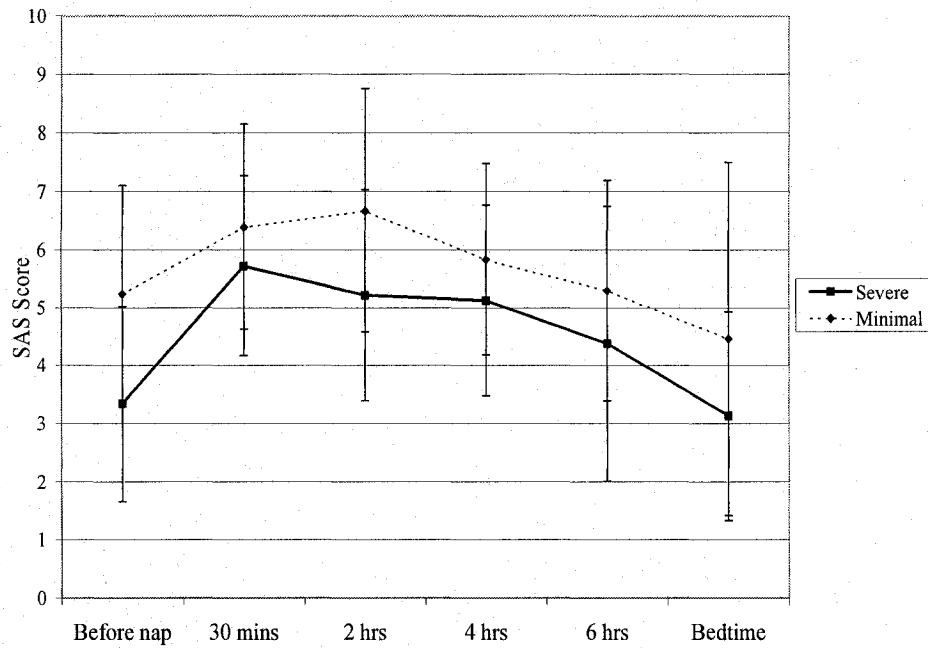


Figure 10. Mean Subjective Alertness Scale (SAS) score and SD for women with severe and minimal premenstrual symptoms before and 30 minutes after the nap condition, as well as at 2-hourly intervals after napping until bedtime.



No nap condition

On the SSS, a significant effect for time was found, $F(4.69, 79.78) = 6.61, p < .001, n^2 = .28$, which is mainly attributable to a significant increase in sleepiness before nocturnal bedtime compared to before the no napping condition, $F(1,17) = 13.35, p < .005, n^2 = .44$. In addition, a significant effect for group was found. More specifically, women with severe symptoms were significantly more sleepy overall during the no napping condition than women with minimal symptoms, $F(1,17) = 10.19, p < .01, n^2 = .38$. No significant interaction between time and group was found, $F(4.69, 79.78) = .30, p = .90, n^2 = .02$. As Figure 11 illustrates, the most significant trend for the severe symptoms group was a quadratic trend, indicating that sleepiness slightly decreased throughout the afternoon and early evening and increased progressively throughout the evening, culminating at nocturnal bedtime, $F(1, 9) = 8.46, p < .025, n^2 = .49$. In addition, a marginally significant linear trend for the minimal symptoms group indicates that, in general, sleepiness increased throughout the day, with a few periods of decreased sleepiness (30 minutes and 4 hours after the no nap condition), $F(1, 8) = 7.40, p = .03, n^2 = .48$.

On the SAS, a significant effect for time was found, $F(4.17, 70.96) = 9.18, p < .001, n^2 = .35$, which is mainly attributable to a significant decrease in alertness before nocturnal bedtime compared to before the no nap condition, $F(1,17) = 12.26, p < .005, n^2 = .42$. A marginally significant effect for group was found. More specifically, women with severe symptoms were less alert overall during the no napping condition than women with minimal symptoms, $F(1, 17) = 3.53, p = .085, n^2 = .17$. No significant interaction between time and group was found, $F(4.17, 70.96) = 1.89, p = .12, n^2 = .10$. As Figure 12 illustrates, linear and quadratic trends were found to be the most significant for the severe symptoms group, indicating that alertness slightly increased throughout the afternoon and decreased in the

evening, culminating at nocturnal bedtime, $F(1, 9) = 11.60, p < .005, n^2 = .56$ and $F(1, 9) = 10.83, p < .005, n^2 = .55$. In addition, a marginally significant order 5 trend for the minimal symptoms group indicates that alertness increased 30 minutes after the no nap condition, decreased 2 hours after, increased again 4 hours after, and then decreased until nocturnal bedtime, $F(1, 8) = 6.76, p = .03, n^2 = .46$.

Figure 11. Mean Stanford Sleepiness Scale (SSS) score and SD for women with severe and minimal premenstrual symptoms before and 30 minutes after the no-nap condition, as well as at 2-hourly intervals after the no nap condition until bedtime.

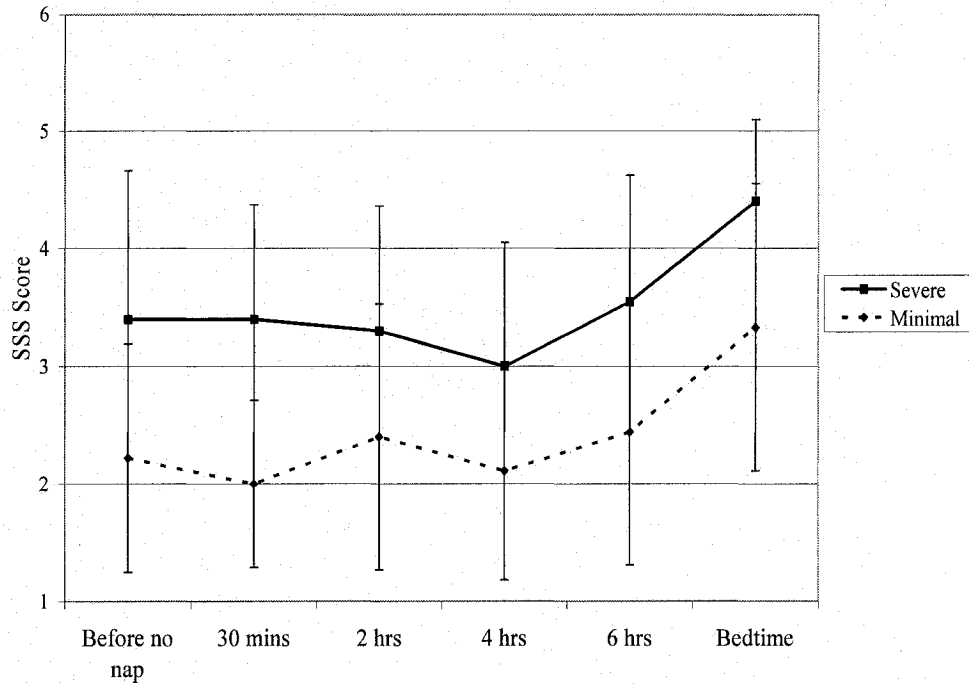
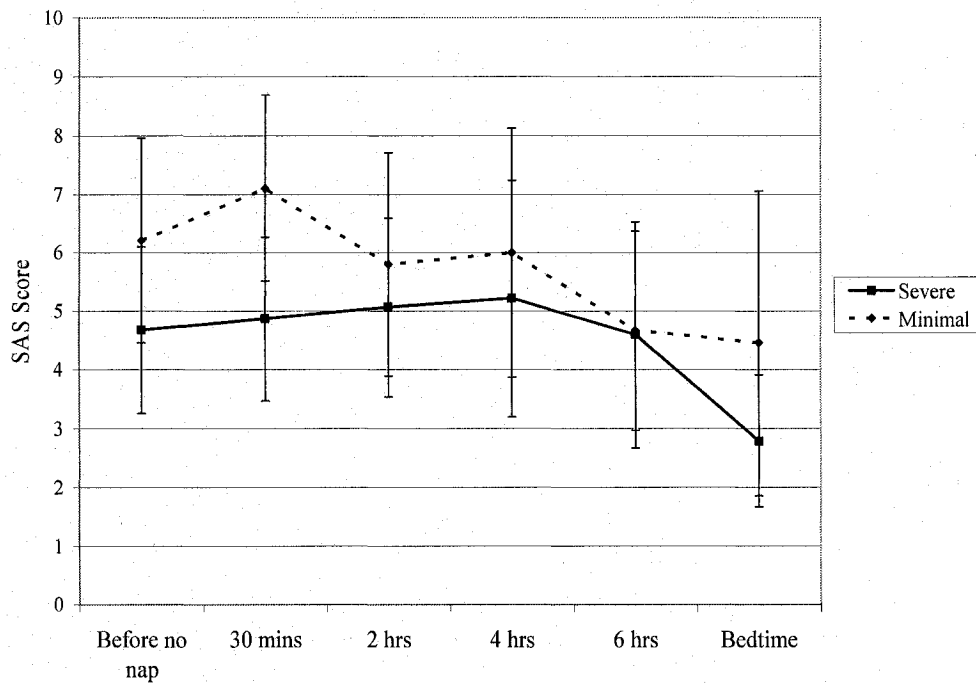


Figure 12. Mean Subjective Alertness Scale (SAS) score and SD for women with severe and minimal premenstrual symptoms before and 30 minutes after the no nap condition, as well as at 2-hourly intervals after the no nap condition until bedtime.



3.1.2 Relationship between changes in sleepiness/alertness and nap characteristics

Nap content

A series of independent t-tests were conducted to compare the nap characteristics of women with severe emotional/behavioural premenstrual symptoms and women with minimal symptoms. Results are presented in Table 2.

All women, with the exception of one participant with minimal symptoms, fell asleep during the napping period. The range for Lights Off was 13h40 to 15h44 and the range for Lights On was 14h15 to 16h31. The average sleep onset latency (SOL) for women with severe symptoms was 5.74 minutes and 7.03 for women with minimal symptoms. Six women from each group entered SWS, and only two women entered REM sleep, both of which were from the severe symptoms group. No significant differences were found between the two groups of women on the following nap characteristics: SOL, percentage of stage 1 sleep, stage 2 sleep, SWS and REM sleep, number of minutes in stage 1 sleep, stage 2 sleep, SWS, and REM sleep, sleep efficiency, number of awakenings and latency to stage 2 sleep and SWS.

Multiple regressions

A series of multiple regressions were conducted to determine whether a relationship existed between the characteristics of the nap and the significant changes found in the level of sleepiness from before napping to 30 minutes, 2 hours, 4 hours, and 6 hours after napping, as well as significant changes in the level of alertness from before napping to 30 minutes, 2 hours, and 4 hours after napping. The first predictor entered was the group variable, and the following predictors were then entered in a stepwise fashion: number of minutes in SWS, number of minutes in stage 2 sleep, sleep efficiency, latency to SWS and latency to stage 2

sleep. The criterion was the change in the level of sleepiness and alertness from before napping to the different times after napping. The assumption of linearity was tested for all significant predictors. Only the results for significant nap characteristic predictors are reported. See Table 3 for correlations between predictors and criterions.

Results indicated that the severity of symptoms did not account for a significant amount of the variability in the change of SSS and SAS scores from before napping to 4 hours after napping, $R^2 = .09$, $F(1, 11) = 1.14$, $p = .31$ and $R^2 = .18$, $F(1, 11) = 2.47$, $p = .14$, respectively. A second analysis was conducted to evaluate whether nap characteristics predicted the change in SSS and SAS scores after 4 hours, over and above the severity of symptoms. Latency to SWS accounted for a significant proportion of the SSS and SAS variance after controlling for the effects of symptom severity, R^2 change = .35, $F(1, 10) = 6.33$, $p < .05$ and R^2 change = .42, $F(1, 10) = 10.77$, $p < .01$, respectively. These results suggest that women who had shorter SWS latencies were less sleepy and more alert 4 hours after napping.

Table 2

Mean and Standard Deviation (SD) of Nap Characteristics for Women with Severe and Minimal Premenstrual Symptoms

Characteristic	Mean (SD)		<i>t</i>	<i>p</i>	<i>df</i>
	Severe	Minimal			
SOL	5.74 (5.02)	7.03 (5.13)	-.54	.60	16
Sleep duration	27.31 (4.29)	25.74 (7.66)	-.55	.59	16
Min stage 1	5.34 (2.87)	5.29 (2.83)	.04	.97	16
Min stage 2	13.20 (6.13)	13.63 (6.92)	-.14	.89	16
Min SWS	8.57 (9.97)	7.46 (8.10)	.25	.80	16
Min REM	1.03 (2.17)	.00 (.00)	1.50	.17	9
% stage 1	20.27 (12.36)	20.74 (9.58)	-.09	.93	16
% stage 2	47.73 (20.86)	54.34 (24.05)	-.62	.54	16
% SWS	27.37 (31.35)	23.69 (25.12)	.27	.79	16
% REM	4.60 (9.82)	.00 (.00)	1.49	.17	9
Sleep Efficiency (%)	89.91 (10.27)	89.3 (6.75)	.14	.89	16
# Awakenings	2.70 (2.41)	2.87 (2.10)	-.16	.87	16
Latency stage 2 (min)	2.80 (3.39)	2.85 (4.04)	-.03	.98	16
Latency SWS (min)	9.97 (6.53)	11.23 (5.81)	-.37	.72	11
Latency REM (min)	8.65 (7.57)	N/A	N/A	N/A	N/A
# REM periods	.20 (.42)	----	1.50	.17	16

Table 3

Correlations and Alpha Levels (p) Between Changes in Level of Sleepiness and Alertness (SAS and SSS) and Nap Characteristics for Women with Severe and Minimal Symptoms

	Group	Minutes SWS	Minutes stage 2	Efficiency	Latency SWS	Latency stage 2
SSS 30 minutes	.28 (.18)	.15 (.31)	-.24 (.22)	.16 (.30)	.35 (.12)	.29 (.17)
SAS 30 minutes	-.35 (.12)	.18 (.27)	.002 (.50)	.13 (.34)	-.47 (.05)*	-.39 (.10)
SSS 2 hours	-.11 (.36)	-.03 (.46)	-.21 (.24)	-.25 (.21)	.55 (.03)*	.25 (.21)
SAS 2 hours	-.12 (.35)	.20 (.26)	.19 (.27)	.48 (.05)*	-.51 (.04)*	-.38 (.10)
SSS 4 hours	.31 (.16)	-.15 (.31)	-.03 (.47)	.25 (.20)	.62 (.01)**	.19 (.27)
SAS 4 hours	-.43 (.07)	.26 (.19)	-.10 (.38)	-.25 (.21)	-.69 (.004)**	-.19 (.27)
SSS 6 hours	.39 (.09)	-.34 (.13)	.01 (.48)	-.41 (.08)	.49 (.04)*	.27 (.18)

* Significant at the .05 level

** Significant at the .025 level

3.2 Mood

Napping will improve mood, as indicated by a decrease in negative mood and/or an increase in positive mood in the hours following napping among women, during the late-luteal phase of their cycle. Women with severe emotional/behavioural symptoms will have a greater improvement in mood than women with minimal symptoms.

3.2.1 Effects of napping on mood

To test this hypothesis, a series of 2 (group) X 6 (time) mixed ANOVAs were conducted to compare mood scores from the Nowlis Mood Adjective Checklist (Nowlis MACL) before and 30 minutes after the nap and no-nap conditions, as well as at 2-hourly intervals after the nap and no nap conditions until nocturnal bedtime, among both groups of women. For these analyses, the Nowlis MACL scale was recoded: the value of 1, which corresponds to “I don’t know if I am experiencing this mood” was coded as 0 which corresponds to “I am not experiencing this mood”, and the values of 2 and 3 were coded as 1 and 2, respectively. Thus, the scale was transformed from 0-3 to 0-2, by putting together the values of 0 and 1. The scores of Aggression, Anxiety, Fatigue and Sadness were combined to form a negative mood variable, and the scores of Surgency, Elation, Social Affection and Vigor were combined to form a positive mood variable. Results are illustrated in Figures 13 to 16. When conducting paired t-tests and trend analyses, a Bonferonni correction was applied and the alpha level was adjusted to .025, since the two groups were analyzed separately.

Nap condition

Negative mood

The assumption of homogeneity of variance was not met for this variable. A square root transformation was applied to the data, which rendered the variances homogenous. A significant effect for group was found, indicating that women with severe symptoms had a significantly higher overall negative mood score compared to women with minimal symptoms, $F(1, 17) = 27.57, p < .001, n^2 = .62$. In addition, a significant effect for time was found, $F(4.73, 80.47) = 7.63, p < .001, n^2 = .31$. More specifically, compared to before napping, intensity of negative mood was found to be significantly lower 30 minutes, 2 hours, and 4 hours after napping, $F(1, 17) = 15.54, p < .005, n^2 = .48$, $F(1, 17) = 8.56, p < .01, n^2 = .34$, and $F(1, 17) = 4.46, p = .05, n^2 = .21$, respectively. A significant interaction between time and group was also found, $F(4.73, 80.47) = 3.14, p < .001, n^2 = .16$. More specifically, women with severe symptoms had a significant decrease in intensity of negative mood 30 minutes after napping, $t(9) = 3.44, p < .01$, while women with minimal symptoms had a marginally significant decrease in intensity of negative mood, $t(8) = 2.20, p = .06$. This was mostly attributable to a decrease in aggression. As figure 13 illustrates, the most significant trend for the severe symptoms group is an order 4 trend, indicating that intensity of negative mood decreased 30 minutes after napping, increased again 2 hours after napping, and slightly decreased throughout the evening, with a slight increase again at nocturnal bedtime, $F(1, 9) = 16.78, p < .005, n^2 = .65$. The most significant trend for the minimal symptoms group was a quadratic trend, indicating that intensity of negative mood decreased in the few hours following the nap, and progressively increased throughout the remainder of the afternoon and evening, culminating at nocturnal bedtime, $F(1, 8) = 15.43, p < .005, n^2 = .66$.

Positive mood

A significant effect for time was found, $F(2.84, 42.53) = 3.22, p < .05, n^2 = .18$. More specifically, intensity of positive mood increased significantly 30 minutes after napping compared to before napping, $F(1, 15) = 5.39, p < .05, n^2 = .26$. Intensity of positive mood did not significantly differ between groups, $F(1, 15) = 1.92, p = .19, n^2 = .11$, and no significant interaction between time and group was found $F(2.84, 42.53) = .86, p = .46, n^2 = .05$. No significant trends were found for either group of women.

No nap condition

Negative mood

The assumption of homogeneity of variance was not met for this variable. A square root transformation was applied to the data, which rendered the variances homogenous. A significant effect for group was found, indicating that women with severe symptoms had a significantly higher overall negative mood score compared to women with minimal symptoms, $F(1, 15) = 23.88, p < .001, n^2 = .61$. No significant effect for time, $F(4.15, 62.28) = .78, p = .55, n^2 = .05$ or interaction between time and group was found, $F(4.14, 62.28) = 1.87, p = .13, n^2 = .11$. No significant trends were found for either group of women.

Positive mood

The assumption of homogeneity of variance was not met for this variable. Since no transformation corrected this problem, the original data were used for the interpretation of findings, and results were interpreted more cautiously, stating only findings that were clearly significant. Results showed that compared to before the no nap condition, intensity of positive mood was found to be significantly lower 2 hours after the no nap condition, $F(1,$

15) = 4.75, $p < .05$, $n^2 = .24$ and before nocturnal bedtime, $F(1, 15) = 5.85$, $p < .05$, $n^2 = .28$.

No significant effect for group, $F(1, 15) = .27$, $p = .61$, $n^2 = .02$ or interaction between time and group, $F(3.10, 46.53) = 1.11$, $p = .36$, $n^2 = .07$ was found. No significant trends were found for either group of women.

Figure 13. Mean negative mood score on the Nowlis Mood Adjective Checklist (Nowlis MACL) and SD for women with severe and minimal premenstrual symptoms before and 30 minutes after the nap condition, as well as at 2-hourly intervals after the nap condition until bedtime.

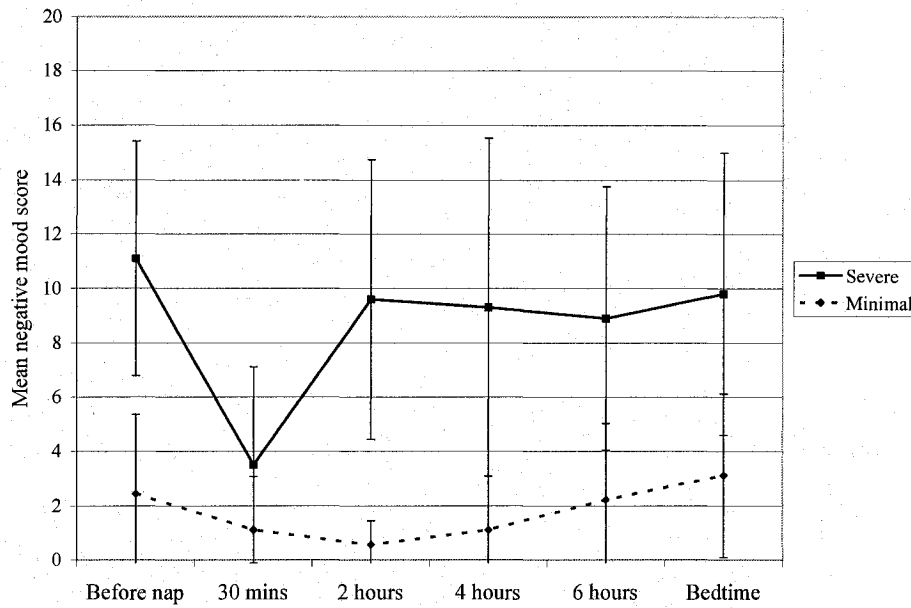
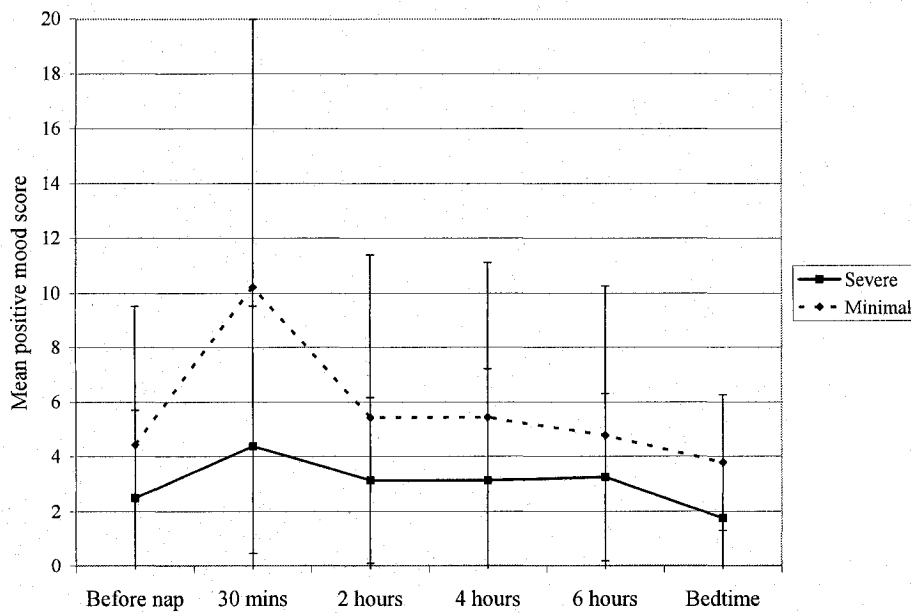


Figure 14. Mean positive mood score on the Nowlis Mood Adjective Checklist (Nowlis MACL) and SD for women with severe and minimal premenstrual symptoms before and 30 minutes after the nap condition, as well as at 2-hourly intervals after the nap condition until bedtime.



*Square root transformation applied to the data of negative mood for analyses

Figure 15. Mean negative mood score on the Nowlis Mood Adjective Checklist (Nowlis MACL) and SD for women with severe and minimal premenstrual symptoms before and 30 minutes after the no nap condition, as well as at 2-hourly intervals after the no nap condition until bedtime.

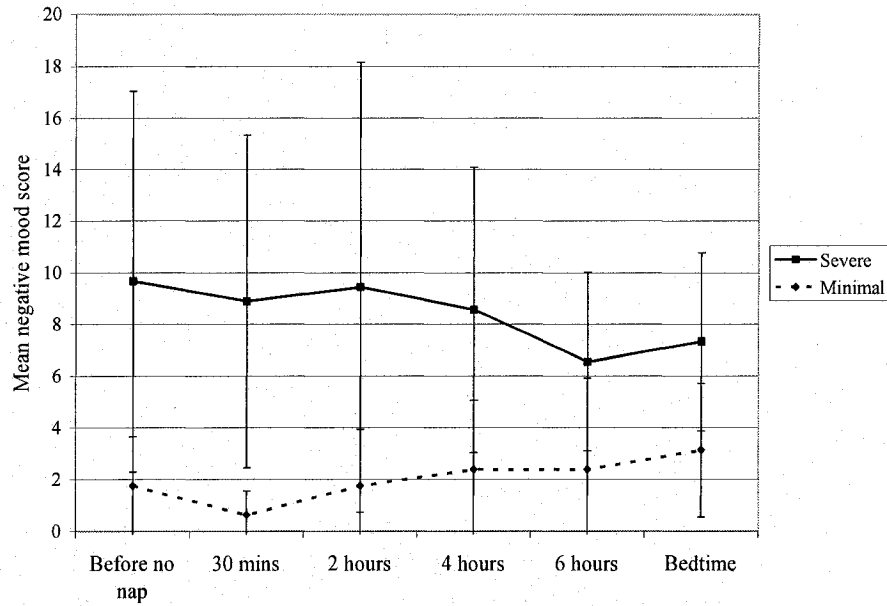
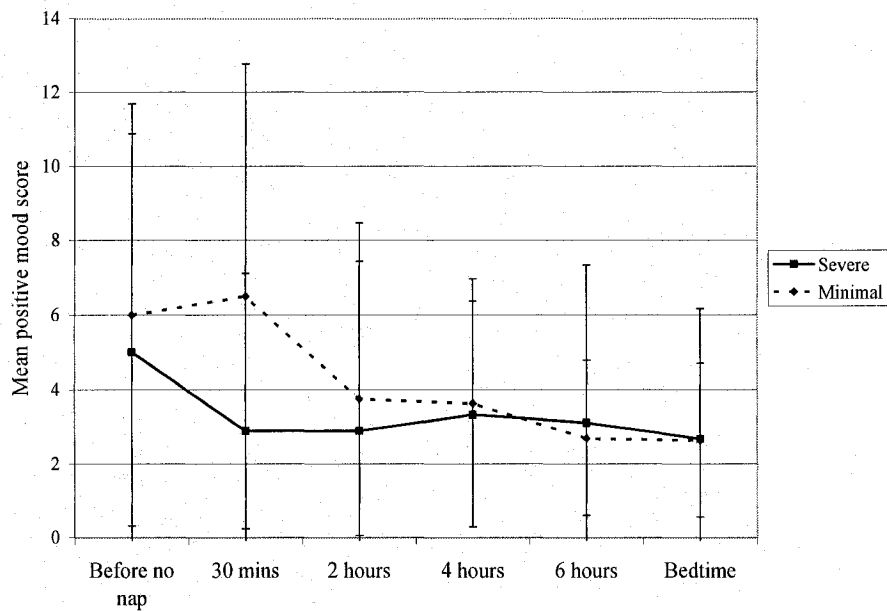


Figure 16. Mean positive mood score on the Nowlis Mood Adjective Checklist (Nowlis MACL) and SD for women with severe and minimal premenstrual symptoms before and 30 minutes after the no nap condition, as well as at 2-hourly intervals after the no nap condition until bedtime.



*Square root transformation applied to the data of negative mood for analyses

3.2.2 Relationship between changes in mood and nap characteristics

Multiple regressions

A series of multiple regressions were conducted to determine whether a relationship existed between the characteristics of the nap and the significant changes found in the intensity of negative mood from before napping to 30 minutes, 2 hours, and 4 hours after napping. The first predictor entered was the group variable, and the following predictors were then entered in a stepwise fashion: number of minutes in SWS, number of minutes in stage 2 sleep, sleep onset latency, latency to SWS and latency to stage 2 sleep. The criterions were the changes in the intensity of negative mood from before napping to the different times after napping. No significant results were found for any of the predictors. See Table 4 for correlations between predictors and criterions. A series of multiple regressions were also conducted to determine whether a relationship existed between the characteristics of the nap and the significant changes found in intensity of positive mood from before napping to 30 minutes after napping, using the same predictors. Again, no significant results were found for any of the predictors.

Table 4

Correlations and Alpha Levels (p) Between Changes in Negative and Positive Mood Scores and Nap Characteristics for Women with Severe and Minimal Symptoms.

	Group	Minutes SWS	Minutes stage 2	Efficiency	Latency SWS	Latency stage 2
Neg 30 min	.34 (.13)	.46 (.06)	-.31 (.15)	.44 (.06)	-.09 (.39)	-.04 (.44)
Pos 30 min	-.01 (.49)	-.33 (.14)	.22 (.25)	-.30 (.17)	-.44 (.08)	-.03 (.47)
Neg 2 hrs	-.34 (.13)	.15 (.31)	.14 (.32)	.33 (.13)	-.30 (.16)	-.40 (.09)
Neg 4 hrs	-.01 (.49)	.14 (.32)	-.05 (.43)	.18 (.27)	.41 (.08)	-.09 (.39)

3.3 Cognitive Performance

Napping will improve cognitive performance among women during the late-luteal phase of their cycle. Women with severe emotional/behavioural symptoms will have a greater improvement in cognitive performance after napping than women with minimal symptoms.

3.3.1 Effects of napping on cognitive performance

To test this hypothesis, a series of 2 (group) X 2 (time) mixed ANOVAs were conducted to compare cognitive performance scores from the Continuous Performance Test (CPT) and the Simple Reaction Time Test (SRTT) before and after the nap and no nap conditions, among both groups of women.

Continuous Performance Test (CPT)

The following variables of the CPT were examined: total number of hits (number of correct identifications of the target stimulus), total reaction time for hits, total number of false alarms (responding when a response is not needed), total reaction time for false alarms, as well as the signal detection parameters total D' (reflecting perceptual sensitivity to targets; a measure of the participant's ability to discriminate a signal from the background noise) and $Beta$ (reflecting the tendency to respond too little or too much relative to the actual distribution of the signal). It was expected that there would be an increase in the number of hits and total D' value, a decrease in the reaction time for hits and number of false alarms, and no difference in the $Beta$ value, from before napping to after napping. Results are presented in Figures 17 to 26.

Nap condition

The total number of hits significantly increased after napping for both groups of women, $F(1,14) = 16.09, p < .005, n^2 = .54$. No significant difference between groups, $F(1,14) = 1.48, p = .24, n^2 = .10$ or interaction between group and time was found $F(1, 14) = 2.38, p = .15, n^2 = .15$. In addition, total reaction time for hits significantly decreased after napping for both groups of women, $F(1,14) = 10.52, p < .01, n^2 = .43$. No significant effect for group, $F(1, 14) = .10, p = .34, n^2 = .07$ or interaction between group and time, $F(1, 14) = 1.33, p = .27, n^2 = .09$ was found.

For the total number of false alarms, no significant effect for time $F(1, 14) = 2.45, p = .14, n^2 = .15$ or group, $F(1, 14) = .90, p = .36, n^2 = .06$, or interaction between time and group $F(1, 14) = 1.33, p = .27, n^2 = .09$ was found. For the total reaction time for false alarms, a marginally significant effect for time was found, $F(1, 14) = 3.99, p = .07, n^2 = .22$. More specifically, compared to before napping, reaction time for false alarms increased after napping, for both groups of women. No significant effect for group $F(1,14) = 0.9, p = .78, n^2 = .006$ or interaction between group and time, $F(1,14) = 2.47, p = .14, n^2 = .15$ was found.

For the total D' value, a significant effect for time was found. More specifically, D' significantly increased after napping for both groups of women, $F(1,14) = 27.44, p < .001, n^2 = .66$. No significant effect for group, $F(1,14) = .003, p = .96, n^2 = .00$ or interaction between time and group, $F(1,14) = .00, p = .99, n^2 = .00$ was found. For the total $Beta$ value, no significant effect for time, $F(1, 14) = 2.51, p = .14, n^2 = .15$ or group, $F(1, 14) = .36, p = .56, n^2 = .03$, or interaction between time and group, $F(1, 14) = 2.53, p = .13, n^2 = .15$ was found.

No nap condition

For the total number of hits, the assumption of homogeneity of variance was not met. A transformation to the power of three was applied to the data and rendered the variances homogenous. No significant effect for time, $F(1,16) = .59, p = .43, n^2 = .04$ or group, $F(1,16) = 1.8, p = .20, n^2 = .10$, or interaction between time and group, $F(1,16) = 2.36, p = .14, n^2 = .13$ was found. For total reaction time for hits, no significant effect for time, $F(1,16) = .87, p = .37, n^2 = .05$ or group, $F(1,16) = 1.14, p = .30, n^2 = .07$, or interaction between time and group, $F(1, 16) = .71, p = .41, n^2 = .04$ was found.

For the total number of false alarms, a significant effect for time was found. More specifically, the number of false alarms decreased after the no nap condition, $F(1, 14) = 6.15, p < .05, n^2 = .31$. No significant effect for group, $F(1,14) = .00, p = .99, n^2 = .99$ or interaction between time and group, $F(1,14) = .17, p = .69, n^2 = .01$ was found. For the total reaction time for false alarms, no significant effect for time, $F(1,16) = .05, p = .82, n^2 = .003$ or group, $F(1,16) = .54, p = .48, n^2 = .03$, or interaction between time and group, $F(1,16) = .90, p = .36, n^2 = .05$ was found.

For the total D' value, no significant effect for time, $F(1,16) = 2.63, p = .13, n^2 = .14$ or group, $F(1,16) = .003, p = .96, n^2 = .00$, or interaction between time and group, $F(1,16) = 2.68, p = .12, n^2 = .14$ was found. For the total $Beta$ value, the assumption for homogeneity of variance was not met. A logarithmic transformation was applied to the data, which rendered the variances homogeneous. No significant effect for time, $F(1,16) = 1.70, p = .21, n^2 = .10$ or group $F(1, 16) = 2.82, p = .11, n^2 = .15$, or interaction between time and group, $F(1, 16) = .62, p = .44, n^2 = .04$ was found.

Figure 17. Mean number of hits (%) and SD on the Continuous Performance Test (CPT) before and after the nap and no nap conditions for women with severe symptoms.

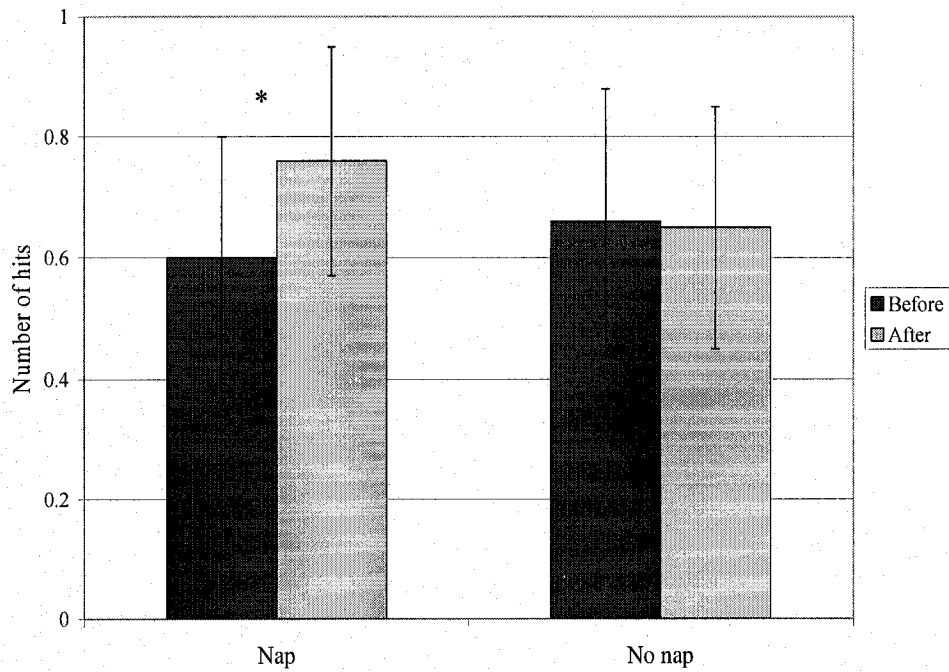
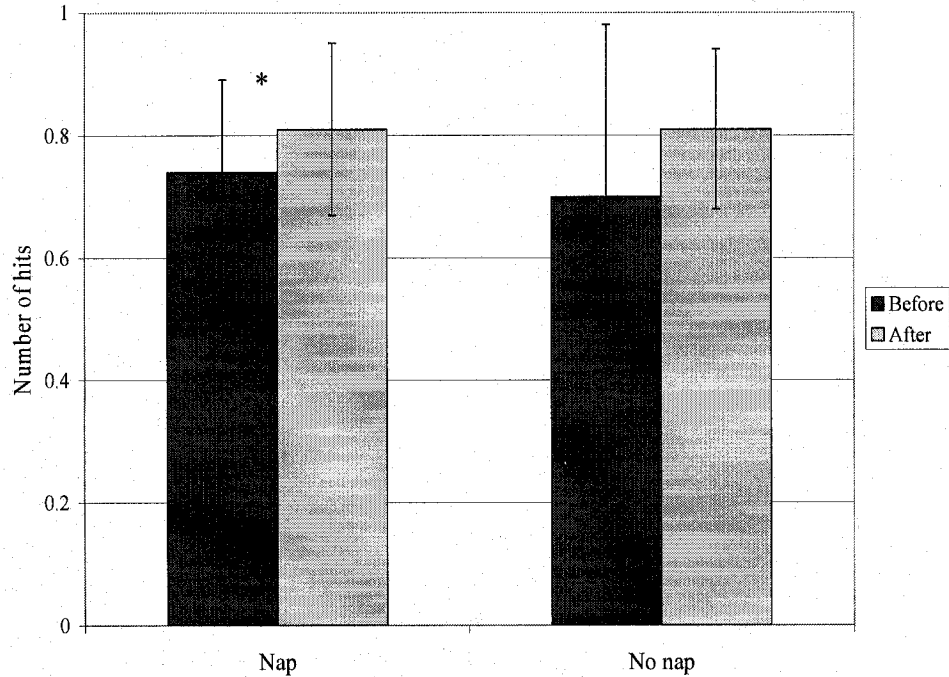


Figure 18. Mean number of hits (%) and SD on the Continuous Performance Test (CPT) before and after the nap and no nap conditions for women with minimal symptoms.



* Significant at the .005 level.

A transformation to the power of three was applied to the data of the no nap condition for analyses

Figure 19. Mean reaction time and SD for hits on the Continuous Performance Test (CPT) before and after the nap and no nap conditions for women with severe symptoms.

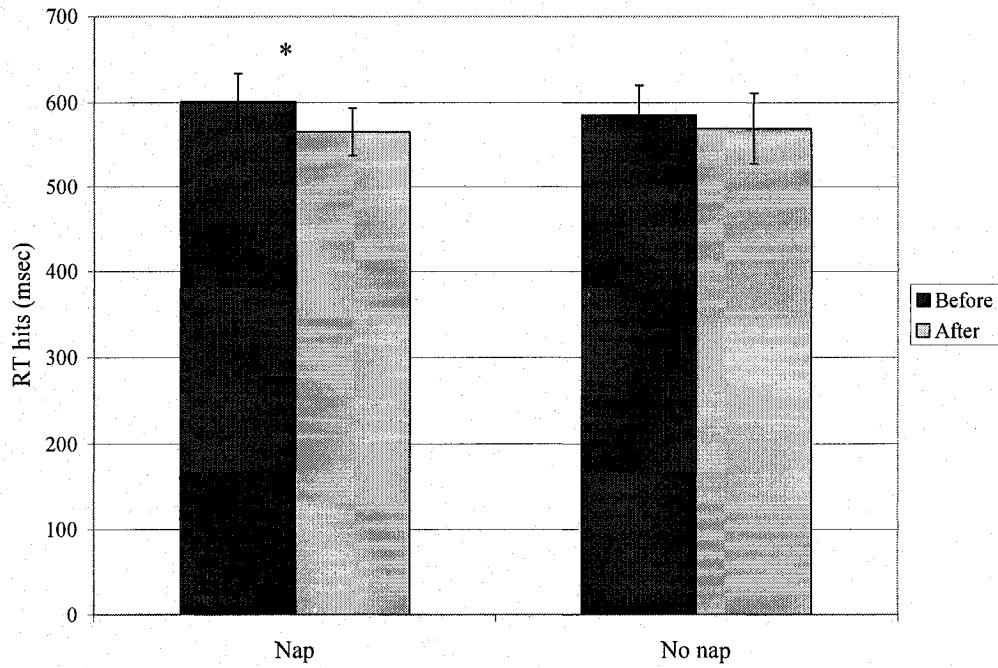
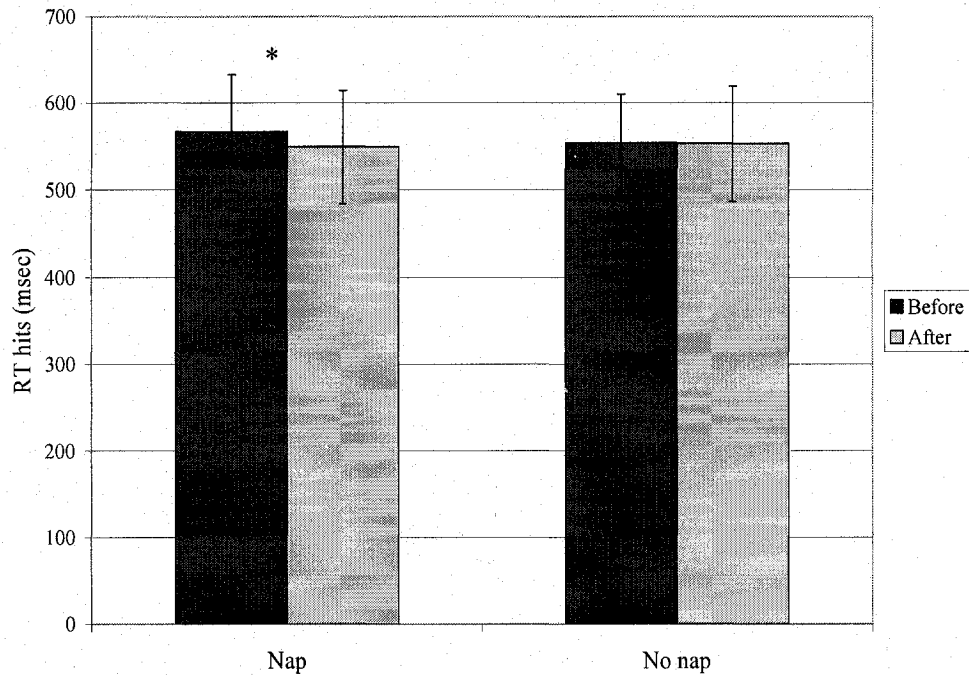


Figure 20. Mean reaction time and SD for hits on the Continuous Performance Test (CPT) and before and after the nap and no nap conditions for women with minimal symptoms.



* Significant at the .01 level.

Figure 21. Mean reaction time and SD for false alarms on the Continuous Performance Test (CPT) before and after the nap and no nap conditions for women with severe symptoms.

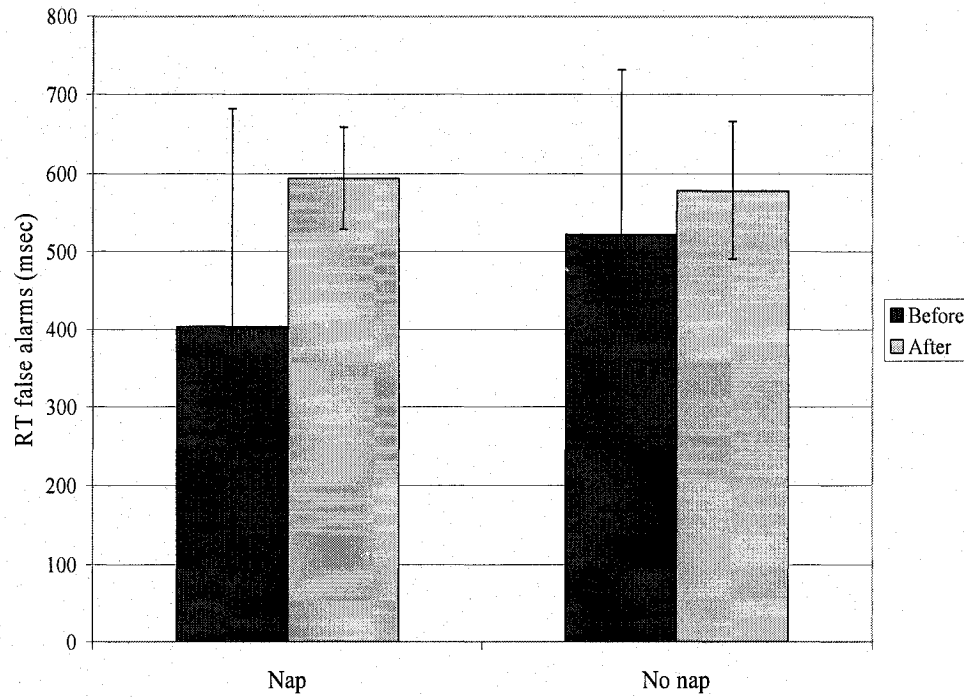


Figure 22. Mean reaction time and SD for false alarms on the Continuous Performance Test (CPT) before and after the nap and no nap conditions for women with minimal symptoms.

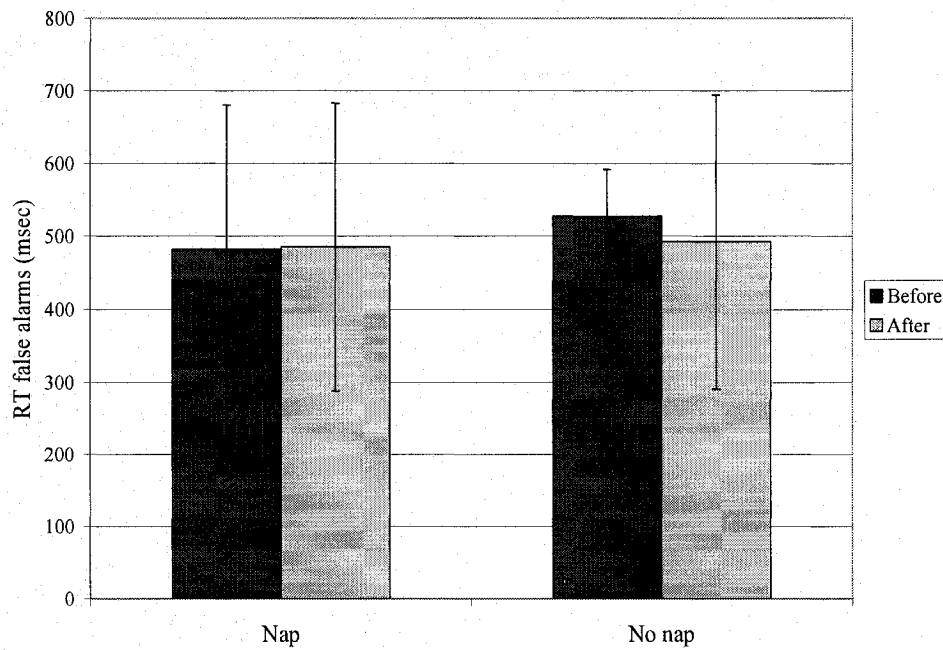


Figure 23. Mean D' value and SD on the Continuous Performance Test (CPT) before and after the nap and no nap conditions for women with severe symptoms.

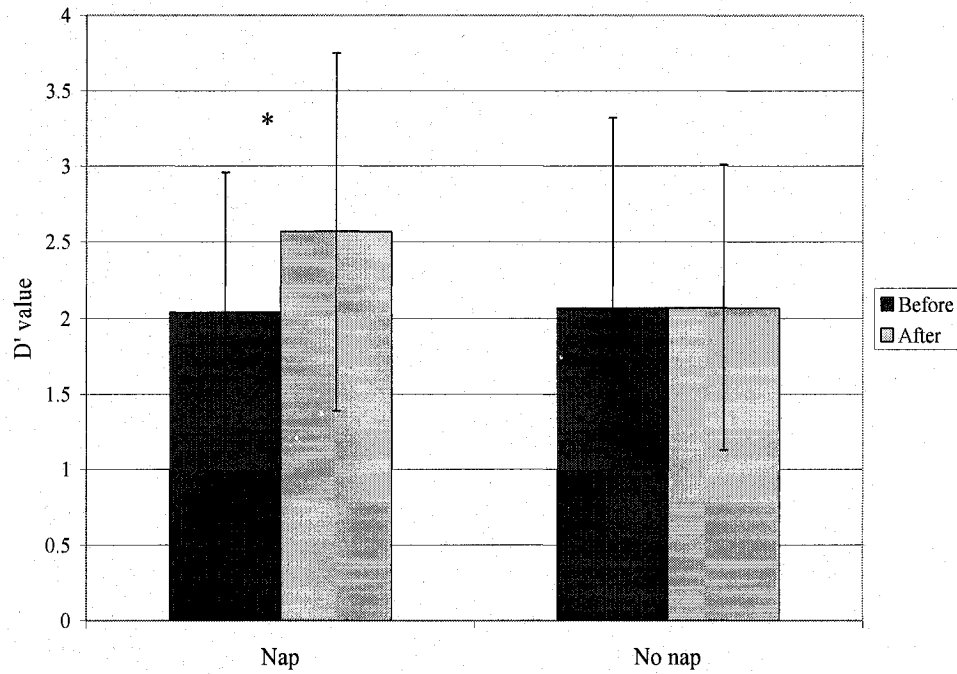
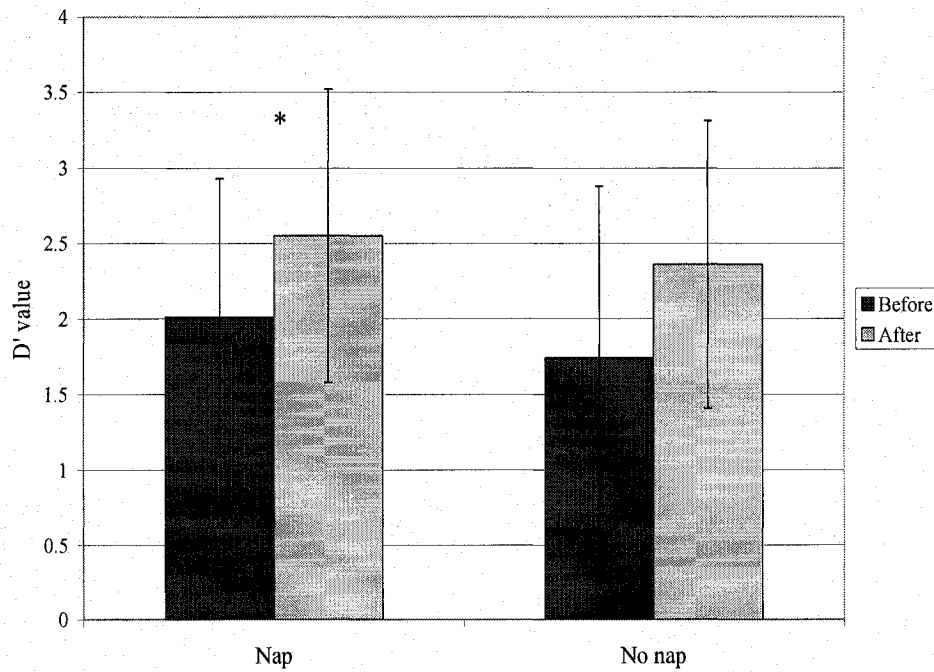


Figure 24. Mean D' value and SD on the Continuous Performance Test (CPT) before and after the nap and no nap conditions for women with minimal symptoms.



* Significant at the .001 level.

Figure 25. Mean Beta value and SD on the Continuous Performance Test (CPT) before and after the nap and no nap conditions for women with severe symptoms.

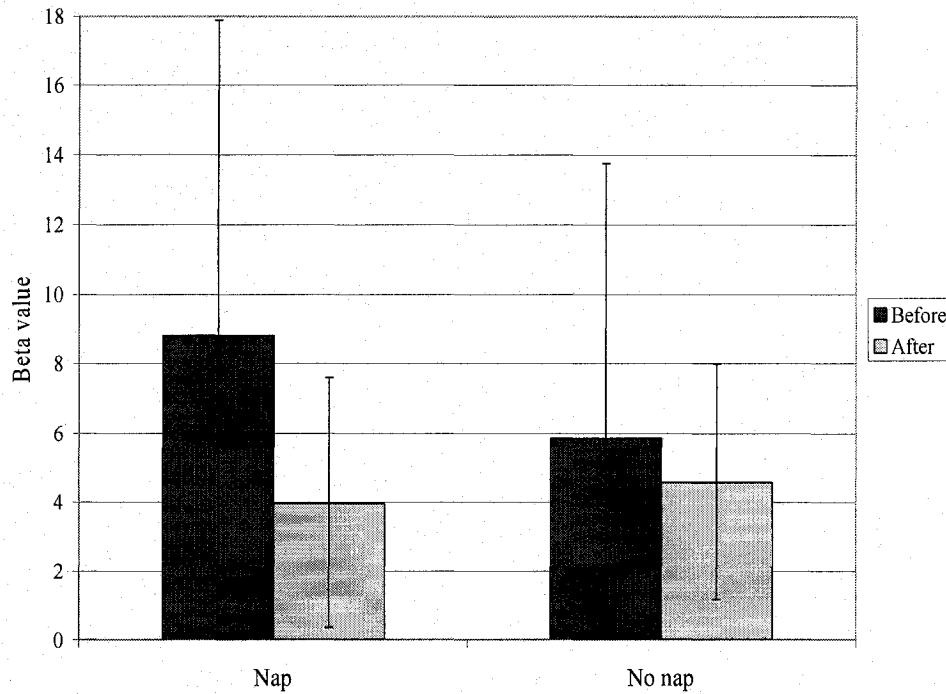
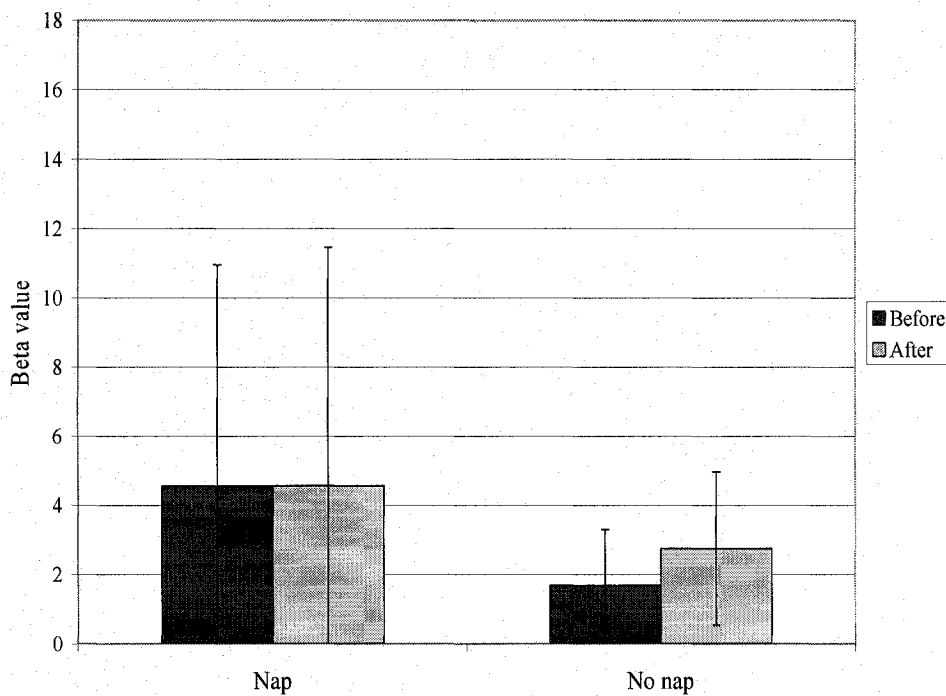


Figure 26. Mean Beta value and SD on the Continuous Performance Test (CPT) before and after the nap and no nap conditions for women with minimal symptoms.



Simple Reaction Time Test (SRTT)

The following variables of the SRTT were examined; average reaction time including all data, number of lapses (3 standard deviations above the mean), and average reaction time excluding all lapses. Results are presented in Table 5.

Nap condition

For the average reaction time including all data, no significant effect for time, $F(1,17) = 1.23, p = .28, n^2 = .07$ or group, $F(1,17) = 1.05, p = .32, n^2 = .06$, or interaction between time and group, $F(1,17) = .07, p = .80, n^2 = .004$ was found. For the number of lapses, no significant effect for time, $F(1,17) = .21, p = .65, n^2 = .01$ or group, $F(1,17) = .03, p = .86, n^2 = .002$, or interaction between time and group was found $F(1,17) = 2.61, p = .65, n^2 = .13$. For the average reaction time excluding lapses, no significant effect for time, $F(1,17) = .94, p = .35, n^2 = .05$ or group, $F(1,17) = 1.77, p = .20, n^2 = .09$, or interaction between time and group $F(1,17) = .35, p = .56, n^2 = .02$ was found.

No nap condition

For the average reaction time including all data, no significant effect for time, $F(1,16) = .06, p = .82, n^2 = .003$ or group, $F(1,16) = 2.58, p = .13, n^2 = .14$, or interaction between time and group, $F(1, 16) = 1.45, p = .25, n^2 = .08$ was found. For the number of lapses, the assumption for homogeneity of variance was not met. A logarithmic transformation was applied to the data, which rendered the variances homogeneous. No significant effect for time, $F(1, 17) = 3.30, p = .09, n^2 = .16$ or group, $F(1,17) = .21, p = .65, n^2 = .01$ was found. A significant interaction between time and group was found, $F(1,17) = 4.99, p < .05, n^2 = .23$. More specifically, compared to before the no nap condition, paired-tests revealed a

marginally significant decrease in the number of lapses after the no nap condition for women with minimal symptoms, $t(8) = 2.65, p = .03$, and no significant change in number of lapses for women with severe symptoms, $t(9) = -.32, p = .76$. For the average reaction time excluding lapses, a marginally significant effect for group was found, indicating that women with severe symptoms had a longer reaction time compared to women with minimal symptoms, $F(1, 15) = 3.66, p = .08, n^2 = .20$. No significant effect for time, $F(1, 15) = .06, p = .82, n^2 = .004$ or interaction between time and group, $F(1, 15) = .89, p = .36, n^2 = .06$ was found.

Table 5

Mean and Standard Deviation (SD) of Simple Reaction Time Test Variables Before and After the Napping and No Napping Conditions, for Women with Severe and Minimal Symptoms

	Severe		Minimal	
	Before	After	Before	After
	<i>M</i> (<i>SD</i>)	<i>n</i>	<i>M</i> (<i>SD</i>)	<i>n</i>
Nap condition				
RT with lapses (msec)	296.38 (75.11)	280.78 (44.62)	271.65 (48.58)	261.95 (27.50)
RT without lapses (msec)	286.62 (69.42)	274.47 (45.80)	255.48 (25.32)	252.56 (28.25)
Number Lapses	1.80 (.79)	1.40 (.52)	1.44 (.73)	1.67 (.71)
No nap condition				
RT with lapses (msec)	282.59 (45.82)	288.32 (67.62)	256.33 (23.02)	247.82 (19.36)
RT without lapses (msec)	260.22 (25.02)	261.92 (23.31)	243.36 (16.63)	240.52 (17.58)
Number Lapses [#]	*1.50 (.71)	*1.60 (.70)	*2.33 (1.00)	*1.44 (1.24)

*Logarithmic transformation applied to data for analyses due to heterogeneity of variances

[#] $p \leq .05$ interaction between group and phase

3.3.2 Relationship between changes in cognitive performance and nap characteristics

Multiple regressions

A series of multiple regressions were conducted to determine whether a relationship existed between the characteristics of the nap and the significant changes found in CPT scores, from before napping to 30 minutes after napping. The first predictor entered was the group variable, and the following predictors were then entered in a stepwise fashion: number of minutes in SWS, number of minutes in stage 2 sleep, sleep efficiency, latency to SWS and latency to stage 2 sleep. The criteria were the changes in the different measures of the CPT (hits, false alarms, D' , and Beta) from before napping to after napping. The assumption of linearity was tested for all significant predictors. Only the results for significant nap characteristic predictors are reported. See Table 6 for correlations between predictors and criteria.

Results indicated that the severity of symptoms did not account for a significant amount of the variability in the change of the number of hits after napping, $R^2 = .001$, $F(1, 11) = .02$, $p = .90$. A second analysis was conducted to evaluate whether nap characteristics predicted the change in the number of hits after napping over and above the severity of symptoms. Sleep efficiency accounted for a significant proportion of the number of hits variance, after controlling for the effects of symptom severity, $R^2 \text{ change} = .88$, $F(1, 10) = 75.09$, $p < .001$. These results suggest that women who had greater sleep efficiencies had a greater number of hits after napping.

Results also indicated that the severity of symptoms did not account for a significant amount of the variability in the change of the *Beta* value after napping, $R^2 = .19$, $F(1, 8) = 1.87$, $p = .21$. A second analysis was conducted to evaluate whether nap characteristics predicted the change in *Beta* value over and above the severity of symptoms. The number of

minutes in stage 2 sleep accounted for a significant proportion of the *Beta* value variance, after controlling for the effects of symptoms severity, R^2 change = .37, $F(1, 7) = 5.98$, $p < .05$. These results suggest that women who had a greater number of minutes in stage 2 sleep had less of a change in the *Beta* value after napping.

Table 6

Correlations and Alpha Levels (p) Between Changes in Continuous Performance Test (CPT) Performance and Nap Characteristics for Women with Severe and Minimal Symptoms

	Group	Minutes SWS	Minutes stage 2	Efficiency	Latency SWS	Latency stage 2
# Hits	-.04 (.45)	.68 (.006)*	-.06 (.42)	.94 (.00)*	-.19 (.28)	-.44 (.07)
RT Hits	-.05 (.45)	.23 (.26)	-.30 (.20)	-.16 (.33)	.58 (.04)*	.22 (.27)
RT False	.26 (.24)	-.32 (.19)	.45 (.10)	-.04 (.46)	-.32 (.19)	-.43 (.11)
D'	-.25 (.24)	-.21 (.28)	.26 (.23)	.23 (.26)	-.14 (.35)	.10 (.40)
<i>Beta</i>	.44 (.11)	.38 (.14)	-.61 (.03)	-.15 (.34)	.01 (.49)	.44 (.10)

* Significant at the .05 level

4.0 Prediction 3: Effects of Napping on Subsequent Nocturnal Sleep

A mid-afternoon nap, taken approximately 12 hours after the mid-point of nocturnal bedtime and lasting a maximum of 30 minutes, will not negatively affect subsequent sleeping patterns.

Potential differences between the nocturnal sleep characteristics of the nap and no nap conditions among both groups of women were examined using paired t-tests. Results are

presented in Table 7. The following sleep characteristics were studied: SOL, percentages of stage 1 sleep, stage 2 sleep, SWS and REM sleep, latency to stage 1 sleep, stage 2 sleep, SWS and REM sleep, number of awakenings, sleep efficiency, and number of REM periods. Since both groups of women were analyzed separately, the Bonferonni correction was applied to the data and the alpha level was adjusted to .025. No significant differences were found for any of the characteristics for either group of women.

Table 7

Paired t-tests Results from Comparison of Nocturnal Sleep Characteristics Between Nap and No Nap Conditions for Women with Severe and Minimal Premenstrual Symptoms

Characteristic	Severe			Minimum		
	<i>t</i>	<i>p</i>	<i>df</i>	<i>t</i>	<i>P</i>	<i>df</i>
Sleep onset latency	.07	.95	8	1.01	.34	7
% Stage 1	.72	.49	9	.54	.61	8
% Stage 2	-.38	.71	9	-.27	.79	8
% SWS	-.4	.70	9	-.26	.80	8
% REM	1.43	.19	9	.19	.85	8
Sleep Efficiency	1.13	.30	9	.63	.55	8
# Awakenings	-.56	.59	9	-.39	.71	8
Latency stage 2	-1.30	.23	9	-.13	.90	8
Latency SWS	.49	.64	9	-.85	.42	8
Latency REM	1.06	.32	9	-1.07	.32	8
# REM periods	-1.15	.28	9	.00	1.00	8

5.0 Summary of Results

In summary, the hypothesis that women with more severe emotional/behavioral premenstrual symptoms have more daytime sleepiness and less alertness than women with minimal symptoms during the late-luteal phase of the cycle was confirmed.

Nocturnal sleep was found to be more disturbed during the late-luteal phase of the cycle compared to the follicular phase for both groups of women, as evidenced by a decreased amount of SWS (%) and an increased amount of stage 2 sleep (%) (both nap and no nap conditions). As well, a lower percentage of REM sleep and a shorter latency to REM sleep was found in the late-luteal phase (no nap condition). Both groups of women had a significantly higher daytime and nocturnal mean and maximum temperature during the late-luteal phase compared to the follicular phase of the cycle. Women with severe symptoms had a significantly higher overall mean nocturnal temperature compared to women with minimal symptoms.

No significant differences in nap characteristics were found between women with severe and minimal symptoms. However, two women from the severe symptoms entered REM sleep while none from the minimal symptoms group did. Compared to before napping, sleepiness decreased 30 minutes, 2 hours, 4 hours, and 6 hours after napping and alertness increased 30 minutes, 2 hours, and 4 hours after napping, with no significant difference between the two groups. No significant decrease in sleepiness or increase in alertness was found when participants did not take a nap. Improvement in sleepiness and alertness 4 hours after napping was found to be significantly related to shorter SWS latencies during napping.

In addition, compared to before napping, intensity of negative mood decreased significantly 30 minutes, 2 hours, and 4 hours after napping, for both groups of women. The decrease at 30 minutes was found to be significant for women with severe symptoms, while

it was only marginally significant for women with minimal symptoms. As well, compared to before napping, intensity of positive mood increased significantly 30 minutes after napping. When participants did not take a nap, no significant change was noted in intensity of negative mood, and intensity of positive mood decreased significantly 2 hours after the no nap condition and before nocturnal bedtime. Changes in mood were found to be unrelated to nap characteristics.

It was also found that cognitive performance, as measured by the Cognitive Performance Test, improved after napping compared to before napping as evidenced by a significant increase in the total number of hits and D' value, a significant decrease in reaction time for hits, and an unchanged $Beta$ value, with no significant differences between the two groups. The increase in the number of hits was found to be related to greater nap sleep efficiencies, and the stability of $Beta$ value was found to be related to a greater amount of stage 2 sleep. When participants did not take a nap, the only improvement in performance found was a significant decrease in the number of false alarms and a stable $Beta$ value among both groups. Napping did not result in any change in performance on the Simple Reaction Time Test.

Napping did not affect subsequent nocturnal sleep, as evidenced by no significant differences between the nap and no nap condition in nocturnal sleep characteristics.

Discussion

1.0 Prediction 1: Daytime Sleepiness

The prediction that women with severe emotional/behavioural premenstrual symptoms have more daytime sleepiness and less alertness than women with minimal symptoms during the late-luteal phase of the cycle was confirmed.

These results are consistent with those obtained by Manber and Bootzin (1997) and Mauri et al. (1988). It is postulated that such an increase in sleepiness among women with more severe premenstrual symptoms is not related to a more disturbed sleeping pattern during the late-luteal phase (Manber & Bootzin, 1997; Shibui et al., 2000). In fact, despite finding a more disturbed sleeping pattern during the luteal phase compared to the follicular phase, Manber and Bootzin (1997) and Parry et al. (1999) failed to find a relationship between the severity of symptoms and sleep disturbance, as was also noted in the present study.

The finding that women with severe symptoms had more daytime sleepiness than women with minimal symptoms during the late-luteal phase, despite both groups having a more disturbed sleeping pattern during the late-luteal phase compared to the follicular phase, offers support for the notion that the increase in daytime sleepiness reflects a need for more sleep at this time of the cycle for women with more severe premenstrual symptoms (Manber & Bootzin, 1997). The finding that women with severe and minimal symptoms only differed in their level of sleepiness and alertness during the late-luteal phase and not during the follicular phase, further suggests that this sleep need is indeed phase specific. These observations are also consistent with the hypothesis that women with more severe symptoms have more difficulty dealing with the effects of disrupted sleep during the late-luteal phase of the cycle (Manber & Bootzin, 1997). Although a disruption in sleep during the late-luteal

phase was found among both groups of women, only women with severe symptoms had a higher level of sleepiness and a lower level of alertness during the late-luteal phase compared to the follicular phase, suggesting that it is more difficult for women with severe symptoms to tolerate the sleep disturbance that occurs during the late-luteal phase. However, the fact that all women, with the exception of one participant from the minimal symptoms group, fell asleep during the napping period, and that sleep onset latency (SOL) was quite short for both groups (5.74 minutes for the severe symptoms group and 7.03 minutes for the minimal symptoms group), suggests that a need for sleep is present for both groups of women during the late-luteal phase, although it is more significant for women with more severe symptoms. We cannot tell however if this is the case during the other phases of the menstrual cycle, as napping was only introduced in the late-luteal phase in this study.

It has been suggested that “variations in sleep duration may reflect differences in either the sleep homeostatic process or the circadian process” (Klerman & Dijk, 2005, p. 1253). More specifically, it is postulated that “these variations may reflect differences in the rate of build-up for sleep “need” during wakefulness, in the rate of dissipation of sleep “need” during sleep, in the amount of sleep people select to take, or modulation by circadian, environmental, behavioural or social factors” (Klerman & Dijk, 2005, p. 1253). Since studies have found that sleep duration is longer but more disturbed during the late-luteal phase compared to the follicular phase (Patakai et al., 1974), it would be interesting to examine whether, if given the opportunity, women with severe symptoms would have slept for a longer period of time during the late-luteal phase compared to women with minimal symptoms, as well as compared to the follicular phase of the cycle. Since the duration of nocturnal sleep was kept constant among both groups of women during both phases of the cycle in the present study, it is only possible to speculate that women with severe symptoms

would have required more sleep during the late-luteal phase, however conclusions on this matter cannot be drawn. The effects of prolonging sleep during the late-luteal phase on subsequent nocturnal sleep, however, are not known and should also be examined.

Finally, the postulation that the increase in daytime sleepiness is related to biological changes during the menstrual cycle (Manber & Bootzin, 1997) may also be worth consideration, although results from the present study suggest that it is not attributable to changes in core body temperature. Past studies have suggested that higher body temperature during the late-luteal phase of the cycle is related to a poorer sleep quality during this phase (Monroe, 1967), which is consistent with the results from the current study, as both groups of women had a higher temperature during the late-luteal phase compared to the follicular phase. However, despite the fact that women with severe symptoms had a higher overall nocturnal body temperature (follicular and late-luteal phase) compared to women with minimal symptoms, a higher level of sleepiness and lower level of alertness was only found during the late-luteal phase for these women, and not during the follicular phase. This suggests that biological changes, other than or in addition to those related to core body temperature, may play a role in the increased daytime sleepiness found among women with severe symptoms during the late-luteal phase. Further analyses of the data could determine whether other measures of body temperature such as phase, amplitude, and mesor are related to daytime sleepiness and nocturnal sleep during the follicular and late-luteal phases of the cycle.

2.0 Prediction 2: Effects of Napping on Symptoms

2.1 Effects of Napping on Sleepiness and Alertness

The prediction that napping would decrease sleepiness and increase alertness in the hours following napping for both groups of women during the late-luteal phase of the cycle was confirmed. However, the prediction that napping would decrease sleepiness and increase alertness to a larger extent for women with severe emotional/behavioural premenstrual symptoms was not confirmed, as both groups of women benefited equally from napping.

Such an improvement in sleepiness and alertness was not found when participants did not nap (no nap condition). In fact, it appears that napping not only improved sleepiness and alertness among both groups of women, but also prevented further deterioration, as sleepiness and alertness were actually found to be worse before nocturnal sleep compared to before the no nap condition, which was not the case when a nap was taken. The results of the present study are consistent with many studies in this area showing that a short early to mid-afternoon nap can improve sleepiness/alertness, even when nocturnal sleep duration of the previous night is adequate (Hayashi et al., 1999; Hayashi et al., 2004; Tamaki et al., 2000), and that napping is more beneficial than simply taking a break (Hayashi et al., 2004; Tamaki et al., 2000).

2.2 Effects of Napping on Mood

The prediction that napping would improve mood, as indicated by a decrease in the intensity of negative mood and/or an increase in the intensity of positive mood in the hours following napping during the late-luteal phase of their cycle was confirmed. In addition, the prediction that women with severe emotional/behavioural symptoms would have a greater improvement in mood than women with minimal symptoms was partially confirmed. The

decrease in the intensity of negative mood, from before to 30 minutes after napping, was found to be significant for women with severe symptoms, while it was only marginally significant for women with minimal symptoms. Again, we note the importance of napping not only for the improvement of symptoms, but also for the prevention of an exacerbation of symptoms, as not only was no improvement noted in the intensity of negative and positive mood when a nap was not taken, but positive mood actually worsened at the 2-hour point as well as before nocturnal bedtime when no nap was taken.

The beneficial effects of napping on mood when nocturnal sleep is not disturbed, observed here, are consistent with those obtained by many studies in this area (Daiss et al., 1986; Luo & Inoué, 2000; Taub et al., 1976; Taub, 1979). The finding that the positive mood improvement was not maintained as long as the negative mood improvement is similar to results obtained in a study by Goodale et al. (1990), who found that although both physical and negative emotional premenstrual symptoms (i.e. lability, impulsivity, low mood, anxiety, anger) improved after 3 months of relaxation compared to a control condition, well-being (i.e. joy and activity) was not increased. These researchers suggest that negative symptoms may respond better to such an intervention than positive symptoms. This also seems to be the case with the napping intervention introduced in the present study. It is plausible that the increase in negative mood that occurs in the late-luteal phase is more intense than the decrease in positive mood. This makes it more probable for interventions, such as napping, to bring improvement to negative symptoms. In fact, in the current study, the two groups of women only differed in the overall intensity of negative mood, with no difference in the overall intensity of positive mood. More specifically, before napping, a difference of 8.31 for the intensity of negative mood on the Nowlis Mood Adjective Checklist (Nowlis MACL) separated the severe and minimal group, whereas only a difference of 1.45 was found

between the two groups for the intensity of positive mood. This suggests that a greater opportunity was present for the intensity of negative mood to be improved, especially for women with severe symptoms. This is consistent with the significant interaction found 30 minutes after napping, with women with severe symptoms having more of a decrease in the intensity of negative mood compared to women with minimal symptoms.

2.3 Effects of Napping on Cognitive Performance

The prediction that napping would improve cognitive performance among women during the late-luteal phase of the cycle was partially confirmed. Although some improvements were noted on the Cognitive Performance Test (CPT) after napping, performance on the Simple Reaction Time Test (SRTT) did not improve. The prediction that women with severe emotional/behavioural symptoms would have a greater improvement in cognitive performance after napping than women with minimal symptoms was not confirmed.

The finding that a short mid-afternoon nap improves or prevents deterioration of some aspects of cognitive performance is consistent with other studies in this area (Brooks & Lack, 2006; Hayashi et al., 1999; Hayashi et al., 2004; Horne & Reyner, 1996). Although no improvement with napping was found on the SRTT, the notion that napping prevents the worsening of symptoms is again detected, as a significant interaction was found in the no nap condition (the number of lapses did not change significantly for women with severe symptoms, while it marginally significantly decreased for women with minimal symptoms), while this was not noted in the nap condition.

Although napping resulted in an improvement in cognitive performance (i.e. number of hits, total reaction time for hits, an increase in D' value, and a stable $Beta$ value) among

both groups, some improvements were also detected when participants did not take a nap (i.e. decrease in number of false alarms and a stable *Beta* value). It is therefore possible that some cognitive variables are more susceptible to change, and therefore responded more significantly to the napping intervention than others. From the results of the present study, it appears that variables that are mainly related to attention and cognitive processing were more responsive to napping than those related to impulsivity.

Since evidence indicates that mood and cognitive performance tend to be related (Mohan, 1976), it is suggested that a positive change in mood among women with premenstrual tension during the late-luteal phase may lead to an improvement in cognitive performance (Mohan & Jogi, 1989). Therefore, although it is possible that napping directly improved cognitive performance in this study, it may also be that napping improved mood, as is consistent with the results of this study, which then led to an improvement in cognitive performance.

The fact that no improvement was found on the SRTT may be attributable to a number of factors. Studies have suggested that the duration and complexity of the task may be important predictors of performance (Purnell, Fever, & Herbison, 2002). More specifically, impairment in cognitive performance is more easily detected by longer vigilance tasks compared to shorter simple reaction time tasks (Purnell et al., 2002). It is therefore possible that a similar phenomenon took place in this study. The SRTT, being short and requiring less attention, may not have been sensitive enough to show changes in performance, compared to the more complex and longer CPT. And, just as simple reaction time tests have been found to not be sensitive enough to detect changes in performance between menstrual cycle phases (Sommer, 1973), they may not be sensitive enough to detect changes from before to after napping. Future research in this area should consider using

cognitive tasks that are more demanding or more likely to be encountered in everyday life, such as driving in traffic or following directions.

As mentioned previously, a relationship between mood and cognitive performance has been found (Mohan, 1976). It is suggested that the magnitude of mood change plays an important role in the relationship. For example, studies have found that small increases in anxiety and depression are not substantial enough to impair performance on cognitive tasks during the late-luteal phase of the cycle (Golub, 1976). It is therefore possible that the improvement in the intensity of negative and positive mood that was found among both groups of women after napping was not significant enough to improve performance on short and simple tasks such as the SRTT, but was substantial enough to increase performance on longer and more complex tasks such as the CPT.

3.0 Prediction 3: Effects of Napping on Subsequent Nocturnal Sleep

The prediction that a mid-afternoon nap, taken approximately 12 hours after the midpoint of nocturnal bedtime and lasting a maximum of 30 minutes, would not negatively affect subsequent sleeping patterns was confirmed. This finding is consistent with that of other studies in this area (Aber & Webb, 1986; Campbell et al., 2005; Tanaka et al., 2001). Since the napping period in this study was short, participants only spent, on average, approximately 8 minutes in SWS and 1 minute in REM sleep (only 2 participants entered this stage). It is therefore evident that sleep during napping was not long enough or deep enough to affect the content and characteristics of subsequent nocturnal sleep.

4.0 Napping as an Intervention for Premenstrual Symptoms

It is therefore evident that napping can improve alertness, sleepiness, positive and negative mood, and some aspects of cognitive performance among women with severe and minimal emotional/behavioural premenstrual symptoms, without having negative effects on subsequent nocturnal sleep. And, as discussed previously, napping can also help prevent further deterioration of some of these symptoms.

Results from the present study also suggest that certain nap characteristics are related to some of these improvements. For example, the increase in the number of hits on the CPT after napping was related to greater sleep efficiencies during napping. In addition, the improvement in sleepiness and alertness 4 hours after napping was related to shorter Slow Wave Sleep (SWS) latencies during the naps. Although this improvement was not found to be related to the amount of SWS, this finding further supports the notion that SWS plays a prominent role in the restoration of sleepiness and alertness, most notably long-term restoration in the present study. This is also in agreement with the recent postulation of Brooks and Lack (2006), suggesting that the onset or first appearance of delta-wave activity during napping may be an important contributor to the improvement in alertness and performance. In their study, it was found that greater improvements in napping corresponded with an increase in the number of participants that achieved delta onset during the nap, and that longer naps containing more SWS than the shorter naps introduced in their study did not seem to be related to greater improvements in alertness and performance. The possibility that those who benefited most from napping in the current study were most affected by the changes occurring during the late-luteal phase (although not necessarily scoring highest on the Premenstrual Tension Syndrome Self-Rating Scale), and were in greater need of deep sleep, and hence had shorter latencies to SWS, is also worth consideration. It is possible that

these individuals would have had a greater amount of SWS during their naps, if all participants had been given the opportunity to nap for a longer period of time.

The current study also found that the stability of the *Beta* value on the CPT was related to a greater amount (minutes) of stage 2 sleep during napping. This later finding is consistent with results obtained by Campbell et al. (2005), who found that accuracy on a logical reasoning task increased as the amount of stage 2 sleep increased. It is also consistent with studies finding no significant relationship between the amount of SWS and improvement in cognitive performance (Stampi et al., 1990), and that naps without SWS can still lead to improvements in cognitive performance (Gillberg et al., 1996; Hayashi et al., 1999). Although this finding seems contradictory to the findings related to SWS noted above, the limited napping duration that was enforced in this study does not permit us to determine whether greater amounts of SWS could have led to greater improvements in performance. Since a shorter nap, such as the one introduced in this study, is less likely to contain SWS than a longer nap (Tassi & Muzet, 2000), it is possible that a significant relationship between the amount of SWS and improvement in performance would have emerged if participants had been given the opportunity to nap for a longer duration, and thus possibly had more SWS in their naps. In addition, further analyses of the data could measure Slow Wave Activity (SWA) by spectral analysis of delta activity, as this may prove to be a more sensitive measure of this phenomenon than SWS. It is also possible that the amount or the latency of SWS is critical for the improvement of only certain variables, and less important for that of others.

The benefits of napping on sleepiness, alertness, mood, and cognitive performance among women with severe premenstrual symptoms are interesting when compared to other interventions. For example, studies have found that decreasing the amount of sleep instead of

increasing it, as suggested in this study with a nap, results in an improvement in premenstrual symptoms (Parry et al., 1995; Parry & Wehr, 1987). More specifically, Parry and Wehr (1987) found that total and partial sleep deprivation among women with premenstrual depression improved affective symptoms. It is suggested that sleep deprivation, among women with PMDD, “may be mediated in part, by correcting underlying circadian processes affecting sleep regulation” (Parry et al., 1999, p. 142), which subsequently leads to an improvement in recovery sleep as well as mood (Parry et al., 1999). This is important, as the mood disturbance found among individuals with PMDD is thought to be related to internal and external desynchronization of biological rhythms (Parry, Udell et al., 1997). It is suggested that depressed individuals may “need stronger zeitgebers in terms of light, sleep, or social cues to help resynchronize their circadian rhythms and thereby decrease their vulnerability to associated mood disturbances” (Parry, Udell et al., 1997, p.454). Other studies have found that women with more severe symptoms (PMDD) display a phase delay or no change in their circadian rhythm in response to morning light compared to asymptomatic women who tend to display a phase advance shift (Parry, Udell et al., 1997). It is suggested that this is indicative of a “disturbance in the underlying circadian clock mechanism that regulates normal adaptive synchronization of the circadian clock internally and with the environment” (Parry & Newton, 2001, p.103), and that “a most important timing function appears to be seriously impaired in PMDD patients” (Parry & Newton, 2001, p.103). The circadian rhythm of women with PMS may therefore be abnormally phase advanced compared to asymptomatic women, and treatments such as bright light therapy work by delaying the circadian rhythms among these women (Parry, 1993). Although only the immediate effects of napping on premenstrual symptoms were examined in the present study, long-term effects may be also present which, similar to sleep deprivation and bright

light therapy, could potentially be attributed to the resynchronization of the circadian rhythm of women with severe emotional/behavioural premenstrual symptoms. However, this postulation remains to be studied.

Studies have also noted that relaxation tends to decrease the psychophysiological response to stress, which in turn reduces the intensity of premenstrual symptoms (Goodale et al. 1990). In fact, Oleson and Flocco (1993) found that 30 minutes of reflexology once a week created a feeling a relaxation among women with premenstrual distress. Many of the women receiving this treatment actually fell asleep during the treatment sessions, and reported having more energy the following day. Similarly, in a survey conducted by Pullon, Reinken, and Sparrow (1989) it was found that massage therapy was the only effective self-help treatment for reducing premenstrual symptoms. It is therefore possible that napping, a form of rest and relaxation, helps improve sleepiness, alertness, mood, and some aspects of cognitive performance by relieving stress. Since it is postulated that stress and the environment are related to premenstrual symptoms (Dennerstein et al., 1984), and that PMS may only be triggered but not caused by biological factors (Rubinow & Schmidt, 1992), the positive effect of napping on symptoms may result from targeting the level of stress of these women during the late-luteal phase of the cycle. This may also be consistent with some of the cognitive performance improvements noted when a nap was not taken, as the quiet activity performed in the no nap condition instead of napping may have served to relieve stress for women from either group.

5.0 Effects of Napping on Severe and Minimal Premenstrual Symptoms

The finding that napping is beneficial for improving sleepiness, alertness, positive and negative mood, and some aspects of cognitive performance for both women with severe

and minimal premenstrual symptoms, with only a slightly greater improvement among women with severe symptoms, may be attributable to several factors. Given the finding that nocturnal sleep was more disturbed during the late-luteal phase compared to the follicular phase for both groups of women, with no differences between them, it is possible that both groups of women were experiencing the effects of sleep disturbance, and therefore responded similarly to the napping intervention. The fact that all women, with the exception of one participant with minimal symptoms, fell asleep during the napping period, and that no differences were found between the two groups in their nap characteristics including SOL, is consistent with this notion that both groups of women were experiencing some deterioration during the late-luteal phase. The possibility that the 12-hour rhythm for SWS, noted by Broughton (1975), played a role in this phenomenon is also worth consideration, as napping was intentionally scheduled approximately 12 hours after the mid-point of habitual nocturnal sleep time and at a time when alertness was thought to be low for both groups of women. It would be interesting to examine the characteristics of napping as well as its effects on sleepiness, alertness, mood, and cognitive performance at a time when a greater difference exists in the level of alertness between women with severe and minimal symptoms, perhaps late afternoon or early evening. In such a case, it is possible that women with severe symptoms would have had a shorter SOL and more SWS during napping compared to women with minimal symptoms, and that the difference in the level of improvement of symptoms with napping would have been greater between the two groups of women than that noted in the present study. However, the effects of a later nap on subsequent nocturnal sleep in this population are unknown.

Another possible explanation for the lack of difference in response to napping between women with severe and minimal symptoms is that, as with many studies in the area

of sleep research, the sample size was too small to detect a difference. This resulted in low statistical power for many of the analyses, which rendered it more difficult to obtain significance. This was especially true for interactions between the groups and time periods, which was in fact a large focus of the present study, as differences in the response to napping between women with severe and minimal symptoms were being examined. In fact, the one significant interaction related to improvement with napping found in this study indeed had the highest power value compared to all other interactions tested. It is therefore possible that other differences between the two groups were present, but not detected because of the limitation of the sample size, as has been suggested by other researchers in this area (Chuong et al., 1997).

Another potential explanation is that the two groups of women did not differ enough in the severity of their symptoms. While the women with severe symptoms in the present study were found to have significantly higher levels of daytime sleepiness, more intense negative mood during the nap and no nap late-luteal conditions, as well as a marginally higher reaction times during the no nap late-luteal condition compared to women with minimal symptoms, it is possible that such differences were not strong enough to differentiate the two groups, or that the lack of differences on other variables such as positive mood and other cognitive variables played a role. It has been found that women who seek treatment for their premenstrual symptoms tend to have more severe symptoms than those who do not seek treatment (Hylan et al., 1999; Johnson, McChesney, & Bean, 1988; Mauri et al., 1988). In this study, only one participant in the severe group was known to have consulted a physician for her premenstrual symptoms, and had taken antidepressant medication for them (which was discontinued for months prior to the beginning of the study). Although an attempt was made to sample participants from a premenstrual clinic, this did not

prove to be successful. However, studies suggest that women who seek treatment for PMS tend to be in their thirties (Gold & Severino, 1994), and since the mean age of the women with severe symptoms in the present study was 26.7 years, the possibility that these women would have consulted for the severity of their symptoms in the future cannot be rejected. In addition, the mean score on the Premenstrual Tension Self-Rating Scale (PMTS Self-Rating Scale) of women with severe symptoms was 20.98, while it was 1.94 for women with minimal symptoms, which seems to be quite a large difference in the severity of symptoms. It would therefore be interesting to repeat the study with a group of women who are currently seeking, but not actively engaged in, treatment for PMS.

Finally, the possibility that different types of PMS exist is also worth consideration. Since PMS is not characterized by a standard set of symptoms, but instead a variety of combinations of symptoms (Abplanalp, 1983), it is postulated that PMS may in fact be characterized by different subtypes or that several different premenstrual syndromes exist (Blumenthal & Nadelson, 1988). For example, Abraham (1980) categorized PMS into four subgroups which comprise of; Type A (anxiety, irritability, mood swings, and nervous tension), Type B (hyperhydration, weight gain, swelling of extremities, breast tenderness and abdominal bloating), Type C (cravings, headache, increased appetite, palpitations, fatigue, dizziness or fainting) and Type D (depression, forgetfulness, crying, confusion and insomnia). It is suggested that a woman may belong to one or more of these categories (Abraham, 1980), and that a trigger may result in the development of different symptoms depending on the woman's susceptibility (Halbreich & Monacelli, 2004). Women with different subtypes of PMS may respond differently to different treatments (Blumenthal & Nadelson, 1988), and one treatment may not be effective for everyone (Abplanalp, 1985). It is postulated that other studies examining the effects of a certain treatment on PMS

symptoms may have failed to find a difference in response between symptomatic and asymptomatic women because the samples were too heterogeneous (Mitchell et al., 1991). It is therefore possible that the women with severe symptoms included in the present study were experiencing different combinations of premenstrual symptoms, and some may have responded differently than others to the napping intervention. By examining the questions endorsed on the PMTS Self-Rating Scale, it appears that the women from this study were mostly suffering from symptoms related to the 'Type D' category described by Abraham (1980) such as depression, forgetfulness, crying, and confusion (4 out of 10 participants) or the 'Type A' category (3 out of 10 participants), characterized by feelings of irritability, mood swings and nervous tension, or had symptoms that were equally consistent with both 'Type A' and 'Type D' categories (3 out of 10 participants). It is important to note, however, that the present study focused on the emotional and behavioural symptoms of PMS, and not on the physical symptoms. Since participants with severe physical symptoms were excluded from the study, it is not surprising that the symptoms experienced by these women were more consistent with these two categories. In addition, since the PMTS Self-Rating Scale places more emphasis on the emotional and behavioural symptoms of PMS and less on the physical symptoms, a greater number of questions related to Type A and D categories are included compared to questions related to Type B and C categories. Future research could examine the effects of napping on the different types or subtypes of PMS, once such a hypothesis has been further validated.

6.0 Limitations and Future Research

Although we submit that this study presents with many strengths, certain limitations exist. Firstly, due to recommendation from the ethics committee and practical consideration,

prediction of ovulation and onset of menstruation was done by having the participants take their oral temperature on a daily basis, instead of using blood hormone levels. Because this method tends to be a less accurate, the nap and no nap conditions did not always both correspond with the late-luteal phase of the cycle, which resulted in having some participants return to the laboratory in the following months to complete or redo a portion of the experiment. Therefore, for some of the participants, the nap and no nap conditions were sometimes separated by a month or a few months. The sleep characteristics, daytime activity, stress levels, severity of symptoms or even combination of symptoms of the participants could have varied from month to month (Chuong et al., 1997). The possibility that this affected the results of the current study must therefore be considered. Future studies in this area could be improved by using hormone blood levels in order to increase the likelihood of accurately predicting the timing of late-luteal phase, and thus avoiding the possible contamination of the passage of time on symptoms and response to the intervention.

Although evidence indicating that some rating scales are better at diagnosing PMS than others is lacking, it is suggested that a rating scale be used instead of a yes/no questionnaire (Freeman, 2003). Therefore, including a questionnaire with a rating scale in this study instead of the yes/no format of the PMTS Self-Rating Scale may have been more effective at distinguishing between women with severe and minimal premenstrual symptoms. In addition, it is important to note that the PMTS Self-Rating Scale has been validated with PMS symptoms and severity, but not with PMDD (Freeman, 2003). Since no diagnostic interview was conducted in this study, it not known whether these women met criteria for PMS or PMDD, but simply that they were experiencing severe emotional/behavioural premenstrual symptoms. Although it is postulated that women with PMS or PMDD would have responded in a similar fashion and perhaps even benefited more from napping, the

results of the current study cannot be generalized to these groups without further investigation. Similarly, although an attempt was made to exclude participants with a history of or present psychiatric or psychological disorders by using self-report questionnaires, it cannot be certain that all such individuals were excluded, since diagnostic interviews were not conducted in this study. Future studies could therefore aim to include a diagnostic interview as part of the screening process, and include women who meet criteria for PMS and/or PMDD.

In the present study, napping was imposed at a certain time (mid-afternoon) and in a certain location (laboratory environment). It would be interesting to examine the effects napping in the participants' natural home environment as well as at a time of day of their choice, perhaps when they feel that their symptoms are most severe. In addition, some studies have found that 'prophylactic napping', which consists of napping before a predicted sleep debt, may in fact be better at counteracting the effects of sleep loss than napping after sleep debt (Dinges et al., 1987). It would therefore be interesting to study the effects of prophylactic napping among women with severe emotional/behavioural premenstrual symptoms, such that naps are taken in the days or week prior to the usual onset of premenstrual symptoms. Could this intervention lead to a larger reduction in symptoms among these women? Could it possibly prevent symptoms from occurring or worsening?

It may also be valuable to compare the effects of napping on individuals who take naps on a regular basis to those who do not usually take naps, as studies have suggested that non nappers do not benefit as much from napping (Dinges, Orne, Orne, & Evans, 1981; Evans et al., 1977) since this may disturb their biological sleep/wake rhythm (Taub, 1977). However, others find that non nappers can benefit from napping (Daiss et al., 1986). In the present study, 3 participants from each group reported that they never napped, while all

others napped at least 1 to 2 times a week. Since the number of women who did not nap was quite low in this study, the statistical comparison between nappers and non nappers in relation to the benefits of napping was not made. However, a visual scan of the data suggests that both nappers and non nappers benefited from napping, and there does not appear to be any obvious differences in the benefits derived from the intervention between the two groups. Future research could intentionally sample both habitual and non habitual nappers, and compare the effectiveness of napping on their premenstrual symptoms.

Finally, the present study focused specifically on emotional and behavioural symptoms of PMS, since women tend to report that these are most distressing (Freeman, 2003). Women with suspected dysmenorrhea (painful uterine cramps, near and during menstruation) were intentionally excluded from this study, since they tend to experience a disturbed sleeping pattern that is different from that experienced by women without physical pain (Baker et al., 1999). However, future research could include women who are suffering from physical symptoms and examine the effects of napping on such symptoms.

7.0 Implications

This study attempted to bring further contributions to the field of menstrual cycles and sleep. It was the first to examine the effects of napping on sleepiness, alertness, mood, and cognitive performance among women with severe emotional/behavioural premenstrual symptoms. It was also the first study to examine the effects of such naps on subsequent sleep architecture among these women. Given the findings of this study, a mid-afternoon nap lasting a maximum of 30 minutes could not only be used as an intervention to improve sleepiness, alertness, mood, and cognitive performance during the late-luteal phase of the cycle among women with premenstrual symptoms, but could also prevent the worsening of

these symptoms. In addition, napping in the days prior to the typical onset of premenstrual symptoms could potentially act as a preventative measure for the development of symptoms. Although participants napped for a mean duration of approximately 25 minutes in this study, other studies have shown that naps as short as 20 minutes (Hayashi et al., 1999; Gillberg et al., 1996), 15 minutes (Takahashi et al., 2004), and 10 minutes (Brooks & Lack, 2006; Horne & Reyner, 1996; Tietzel & Lack, 2001) can improve sleepiness/alertness and/or performance. In fact, results from the recent study by Brooks and Lack (2006) indicated that, following mild restricted nocturnal sleep, a shorter mid-afternoon nap of 10 minutes was most effective for improving sleepiness/alertness and cognitive performance over a period of 3 hours, compared to longer naps of 20 and 30 minutes. Improvements with the 10 minute nap were more immediate than that of the longer naps, and were maintained for at least the same duration of time. Given that the nap SOL was quite short among the women of this study, suggesting a need for sleep at this time, it is postulated that the women in this study would have also benefited from a shorter nap (i.e. 10 to 20 minutes), which may be more practical.

The benefits of napping among women with severe premenstrual symptoms may extend beyond that of improving premenstrual symptoms. Napping among women with severe premenstrual symptoms may also help prevent the occurrence of accidents caused by increased levels of sleepiness and lower levels of alertness, as well as lead to improvements in other life domains such as work, family, and relationships. In addition, studies have found that severe depressive symptoms during the late-luteal phase of the cycle are related to the development of Major Depressive Disorder (Graze et al., 1990). Although it is unknown at this point whether interventions aimed at treating severe premenstrual depression may also act as preventative measures for the development of future episodes of mood disorders

(Endicott, 1993), the possibility that napping could play a role in breaking this cycle may prove to be quite valuable.

Given the benefits of napping noted in the present study, as well as the finding that napping does not negatively affect subsequent nocturnal sleep, it is clear that nothing is to be lost by applying this intervention, while the gains could be substantial. Since most women have a menstrual cycle for over 30 years (Logue & Moos, 1986), it is evident that the changes associated with it can negatively affect women for prolonged periods of time. The safety and possible long-term efficacy of napping could significantly help alleviate some of the distress experienced by these women on a monthly basis. In addition, since most women with premenstrual symptoms report poor efficacy of past treatments (Hunter et al., 1995), napping will likely be perceived as a practical, non-invasive and simple intervention compared to other existing treatments such as medications, long-term therapy and sleep deprivation. It is therefore suggested that napping be tried before other more aversive and controversial treatments for alleviating symptoms of PMS. Although a cure for PMS will likely not be discovered until its exact cause is found (Casper & Hearn, 1990), interventions aimed at alleviating symptoms, such as napping, are valuable.

At present, the negative effects of premenstrual symptoms on the health and functioning of women and society at large are not well recognized (Halbreich et al., 2003). Given the benefits of napping found among women with severe emotional/behavioural premenstrual symptoms in this study, it is suggested that women who are affected by premenstrual symptoms, their employers, and their family members be made aware of the improvements related to napping, and that napping be incorporated into work and family routines on a monthly basis. The 'Napping Company' for example, is an organization that helps integrate napping into the workplace so that employees and employers can benefit from

this intervention. Their goal is to promote “napping on the break” rather than “sleeping on the job” (Anthony & Anthony, 2005, p.210). It would be interesting to compare the prevalence of severe premenstrual symptoms in a society that integrates napping into their daily schedule, such as the Spanish and Portuguese, to that of societies less socialized to napping.

Conclusion

This thesis demonstrates that a short mid-afternoon nap during the late-luteal phase of the cycle could be used to improve and prevent worsening of emotional and behavioural premenstrual symptoms such as sleepiness, alertness, negative and positive mood, as well as some aspects of cognitive performance. Napping could also potentially act as a preventative measure for the development or exacerbation of these symptoms. Such an intervention could not only provide relief from symptoms on a monthly basis, but could also potentially lead to improvements in family and social domains, mental health, and overall quality of life. Given the lack of response to available treatments by women with severe premenstrual symptoms, and given the fact that napping is a practical and non aversive intervention, it is suggested that napping be tried before other more controversial and inconsistent treatments for alleviating symptoms of PMS.

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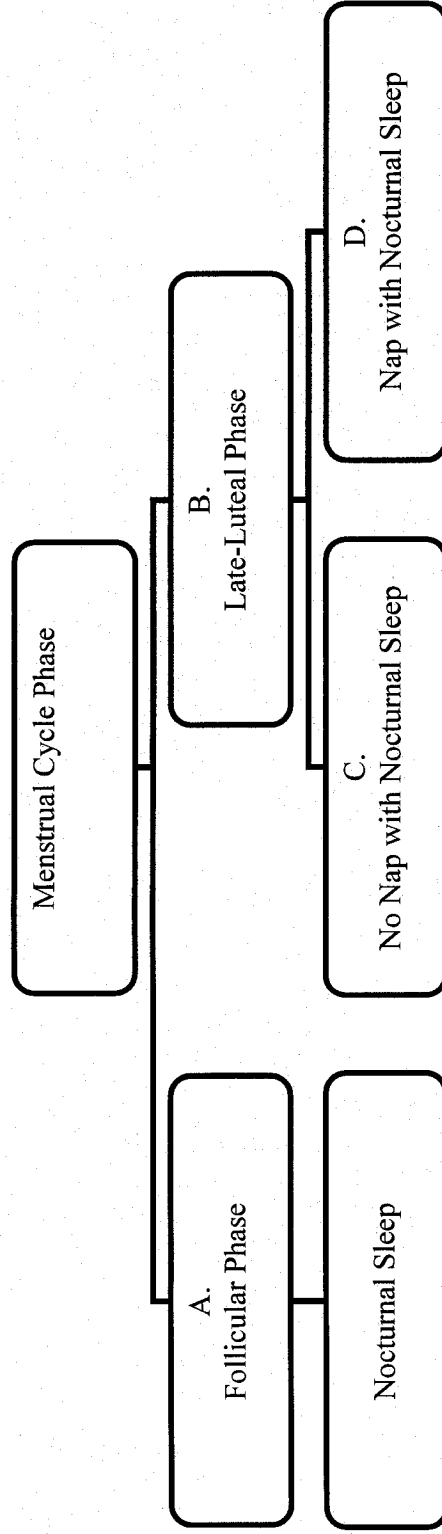
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Appendix A

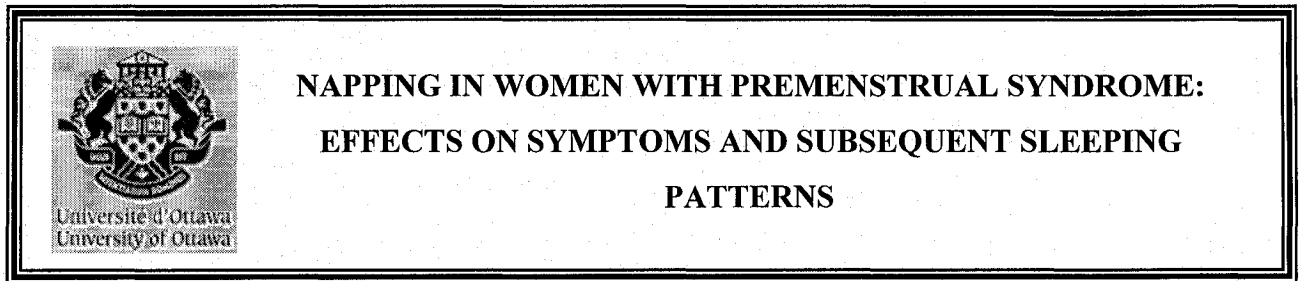
Study Design



- Adaptation nocturnal recording was first completed
- A. Follicular Phase = 5-9 days after onset of menses
- B. Luteal Phase = 6-1 days before onset of menses
- C and D counterbalanced

Appendix B

English Information Sheet and Consent Form



English Information Sheet and Consent Form

**NAPPING IN WOMEN WITH PREMENSTRUAL SYNDROME: EFFECTS ON
SYMPTOMS AND SUBSEQUENT SLEEPING PATTERNS**

RESEARCH CONDUCTED BY :

**LYNNE LAMARCHE, Ph.D. candidate, Psychology
Sleep and Dream Laboratory, University of Ottawa
Telephone: 562-5800 (ext 4314) or 562-5250**

NATURE AND OBJECTIVES OF THIS STUDY

It is well known that core body temperature changes in association with different phases of the menstrual cycle. The changes in temperature observed in the premenstrual and the postmenstrual phases of the menstrual cycle are possibly related to changes in sleep architecture during these phases. The level of daytime sleepiness during these different phases is found to differ in women who experience a variation of premenstrual symptoms. This study will aim at examining the effects of a mid-afternoon nap on premenstrual symptoms and subsequent sleeping patterns among women with severe and minimal premenstrual symptoms.

RECRUITMENT

Before the commencement of the study, you will be asked to complete a number of questionnaires to ensure that all required conditions for participation in this study are met. It is important that you understand that your participation in the completion of these questionnaires does not guarantee that you will be a participant in this study since this decision will only be made once all the results from the questionnaires are obtained.

You will be asked to come to the sleep laboratory at the University of Ottawa (Montpetit, 424) for approximately 1 hour. During this time, you will be asked to complete

questionnaires regarding your; sleeping habits, general health, sleep quality, daytime sleepiness, and menstrual cycle. These questionnaires are in English. You will then be contacted once again to inform you of your inclusion or not in the study. There is no monetary compensation for this part of the study.

EXPERIMENT PROCEDURE

If you are selected to take part in this study, you will be asked to complete a number of measures for approximately one month before any sleep recordings. This includes taking and recording your oral temperature every morning upon awakening for one menstrual cycle. You will also be asked to complete the Menstrual Cycle Questionnaire and the Premenstrual Self-Rating Scale once again, to confirm that your cycle is regular, and to measure the severity of your premenstrual symptoms. You will also be asked to record the time you wake up, and go to bed, as well as any napping activity.

If you continue to meet criteria for this study, you will first be asked to spend one night sleeping in the sleep laboratory in order to familiarize yourself with the environment. You will then be asked to spend one night during the follicular phase of your menstrual cycle (between 4-11 days after onset of menses) sleeping in the laboratory. You will be asked to come to the laboratory to pick up the rectal thermometer, the day before the nocturnal recording of the follicular phase. Upon awakening the day of the nocturnal recording, you will be asked to insert the rectal thermometer, at a depth of approximately 6 inches, and it will be worn until the next morning. You may remove it for certain activities, such as going to the washroom and taking a shower, however the time of the removal must be documented. You will then be asked to arrive at the sleep laboratory approximately 1.5 hours earlier than your habitual bedtime. Upon arrival, electrodes will be applied (metal disks and not needles) on your scalp as well as on your face with the use of a special wax and hypo-allergenic adhesive tape. You will then be asked to complete a number of mood and alertness/sleepiness measures. You will then enter the sound proof bedroom, and lights will be turned off. Upon awakening in the morning, the electrodes and the rectal thermometer will be removed. Approximately 30 minutes following awakening, the mood and alertness/sleepiness measures will be re-administered.

You will then be asked to spend two nights and one napping session during the premenstrual phase of your cycle (between 4 to 1 days before onset of menstrual bleeding) sleeping in the laboratory. You will first be asked to come take a nap at the sleep laboratory during the mid-afternoon (time to be assigned by the experimenter), and you will then return to the sleep laboratory that evening for a nocturnal sleep recording. Two days later, you will be asked to come to the laboratory at the same time as the supposed napping session, but will remain awake during this time. You will again be asked to return to the laboratory that evening for a nocturnal sleep recording. You will be asked to come to the sleep laboratory to pick up the rectal thermometer the day before the first nocturnal recording of the premenstrual phase. Upon awakening the day of the nocturnal recording, you will insert the rectal thermometer, at a depth of approximately 6 inches, and it will be worn until the next morning. You will then arrive at the sleep laboratory approximately one and a half hours prior to the time of napping. In the case that you will be napping, electrodes will be placed upon arrival. You will then be asked to complete a number of alertness/sleepiness, mood, and cognitive performance measures. These measures are in English. In the case of the napping condition, you will then be brought into the sound proof bedroom to attempt to take a nap.

Lights will be turned off, and you will be given 40 minutes to fall asleep. If you have not fallen asleep within 40 minutes, you will be asked to get up. If you have fallen asleep, you will be given 30 minutes to sleep. In the case of the no napping condition, you will remain awake during this time. The same tests and questionnaires that were administered before the supposed napping time will then be re-administered approximately 30 minutes after the supposed napping time. You will be asked to continue completing the mood and alertness/sleepiness measures yourself, every 2 hours throughout the remainder of the day, until bedtime that night.

You will be asked to return to the sleep laboratory that same night for a nocturnal sleep recording. Again, you must arrive approximately 2 hours before your usual bedtime. After electrode application, you will be brought into the bedroom, and lights will be turned off. Upon awakening, the electrodes and the rectal thermometer will be removed. Approximately 30 minutes upon awakening, the mood and alertness/sleepiness measures will again be administered. After one of the nocturnal recordings during this phase of your cycle, you will be asked to get a blood sample taken at the local health clinic.

During the day in between the napping and no napping conditions, measures of mood and alertness/sleepiness will be taken by yourself, at two-hourly intervals. We ask that you go to sleep and wake up at the same time as during the nocturnal sleep recordings in the laboratory. We also ask that you do not consume any alcohol, drugs, or caffeine during the days of nocturnal and nap recordings as well as during the day separating the nap and no nap conditions. You will be asked to gradually withdraw from these substances one week prior to any sleep recordings. We also ask that you refrain from taking any naps outside of the laboratory.

You will be asked, on a volunteer basis, to continue taking a mid-afternoon nap during the late-luteal phase of your cycle for 2 months after the completion of sleep recordings in the laboratory. In this case, you will be asked to complete mood and alertness/sleepiness measures before and 30 minutes after the nap, as well as at 2-hourly intervals throughout the remainder of the day, until bedtime.

RISKS AND DISCOMFORT

The techniques that will be used throughout this study do not present any risk of pain or harm in any way. However, they may cause some discomfort:

- 1) The electrodes may cause a skin irritation for a few hours. However, the products that we use are hypo-allergenic and skin reactions are rare.
- 2) The rectal thermometer may feel a little uncomfortable at first, however participants who have used these devices in the past report that this is only temporary.

BENEFITS AND COMPENSATION

Monetary compensation for your participation in this study is as follows: \$20 for completing the measures during 1 cycle before the commencement of sleep recording, \$10 for 1 day (approximately 24 hours, from awakening one day to awakening the next day) of wearing the rectal thermometer, \$15 for 1 nap recording and the completion of measures (this includes the day you come in for the no nap condition), \$15 for 1 night recording with

the completion of measures, \$5 for the completion of mood and alertness measures during the day that separates the nap and no nap condition, and \$5 for the blood sample. You will be given the choice before you begin each session as to whether you prefer to receive the monetary compensation at the beginning or the end of each session or after your participation in the study. If you do not complete the study, you will receive compensation according to the part of the experiment that you have completed.

CONFIDENTIALITY

The data that will be collected throughout this study will remain confidential. It will be conserved on CD-Rom as well as in a folder, in a locked cabinet in the office of the experimenter, for a period of 10 years. If the data collected throughout this study is to be used for scientific communications, your identity will never be revealed. Your name will be replaced by an identification code known only to the experimenter and the principal researcher. No information will be revealed without your consent.

VOLUNTARY PARTICIPATION AND WITHDRAWAL RIGHTS

Your participation in this study is strictly voluntary. You can refuse participation at any point of the experiment. You are able to withdraw from the study at any point in time by informing the experimenter of your decision.

CONTACTS

If you have any question regarding this study, if an incident arises or if you decide to withdraw from the study, you may contact the following people at any time.

Dr. Joseph De Koninck, Ph.D. Psychology
Telephone : (613) 562-5800 extension 1234
E-mail address : jdekonin@uottawa.ca

Lynne Lamarche, B.SC., Ph.D. Candidate
Telephone: (613) 562-5800 extension 4314
Residence : (613) 749-0285
E-mail address: llama098@uottawa.ca

FOR ANY ETHICAL QUESTIONS

Any information about your rights as a research participant may be addressed to **Protocol Officer for Ethics in Research, 550 Cumberland Street, Room 160, (613) 562-5387** or ethics@uottawa.ca.

CONSENT FORM

The nature of the study, the procedures to be followed, and the risks and benefits involved with my participation in this study have been clearly explained to me. I have received assurance from the researchers that information I will share will remain strictly confidential and that anonymity will be assured.

I have had the occasion to ask any question that I may have had regarding the different aspects of the study and have received answers to my satisfaction.

I agree to participate in this research conducted by Lynne Lamarche of the School of Psychology at the University of Ottawa. I understand that I am free to withdraw from this study at any time, without fear of reprisal or ill treatment.

I recognize that there are two copies of this consent form, one of which I may keep. I have also been provided with a copy of the information sheet.

Participant's name

Signature

Date

Researcher's name

Signature

Date

Appendix C

French Information Sheet and Consent Form

FORMULAIRE D'INFORMATION ET DE CONSENTEMENT



**SIESTES CHEZ LES FEMMES AVEC SYNDROME
PRÉMENSTRUEL : EFFETS SUR LES SYMPTÔMES ET LE
SOMMEIL SUBSÉQUENT**

**SIESTES CHEZ LES FEMMES AVEC SYNDROME PRÉMENSTRUEL : EFFETS
SUR LES SYMPTÔMES ET LE SOMMEIL SUBSÉQUENT**

RECHERCHE EFFECTUÉE PAR :

**LYNNE LAMARCHE, étudiante au doctorat en psychologie
Laboratoire du sommeil, Université d'Ottawa
Téléphone : 562-5800 (poste 4314) ou 562-5250**

NATURE ET OBJECTIF DE L'ÉTUDE

Il est bien connu que la température corporelle subit des changements selon les différentes phases du cycle menstruel. Les changements de température observés durant les phases prémenstruelles et post-menstruelles de ce cycle sont possiblement liés aux changements observés dans l'architecture du sommeil. Le niveau de somnolence durant la journée est sujet à changement dépendant de la sévérité des symptômes prémenstruels. Cette étude a pour but de mesurer les effets de siestes sur le fonctionnement diurne et sur l'humeur, et par après, sur le sommeil nocturne.

DÉPISTAGE GÉNÉRAL

Avant de débiter l'étude, vous devrez compléter des questionnaires dans le but de s'assurer que vous remplissez toutes les conditions requises par cette étude. Ces questionnaires sont en anglais. Il est important de comprendre que votre participation aux examens de dépistage ne vous garantit pas une place comme participante puisque cette décision ne pourra être prise que lorsque nous aurons les résultats des questionnaires.

Ces questionnaires impliqueront une visite d'environ une heure au laboratoire de sommeil de l'université d'Ottawa (125 rue Université, Édifice Montpetit 424). Au cours de cette visite, vous devrez compléter des questionnaires au sujet de vos habitudes de sommeil,

de votre santé générale, de la qualité de votre sommeil, de votre cycle menstruel et vos symptômes prémenstruels. Vous serez alors contacté de nouveau pour vous informer de votre inclusion dans l'étude. Il n'y a aucune compensation financière pour cette partie de l'étude.

DÉROULEMENT DE L'ÉTUDE

Si vous êtes sélectionnée pour participer à cette étude, nous vous demanderons de prendre quelques mesures et de compléter un nombre de questionnaires pendant une période d'un mois avant de venir dormir au laboratoire du sommeil. Nous vous demanderons de prendre votre température orale chaque matin en vous levant, pendant au moins un cycle menstruel. Nous vous demanderons aussi de compléter le 'Menstrual Cycle Questionnaire' et le 'Premenstrual Self-Rating Scale' encore une fois, afin de confirmer que vous avez un cycle régulier ainsi que de mesurer la sévérité de vos symptômes prémenstruels. Nous vous demanderons de noter le temps que vous vous levez chaque matin, et le temps que vous vous couchez le soir, ainsi que si vous avez prit une sieste pendant le jour.

Si vous remplissez encore toutes les conditions requises par cette étude, nous vous demanderons de premièrement passer une nuit d'enregistrement au laboratoire, afin de vous familiariser avec l'environnement du laboratoire. Par la suite, on vous demandera de passer une nuit durant la phase folliculaire de votre cycle menstruel (entre 4-11 jours après le début de vos menstruations) en dormant dans le laboratoire du sommeil. Vous devrez vous présenter au laboratoire le jour avant l'enregistrement de nuit, pour que l'on vous remette un thermomètre rectal. On vous demandera d'insérer le thermomètre (à une profondeur d'environ 6 pouces) aussitôt que vous vous levez le lendemain matin. Le thermomètre sera porté jusqu'au lendemain matin. Vous pouvez le retirer pour certaines activités telles que pour aller à la salle de bain et prendre une douche, mais vous devez noter chaque fois que vous le retirez. Vous devez ensuite vous présenter au laboratoire environ 1.5 heures avant votre heure de coucher habituelle. À votre arrivée, les électrodes seront appliquées (des cupules de métal et non pas des aiguilles) sur votre cuir chevelu et sur votre figure au moyen d'une colle spéciale et de ruban adhésif hypoallergique. Vous devez ensuite remplir des questionnaires portant sur votre humeur et votre niveau de somnolence. Ces questionnaires sont en anglais. Vous allez ensuite vous coucher. Une fois réveillée le matin, les électrodes et le thermomètre rectal seront retirés. Les mêmes questionnaires seront remplis après 30 minutes d'éveil.

Dans une deuxième partie de l'étude, nous vous demanderons de passer deux nuits et une session de sieste durant la phase prémenstruelle de votre cycle (entre 4-1 jour avant le début de vos menstruations) à dormir dans le laboratoire. Sur une occasion, nous vous demanderons de prendre une sieste au laboratoire (temps à déterminer dépendant de vos heures habituelles de coucher), et de retourner ce même soir pour dormir durant la nuit. Deux jours après, on vous demandera de venir au laboratoire pendant le même temps que le jour de la sieste, mais vous allez rester éveillée pendant ce temps. Nous vous demanderons de vous présenter au laboratoire le jour avant l'enregistrement de sommeil pour que l'on vous remette le thermomètre rectal. On vous demandera d'insérer le thermomètre (à une profondeur d'environ 6 pouces) aussitôt que vous vous levez le lendemain matin. Le thermomètre sera porté jusqu'au lendemain matin. Nous vous demanderons de vous présenter au laboratoire une heure et demie avant l'heure prévue pour la sieste. Dans le cas que vous prenez une sieste, les électrodes seront appliquées à votre arrivée. Nous vous demanderons ensuite de compléter certaines mesures d'humeur, de votre niveau de

somnolence, et de votre performance cognitive. Ces tests et questionnaires sont en anglais. Dans le cas que vous prenez une sieste, vous entrerez dans la chambre à coucher et vous tenterez de dormir. Les lumières seront éteintes, et on vous donnera 40 minutes pour vous endormir. Si vous ne réussissez pas à vous endormir au bout de 40 minutes, on vous demandera de vous lever. Si vous vous endormez avant 40 minutes, on vous donnera une période de 30 minutes pour dormir.

Dans le cas que vous ne prenez pas de sieste, vous allez rester éveillée durant ce même temps. Les mêmes mesures qui ont été prises avant le temps de la sieste seront données 30 minutes après la sieste. Ces mesures seront données également, au même temps, dans le cas que vous ne prenez pas de sieste. Nous vous demanderons de compléter les mesures d'humeur et de somnolence à chaque 2 heures pendant le restant de la journée, jusqu'à l'heure du coucher. Après une des sessions d'enregistrement de nuit dans la phase prémenstruelle, on vous demandera de faire prendre une prise de sang à la clinique locale.

Nous vous demanderons ensuite de retourner au laboratoire du sommeil cette même soirée pour l'enregistrement nocturne. Encore une fois, vous devez vous présenter 2 heures avant l'heure habituelle de votre coucher. Après que les électrodes sont appliquées, vous allez ensuite vous coucher. À l'éveil, les électrodes et le thermomètre rectal seront retirés. Trente-minute après l'éveil le matin, les mesures d'humeur et de somnolence seront administrées.

Pendant le jour qui sépare le jour de la sieste et le jour qu'aucune sieste est prise, les mesures d'humeur et de somnolence seront complétées par vous-même, à chaque deux heures. On vous demande de vous coucher et de vous réveiller au même temps que lors de vos nuits passées au laboratoire. Les jours d'enregistrements de nuits et de siestes, ainsi que le jour sans sieste, on vous demande de vous abstenir de consommer d'alcool, de drogue ou de caféine. On vous demande de vous abstenir graduellement une semaine avant les enregistrements de sommeil. Bien entendu, vous ne devez pas faire de siestes en dehors de celles que vous devrez faire en laboratoire.

RISQUES ET DÉSAGRÉMENTS

Les techniques utilisées ne présentent aucun risque de douleur ou de blessure. Toutefois, elles vous causeront possiblement des moments d'inconfort :

1. Les électrodes peuvent causer une irritation cutanée de quelques heures. Toutefois, les produits que nous utilisons sont hypoallergiques.
2. Le thermomètre rectal pourra causer un léger inconfort au départ, cependant les participants qui se sont servi de cet instrument lors des études précédentes rapportent que ce léger inconfort est temporaire.

BÉNÉFICES ET VERSEMENT D'UNE INDEMNITÉ

La compensation financière pour la participation à cette recherche se divise de la façon suivante : \$20 pour avoir complété les mesures durant 1 cycle avant l'enregistrement de sommeil, \$10 pour avoir porté le thermomètre rectal pour une journée (approximativement 24 heures, du levé un matin jusqu'au levé le lendemain matin), \$15 pour un enregistrement de sieste, incluant les mesures de somnolence, d'humeur, et de performance cognitive, (ceci inclut le jour ou vous venez au laboratoire et que vous ne

prenez pas de sieste), \$15 pour l'enregistrement d'une nuit incluant les mesures de somnolence, d'humeur, et de performance cognitive, \$5 pour avoir complété les mesures d'humeur et de somnolence durant le jour qui sépare les deux conditions de siestes, et \$5 pour une prise de sang. Le thermomètre rectal doit être porté durant les siestes et les nuits au laboratoire. Vous avez le choix de recevoir la compensation au début ou à la fin de chaque session, ou après avoir terminé l'expérience. Si vous ne terminez pas l'étude, vous recevrez la compensation financière correspondant à ce que vous aurez complétée.

CONFIDENTIALITÉ

Les données recueillies lors de cette étude demeureront totalement confidentielles. Elles seront conservées sur CD-Rom et dans une chemise, dans un classeur verrouillé dans le bureau de l'assistante de recherche, pour une période de 10 ans. Si les données de cette étude étaient utilisées dans des communications scientifiques, votre identité ne serait jamais dévoilée. Votre nom sera remplacé par un code d'identification connu de l'assistante de recherche, et du chercheur principal seulement. Aucune information ne sera divulguée sans votre consentement.

PARTICIPATION VOLONTAIRE ET DROIT DE RETRAIT

Votre participation à cette étude est volontaire. Vous êtes libre de refuser d'y participer. Vous pouvez également vous retirer de l'étude à n'importe quel moment en faisant part de votre décision à l'assistante de recherche, et ce sans aucun préjudice ni aucune conséquence.

PERSONNE À CONTACTER

Si vous avez des questions au sujet de l'étude ou s'il survient un incident quelconque ou si encore vous désirez vous retirer de l'étude, vous pouvez contacter en tout temps :

Dr. Joseph De Koninck, Ph.D. Psychologie
Téléphone : (613) 562-5800 poste 1234
Courriel : jdekonin@uottawa.ca

Lynne Lamarche, BSCH., étudiante au Ph.D.
Téléphone : (613) 562-5800 poste 4314
Résidence : (613) 749-0285
Courriel : llama098@uottawa.ca

POUR TOUTE QUESTION D'ÉTHIQUE

Pour toute question d'éthique, je peux m'adresser au **responsable de la déontologie en recherche, 550, rue Cumberland, pièce 160, (613) 562-5387** ou ethics@uottawa.ca.

CONSENTEMENT

La nature de l'étude, les procédés à utiliser, les risques et les bénéfices que comporte ma participation à cette étude ainsi que le caractère confidentiel des informations qui seront recueillies au cours de l'étude m'ont été expliqués.

J'ai eu l'occasion de poser toutes les questions concernant les différents aspects de l'étude et de recevoir des réponses qui m'ont satisfaite.

Je, soussignée, accepte volontairement de participer à cette étude effectuée par Lynne Lamarche de l'école de Psychologie de l'université d'Ottawa. Je peux me retirer en tout temps et ce, sans préjudice d'aucune sorte.

Je reconnais avoir reçu une copie signée de ce formulaire de consentement. Je reconnais aussi avoir reçu une copie du formulaire d'information.

 Nom de la participante

Signature

Date

 Non du responsable

Signature

Date

Appendix D

General Health Questionnaire

1. Do you currently suffer or have you ever suffered from:

- | | | |
|------------------------------|------------|-----------|
| -Epilepsy: | Yes: _____ | No: _____ |
| -Heart disease: | Yes: _____ | No: _____ |
| -Cerebral-Vascular problems: | Yes: _____ | No: _____ |
| -Arterial Hypertension: | Yes: _____ | No: _____ |
| -Diabetes: | Yes: _____ | No: _____ |
| -Hypo or hyperthyroidism: | Yes: _____ | No: _____ |
| -Respiratory problems: | Yes: _____ | No: _____ |
| -Head Trauma: | Yes: _____ | No: _____ |
| -Depression: | Yes: _____ | No: _____ |
| -Mental health problems: | Yes: _____ | No: _____ |
| -Allergies: | Yes: _____ | No: _____ |
| -Color blindness: | Yes: _____ | No: _____ |
| -Other: | _____ | |

2. Have you ever:

- | | | |
|----------------|------------|-----------|
| -Snored: | Yes: _____ | No: _____ |
| -Slept-walked: | Yes: _____ | No: _____ |
| -Slept-talked: | Yes: _____ | No: _____ |
| -Had insomnia: | Yes: _____ | No: _____ |
| -Other: | _____ | |

3. Have you ever:

- | | | |
|-------------------------------------|------------|-----------|
| -Lost consciousness without reason: | Yes: _____ | No: _____ |
| -Had brain surgery: | Yes: _____ | No: _____ |
| -Had surgery to the feet: | Yes: _____ | No: _____ |
| -Had a seizure: | Yes: _____ | No: _____ |
| -Other: | _____ | |

4. Do any members of your family currently suffer or have suffered from:

- | | | |
|------------------------------|------------|-----------|
| -Mental health problems | Yes: _____ | No: _____ |
| -Heart disease | Yes: _____ | No: _____ |
| -Cerebral vascular problems: | Yes: _____ | No: _____ |
| -Depression: | Yes: _____ | No: _____ |
| -Other: | _____ | |

5. Are you currently taking any medication?

- Yes: _____ Which one(s): _____
- No: _____

6. What are your tobacco consuming habits?

- None: _____
- Number of cigarettes per day: _____
- Number of cigarettes per week: _____

7. What are your alcohol consuming habits?

- None: _____
- Occasionally: _____
- Daily: _____

8. How often do you exercise?

Never:

Less than once a week:

2-3 times a week:

3-4 times a week:

4-5 times a week:

More than 5 times a week:

9. At what time of the day do you normally exercise? _____ O'clock

Appendix E

General Sleep Questionnaire

1. Do you take any medication for sleeping?

- Never: _____
- More than once a week: _____
- Less than once a week: _____
- Less than once a month: _____

2. How long does it usually take you to fall asleep?
 _____ minutes, on average

3. How many times a week does it usually take you longer than 30 minutes to fall asleep?
 _____ times

4. What time do you usually go to bed at?
 _____ hour

5. What time do you usually wake up?
 _____ hour

6. Therefore, for how many hours of sleep do you usually get?
 _____ hours per night

7. How many times on average do you usually wake up during the night?
 _____ times

8. If you wake up during the night, is it difficult to fall back asleep?

- Very difficult: _____
- Moderately difficult: _____
- Nor easy, nor difficult: _____
- Moderately easy: _____
- Very easy: _____
- I never wake up during the night: _____

9. Do you feel rested in the morning?

- Very rested: _____
- Rested enough: _____
- Just a little rested: _____
- Not rested at all: _____

10. How often do you take naps?

- Every day _____
- 3-5 times a week _____
- 1-2 times a week _____
- Never _____

11. On average, how long are these naps?

- 3-4 hours _____
- 1-2 hours _____
- half an hour _____
- Less than half an hour _____

12. Do you consider your daily wake/sleep activity to be regular?

Yes: _____

No: _____

13. Do you consider yourself to be more of a morning person or an evening person?

Morning person _____

Evening person _____

Appendix F

Pittsburgh Sleep Quality Index

Name: _____ Date: _____ Age: _____

Instructions: The following questions apply only to your sleeping habits from the last month only. Your answers should reflect your best estimation of the majority of the days and nights of the last month. Please answer to all questions.

- | | |
|---|---------------------------------|
| 1. During the last month, at what time did you go to bed? | Usual bedtime:
_____ |
| 2. During the last month, how much time did you take (in minutes) to fall asleep? | Number of minutes
_____ |
| 3. During the last month, at what time did you wake up in the morning?
time: | Usual wake up
_____ |
| 4. During the last month, how many hours of sleep did you have?
(this can be different than the number of hours spent in bed). | Hours of sleep per night: _____ |

For each of the following questions, check the best answer. Please answer all the questions.

5. During the last month, how many times did you have a hard time sleeping because you...

a) Couldn't fall asleep in less than 30 minutes.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

b) Would wake up in the middle of the night or very early in the morning.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

c) Had to go to the bathroom.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

d) Couldn't breathe well.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

e) Were coughing or snoring loudly.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

f) Were too cold.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

g) Were too hot.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

h) Had bad dreams.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

i) Felt pain.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

j) Other reasons, please describe:

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

6. During the last month, how would you rate the global quality of your sleep?

Very good _____ Somewhat good _____ Somewhat bad _____ Very bad _____

7. During the last month, how many times did you have to take some medication (with or without a prescription) to help you fall asleep?

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

8. During the last month, how many times have you had difficulty staying awake while driving, eating or taking part in a social activity?

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

9. During the last month, was it difficult to have enough enthusiasm to complete your activities?

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

10. Do you share a room or a bed?

- a) No bed or room partner _____
- b) Partner or roommate in another room _____
- c) Partner in the same room but not the same bed _____
- d) Partner in the same bed _____

If you have a bed or a room partner, please ask him or her how many times in the last month have you....

a) Snored loudly.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

b) Had long pauses of breath during your sleep.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

c) Had concentration or agitation in your legs during your sleep.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

d) Had episodes of disorientation or confusion during your sleep.

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

e) Had other agitations during your sleep. Please describe:

Not in the last month	Less than once a week	Once or twice a week	3 or more times a week
_____	_____	_____	_____

Appendix G

Sleep Log

Name: _____

Date: _____

Wake Time: _____

Nap during the day?: _____
If so, for how long? _____

Bed Time: _____

Time needed to fall asleep: _____

Number of time you woke up during the night?: _____

For how long (each time)? _____

Did you exercise today? _____

If yes, at what time did you exercise today? _____

For how long did you exercise today? _____

Did you take any medication today? _____

If so, which ones? _____

At what time? _____

What dosage? _____

What period of your menstrual cycle are you in?

Dreaming activity

Appendix H

Menstrual Cycle Questionnaire

Date: _____ Age: _____ yrs Subject's Initials: _____

Thank you for considering participation in our study assessing menstrual cycle changes. The questions below concern the regularity of your menstrual cycle, whether you are taking oral contraceptives, any psychological or physical experiences you may have and any pain at menstruation (dysmenorrhoea).

YOUR MENSTRUAL CYCLE

1. Do you have a regular menstrual cycle? YES / USUALLY / NO
2. If yes, how many days are there between the beginning of one menstrual period (first day of bleeding) and the beginning of the next? _____ days
3. Number of days of menstruation (bleeding): _____ days
4. Date of last menstruation (first day of bleeding): Date: _____
5. If you have an irregular cycle, what is the range (shortest to longest) for the number of days between each menstrual period (first day of bleeding)? _____ days
6. Are you currently taking any medication for symptoms during the premenstrual phase of your period? YES / NO
7. Are you currently pregnant, or is there a possibility that you are pregnant? YES / NO
8. Have you been pregnant within the last year? YES / NO

ORAL CONTRACEPTIVE USE

9. Are you currently taking oral contraceptives? YES / NO
10. If yes, what oral contraceptive are you taking? _____
11. How long have you been using oral contraceptives for? _____
12. What date did you take the first pill from the current package: Date: _____
13. Date of last menstruation (first day of bleeding): Date: _____
14. If you have ever taken oral contraceptives, when did you stop taking them?

More than 6 months ago? YES / NO Date: _____

15. Are you taking any other form of contraceptive medication? YES / NO

16. If YES, which medication? _____

PRE-MENSTRUAL EXPERIENCES

17. Please underline the absence (not present) or severity (mild to severe) of the following symptoms that you may experience **pre-menstrually** (from 6 days before the onset of menstruation until the onset of menstruation) compared with 5-10 days after the onset of menstruation (bleeding).

	Irritability		
Not present	Mild	Moderate	Severe
	Depression		
Not present	Mild	Moderate	Severe
	Anxiety		
Not present	Mild	Moderate	Severe
	Tension		
Not present	Mild	Moderate	Severe
	Feeling tearful		
Not present	Mild	Moderate	Severe
	Headache		
Not present	Mild	Moderate	Severe
	Breast tenderness		
Not present	Mild	Moderate	Severe

18. If you experience a symptom not listed above, please give a brief description, and rate the severity.

19. Do these symptoms occur during the premenstrual phase of most of your cycles?

YES / NO

SEVERITY OF DYSMENORRHOEA (menstrual pain)

19. Does menstrual pain affect your working ability:

Unaffected Rarely affected Moderately affected Clearly inhibited

20. Do you ever take days off work/school/college/university due to menstrual pain?

Never Seldom Frequently Always

21. Do you require analgesics for the pain?

Not required Rarely required Required Poor effect

22. Do you ever suffer from nausea, headaches, diarrhoea or any other symptoms associated with your dysmenorrhoea?

Never Seldom Frequently Always

23. Mark, with an X on the scale below, how severe the pain is during menstruation.

No pain at all _____ Unbearable pain

THANK YOU FOR YOUR TIME, IF YOU HAVE ANY QUESTIONS, PLEASE CALL

LYNNE at the Sleep Laboratory of the University of Ottawa, Tel # 613 562-5800 ext. 4314

or 5250..

Appendix I
Premenstrual Tension Syndrome Self-Rating Scale (PMTS Self-Rating Scale)

Name:

Date:

Identification Number:

Instructions: The following questions are concerned with the way you feel or act during the **premenstrual phase** (from 6 days before the onset of menstruation until the onset of menstruation) of your menstrual cycle.

Please answer all questions by circling YES or NO as indicated.

- | | | |
|---|-----|----|
| 1. Do you find yourself avoiding some of your social commitments? | YES | NO |
| 2. Have you gained 5 or more pounds during the past week? | YES | NO |
| 3. Is your coordination so poor that you are unable to use kitchen utensils, garden tools or unable to drive? | YES | NO |
| 4. Do you feel more angry than usual? | YES | NO |
| 5. Do you avoid family activities and prefer to be left alone? | YES | NO |
| 6. Do you doubt your judgment or feel that you are prone to hasty decisions? | YES | NO |
| 7. Do you feel more irritable than usual? | YES | NO |
| 8. Is your efficiency diminished? | YES | NO |
| 9. Do you feel tense and restless? | YES | NO |
| 10. Do you feel a marked change in your sexual drive or desire? | YES | NO |
| If YES, it is <i>increased</i> or <i>decreased</i>? | | |
| 11. Are your physical symptoms causing so much pain and discomfort that you are unable to function? | YES | NO |
| 12. Have you recently cancelled previously scheduled social activities? | YES | NO |
| 13. Do you feel as you were unable to relax at all? | YES | NO |
| 14. Do you feel confused? | YES | NO |
| 15. Do you suffer from painful or tender breasts? | YES | NO |
| 16. Do you have an increased desire for specific kinds of food (e.g. cravings for candy, chocolate, etc.)? | YES | NO |
| 17. Do you scream/yell at family members (friends, colleagues) more than usual? Are you "short-fused"? | YES | NO |
| 18. Do you feel sad, gloomy, and hopeless most of the time? | YES | NO |
| 19. Do you feel like crying? | YES | NO |
| 20. Do you have difficulty completing your daily household/job routine? | YES | NO |
| 21. Is there a marked change in your sexual drive with definite change in your sexual behavior? | YES | NO |
| 22. Do you find yourself being more forgetful than usual or unable to concentrate? | YES | NO |
| 23. Do you happen to have more "accidents" with your daily housework/job (cut fingers, break dishes, etc.)? | YES | NO |
| 24. Have you noticed significant swelling of your breasts and/or ankles and/or bloating of your abdomen? | YES | NO |
| 25. Does your mood change suddenly without obvious reason? | YES | NO |

- | | | |
|--|-----|----|
| 26. Are you easily distracted? | YES | NO |
| 27. Do you think that your restless behavior is noticeable to others? | YES | NO |
| 28. Are you clumsier than usual? | YES | NO |
| 29. Are you obviously negative and hostile towards other people? | YES | NO |
| 30. Are you so fatigued that it interferes with your usual level of functioning? | YES | NO |
| 31. Do you tend to eat more than usual or at odd irregular hours (sweets, snacks, etc.)? | YES | NO |
| 32. Do you become more easily fatigued than usual? | YES | NO |
| 33. Is your handwriting different (less neat than usual)? | YES | NO |
| 34. Do you feel jittery or upset? | YES | NO |
| 35. Do you feel sad or blue? | YES | NO |
| 36. Have you stopped calling or visiting some of your best friends? | YES | NO |

Premenstrual Tension Syndrome Self-Rating Scale (PMTS Self-Rating Scale)

Name:

Date:

Identification Number:

Instructions: The following questions are concerned with the way you feel or act during the **follicular phase** of your menstrual cycle (anytime other the premenstrual and menstrual phases—meaning anytime other than a week before you period starts to the end of your period).

Please answer all questions by circling YES or NO as indicated.

- | | | |
|---|-----|----|
| 1. Do you find yourself avoiding some of your social commitments? | YES | NO |
| 2. Have you gained 5 or more pounds during the past week? | YES | NO |
| 3. Is your coordination so poor that you are unable to use kitchen utensils, garden tools or unable to drive? | YES | NO |
| 4. Do you feel more angry than usual? | YES | NO |
| 5. Do you avoid family activities and prefer to be left alone? | YES | NO |
| 6. Do you doubt your judgment or feel that you are prone to hasty decisions? | YES | NO |
| 7. Do you feel more irritable than usual? | YES | NO |
| 8. Is your efficiency diminished? | YES | NO |
| 9. Do you feel tense and restless? | YES | NO |
| 10. Do you feel a marked change in your sexual drive or desire? | YES | NO |
| <i>If YES, it is increased or decreased?</i> | | |
| 11. Are your physical symptoms causing so much pain and discomfort that you are unable to function? | YES | NO |
| 12. Have you recently cancelled previously scheduled social activities? | YES | NO |
| 13. Do you feel as you were unable to relax at all? | YES | NO |
| 14. Do you feel confused? | YES | NO |
| 15. Do you suffer from painful or tender breasts? | YES | NO |
| 16. Do you have an increased desire for specific kinds of food (e.g. cravings for candy, chocolate, etc.)? | YES | NO |
| 17. Do you scream/yell at family members (friends, colleagues) more than usual? Are you "short-fused"? | YES | NO |
| 18. Do you feel sad, gloomy, and hopeless most of the time? | YES | NO |
| 19. Do you feel like crying? | YES | NO |
| 20. Do you have difficulty completing your daily household/job routine? | YES | NO |
| 21. Is there a marked change in your sexual drive with definite change in your sexual behavior? | YES | NO |
| 22. Do you find yourself being more forgetful than usual or unable to concentrate? | YES | NO |
| 23. Do you happen to have more "accidents" with your daily housework/job (cut fingers, break dishes, etc.)? | YES | NO |
| 24. Have you noticed significant swelling of your breasts and/or ankles and/or bloating of your abdomen? | YES | NO |
| 25. Does your mood change suddenly without obvious reason? | YES | NO |

- | | | |
|--|-----|----|
| 26. Are you easily distracted? | YES | NO |
| 27. Do you think that your restless behavior is noticeable to others? | YES | NO |
| 28. Are you clumsier than usual? | YES | NO |
| 29. Are you obviously negative and hostile towards other people? | YES | NO |
| 30. Are you so fatigued that it interferes with your usual level of functioning? | YES | NO |
| 31. Do you tend to eat more than usual or at odd irregular hours (sweets, snacks, etc.)? | YES | NO |
| 32. Do you become more easily fatigued than usual? | YES | NO |
| 33. Is your handwriting different (less neat than usual)? | YES | NO |
| 34. Do you feel jittery or upset? | YES | NO |
| 35. Do you feel sad or blue? | YES | NO |
| 36. Have you stopped calling or visiting some of your best friends? | YES | NO |

Appendix K

Stanford Sleepiness Scale

Name: _____

Date: _____

Time: _____

Condition: _____

Please circle the statement which best describes your state of sleepiness:

1. Feeling active and vital: alert; wide awake
2. Functioning at a high level, but not at peak; able to concentrate
3. Relaxed; awake; not at full alertness; responsive
4. A little foggy; not at peak; let down.
5. Fogginess; beginning to lose interest in remaining awake; slowed down
6. Sleepiness; prefer to be lying down; fighting sleep; woozy
7. Almost in reverie; sleep onset soon; lost struggle to remain awake

Appendix L

Subjective Alertness Scale

Name: _____

Date: _____

Time: _____

Condition: _____

Please place an "X" on this line to indicate your level of sleepiness.

extremely sleepy extremely alert

Appendix M

Beck Depression Inventory

Name: _____ Date: _____

Condition: _____

On this questionnaire are a group of statements. Please pick out the one statement in each group which best describes the way you feel *today*.

A. (SADNESS)

- 0 I do not feel sad
- 1 I feel blue or sad
- 2a I am blue or sad all the time and I can't snap out of it
- 2b I am so sad or unhappy that it is quite painful
- 3 I am so sad or unhappy that I can't stand it

B. (PESSIMISM)

- 0 I am not particularly pessimistic or discouraged about the future
- 1 I feel discouraged about the future
- 2a I feel I have nothing to look forward to
- 2b I feel that I won't ever get over my troubles
- 3 I feel that the future is hopeless and that things cannot improve

C. (SENSE OF FAILURE)

- 0 I do not feel like a failure
- 1 I feel I have failed more than the average person
- 2a I feel I have accomplished very little that is worthwhile or that means anything
- 2b As I look back on my life I see a lot of failures
- 3 I feel I am a complete failure as a person (parent, husband, wife)

D. (DISSATISFACTION)

- 0 I am not particularly dissatisfied
- 1a I feel bored most of the time
- 1b I don't enjoy things the way I used to
- 2 I don't get satisfaction out of anything any more
- 3 I am dissatisfied with everything

E. (GUILT)

- 0 I don't feel particularly guilty
- 1 I feel bad or unworthy a good part of the time
- 2a I feel quite guilty
- 2b I feel bad or unworthy practically all the time now
- 3 I feel as though I am very bad or worthless

F. (EXPECTATION OF PUNISHMENT)

- 0 I don't feel I am being punished
- 1 I have a feeling that something bad may happen to me
- 2 I feel I am being punished or will be punished
- 3a I feel I deserve to be punished
- 3b I want to be punished

G. (SELF-DISLIKE)

- 0 I don't feel disappointed in myself
- 1a I am disappointed in myself
- 1b I don't like myself
- 2 I am disgusted with myself
- 3 I hate myself

H. (SELF-ACCUSATIONS)

- 0 I don't feel I am any worse than anybody else
- 1 I am critical of myself for my weaknesses or mistakes
- 2 I blame myself for my faults
- 3 I blame myself for everything bad that happens

I. (SUICIDAL IDEAS)

- 0 I don't have any thought of harming myself
- 1 I have thoughts of harming myself but I would not carry them out
- 2a I feel I would be better off dead
- 2b I feel my family would be better off if I were dead
- 3a I have definite plans about committing suicide
- 3b I would kill myself if I could

J. (CRYING)

- 0 I don't cry any more than usual
- 1 I cry more now than I used to
- 2 I cry all the time now. I can't stop it
- 3 I used to be able to cry but now I can't cry at all even though I want to

K. (IRRITABILITY)

- 0 I am no more irritated than I ever am
- 1 I get annoyed or irritated more easily than I used to
- 2 I feel irritated all the time
- 3 I don't get irritated at all the things that used to irritate me

L. (SOCIAL WITHDRAWAL)

- 0 I have not lost interest in people
- 1 I am less interested in other people now than I used to be
- 2 I have lost most of my interest in other people and have little feeling for them
- 3 I have lost all my interest in other people and don't care about them at all

M. (INDECISIVENESS)

- 0 I make decisions about as well as ever
- 1 I try to put off making decisions
- 2 I have great difficulty in making decisions
- 3 I can't make any decisions at all any more

N. (BODY IMAGE CHANGE)

- 0 I don't feel I look any worse than I used to
- 1 I am worried that I am looking old or unattractive
- 2 I feel that there are permanent changes in my appearance and they make me look unattractive
- 3 I feel that I am ugly or repulsive looking

O. (WORK RETARDATION)

- 0 I can work about as well as before
- 1a It take extra effort to get started at doing something
- 1b I don't work as well as I used to
- 2 I have to push myself very hard to do anything
- 3 I can't do any work at all

P. (INSOMNIA)

- 0 I can sleep as well as usual
- 1 I wake up more tired in the morning that I used to
- 2 I wake up 1-2 hours earlier than usual and find it heard to get back to sleep
- 3 I wake up early every day and can't get more than 5 hours sleep

Q. (FATIGABILITY)

- 0 I don't get more tired than usual
- 1 I get tired more easily than I used to
- 2 I get tired from doing anything
- 3 I get too tired to do anything

R. (ANOREXIA)

- 0 My appetite is no worse than usual
- 1 My appetite is not as good as it used to be
- 2 My appetite is much worse now
- 3 I have no appetite at all anymore

S. (WEIGHT LOSS)

- 0 I haven't loss much weight, if any, lately
- 1 I have lost more than 5 pounds
- 2 I have lost more than 10 pounds
- 3 I have lost more than 15 pounds

T. (SOMATIC PREOCCUPATION)

- 0 I am no more concerned about my health than usual
- 1 I am concerned about aches and pains *or* upset stomach *or* constipation
- 2 I am so concerned with how I feel or what I feel that it's hard to think of much else
- 3 I am completely absorbed in what I feel

U. (LOSS OF LIBIDO)

- 0 I have not noticed any recent changes in my interest in sex
- 1 I am less interested in sex that I used to be
- 2 I am much less interested in sex now
- 3 I have lost interest in sex completely

Appendix N

Mood Adjective Checklist

Name: _____

Date: _____

Time: _____

Condition _____

Each of the following words describes feelings or mood. Please use the list to describe your feelings at the moment you read each word. Please indicate 3, 2, 1, or 0 on the line beside each word, according to the scoring system below.

3 = much

2 = little

1 = don't know

0 = no

Aggression:
 defiant _____
 rebellious _____
 angry _____
 grouchy _____
 annoyed _____
 fed-up _____
Anxiety:
 clutched up _____
 fearful _____
 jittery _____
Surgency:
 carefree _____
 playful _____
 witty _____
 lively _____
 talkative _____
Elation:
 elated _____
 overjoyed _____
 pleased _____
 refreshsed _____
Concentration:
 Attentive _____
 earnest _____
 serious _____
 contemplative _____
 concentrating _____
 engaged in thought _____
 intent _____
 introspective _____
Fatigue:
 drowsy _____
 dull _____
 sluggish _____
 tired _____
Social Affection :
 affectionate _____
 forgiving _____
 kindly _____
 warmhearted _____
Sadness :
 regretful _____
 sad _____
 sorry _____
Skepticism:
 dubious _____
 skeptical _____
 suspicious _____
Egotism:
 egotistic _____
 self-centred _____
 aloof _____
 boastful _____
Vigor:
 active _____
 energetic _____
 vigorous _____
Nonchalance:
 leisurely _____
 nonchalant _____