The Effects of Oral Contraceptives on Emotional Reactivity and Cognition

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Abstract

The purpose of this study was to investigate the effects of oral contraceptives (OCs) on emotional reactivity and cognitive ability. Previous research has suggested that OC users may experience blunted positive affect (PA) reactivity and that some women also experience negative mood side effects from OCs. In the present study, 149 participants (58 OC users, 46 nonusers, and 38 men) viewed three different emotional videos paired with music intended to evoke either happiness, sadness, or fear. After each emotional video, participants completed a facial emotions recognition task, and a GoNogo task of inhibition. The hypothesis that women taking OCs would have lower PA reactivity compared to nonusers and men was not supported. However, a sex difference in negative emotional reactivity (women > men) was found and was strongest in OC users (OC users > men) and longer duration OC users. While a small sample size reduces validity of the findings, the hypothesis that OC users with current negative mood side effects would have faster response times than nonusers and men was not supported. However, a sex difference was evident in that men had slower response times to negative faces. Also, men had slower response times than OC users, after sad and fear mood inductions. There was partial support for the third hypothesis that OC users would have more errors of commission than nonusers and men. OC users (and women as a group) made more errors of commission during the GoNogo task compared to men, but only after the happy mood induction. Also, OC users with current negative mood side effects had fewer errors of commission after the sad mood induction compared to OC users with no mood side effects. Possible mechanisms are discussed for OC-associated impulsivity and for the possible reversal of such an effect in women experiencing OC mood side effects.

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The Effects of Oral Contraceptives on Emotional Reactivity and Cognition

Oral contraceptive (OC) use has grown steadily since the 1960s and has now become the number one contraception method in Canada (Black et al., 2004). The Canadian Contraceptive Consensus conducted in 2002 indicated that 28% of Canadian women aged 15 to 44 were using OCs (Fisher & Black, 2007) and 80 to 84% of women in North America have taken OCs during their lifetime (Fisher, Boroditsky, & Bridges, 1999; Mosher, Martinez, Chandra, Abma, & Wilson, 2004). Despite the prevalence of OC use, however, very little is known about the particular emotional and cognitive consequences of consuming various combinations of synthetic hormones.

Emotional side effects, though widely researched, have shown equivocal findings across studies. Among the most common emotional side effects of OC use are: increased negative mood or depression, less affect variability across the menstrual cycle, and less negative affect during menstruation (see review in Oinonen & Mazmanian, 2002). An individual's reproductive history, baseline emotional and personality variables, and genetic factors have all been suggested as possible explanations for individual differences in emotional response to OCs (Oinonen & Mazmanian, 2002).

There is even less evidence, however, to suggest that women experience any cognitive changes as a result of OC use. The lack of research on the cognitive side effects of OCs is interesting because it has been established that there are some structural brain differences between women on OCs and naturally cycling women (Pletzer, Kronbichler, Aichhorn, Bergmann, Ladurner & Kerschbau, 2010; Protopopescu et al., 2008). Nevertheless, group differences in particular functional abilities have yet to be established. For example, even when brain activation patterns differ between OC-using

and free-cycling women during a cognitive task, performance on the task may not differ significantly (e.g., Rumberg et al., 2010). Investigating potential emotional and cognitive functional differences between OC using and free-cycling women was one of the primary goals of the current study.

Additionally, it is possible that emotional and cognitive side effects, negative or positive, go unreported or unnoticed by OC users. For example, it may take a particularly introspective individual to notice subtleties in their emotional reactivity or to associate any emotional or cognitive changes to OC use, and not some other situational factor. The current study, therefore, examined the potential emotional and cognitive differences between OC users and non-users in a laboratory environment rather than relying solely on self-report measures. This study also investigated possible differences in emotional reactivity and cognitive ability between free-cycling women, women taking OCs, and men.

The Menstrual Cycle

Due to hormonal fluctuations across the menstrual cycle, it is important to take menstrual cycle phase into account when scheduling or collecting data from female participants. Given associations between menstrual cycle phase and both mood (e.g. see review in Farage, Osborn, & MacLean, 2008) and cognition (e.g. see reviews in Kimura, 1996; Torres, Gomez-Gil, Vidal, Puig, Boget & Salamero, 2006) such controls are particularly important in this area of research, The menstrual cycle is typically divided into two phases: the follicular phase and the luteal phase. Both the follicular and luteal phases can be further subdivided into early, mid, and late periods. In order to understand

how hormones can potentially affect emotions and cognitions, it is integral to first understand the hormonal fluctuations across the adult female's menstrual cycle.

The early follicular phase begins on day one of the cycle and is the first day of menstrual bleeding. The early follicular phase is typically defined as days 1 to 5 (e.g., Pletzer at al., 2010) while the mid-follicular phase is typically defined as days 6 to 10 and the late follicular phase from day 11 to after ovulation (e.g., Parry, 1997; Protopopescu et al., 2008). During the early follicular phase, when estradiol and progesterone levels are low, the anterior pituitary gland begins to release the follicle-stimulating hormone (FSH) which then triggers the growth of ovarian follicles. In the mid follicular phase (days 6 to 10), the ovarian follicles begin to mature and release increasing amounts of estradiol. Estradiol peaks by the late follicular phase (days 11 to 13) as the dominant ovarian follicle reaches maturity (Merck Laboratories Inc., 2003).

Ovulation occurs in the late follicular phase when serum estradiol concentrations are at their peak and when luteinizing hormone (LH) is released from the anterior pituitary. The release of LH from the anterior pituitary stimulates the release of the secondary oocyte (immature ovum), from the follicle. The rupturing of the follicle and release of the secondary oocyte constitutes ovulation. Ovulation lasts between 16 and 32 hours and typically occurs 13 to 14 days into the cycle (Merck Laboratories Inc., 2003). The time around ovulation is associated with maximal conception likelihood (Wilcox, Dunson, & Baird, 2000).

The luteal phase begins following ovulation. During the early luteal phase (the first five following ovulation or LH surge; days 15 to 19 for a regular 28-day cycle), the ruptured follicle closes and forms a body known as the corpus luteum, which begins to

produce increasing amounts of progesterone. The mid luteal phase begins approximately five or six days following the LH surge or roughly days 20 to 24 for a regular 28-day cycle. It is characterized by elevated levels of progesterone, and low levels of LH and FSH (Baker, Waner, Viera, Taylor, Driver, & Mitchell, 2001). At this point, levels of estradiol are intermediate between levels seen at ovulation (high) and levels seen at menses (low) (Parry, 1997). During the late luteal phase, (days 10 to 14 following LH surge; day 25 and on for a regular 28-day cycle) progesterone levels begin to decline and it is the fall in progesterone levels that trigger the re-release of FSH and the beginning of a new menstrual cycle (Merck Laboratories Inc., 2003). If fertilization does not occur, the corpus luteum degenerates, thereby leading to a cessation of secreted progesterone and the sloughing off of the blood-enriched uterine lining, thus beginning menstruation (Merck Laboratories Inc., 2003).

In sum, both the early follicular and late luteal phases represent low hormonal periods in the cycle, while the late follicular (including ovulation) and mid luteal phases represent high hormonal periods in the cycle. Specifically, the late follicular period (days 11 to 13) is marked by peak estradiol, LH, and FH levels, while the mid luteal phase (days 5 to 9 following the LH surge), is marked by peak progesterone, intermediate estradiol, and low LH and FH levels. Indeed, comparing women between particular phases in their menstrual cycle is an efficient and non-invasive method of approximating hormonal levels and thus examining hormonal effects on behaviour or physical characteristics (e.g. Gasbarri, Pompili, d'Onofrio, Cifariello, Tavares, & Tomaz, 2008; Oinonen & Mazmanian, 2007).

It is important to recognize, however, that menstrual cycle phases differ between free-cyclers and women taking OCs. In particular, OCs typically suppress gonadotropin secretion thereby halting the LH surge during the late follicular phase and inhibiting follicular maturation and ovulation (van Heusdan, & Fauser, 1999). Moreover, OC users do not experience the progesterone-induced thickening of the uterine wall and consequently do not experience true menstruation. Instead, women taking OCs experience "withdrawal bleeding" during the last week of the cycle as a reaction to withdrawal from the hormones in the OC pills (van Heusdan, & Fauser, 1999). Therefore, in addition to having exogenous estrogen and progestin in their bloodsream, women on OCs, show a very different endogenous hormonal pattern across the cycle than naturally cycling women.

Generally speaking, women on OCs have reduced endogenous sex steroid levels and reduced hormonal fluctuations across the cycle than free-cycling women (van Heusdan, & Fauser, 1999). For example, Folessa et al. (2002) measured neurosteroid levels (estradiol and progesterone) in healthy women before and after taking OCs. They found that the elevation in neurosteroid levels that previously occurred in the luteal phase was completely abolished after three months of OC treatment. Additionally, they found that the neurosteroid levels measured during the follicular phase after the onset of the third OC cycle were all lower than the neurosteroid levels measured in the follicular phase prior to OC use. This within-subjects design verified that hormonal levels change across the cycle as a direct result of OC use.

While it is important to compare OC-using and free-cycling women, it is of additional importance to examine differences within OC-using women. Indeed, there are

numerous brands of OCs, many of which have different hormonal combinations from one another. In order to adequately investigate and understand the effects of OCs on women's emotional and cognitive functioning, it is integral to be aware of the different types of OCs and their constituents.

Oral Contraceptives

The OCs most commonly prescribed today can be divided into three different categories, each with its own different hormonal combination: new generation (also known as antiandrogenic), second generation, and third generation OCs (Batur, Edler, & Mayer 2003; Wharton, Hirshman, Merritt, Doyle, Paris, & Gleason, 2008). Most of the OCs available in all three categories have the same estrogen compound called ethinyl estradiol which comes most frequently in a low-dose of 30 to35 μg, or an ultra low dose of 20 to 25 μg (Batur, Edler, & Mayer 2003). It is the progesterone compounds in OCs, however, that vary in type and ultimately determine the generation of OC pills (Glasier, 2006).

New generation OCs contain the progesterone compound drospirenone (e.g. Yaz®, Yasmin®) and tend to be monophasic in that they deliver a single dose of hormone throughout the cycle (Baker et al., 2012; Glasier, 2006). Second generation OCs contain the progesterone compound levonorgestrel or norethindrone (e.g. Alesse®, Ortho 7/7/7®) and are also typically monophasic (Baker et al., 2012; Glasier, 2006; Wharton, Hirshman, Merritt, Doyle, Paris, & Gleason, 2008). Lastly, third generation OCs contain gestodene, desogestrel, and norgestimate (e.g. Tri-Cyclen Lo®), yet third generation OCs tend to deliver increasing amounts of hormones throughout the cycle in a triphasic rather than monophasic fashion (Baker et al., 2012; Glasier, 2006; Wharton et al., 2008).

Consequently, while all OCs typically reduce endogenous hormone levels and increase exogenous estrogen and progestin levels, different types of OCs can lead to a different hormonal profile. This should be taken into consideration when conducting hormonal research. Failure to find consistent emotional or cognitive differences between naturally cycling women and women on OCs may be due to the fact that many researchers group all women taking OCs into one category without taking OC generation or dosage into consideration (e.g. Kirschbaum, Pirke, & Hellhammer, 1995; Postma et al., 1999; Rumberg et al. , 2010). In fact, as discussed below, the hormone derivatives in second and third generation OCs have some effects on the brain that are opposite to those of the hormone derivatives in new generation OCs.

Both second and third generations OCs contain progestins that are testosterone-derived. These testosterone-derived progestins bind to the androgen receptors in the brain and are responsible for varying levels of androgenic activity (Batur, Edler, & Mayer 2003). Having a more androgenic brain implies a more "masculinized" brain in that androgens are responsible for the development of male-typical characteristics (Batur, Edler, & Mayer 2003). Second generation pills are the most androgenic of OCs while third generation OCs are also androgenic but less so than second generation OCs. In contrast, the drospirenone found in new generation OCs is spironoelactone- rather than testosterone-derived and has antimineralocorticoid and antiandrogenic properties (Wharton et al., 2008). Therefore, OCs can have a largely different and potentially opposite effect on women depending on the generation of OC used. For example, Wharton et al. (2008) found that performance on a mental rotation task (MRT) differed depending on OC generation. Second generation OCs users outperformed other OC users

on the MRT. New generation users, on the other hand, showed the worst performance on the MRT task compared to all other OC users and naturally cycling women combined. Thus, while looking at OC users as a whole may be valuable due to some common hormonal changes within this group, taking OC type into consideration may also be important for understanding some hormonal, cognitive, and emotional differences between and within OC user and nonuser groups of women.

Hormones and Brain Structure

Along with differences in hormonal concentrations, sex-related steroid hormones, and OC use have also been associated with differences in brain structures and grey matter quantities (see Cosgrove, Mazure, & Staley, 2007; Goldstein et al., 2001; McEwan, Allves, Bulloch, & Weiland, 1997 for a review). Pletzer at al. (2010) obtained high-resolution structural images of the brains of 14 men, 14 women using OCs, and 14 women not using OCs. Women who were not using OCs were scanned once during the early follicular phase (which the authors defined as onset of menstruation to 5 days before ovulation) and again during the mid-luteal phase (which the authors defined as 3 days post ovulation to 5 days before menstruation). The scans revealed that men had larger hippocampi, parahippocampal and fusiform gyri, amygdalae, and basal ganglia than both OC-using and free-cycling women. Gray matter volumes were also larger in men compared to women bilaterally in the hippocampus, parahippocampal and fusiform gyri, putamen, pallidum, amygdala, and temporal regions. However, gray matter volumes were larger in women compared to men bilaterally in: the prefrontal cortex, the pre- and postcentral gyri, the supplementary motor area, and the inferior parietal lobule. These

scans provide evidence that there may be hormonally related differences in brain structures between men and women.

In the same study, brain structure differences were found in women as a function of cycle phase and OC use. Free-cycling women during the early follicular phase (when estrogen and progesterone levels are both low) showed larger gray matter volumes in the prefrontal cortex, pre- and postcentral gyri and larger volumes in the right fusiform/ parahippocampal gyrus compared to free-cycling women in the mid-luteal phase (when estrogen and progesterone levels are both high) (Pletzer et al., 2010). Additionally, women using hormonal contraceptives showed significantly larger prefrontal cortices, pre- and postcentral gyri, parahippocampal and fusiform gyri and temporal regions, compared to women not using OCs. Furthermore, total grey matter volume of women using hormonal contraceptives was smaller than in naturally cycling women. Pletzer et al. (2010) used a between- rather than a within-subjects design. A within-subjects design (before and during OC use) would better provide evidence for a direct effect of OC use on changes in grey matter and brain structure. Nevertheless, the scans from the Pletzer et al. (2010) study suggest that there are differences in brain structures between women as a function of cycle phase and OC use.

Protopopescu et al. (2008) used brain scans and a within-subjects design to compare women during the late follicular phase (days 10 to 12 after onset of menstruation) and the late luteal phase (1 to 5 days before menstruation). They found that during the late follicular phase (when estrogen is high but progesterone is low) the women had increased grey matter volumes in the lingual gyrus and hippocampus and decreased grey matter volumes in the superior parietal lobe, pallidum/putamen and

anterior cingulate gyrus compared to during the late luteal phase (when both estrogen and progesterone are low). These findings provide further evidence of menstrual cyclicity and hormonal effects on grey matter structure.

These two studies provide evidence that sex steroid hormones likely influence structural brain differences in women and men as well as within women across the menstrual cycle or with use of OCs. The implications of these structural differences, however, are unknown and it is of interest to determine if they are associated with differences in mood and/or differences in functional ability or performance on emotional or cognitive tasks. Future studies should investigate the implications of these structural differences by choosing particular tasks that tap into brain areas affected by hormonal changes.

Oral Contraceptives and Affect

Along with structural brain differences, OCs have also been linked to mood changes in users. Mood side effects have been reported by women and recognized by researchers since the release of the pill (Sanders, Graham, Bass, & Bancroft, 2001; see review in Oinonen & Mazmanian, 2002). Currently, approximately 4 to 10% of women on OCs experience negative mood side effects (Gingnell et al., 2013). Many of those women opt to discontinue OCs as a consequence of the negative mood effects and begin to rely on other, possibly less effective, means of birth control. For example, Sanders et al. (2001) found that, in their study of 79 OC-using women, 49% of the participants discontinued OCs, and 87% of those who discontinued cited negative emotional side effects, worsening of PMS, or decreased sexual thoughts and desire as their main reason for discontinuation.

Interestingly, Gingnell et al. (2013) found that when women who discontinued OCs due to negative mood side effects were put back on OCs using a randomized placebo-controlled design, they re-experienced the negative mood side effects while those given placebo did not report the negative mood side effects. These results support the idea that negative mood side effects are indeed a possible consequence of OCs, that a subset of women seem susceptible or sensitive to such effects, and that upon terminating OC use, negative mood side effects are diminished. Importantly, this study also provided evidence for the validity women's self-report of negative mood side effects from OC use.

While research on women who report negative mood side effects from OCs is important, it is integral to recognize that many women do not report negative mood side effects from OC use. In fact, a review by Kurshan and Epperson (2006) indicated that women taking new generation pills (estradiol ethyl and drospirenone combination) indicated an improvement of mood symptoms from baseline (Brown et al., 2001; Parsey & Pong, 2000; Silem at al., 2003; Freeman et al., 2001). Additionally, a study conducted by Rosenthal et al. (2002) indicated that the adolescents in their study anticipated negative mood changes upon starting a levonorgestrel based OC (second generation) yet despite their expectations, 91% of the participants did not experience a negative mood change. Also, a study conducted by Graham and Sherwin (1992) indicated that women who had been depressed at baseline prior to OC use reported greater improvement in measures of impairment at work, needing sleep, and lack of energy premenstrually after taking an estradiol ethyl and norethindrone combination (second generation) OC for three cycles. Therefore, while much of the research on the emotional effect from OCs tends to

focus on negative side effects, there may in fact be positive emotional side effects as well for some women or with some OCs.

Another recent finding in the link between OC use and affect is not the presence of a change in the level of positive or negative affect per se, but instead there is evidence suggesting that OCs may cause a blunting of affect (i.e., less mood reactivity). Jarva and Oinonen (2007) conducted a study that indicated that women on OCs experience a blunting of positive affect variability compared to non-users. A sample of 40 OC users, 36 nonusers, and 31 men completed the Positive and Negative Affect Schedule (PANAS) before and after a series of procedures designed to induce positive affect, jealousy, social ostracism, and parental feelings. While no differences were found between groups for the level of jealousy, social ostracism, or parental feelings, OC users did display significantly less positive affect reactivity than non-users and men across the laboratory session. Furthermore, women who had been taking OCs for less than 24-months displayed the highest blunting of positive affect reactivity. These results suggest that OCs may cause women's range of positive emotions to be reduced or blunted.

The idea that women on OCs may experience a blunting of positive affect might potentially be explained by the constant low dose of ethinyl estradiol (estrogen) that most OCs contain as opposed to the cyclical peaks in estradiol found in free-cycling women. Indeed, research suggests that estrogen has been linked to an increase in positive moods (Gasbarri, Pompili, d'Onofrio, Cifariello, Tavares, & Tomaz, 2008; Jacobs & D'Esposito, 201; Miller, Conney, Rasgon, Fairbanks, & Small, 2002). Therefore, if women on OCs are not experiencing the high levels of estradiol that free-cycling women are experiencing, they may also not experience positive emotions in the same way as free-

cycling women. Moreover, if women on OCs are indeed experiencing a blunting in positive affect reactivity, it may have both negative emotional and social consequences. It is important, therefore, for future studies to further investigate the potential blunting of positive affect reactivity in women on OCs.

The Effect of Hormones on Emotional Tasks and Response Inhibition

Differences in how free-cycling and OC-using women experience affect can have not only emotional and social consequences, but cognitive consequences, as well. As mentioned above, a study conducted by Gingnell et al. (2013) found that when women discontinued OCs due to negative mood side effects and were put back on OCs using a randomized placebo-controlled design, they re-experienced the negative mood side effects. While this provides strong evidence that OCs did in fact directly contribute to negative mood side effects for these women, Gingnell et al. (2013) also found some notable cognitive effects. Specifically they found that while viewing angry or fearful faces, brain reactivity patterns differed between the women who were put back on the OC regimen and the free-cycling women taking a placebo.

Gingnell et al. (2013) recruited 34 women with previous experience of mood deterioration during OC use and randomized the participants to one treatment cycle using a levonorgestrel-containing OC or placebo. The women taking the OCs had quicker response times to identify the angry and fearful faces, lower reactivity in the left insula (typically associated with positive or salient emotional stimuli) (Jabbi et al., 2007; Takahashi et al., 2008), and lower reactivity in the inferior frontal gyri (associated with verbal language production, empathy, response inhibition, and emotional distraction) (Hampshire et al., 2010; Liakakis et al. 2011; Wang et al., 2008). These results indicate

that OCs may cause some women to be more reactive to negative stimuli and have lower emotional distraction and lower response inhibition while viewing negative stimuli compared to naturally cycling women.

Interestingly, since the inferior frontal gyrus is involved in a number of cognitive functions and processes related to social interactions such as: speech processing, verbal language production, empathy, and motor execution and response inhibition (Hampshire et al., 2010; Liakakis et al. 2011; Wang et al., 2008), it would be interesting to conduct additional studies that use tasks that target the inferior frontal gyrus. This would further clarify are any additional functional differences between women taking OCs and free-cycling women.

It would be of additional interest for future studies to examine whether women on OCs with negative mood side effects also differ in their responses to other negative emotional stimuli besides fear and anger such as sadness or disgust. Additionally, since the Gingnell et al. (2013) study did not collect information on the level of emotional distraction between groups, future studies should investigate if women experiencing negative mood side effects from OCs are less able to disengage from the negative emotion and focus their attention elsewhere. This would provide confirmation that the low reactivity in the inferior frontal gyrus of OC users with current negative mood side effects noted by Gingnell and colleagues is indeed associated with low emotional distraction. Lastly, the Gingnell et al. (2013) study only used levonorgestrel-containing (second generation) OCs with the explanation that levonorgestrel has been most linked with negative mood side effects. Undoubtedly, other OCs containing different hormone combinations could have a different effect on brain regions as well as on mood side

effects. Thus, it is of great importance to also look into the differences between women taking different brands and hormonal combinations of OCs as well as to examine emotional and cognitive effects on OC users as a whole. In sum, future studies should investigate the differences between free-cycling women and women using a variety of different generations of OCs in their responses to a diverse range of emotional faces, and in their level of emotional distraction.

In contrast to the finding that OC users may show a quicker response to identify negative emotional stimuli, Gasbarri, Pompili, d'Onofrio, Cifariello, Tavares, and Tomaz (2008) found that naturally cycling women during the late follicular (high estrogen) phase had slower response times and made more errors when trying to remember and respond to certain negative emotional faces. Participants included 56 naturally cycling females who were either menstruating, in the middle to late follicular phase (day 4 to 13), or in the luteal phase (days 14 to 32). They completed a Delayed Matching To Sample (DMTS) working memory task that presented a sample stimulus of a face expressing 1 of 6 emotions (happiness, anger, fear, sadness, disgust, surprise) and after a delay of 8 seconds 4 stimuli appeared of the same actor emitting different expressions. The participant was instructed to choose the expression that matched the one they just saw in the sample stimulus. They found that women during the mid to late follicular phase had higher errors than women in the luteal or menstrual phase when it came to remembering and matching faces emoting sadness or disgust. Furthermore, women in the middle to late follicular phase took significantly longer than the other groups to respond to sad facial expressions. This study further contributed to the evidence that gonadal hormones influence accuracy and speed in recognizing facial emotions.

The authors suggested that because estrogen is known to improve mood, perhaps the high estrogen levels from the middle to late follicular phase caused the women to have problems in identifying mood incongruent stimuli (Gasbarri et al., 2008). Alternatively, the authors suggest that during the middle to late follicular phase the higher levels of estrogen increase a woman's sensitivity to stimuli that have reproductive relevance because the chance of conception is higher (e.g. Krug, Piertrowsky, Fehm, & Born, 1994). Therefore, since sadness and disgust are less important from a sexual or reproductive point of view, women during the follicular phase may be less likely to recognize or correctly identify those emotions (Gasbarri et al., 2008).

Evidently, there may be some important differences in women's emotional reactivity and ability to identify particular emotions depending on their use of OCs, or phase in the menstrual cycle. Moreover, there may be particular subgroups of women that experience negative mood side effects from OCs or a blunting of affect reactivity from OCs. It would be of particular interest to further investigate how OC use and menstrual cycle phase affect emotional reaction to both positive and negative stimuli as well as how they would affect women's ability to recognize various emotions. To date, there has been no study that directly compares how both positive and negative mood or affect might differentially influence emotional recognition abilities of free-cycling, and OC-using women.

Moreover, since both endogenous and exogenous hormones have been shown to influence emotion recognition abilities, there may also be sex differences in the way men and women perform on facial emotion recognition tasks. Previous research has indicated women outperform men on facial emotion recognition (e.g. see reviews in McClure,

2000; Thayer & Johnsen, 2000). Fewer studies, however, have examined sex differences in response times to facial expressions. Rizzolatti and Buchtel (1977) found in their study that men had faster reaction times to faces when the stimuli were presented to the right hemisphere. They found no hemispheric differences for females. However, this study did not take into account the emotional expression of the faces and how the men and women may respond based on the emotional expression. Future studies, therefore, should look into sex differences on performance on facial recognition tasks, including correct identification and differences in response times.

Along with differing responses to facial stimuli, Borgstrom, Kask, Gulinello, Odlind, and Sundstrom-Poromaa (2008) found that women on OCs with current negative mood side effects also differed in their prepulse inhibition (PPI) responses compared to naturally cycling women and OC using women with no mood side effects. Borgstrom et al. (2008) conducted a study examining the acoustic startle reflex of 20 women on OCs with no reported mood symptoms, 28 women currently on OCs and reporting adverse mood side effects, 27 women who has discontinued OCs not due to adverse mood side effects, and 32 women who discontinued OCs due to adverse mood side effects. The acoustic startle reflex was measured via eyeblink responses to the prepulse inhibition (PPI) trials. The prepulse stimuli consisted of 115 dB noise bursts for 40ms followed by 20ms prepulses that were 72, 74, 78, or 86 dB. Those who have the expected reduction in the startle reflex after prepulse exposure are those who are considered to have prepulse inhibition. Deficits in PPI manifest in the inability to filter out unnecessary information and possible abnormalities in sensorimotor gating (see Braff, Geyer, & Swerdlow, 2001 for a review).

Borgstrom et al. (2008) found that the women with current adverse mood effects from OCs exhibited lower levels of PPI at 86 dB compared to current OC users with no adverse mood effects. There was no difference in PPI between the two groups of prior OC users. These findings also replicated Borgstrom's previous findings in patients with Premenstrual Dysphoric Disorder (PMDD) where PMDD patients displayed lower levels of PPI in the late luteal phase (when mood would be most negative) compared to healthy controls (Kask, Gulinello, Backstrom, geyer, & Sundstrom-Poropmaa, 2007). The findings of lower PPI in OC users with negative mood side effects suggest that these women may possibly experience difficulty filtering out unnecessary information.

Holloway, Beck, and Servatius (2011) also found PPI differences between OC users and nonusers even without taking into account mood side effects. Using a classic eyeblink conditioned response, they tested 71 participant's eyeblink responses to a 500-ms conditional stimulus or a 100ms air-puff unconditional stimulus. They found that PPI was lower in both males and OC users than free-cyclers. Also, free-cycling women acquired a conditioned eyeblink response faster than males, and OC users developed an accelerated conditioned eyeblink response compared to non-users. Nevertheless, the authors of this study did not collect information about the mood side effects of their OC users. Therefore, it is difficult to determine if the differences in PPI are due to OCs in general, or if the women in this particular study had negative mood side effects that were not recorded. Nevertheless, it is evident that hormones have an effect on automatic startle responses, which could be a reflection of structural and functional brain differences between OC users and naturally cycling women.

Borgstrom et al. (2008) explained that PPI is subject to regulation by steroid hormones and dysregulation of inhibitory neurotransmission. Inhibition and sensorimotor gating are regulated by GABA receptors in several brain regions. Disturbances in GABAergic systems have been shown to contribute to deficits in PPI. For example, pharmacological interventions (such as GABA antagonist picrotoxin) aiming to decrease GABAergic inhibition in the hippocampus as well as the medial prefrontal cortex also result in PPI deficits (Japha & Koch, 1999). Therefore, it is possible that women taking OCs or women experiencing negative side effects from OCs may be experiencing GABAergic disturbances. This finding fits with the findings of the Follessa et al. (2002) study which investigated the effects of OCs in rats and women. They found that 3 months of treatment with an ethinyl estradiol and levonorgestrel OC (second generation OC) resulted in decreased levels of progesterone and its $GABA_A$ receptor-active metabolite allopregnanolone in both rats and women. Moreover, rats treated with OCs displayed more anxious behaviours during a maze test. Since the $GABA_A$ system is the major inhibitory system in the CNS of mammals, reduction of its metabolites can cause disturbances in steroid hormone concentrations as well as in functional behavior. Using a task that taps into inhibitory processes and examines an individual's ability to inhibit certain responses could determine possible GABAergic disturbances that affect functioning in OC users and would be an interesting avenue for future studies.

Indeed, Bannbers et al. (2012) conducted a study looking at how hormones affect response inhibition among 13 healthy postpartum women. The women were tested immediately after delivery and 4 to 6 weeks after delivery in order to capture the dramatic drop in progesterone and estradiol, and the abundance of ovarian steroid receptors in the

brain following delivery. The women performed a non-emotional Go/Nogo task while undergoing an fMRI. The Go/Nogo task instructed participants to press a button whenever the letters X or Y appeared but to refrain from pressing the button when the same letter was presented two times in a row. Scans from the fMRI showed that correct inhibition to Nogo trials activated several areas of the brain that are responsible for inhibition including the left inferior frontal gyrus, right superior frontal gyrus, right ACC, left cingulate gyrus, right posterior cingulate gyrus, and left parahippocampal gyrus. Also, fMRIs revealed a decrease in activation in task-related and ovarian steroid-related brain areas such as the right inferior frontal gyrus, right ACC, and bilateral precentral gyrus in the late post-partum phase. However, no difference in performance during response inhibition was detected across the postpartum period or between the postpartum women and non-postpartum controls. Despite the lack of group differences in performance, this study found important brain activation patterns responsible for inhibition in women.

Albert, Lopez-Martin, and Carretie (2010) also investigated behavioural inhibition, however they used an emotional rather than a non-emotional GoNogo task. Thirty healthy students (16 females, 14 males) were instructed to press a key with their right thumb when they saw the letter “M” (Go task) and not press the key if they saw the letter “W” (Nogo task). The letters would appear on top of an image selected from the IAPS that was deemed as positive, negative, or neutral in valence. Error rates, response times, and ERP data was collected. Error rates were higher for the nogo trials than the go trials meaning it was generally harder for participants to inhibit a response than to respond, regardless of the emotional context of the pictures. In contrast, response times

on the Go trials differed based on the emotional context. Response times were shorter in the positive context for the Go trials than in the negative and neutral contexts.

ERPs showed that, during the nogo trials, P3 amplitude was larger and anterior cingulate cortex activation was stronger in the positive context than in the negative context (Albert, Lopez-Martin, & Carretie, 2010). P3 is a component of the frontocentral area of the brain that is related to the inhibitory process. Therefore, the positive emotional contexts require the mobilization of inhibitory resources more than negative emotional contexts in healthy individuals. Furthermore, the authors found that it was valence and not arousal that was associated with the Nogo-P3 amplitude. Based on P3 and cingulate cortex activation, they concluded that withholding a prepared response within a positive context is more difficult and consumes greater inhibitory resources than within a negative context, regardless of the arousal level of the context.

Nevertheless, Albert, Lopez-Martin, and Carretie (2010) did not take hormonal influences into consideration and did not explicitly include women on OCs with negative mood side effects in their study. While it can generally be expected that most individuals can more easily inhibit their responses to negative stimuli (Albert, Lopez-Martin, & Carretie, 2010), there may be a different pattern for women on OCs with negative mood side effects. In the Gignell et al. (2013) study mentioned above, women on OCs who had previous negative mood side effects who were viewing angry and fearful faces responded much faster to the faces and showed decreased activation in the inferior frontal gyrus (indicating low emotional distraction) as compared to women not on OCs. Interestingly, the pattern observed among women who are correctly inhibiting a response as shown in the Bannbers et al. (2012) study is that women had increased activity in the inferior

frontal gyrus while correctly inhibiting a response. Perhaps women taking OCs with negative mood side effects are a specific subgroup of individuals that have lower emotional distraction after viewing emotionally negative stimuli and therefore have differing inhibitive responses compared to women with no negative mood side effects. It would be of interest for future studies to investigate whether emotional inhibitory processes generally differ between OC users and nonusers or if emotional inhibitory processes are particularly affected in women with negative mood side effects (either generally or when taking OCs).

In sum, natural hormonal fluctuations and OC use have been shown to influence women's performance on emotional and inhibitory tasks. Women on OCs with negative side effects have an accelerated ability to detect negative emotional faces (Gignell et al., 2013), while naturally cycling women in the high estrogen phase (late follicular) have a decreased ability to detect negative emotional faces (Gasbarri et al., 2008). Additionally, regardless of mood side effects, women on OCs have generally shown a decreased ability to inhibit behaviour as seen in PPI studies (Borgstrom et al 2008; Holloway, Beck, & Servatius, 2011), which may be explained by hormonally induced GABAergic disturbances (Borgstrom et al., 2008; Follesa et al., 2002). Future studies should further investigate the facial-expression detecting performances of women on OCs and free-cycling women across the menstrual cycle. Moreover, future studies should also investigate inhibitory responses in an emotional context in order to tap into possible hormonally-related differences in emotional inhibition (Albert, Lopez-Martin, & Carretie, 2010; Bannbers et al. 2012).

Cortisol and Affect

Another possible explanation for the emotional differences between free-cyclers and women using OCs is the possible moderating effects of cortisol. A study by Kirschbaum, Pirke and Hellhammer (1995) found no differences in baseline cortisol levels between OC users and non-users, but instead found significantly attenuated cortisol responses in OC users during the Trier Social Stress Test (TSST) compared to non-users and men. The TSST requires participants to perform a 5-minute public speaking task and a 5-minute mental arithmetic in front of an audience. In response to the stressor, women on OCs showed peak cortisol levels only slightly elevated above baseline, less than half of what was found in non-OC users. The authors suggest that this could provide preliminary evidence for an altered hypothalamus-pituitary-adrenal (HPA) Axis due to OC use. Yet despite the differences in cortisol responses, they found no significant differences in perceived stress between subject groups as measure by a Visual Analogue Scale (VAS).

Interestingly, Het and Wolf (2007) found that when women on OCs were treated with exogenous cortisol, the cortisol did indeed have buffering effects on mood in response to the TSST. Forty-four women on monophasic OCs (containing a progesterone derivative and between 0.02 to 0.035 ethinylestradiol) were treated with 30mg cortisol or matching placebo before participating in the TSST. They found the women treated with placebo had a blunted free-cortisol response to the TSST as previously established by Kirschbaum and colleagues (1995). Moreover, the women treated with cortisol reported significantly less negative mood than the women treated with placebo. Het and Wolf (2007) offer several explanations as to why cortisol may inhibit a stress response.

Cortisol treatment may modulate the emotional processing pathway including the network involving the prefrontal cortex, amygdala, insula, basal ganglia and anterior cingulate. Alternatively, cortisol may exert a negative feedback response on the hypothalamic neurons and cause cortisol-treated individuals to have a reduced central corticotropin-releasing hormone (CRH) secretion in response to a stressor and thus, reduce negative affect.

These studies show that while the blunted free cortisol response affects some important brain mechanisms, it does not always influence affective response to a psychosocial stressor. Also, Kirschbaum, Pirke and Hellhammer (1995) studied naturally occurring levels of cortisol while Het and Wolf (2007) administered synthetic cortisol. Therefore, any differences in the reported mood effects subsequent to the stressful event may not be comparable between the two studies. It would be of interest to further investigate the emotional reactions of OC users and non users experiencing a variety of different emotions, stressful or otherwise, to determine if there are differences in reported affect. For example, if there is an altered HPA axis reactivity, this may be evident in a blunting of other stressful emotions such as fear, rather than social stress.

Interestingly, despite the above finding that cortisol may have a protective effect in terms of experiencing negative affect, Merz et al. (2012) found that cortisol actually enhanced implicit fear learning in women on OCs. Participants were given 30 mg of cortisol or matching placebo and shown three different shapes on a screen in random order with one shape consistently being paired with a mild electric shock. The participants were not told about when to expect the shock. Fear conditioned responses were detected via brain scans and skin conductance responses. Brain scans revealed an

increase in neuronal differentiation in women using OCs and reduced fear learning in the anterior parahippocampal gyrus and the hippocampus in men and naturally cycling women. Thus, Merz et al. (2012) stated that cortisol enhanced fear conditioning for OC users yet decreased fear conditioning in men and women both in the luteal and follicular phase. They concluded that OC usage modifies cortisol effects on emotional learning.

In 2013, Merz, Stark, Vaitl, Tabbert, and Wolf conducted another study on cortisol and fear conditioning. However, they did not administer cortisol and instead sampled endogenous cortisol levels from the participants' saliva. The participants were again shown three different shapes but this time were told explicitly when to expect a mild electric shock. Through fMRI, a higher conditioned-unconditioned stimulus differentiation was revealed in the amygdala of women during their follicular phase compared to men and OC users. In other words, women during their follicular phase demonstrated the strongest neuronal evidence of the conditioned response as compared to men and OC users. This result is congruent with previous research that has suggested that women on OCs have an attenuated cortisol response and that cortisol enhances fear conditioning. If cortisol enhances fear conditioning (i.e., Merz et al., 2012) and women on OCs have an attenuated cortisol response (i.e., Kirschbaum, Pirke & Hellhammer, 1995; Het & Wolf, 2007) then it would be expected that women on OCs would have weaker cortisol response and thus a weaker conditioned-unconditioned stimulus differentiation compared to naturally cycling women. This might also suggest that women taking OCs would be less able to implicitly or automatically differentiate relevant fearful stimuli from irrelevant stimuli and may thus overreact to irrelevant stimuli (i.e., a failure of inhibition).

Nevertheless, neither of the Merz et al. (2012) or Merz et al. (2013) studies collected mood or affect information from their participants so it remains unknown as to whether these cortical structural and neuronal differentiations would translate into actual enhanced or decreased feelings of fear. It would be of interest for future studies to further investigate whether or not there are hormonal and OC-related influences on reactivity to fear stimuli.

The Effects of Hormones on Cognition

Along with hormones affecting brain regions related to emotion and inhibition, hormones also largely affect brain areas related to cognition and performance on cognitive tasks (see reviews in Kimura, 1996;Torres, Gomez-Gil, Vidal, Puig, Boget & Salamero, 2006). In reviews on sex hormones and cognitive tasks, women tend to outperform men in tasks of verbal memory, verbal fluency, item memory, and the specific visuospatial task of object location memory (Kimura, 1996; Torres et al., 2006). Also, men generally tend to outperform women on mental rotation tasks (Collins & Kimura, 1997), targeting tasks, and generally all visuospatial tasks with the exception of object location memory (Kimura, 1996). Within women, performance on spatial tasks is improved during the early follicular phase (menstruation) compared to during the late follicular or midluteal phases (Collins & Kimura, 1997; Torres et al., 2006). In fact, spatial working memory is related to the hippocampal region in humans and hippocampal volume in women has shown to change across the menstrual cycle (Pleil & Williams, 2010). This hormonally related change in the hippocampus has led to performance variations on certain hippocampal-related cognitive tasks (Pleil & Williams, 2010).

A study conducted by Postma, Winkel, Tuiten, and Van Honk (1999) found sex and hormonal differences on a visuospatial task in their sample of 23 males and 34 females. The participants viewed a screen that contained 10 of the same objects for 30 seconds. The objects then disappeared and reappeared again in different locations and the participants were asked to move the objects back into the original positions. Males showed a selective advantage for this metric position reconstruction task compared to women. From these results, the authors conducted another study to investigate the differences within women.

In their second study, Postma et al. (1999) examined spatial abilities in women as a function of menstrual cycle phase using a between-subjects design (22 OC users, 11 naturally cycling women). Combining both the free-cycling and OC-using women, those in the non-menstrual phase performed better on the position reconstruction task than those during the menstrual phase. Unfortunately, since naturally cycling women and OC users were analyzed together, interpretation of the differences in spatial ability should be made with caution. The authors found that OC use did not yield any significant main effects, however the sample of OC users (22) and naturally cycling women (11) was small and may not have been powerful enough to detect an effect. A within-subjects design would have been more sensitive in this study. Furthermore, women were grouped as either menstruating or non-menstruating and there was no differentiation between luteal and follicular phases. Future research would need to group naturally cycling women based on their phase in the menstrual cycle as cycle phase has been shown to influence spatial abilities (Collins & Kimura, 1997; Torres et al., 2006) and brain region activation patterns during spatial tasks (Pleil & Williams, 2010). Furthermore, when

studying women on OCs, the particular hormonal combination of each woman's OC should be taken into consideration as different OCs types have also been shown to differentially influence performance on spatial tasks (e.g., Wharton et al., 2008).

Indeed, a study conducted by Wharton et al. (2008) indicated that certain types of OCs affect visuospatial skills in different ways. Wharton and colleagues conducted a between-subjects design and recorded the performance of 155 females on a Mental Rotation Task and a Recognition Memory Task. Women on anti-androgenic pills (New generation pills such as Yasmin®) showed the worst performance on the Mental Rotation Task compared to nonusers. Second generation users, on the other hand, had a tendency to outperform nonusers on the Mental Rotation Task, however this difference was not significant. Their results generally showed a correlation between androgenic activity in OCs and visuospatial performance with higher androgenic activity being associated with better performance on the MRT. This result is consistent with previous studies indicating that androgenic or "male hormones" are related to better performance on visuospatial tasks (Collins & Kimura, 1997; Kimura, 1996).

Interestingly, Wharton et al. (2008) did not find any differences on the Recognition Memory Task, confirming that spatial tasks such as the MRT are more affected by androgenicity than verbal recognition tasks. Additionally, no significant difference in performance was found between menstrual cycle phases for free-cyclers during different phases of their cycle. This is inconsistent with previous findings indicating performance difference across the menstrual cycle (Collins & Kimura, 1997; Torres et al., 2006). Nevertheless, the means followed the expected direction of higher

performance on the MRT during the menstrual phase followed by the follicular and luteal phase, respectively.

Evidently, while it is important to investigate general differences between naturally cycling women and women on OCs, studies such as that by Wharton et al. (2008) demonstrate the importance of taking into consideration the differences in hormonal combinations within OC users. It is possible that inconsistencies in findings or lack of differences in visuospatial performance between men and women and across the menstrual cycle may be a result of researchers grouping all OC users together or grouping all women together without taking OC use into account.

Along with influencing spatial navigation, hormones also influence performance in other important cognitive areas. Miller, Conney, Rasgon, Fairbanks, and Small (2002) examined the verbal fluency and working memory of 31 postmenopausal women using Estrogen replacement Therapy (ERT) (19 using an estrogen-progesterone combination, 12 using estrogen only), 16 nonusers, and 49 men. They found that the post-menopausal women using ERT had less-severe symptoms of depression and anger and performed better on a verbal fluency, and a working memory and attention task than non-ERT users. Furthermore, ERT users performed better on semantic fluency (generating words in a category) than men. On the other hand, men had lower levels of anger and better working memory than women who do not use ERT. There were no significant correlations between the cognitive factors and the mood variables.

Interestingly, the authors noted that ERT was associated with several variables that are modulated by the orbitofrontal areas such as mood, verbal fluency, and working memory. This is consistent with the fact that estrogen receptors are found in higher

concentrations in the orbitofrontal areas such as the basal forebrain and locus coeruleus (responsible for the mood-related origin of cholinergic pathways and norepinephrine production, respectively), the frontal lobe (modulates the verbal encoding and retrieval system), and the hippocampus (modulates learning and semantic memory). Therefore when estrogen is high in these areas of the brain, performance is likely to improve in tasks tapping into these functions or abilities.

When considering the potential effects of OCs on mood or cognition, however, it is particularly helpful to look at the possible effects of estrogen on premenopausal women. Vranic and Hromakto (2008) studied the working memory of 96 women by having them complete a working memory task that involved matching the faces of adult men and infants. Twenty-seven women were on tri-phasic OCs and 69 were naturally cycling. They found that regardless of whether women were free-cycling or using OCs, when women were in their high estrogen phases (both midluteal and late follicular) they were more efficient in solving the memory task with adult male faces than were women in the low estrogen phase of their cycle (early follicular). There was no difference in task performance with infant faces indicating that there is a differential influence of estrogen on working memory when different stimuli are used. A potential explanation for this is that women are more fertile in their high estrogen phase as it typically occurs close to ovulation. Therefore, adult male faces may be more salient to women in this more fertile high estrogen phase. However, this explanation is only valid for women during their late follicular phase as the late follicular phase is when women are most fertile. Another possible explanation is that during high estrogen phases, the encoding of male faces is deeper than during low estrogen phases (Vranic & Hromakto, 2008). Nevertheless, more

research would be needed to directly identify whether or not adult male faces are more deeply encoded during high estrogen periods than other types of faces such as adult female faces, for example.

Along with estrogen, progesterone is also associated with some important areas of cognition. Schultheiss, Patalakh, and Rosch (2012) explain that progesterone influences cognition, emotion, and behaviour by binding to the GABA receptors which, as previously discussed, have an inhibitory effect on neural signal transmission. Therefore progesterone can have wide-ranging effects on alertness, emotionality, and learning. Furthermore, it had been found that progesterone influences lateralization. Women in the lower progesterone (early follicular) phase show lateralization on tasks for which lateralization is typically found. For example, women in the early follicular phase show high activation in the left-brain during a verbal task. Women during their high progesterone (mid luteal) phase, however, show less lateralization on tasks for which lateralization is typically found. For example, women with high progesterone will show brain activation in both the left- and right-brain during a verbal task. (Hausmann, Slabbekoorn, Van Goozen, Cohen-Kettenis & Gunturkun, 2000).

In their study, Schultheiss, Patalakh, and Rosch (2012) recruited 28 OC users, 14 nonusers, and 50 men who provided saliva samples for cortisol and progesterone levels and completed a number of cognitive tasks including the Lateralized Network Attention Task. Assessment of alerting was tested by presenting a cue that precedes the target stimulus of an arrow point either up or down. Faster responses on cued rather than uncued trials indicate efficient alerting. Assessment of orienting was tested using the same concept as alerting however the cues would appear in different locations across the

screen. Correctly identifying cues that were in the same location as the target stimuli was indicative of efficient orienting. Conflict resolution performance was indicated by how long the participant responded when a target arrow was present within an incongruent context (i.e. presented with another arrow pointing in a different direction than the target arrow). Slower responses on incongruent trials than on congruent trials was an indicator of less efficient conflict resolution.

Schultheiss and colleagues (2012) found that high progesterone levels, regardless of OC use or non-use, were linked to lower inter-hemispheric correlations for alerting and orienting (functions dependent on the posterior and subcortical brain networks) but were linked to a higher correlation of conflict-resolution performance (functions dependent on prefrontal brain functions such as the anterior cingulate). Higher progesterone was also linked to slower interhemispheric transfer times. This study shows the complicated interaction between hormones and cognition. Evidently, depending on the task, progesterone may influence performance in different ways. It could be expected that attention tasks that rely on subcortical structures would show worse performance during high progesterone periods, while tasks tapping into prefrontal brain regions like judgment and working memory may show improved performance during high progesterone periods.

Nevertheless, differences in brain activation do not always lead to differences in performance on a task. A study by Rumberg et al. (2010) sought to investigate the cycle- and gender-dependent cerebral activation effects in 12 males, 12 females using OCs, and 12 females not using OCs during a verbal generation task. For male subjects, the regions that were most activated were the left inferior frontal, the left medial temporal, and the

left prefrontal cortex. For female subjects regardless of cycle phase or OC use, the areas that were the most activated were left inferior frontal, the left medial temporal, and the bilateral occipital cortex. Women scanned during their menses and during their luteal phase did not show brain differences during the verbal generation task. However, women using OCs showed higher levels of activation in the right superior temporal cortex during verb generation compared to free-cycling women in the menstrual phase. Higher levels of activation for OCs users were also found in the right inferior frontal cortex compared to women in the mid-luteal phase. Overall, the study by Rumberg and colleagues showed significant sex differences in cerebral activation when women were in their mid-luteal phase however no groups showed significant difference in their performance on the tasks.

Similarly, Kucian, Loenneker, Dietrich, Martin, and Von Aster (2005) had a small sample of men and women complete a calculation task, a magnitude task, or a mental rotation task while scanning their brains with an fMRI. During the mental rotation task, women showed a significant bilateral activation during mental rotation in the inferior parietal lobe, the visual areas, fusiform gyrus and the inferior frontal gyrus. Men, on the other hand, showed activation in a similar but more diffuse network than women during mental rotation. Generally, women utilized additional brain regions during approximation calculation, exact calculation, and mental rotation tasks compared to men. No gender differences were found, however, in terms of accuracy or performance on any of the cognitive tasks. Additionally, Bell, Willson, Wilman, Dave, and Silverstone (2006) found brain activation differences among their sample of 23 males and 10 females completing four separate digit memory, spatial attention, word generation, and motor tasks. Yet, there were no significant sex differences in performance on any of the tasks. Evidently, brain

activation patterns are not always indicative of actual functional differences. More research needs to be done to further clarify precise hormonal influences on performance on cognitive tasks.

Mood Induction and Cognition

When looking at hormonal influences on cognition many studies do not take into account mood or affect variables. Understanding how hormones influence the experience of certain emotions, and how those emotions in turn influence cognition was an integral component of this current study. Consequently, it is important to first understand different methods of mood induction and how mood influences performance on cognitive tasks (See Gilet, 2008; Västfjäll, 2002 for a review).

Generally, it has been found that positive mood leads to improved performance on a variety of tasks. For example, Lesiuk (2010) examined 24 computer information systems developers who participated in a 3-week study where they listened to their own music whenever they wanted for the first and last week, and no music during the second week. Cognitive performance scores were measured by self-report Quality of Work questionnaires. Mood and cognitive performance were significantly improved during the music listening weeks versus the non-music listening week.

Brand and Opwis (2007) found that a positive mood increases cognitive performance. Males and females were instructed to write about a positive or negative event for 15 minutes. They were then asked to solve several problem-solving tasks in pairs and alone. They found that positive mood facilitated individual transfer performance of a previously learned task acquired in dyads or alone.

Indeed, the dopamine released from positive mood induction could be responsible for helping several cognitive functions. Fried et al. (2001) explains that dopamine potentiates the firing or delay-active neurons thought to be critical for working memory. Moreover, in the amygdala, dopamine projections from the midbrain are thought to modulate the associative learning processes, particularly those involving behavioural responses to rewarding or aversive stimuli. The amygdala and the prefrontal cortex are interconnected and activity in one can affect activity in the other.

Fried et al. (2001) used intercerebral micro dialysis to directly sample extracellular dopamine in the amygdala of seven patients undergoing evaluation for epileptic surgery. They found that dopamine release in the amygdala was related to learning performance. In their study, participants completed a working memory task accompanied by a controlled reading task, followed by a rest period and then a word paired-associates learning task. The data appeared to reveal two groups of people. In one group, the rise in dopamine was transient and was coincident with the early phase of the task when most of the learning occurred. These subjects learned 95% or more of the paired associates and had 75% correct by the end of this trial. In the second group, however, the rise in dopamine was protracted and these subjects never learned more than 60% of the pairs and knew 40% or less by the third trial. Therefore, increase in dopamine release in the amygdala is related to learning performance.

On the other hand, negative mood induction may have a more complex effect on cognition. Chepenik, Cornew, and Farah (2007) found that sad mood affected performance on only certain types of cognitive tasks. Participants (14 men and 19 women) were induced with a sad or neutral mood and were required to subsequently

perform a series of cognitive tasks. All participants were tested under both a neutral and sad mood condition one week apart. To induce sad mood, the experimenters read a script to the participants that involved imagining the death of a loved one while mood congruent music played. To induce neutral mood, the experimenters read a script to the participants that involved them imagining they were going to the grocery store while mood congruent music was played. The participants then completed working memory tasks (object 2-back and digit span); cognitive control tasks (Stroop Color-Word Interference, Go/Nogo); and attention, perception, and memory for affectively valenced materials tasks (Attention Probe, Free Recall and Recognition Memory, and Facial Emotion recognition). They found that sad mood caused a significant bias in recognition memory towards negatively valenced words relative to the neutral mood condition, however, overall word recognition was not affected by mood. Additionally, sad mood caused more inaccuracies in facial emotion recognition than neutral mood, however, sad mood did not cause a bias towards mislabeling non-sad faces as sad. There was no difference in performance between sad and neutral mood for the other cognitive tasks. Evidently, sad mood does not influence performance on cognitive tasks across the board but rather influences performance on memory of emotionally relevant words and facial recognition tasks.

Interestingly, Spering, Wagener, and Funke (2005) found that induced emotions did not affect overall performance on their cognitive task, however, induced positive or negative emotions did influence the types of strategies used by individuals. Participants were given false positive or false negative feedback about their performance twice throughout a complex cognitive task (computer-simulated town). The computer-

simulated task required participants to manage a forest enterprise (plant, grow, cut down tress, and maintain tree and soil quality) over 50 months at a profit. Those who were induced with negative emotion tended to adopt a more detail-oriented and information search approach than those who were in the positive induction group.

Some individuals, however, are more likely to attempt to suppress their emotions during a negative emotional event. Pu, Schmeichel, and Damaree (2009) found that participants who were suppressing their emotions during a negative emotional video performed worse on verbal and spatial working memory tasks than those who did not suppress emotions and than those in the neutral film condition. Facial expressions of 136 participants were recorded while watching either an emotionally negative or neutral film clip and emotional responses were assessed afterwards. Visual and spatial working memory tasks were performed both before and after film clips. Participants with higher resting Respiratory Sinus Arrhythmia (RSA) showed less emotional facial expressions but reported the same amount of negative emotion as those with lower resting RSA. However higher resting RSA individuals had smaller pre-film to post-film improvements in spatial working memory performance in the negative film condition. This expressive suppression, therefore, temporarily undermined the operation of working memory. For the neutral film condition, resting RSA did not relate to expressive or subjective responses or differences in working memory performance.

Two common explanations for the decrease in cognitive performance subsequent to negative mood induction are the capacity position (Pu, Schmeichel, & Damaree, 2009) and the strategy position (Spering, Wagner, & Funke, 2005). The capacity position suggests that negative mood induction decreases processing capacity, thus causing

individuals to perform worse on cognitive tasks. The strategy position, on the other hand, suggests that negative mood induction results in systematic, analytical, and detail-oriented strategies. In the Pu et al. study discussed above, emotion suppression after a negative mood induction may have utilized valuable cognitive resources that undermined the participant's ability to perform on the verbal and spatial tasks. Thus the Pu et al. findings provide support for the capacity position. The Spering et al. study, on the other hand, demonstrated that negative mood did not influence performance on the tasks, but instead influenced the strategic approach to the task. Thus, Spering et al. showed clear support for the strategy position rather than the capacity position.

Another element of affect worth exploring in relation to cognitive performance is whether the emotion evokes an approach or avoidance motivation within the individual. Papousek, Schulter, and Lang (2009) had 70 female participants watch videos of an actress going through particular emotional states (anger, sadness, joy) and they were asked to identify with the actress and indicate how the short clips made them feel and their tendency to want to approach or avoid the person in the video. The participants then completed a verbal and figural fluency task. They found that both approach motivation and low intensity of emotional arousal were associated with relatively better left (Verbal fluency) than right (Figural fluency) hemisphere performance. Withdrawal motivation and high intensity of arousal were associated with relatively better right (Figural fluency) than left (Verbal fluency) hemisphere performance. These results may possibly relate to the Albert, Lopez-Martin, and Carretie (2010) findings from their study on the emotional Go/Nogo task. Since it is harder to inhibit a response during the positive emotional context on the emotional Go/Nogo task, it could be that positive emotions generally elicit

an approach reaction while negative emotions elicit a withdraw reaction. Nevertheless, the Papousek, Schulter, and Lang (2009) study did not necessarily find approach-withdraw reactions consistent across emotions. For example when angered, some individuals may feel a withdraw response and prefer to avoid the source of anger, while others may feel an approach response and prefer to approach or confront the source of anger. Thus, approach-withdraw information would be valuable to consider when using emotion induction in a future study as it may influence performance on cognitive tasks irrespective of the type of emotion.

Bartolic, Basso, Schefft, Glauser, and Titanic-Schefft (1999) also looked at how mood induction influences performance on left and right hemisphere tasks. Either a positive or negative Velten Mood Induction procedure was performed on 60 women who subsequently performed either a verbal or figural fluency task. Euphoria resulted in better verbal than figural fluency (i.e. better left than right hemisphere performance) while dysphoria resulted in better figural than verbal fluency (i.e. better right than left hemisphere performance). Evidently, both positive emotion, and approach response are related to better performance in tasks that engage the left hemisphere while negative emotion and withdrawal response are related to better performance in tasks that engage the right hemisphere. Nevertheless, Bartolic et al. (1999) did not collect menstrual cycle phase data. Since the presence of progesterone may influence laterality of tasks, it would be important for future studies to collect hormonal data in order to better determine the variables influencing performance on cognitive tasks

Basso, Schefft and Hoffman (1994) found that an individual's affect intensity also affected cognitive performance. Female participants were given false negative or positive

feedback on IQ performance and given questionnaires to measure their affect intensity and mood prior to performing a verbal learning task. Interestingly, after a positive mood induction, individuals with low affect intensity outperformed individuals with high affect intensity on a verbal learning task. On the other hand, after a negative mood induction, individuals with high affect intensity outperformed individuals with low affect intensity on a verbal learning task. The authors explain that individuals with high affect intensity generally tend to be more drawn towards positive affect-related stimuli relative to low-affect intense individuals. Furthermore, task performance is disrupted when attention resources are taken away from the task and directed toward emotionally related stimuli. Therefore, when high affect intense individuals experience positive emotion, the experience of the positive emotion draws more attentional resources and thus results in poorer performance on learning tasks.

However, Basso, Schefft and Hoffman (1994) investigated women with no known negative mood problems and did not collect information on hormones or use of oral contraception. Therefore, women on OCs with negative mood side effects, for example, may have a different response than other women with no mood side effects. Indeed, individuals with high affect intensity and negative mood side effects may potentially be more drawn towards negative stimuli rather than positive. However, as demonstrated by Cheperik, Cornew, and Farah (2007), and Spering, Wagner and Funke (2005) negative emotion may have a more complex effect on cognitive performance and does not necessarily hinder cognitive performance across the board. Future studies investigating hormones, emotions, and cognition should take into account possible hormonally-related

mood side effects, various reactions to different types of negative emotions, as well as affect intensity.

Current Study

As reviewed above, both exogenous and endogenous hormones affect the structure and function of the brain in many important ways. Despite consistent differences in brain activity, however, studies on emotional and cognitive function differences between women on OCs, naturally cycling women, and men have been inconsistent. This current study aimed to investigate any differences in the emotional variability, reactivity, and cognitive performance of women on OCs, naturally cycling women, and men. This was the first study to our knowledge that compared the cognitive performance of free-cycling women and women on OCs after mood induction. In this study, participants underwent three different mood inductions (happy, sad, and fear) via an emotional video paired with mood congruent music. After each and every mood induction, participants performed two cognitive tasks aimed to tap into facial recognition, inhibition, and attentional abilities. Despite a lack of consensus in the literature about hormonal influences on emotion and cognition, however, several hypotheses were made about the potential outcomes for this study.

The first hypothesis (Hypothesis 1) was that there will be reduced positive affect reactivity across the lab session among OC users compared to naturally cycling women. This hypothesis was an attempt to replicate the Jarva and Oinonen (2007) findings of blunted positive affect variability among women taking OCs. The Jarva and Oinonen (2007) study used the term ‘variability’ to capture the variability of emotional reactivity

of the participants across the laboratory session. For the purposes of this study, however, the term 'reactivity' is used as a more accurate way to describe the same phenomenon.

The second hypothesis (Hypothesis 2) was that women on OCs with current negative mood side effects will have quicker reaction times to negative faces, especially during negative emotion inductions, and make overall more errors in facial emotional recognition compared to women on OCs with no current negative mood side effects, free-cycling women, and men. This hypothesis was based on one study which indicated that women on OCs with current negative mood side effects have quicker reaction times to angry and fearful faces as well as lower activity in the inferior frontal gyri and left insula while viewing angry and fearful faces (Gingnell et al., 2013). Lower activity in the inferior frontal gyri suggests lower emotional distraction likely because the women on OCs with current negative mood side effects were viewing negative (thus, mood-congruent) faces. Therefore, it was predicted that after the negative mood inductions, the salience of the mood-congruent stimuli would be higher for OC users with current negative mood side effects and the OC users with current negative mood side effects would respond even quicker the negative faces compared to the other groups.

Lower activity in the inferior frontal gyri, however, also may be indicative of lower response inhibition and potentially blunted processes related to social interaction, such as empathy (Hampshire et al., 2010; Liakakis et al. 2011; Wang et al., 2008). Therefore, OC users with current negative mood side effects may respond in a less inhibited manner to the emotional facial stimuli, have a lower ability to recognize facial emotions and thus, make overall more errors during the facial emotion recognition task

compared to the other groups. This is expected to occur across the laboratory session regardless of mood induction.

The third hypothesis (Hypothesis 3) was that women on OCs will make more errors of commission on the GoNogo task than free-cycling women and men, especially during the positive mood induction. This hypothesis was based on previous literature that indicated that quicker response times occur during the positive context of the emotional GoNogo task (Albert, Lopez-Martin, & Carretie, 2010). The same study also reported that, generally, individuals make more errors of commission rather than errors of omission regardless of the emotional context. Since women on OCs have been shown to have lower pre-pulse inhibition (Borgstrom et al., 2008; Holloway, Beck, & Servatius, 2011) and possible GABAergic disturbances (Borgstrom et al., 2008; Follesa et al., 2002; Schultheiss, Patalakh, & Rosch, 2012), it was predicted that they would show more pronounced difficulty inhibiting their responses. Moreover, since the Albert, Lopez-Martin, and Carretie (2010) study demonstrated that individuals have a more difficult time inhibiting their responses during positive emotional context, these effects were expected to be further pronounced after the positive mood induction.

The fourth and final hypothesis (Hypothesis 4) was exploratory in nature. It was expected that OC users would differ in their overall performance on the cognitive and perceptual tasks as a function of the mood primes compared to free-cycling women and men. This hypothesis was nondirectional in nature. Positive mood induction has been shown to improve performance on cognitive tasks (Brand & Opwis, 2007; Fried et al., 2001; & Lesiuk, 2010). However if women on OCs have a blunting of positive affect

variability (Jarva & Oinonen, 2007), positive mood induction may not necessarily improve performance relative to the other mood inductions for this group.

Method

Participants

Screening phase. A total of 377 participants (mean age = 22.02 *SD* = 5.78; 138 OC users, 73 nonusers, 76 men) completed an online screening questionnaire and provided enough data to be used for the analyses in this phase (for frequencies and percentages of demographic variables see Table 1).

Participants were recruited from Psychology and other university classes at a Canadian university as well as from the local community. University students were 16 years and members of the general public were 18 years or older. University students were recruited directly through classroom visits, or indirectly through email, and posters. From the larger community, participants were recruited through the use of posters. Additionally, emails were sent out to individuals in the Health Hormones and Behaviour (HHAB) lab's database who have previously indicated an interest in being contacted for future studies. Lakehead University's Research Ethics Board (REB) approved the project and all recruitment materials (Appendix I to L). All participants were told that they were being recruited for a project investigating the effects of sex and hormones on emotion. Students received a one-half bonus point towards their Introductory Psychology mark for their participation in the screening phase of the study. No exclusionary criteria were used at this phase of the study.

Table 1

Frequencies (Percentages) of Demographic Information for Participants in the Screening and Laboratory Phases of the Study

Variable	Screening Phase (n = 377)	Laboratory Phase (n= 147)
Sex		
Male	76 (20.2)	38 (25.9)
Female	301 (79.8)	109 (74.1)
Ethnicity		
Caucasian or European	314 (83.28)	125 (85.03)
African-Canadian/ America/Black	16 (4.2)	6 (4.1)
First Nation/ Aboriginal/ American Indian	17 (4.5)	5 (3.4)
Other	40(10.61)	11 (7.48)
Highest Education		
Less than High school	2 (0.6)	0 (0.0)
Completed High School	50 (13.3)	22 (15.0)
Some College or University	266 (70.56)	97 (65.99)
Completed College or University	41 (10.88)	17 (11.56)
Some Graduate Studies	2 (0.5)	2 (1.4)
Completed a Graduate Degree	16 (4.2)	9 (6.1)

Note. For laboratory phase, there were missing data for 2 participants.

Experimental Phase. From the participants in the screening phase, 149 volunteers (mean age = 21.82, *SD* = 4.22) participated in the experimental phase of the study (58 OC users, 46 nonusers, and 38 men). The 58 OC users included 15 (25.9%) with current OC negative mood side effects and 43 (73.1%) without current negative mood side effects (see Table 2 for frequencies and percentages of OC brand usage). The 46 nonusers or naturally cycling women included 20 (18.7%) previous OC users and 26 (24.3%) never-users. Inclusion criteria for the OC user group included a minimum of 2 months of OC use. All naturally cycling women were selected based on the criterion of no OC use for the past 2 months (see Table 3 for means and standard deviations of length of OC use for current OC users and length of nonuse for previous OC users). Women on OCs with current negative mood side effects were determined based on their answers to questions in the screening questionnaire regarding their belief that OCs are currently causing them negative emotional symptoms. Women that indicated experiencing one or more current negative mood side effect(s) from OCs were categorized into the OC users with current negative mood side effects group.

There were eight exclusion criteria used to select participants for the laboratory portion of the study. In order to ensure that women of reproductive age were sampled, peri-menopausal and post-menopausal women were excluded from participation (*n* = 11). Participants taking psychotropic medication(s) or anti-depressants at the time of screening (n = 40), participants 45 years or older (n = 9), participants who have been on OCs for less than 2 months (n =8), participants who have been off OCs for less than 2

Table 2

Frequencies (Percentages) of Oral Contraceptive (OC) Brand Usage for Current OC Users in the Screening and Laboratory Samples

Variable	Screening Phase (n = 138)	Laboratory Phase (n = 57)
OC Formulation		(n = 56)
Alesse	50 (36.2)	21 (37.5)
Alysena	6 (4.4)	3 (5.4)
Apri	5 (3.7)	3 (5.4)
Aviane	1 (0.7)	1 (1.8)
Brevicon 0.5/35	1 (0.7)	1 (1.8)
Cyclen	1 (.07)	0 (0.0)
Cyestra	3 (2.2)	1 (1.8)
Diane 35	1 (0.7)	0 (0.0)
Loestrin 1.5/30	4 (2.9)	0 (0.0)
Marvelon	11 (8.1)	8 (14.3)
Micronor	1 (0.7)	0 (0.0)
Min-Ovral	7 (5.1)	3 (5.4)
Portia	3 (2.2)	2 (3.6)
Seasonique	1 (0.7)	1 (1.8)
Seasonale	4 (2.9)	0 (0.0)
Synphasic	1 (0.7)	0 (0.0)
Tri-Cyclen	4 (2.9)	1 (1.8)
Tri-cyclen Lo	25 (18.4)	8 (14.3)
Tricera Lo	2 (1.5)	1 (1.8)
Yasmin	1 (0.7)	0 (0.0)
Yaz	3 (2.2)	1 (1.8)
Zarah	1 (0.7)	1 (1.8)
Number of Brands used		(n =57)
1 Brand	78 (57.8)	35 (61.4)
2 Brands	33 (24.4)	11 (19.3)
3 Brands	13 (9.6)	6 (10.5)
4 Brands	6 (4.4)	3 (5.3)
5 Brands	4 (3.0)	1 (1.8)
9 Brands	1 (0.7)	1 (1.8)

Note. For current OC formulation in laboratory phase data for two participants is missing and for number of brands use in the laboratory phase, data from one participant is missing.

Table 3

Means (Standard Deviations) for Length of Oral Contraceptive (OC) use for Current OC Users and Means (Standard Deviations) for Length Since Last Use of OCs for Nonusers in the Screening and Laboratory Phases

Variable	Screening Phase (n = 137)	Laboratory Phase (n = 57)
Total OC use months	51.58 (38.43)	48.82 (32.21)
Mode	48.0	48.0
Median	48.0	44.0
Current OC months	37.73 (27.81)	35.44 (23.69)
Mode	48	31.0
Median	36	15.0
Nonusers	(*n* = 69)	(*n* = 17)
Last took OCs months	57.97 (82.74)	35.18 (41.0)
Mode	36.0	2.0
Median	36.0	36.0

Note. In screening phase, OC users missing data for 1 participant.
For screening phase, nonusers missing data for 4 participants. For laboratory phase nonusers data missing for 1 participant.

months (n =7), those who have taken plan B in the past 2 months before screening (n = 23), those who are currently taking another hormonal contraception (n = 24) and participants who had irregular menstrual cycles (n = 56) were also excluded from participation. For participation in the experimental laboratory phase of the study, eligible psychology students received one and a half bonus points toward their applicable Psychology grade. For those participants that were not eligible to receive bonus marks, they received $2 for their participation in the laboratory session.

Screening Phase Measures

Screening questionnaire (SQ). The screening questionnaire (see appendix A) provided information regarding the menstrual cycle, OC use and history, demographics, psychiatric diagnoses, reproductive history, medical and health history, and PMS symptom history. The OC use and history section included questions about length of OC use and specific questions regarding the experience of certain OC side effects including any positive or negative physical symptoms or mood changes. Most of these items have been developed and used within our lab in past studies (e.g., Oinonen, 2009) and have demonstrated reliability and validity. Additional measures included within the SQ are described below. Many of these measures were included as possible covariates or for exploratory purposes and are not examined in the current theses but may be used in the larger project.

The Reactivity Subscale of the Mood Survey. This scale developed by Underwood and Froming (1980) consists of 6 statements regarding the participant's perceived mood reactivity and changeability (see Question 10). The participant is asked to indicate on a scale from 1 (*Strongly disagree*) to 6 (*Strongly agree*) how much they

agree with the statements. Two additional questions have the participant rate the following on a scale from 1 (*hardly ever*) to 99 (*extremely*): "*how frequently do your moods change*?" and "*how intensely do you react to mood experiences*?" Test-retest reliability for the reactivity subscale has been found to be high for both three (.85) and seven (.83) week periods (Underwood & Froming, 1980). The Mood Survey has good concurrent validity and preliminary construct validity (Underwood & Froming, 1980). In the present study, the instructions were amended to ask participants to consider their mood and behavior "*over the past two months*". This was done to ensure that responses provided represented a time frame where participants were generally consistently users or nonusers of OCs.

Affect Intensity Measure (AIM). The affect intensity measure was developed by Larson in 1984 and used in the Basso, Schefft, and Hoffman (1994) study which investigated the influence of affect intensity on cognitive performance subsequent to mood induction (Question 11). For efficiency, the current study used the short-form version of this scale which involves 20 questions regarding an individual's self-report on their emotional reaction and intensity to various events. Answers are rated on a 6-point scale from 1 (*Never*) to 6 (*Almost Always*). A significant mean difference in scores was found for males and females with females obtaining higher overall mean scores than males (Goldsmith & Walters, 1989). Bagozzi and Moore (2011) determined the AIM's external and internal construct validity using factor analysis and replicated the finding that women tend to have an overall higher mean score than men. In the present study, the instructions were amended to ask participants to consider their reactions "over the past two months".

Hamilton Rating Scale for Depression (HRSD). The HRSD (Hamilton, 1960) is a widely used tool to assess current symptoms of depression in both clinical and research settings (Question 12). The core scale consists of 21 items, scored from 0 *(Not at all)* to 4 (*Marked or severely*). For this study, the 17-item HRSD was employed because it is the standard for use of the scale in clinical trials (Cusin, Yang, Yeung, & Fava, 2009). For ethical reasons, item 11 "wishing for death or suicidal" was removed.

Handedness assessment. This measure was included as a measure of handedness and lateral dominance of the participants. It was adopted from Briggs and Nebes (1975). This 7-item self-report measure requires participants to indicate their hand preference for various activities (Question 13). Their hand preference is indicated on a 5-point likert-type scale from 1 indicating "*always right*" to 5 "*always left*" with the middle option 3 indicating a preference for "*both*". Scoring on each item can range from -2 to +2 with negative scores indicating left preferences and positive scores indicating right preferences. Total scores can range from -14 to +14.

Negative Impression (NIM)/Positive Impression scales (PIM). These scales are used as part of a validity measure for the Personality Assessment Inventory (PAI) developed by Morey (1991). The NIM scale items are intended to detect respondents whom are likely to present themselves in an exaggeratedly negative way while the PIM scale items are intended to detect respondents whom are likely to present themselves in an exaggeratedly positive way (Morey, 2007).

Both the NIM and PIM scales are each made up of 9 items that consist of sentences endorsed most frequently by those attempting to fake a mental disorder, yet rarely endorsed by individuals who actually have a mental disorder and sentences

endorsed most frequently by those attempting to make a positive impression, yet rarely endorsed by individuals that are filling out the answers honestly (Morey, 2007).

Both scales have been widely used and have highly established reliability and validity. The NIM has been shown to have a Cronbach's alpha ranging from .63 to 74, with a mean inter-item correlation ranging from .17 to .25 and a test-retest reliability ranging from .71 to .80. Similarly, the PIM has been shown to have a Cronbach's alpha ranging from .71 to 77, with a mean inter-item correlation ranging from .17 to .26, and a test-retest reliability ranging from .75 to .81. (Morey, 2007).

Several criterion and correlational studies have demonstrated the validity of the NIM and PIM scales. Both NIM and PIM scales accurately detected respondents that were told to malinger their responses either in a negative or positive manner from those who were told to respond honestly with 88.6% identification rate for the NIM and 95.5% correct identification rate for the PIM. Furthermore, both scales have been shown to correlate highly with other established measures that are intended to measure similar constructs. For example, the correlation between the NIM and the Minnesota Multi Phasic Personality Inventory F-scale ranges from .70 to .75. (Morey, 2007).

Big Five Inventory (BFI): Neuroticism scale. The neuroticism scale from the Big Five Inventory (Question 15) consists of 9 personal statements that begin with "*I am someone who*" and the respondent is required to indicate the extent to which they agree with each statement on a scale of 1 (*Strongly disagree*) to 5 (*Strongly agree*) (John, Donahue, & Kentle, 1991). Sentences are forward scored, for example, "*can be moody*", as well as backward scored, for example, "*is emotionally stable, not easily upset*". Items b, e, and g are reversed scored and items a, c, d, f, and h are forward scored. Scores can

range from 8 to 40. To code the reverse score items, the answer for each item is subtracted from six. Therefore for reverse score items, a score of 5 becomes 1, 4 becomes 2, 3 remains 3, 2 becomes 4, and 1 becomes 5.

Both the reliability and validity of the BFI neuroticism scale have been established. The test-retest stability of the BFI neuroticism scale ranges from .71 to .76 with a self-peer convergent validity correlation ranging from .30 to .45. The neuroticism scale also had correlations in the expected direction for similar scales on other established measures of personality. For example, the BFI neuroticism scale has a correlation ranging from .67 to .72 with the NEO Personality Inventory Revised anxiety and vulnerability subscales (Rammstedt & John, 2006).

The Behavioral Inhibition System (BIS) and Behavioural Activation System (BAS) Scales. These measures comprise one 24-item questionnaire (see question 16) where respondents are asked to rate each statement on a scale ranging from 1 (*very true for me*) to 4 (*very false for me*). The BIS questions (items b, h, m, p, s, v, x) represent an avoidance or behavioural inhibition motivational-approach. An example of a BIS item would be: "*Criticism or scolding hurts me quite a bit*". The BAS questions, on the other hand, represent appetitive motives or the tendency to move toward something. The BAS questions are subdivided into 3 different subscales: Funseeking, Drive, and Reward Responsiveness subscales. BAS fun seeking items are e, j, o, t; BAS Drive items are c, i, l, u; and the BAS reward responsiveness items are d, g, n, r, w. An example of a BAS fun seeking item would be: "*I'm always willing to try something new if I think it will be fun*" while an example of a BAS drive item would be: "*I go out of my way to get things I want*" and an example of a BAS reward responsiveness item would be: "*When I'm doing*

well at something I love to keep at it". The remainder of the items (a, f, k, q) are filler items that are not scored or calculated into the final score.

Carver and White (1994) created these scales on the theoretical basis that there are two general motivational systems that underlie behaviour: An approach system, and an avoidance system. The three BAS subscales emerged empirically through validity testing and factor analyses. The BIS scale is highly correlated with measures of related constructs such as neuroticism (Elliot & Thrash, 2002). Both the internal consistency and test-retest reliability of the BIS/BAS scales range from .66 to .76 (Sutton & Davidson, 1997). Additionally, the BIS scale was relatively independent of the BAS subscales with correlations of -.12 with the Drive subscale, .28 with the Reward Responsiveness subscale, and -.08 with the Fun Seeking subscale (Carver & White, 1994).

Stress Questionnaire. This questionnaire was developed by Oinonen and Teatero (See question 17) as part of a dissertation (Oinonen & Teatero, unpublished manuscript). The measure consists of four questions that require the participant to indicate on a scale of 1 (much less) to 7 (Much more) the extent to which they experience positive or negative stressful experiences during a certain time period compared to same-sex same-aged individuals. For example, participants are asked to indicate, compared to other people your age, to what extent did you "*experience stressful negative life events in the past year"*? The original questionnaire contained two questions about stressful negative or positive life events from birth to age 10. For the purposes of this study, however, those questions were replaced with questions about stressful negative or positive life events in the past two months.

Lakehead Inventory of Premenstrual Symptoms (LIPS). This is a 33-item scale developed by Richards and Oinonen (2009) designed to assess the degree to which participants meet the American Psychological Association's preliminary Diagnostic and Statistical Manual-IV criteria for Pre-Menstrual Dysphoric Disorder (Question 20). The scale can also be used as a subclinical measure of premenstrual symptom severity. For each of the eleven criteria listed in the DSM-IV, participants are asked three questions assessing: (1) the frequency with which each set of symptoms is experienced, (2) the degree to which each symptom impairs work, school, or interpersonal performance/functioning, and (3) the severity with which each symptom is experienced. All questions are rated using seven-point likert scales anchored by 0 (*Not at all*) on one end, and 6 (*Extremely*) for the latter two categories of questions and 6 (*Frequently*) for the first category. All questions ask women to estimate whether the described symptoms have occurred during the week prior to their menstrual period over the past 12 months.

Scores can range from 0 to 198 with higher scores indicating a larger degree of symptom severity and a greater degree of impairment. Internal consistency for this measure has been examined and a Cronbach's alpha of .89 was found for a sample of 177 women (Richards, Oinonen, and Wesner, unpublished manuscript). This scale also reliably differentiates between women low and high on PMS symptoms.

Physical Symptoms from OCs Questionnaire. The physical Symptoms from OCs Questionnaire is a 26-item questionnaire that required participants to indicate whether or not they have experienced a certain physical symptoms as a result of oral contraceptive use. The list of potential physical symptoms from OCs was taken from questionnaires that have been developed and used within the Health Hormones and

Behaviour lab in past studies (e.g., Oinonen, 2009). Symptoms include both negative and positive physical symptoms such as: nausea, headaches, more menstrual cramps, clearer complexion, and fewer menstrual cramps. If the respondent indicated they had experienced a particular physical symptom from OC use, the respondent was then be required to indicate which brand of OC they experienced the symptom on, and what action they took as a result of this symptom (see Question 22 a.i). The potential actions taken as a result of the symptom appeared in a drop down list with the following options: "*Discontinued OC use because of this symptom, Switched OC brand because of this symptom"*, "*Experienced symptom but did not change OC use"*, "*No action taken and symptoms resolved"*, and "*No action taken and symptoms continue now"*.

Emotional symptoms from OCs Questionnaire. The Emotional Symptoms from OCs Questionnaire is a 26-item questionnaire that required participants to indicate whether or not they have experienced a certain emotional symptoms as a result of oral contraceptive use. The list of potential emotional symptoms from OCs were taken from questionnaires that have been developed and used within the Health Hormones and Behaviour lab in past studies. Symptoms include both negative and positive emotional symptoms such as: Lower self-esteem, more pessimistic, negative mood change, more optimistic, higher self esteem, and less sensitive to criticism. If the respondent indicated they have experienced a particular emotional symptom from OC use, the respondent would then be required to indicate which brand of OC they experienced the symptom on, and what action they took as a result of this symptom (see Question 22 a.ii). The potential actions taken as a result of the symptom appeared in a drop down list with the following options: "*Discontinued OC use because of this symptom, Switched OC brand because of*

this symptom", "*Experienced symptom but did not change OC use"*, "*No action taken and symptoms resolved"*, and "*No action taken and symptoms continue now".* These emotional symptoms from OCs Questionnaire were used to determine women on OCs with current negative mood side effects.

Laboratory Phase Measures and Materials

Laboratory Questionnaire. Subsequent to completing the other laboratory procedures (see below), participants were asked to complete a brief laboratory questionnaire (see Appendix B) designed to collect final demographic, mental state, and OC use and menstrual cycle information. Participants were asked to indicate whether they have taken any pain medication, consumed any caffeine, and how much sleep they had the previous evening. Also, using a scale from 1 (*Strongly Agree*) to 5 (*Strongly Disagree*), participants were asked to rate their enjoyment of and their effort on the laboratory tasks (see question 9). Further, women were asked to confirm their current phase in their menstrual cycle by indicating the first day of their last period and when they expect their next period. This laboratory questionnaire was presented after the completion of the mood inductions and cognitive tasks so as to not influence the participant's performance.

The Positive and Negative Affect Schedule (PANAS). The PANAS was developed by Watson, Clark, and Tellegen (1988) and consists of two scales: one for positive affect (PA) and one for negative affect (NA). High positive affect reflects a state of high energy, full concentration, and pleasurable engagement; whereas low PA is characterized by sadness and lethargy. Alternatively, high NA reflects subjective distress and unpleasant mood states such as anger, contempt, and disgust. Low NA indicates a

sense of calm and security. The PA PANAS items include *attentive, interested, alert, excited, enthusiastic, inspired, proud, determined, strong,* and *active,* while the PANAS scale for NA includes the items *distressed*, *upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery,* and *afraid* (see Appendix C). The questions require the participants to rate each adjective on a five-point response scale ranging from 1 *(Very slightly or not at all)* to 5 (*Extremely)*. For the current study, this scale was used to gather information about the participants' affect both before and after each mood induction. Participants were asked to indicate how they felt "at the moment" they were completing the surveys.

The PANAS scales have been shown to be highly internally consistent, largely uncorrelated with one another, with alpha reliabilities ranging from .84 to .90 for PA and from .84 to .87 for NA (Watson, Clark, & Tellegen, 1988). The PANAS scales are also high in convergent and discriminant validity (Watson, Clark, & Tellegen, 1988).

Physical Experiences of Emotions Questionnaire (PEEQ). This questionnaire was developed by the researchers for this study with the intention of tapping into physical experiences of emotion. The questionnaire consists of 32 items that ask the participant to rate on a scale of 1 (*Slightly or not at all*) to 5 (*Extremely*) the extent to which they felt a certain physical symptom while watching the mood induction slide shows. Items contain physical sensations such as "*Energized*", "*Drained of energy/fatigued*", and "*Nausea*" (See Appendix D, Question 2). Participants completed this measure after each mood induction. Validity and reliability of this measure will be calculated and reported on in the results section of this paper.

Approach/Avoid Questionnaire. This questionnaire was adapted from the dimension ratings questionnaire used by Papousek, Schulter, and Lang (2009) to tap into the degree to which the mood induction induced feelings of approach or withdrawal in the participants. Examples of the approach/avoid questions are: "*The film aroused the want to escape in me*", "*The film aroused the want to take action in me*" (see Appendix D, Question 3). A motivational direction score is calculated by combining the escape and take action ratings. Low values indicate a tendency towards approach and high values indicating a tendency towards withdrawal. Papousek, Schulter, and Lang (2009) used a Visual Analogue Scale to record responses, however, for the purposes of consistency and for ease of computer administration, the current study employed a 5-point likert scale ranging from 1 (*Not at all*) to 5 (*Extremely*).

While no standard reliability or validity studies have been conducted on this questionnaire, Papousek and colleagues (2009) did find the responses of their questionnaire to correspond significantly, and in the expected direction with the emotional films displayed in their study. For example, they found that the sadness and anxiety films were associated with significantly more withdrawal motivation than the neutral, cheerfulness, and anger films. Also, the cheerfulness film was associated with significantly more approach motivation than the neutral film.

Mood induction stimuli. The mood induction stimuli consisted of three separate emotional videos. The videos were a compilation of different emotional videos and slideshows of emotional pictures that were chosen based on their ability to elicit happiness, sadness and fear. The videos and stimuli were identified using popular search engines such as Google and YouTube using general search terms such as "saddest

videos", "happiest videos" and "scariest videos" and more specific search terms such as: "people laughing", "people crying", and "haunted houses". The pictures for the slideshow were chosen for this study from the International Affective Picture System (IAPS) (Lang et al., 2005) based on their scores of arousal and valence. The videos and pictures were edited using iMovie on a Macintosh computer. The stimuli for each emotion induction transitioned into one another creating a 5-minute video and slideshow compilation for each emotion induction. Data supporting the validity of the emotion induction stimuli are reported below in the results.

Mood induction music. Mood congruent music was also chosen to play during each of the three mood induction videos. Music chosen was based on Google and YouTube searches for sad, happy, and fear-inducing music. Less popular music was selected to decrease the likelihood that participants had previously heard the song and had existing associations or experience with them. The music was played on loop during the emotional videos and continued playing throughout the Facial Emotion Recognition and the GoNogo tasks.

Facial Emotion Recognition Task. The facial emotion recognition task was created specifically for this study was using the Psychopy Software. The faces used for the study were obtained from a previously established NimStim Face Stimulus Set (available for public at: http://www.macbrain.org/resources.htm). The stimulus set included 646 colour images of the faces of actors of different sexes and races displaying the following range of emotions: fearful, happy, sad, angry, surprised, calm, neutral, and disgusted. Previous research on the identification of the emotional expressions in these

photos has established reliability and high agreement among raters (Tottenham, Borscheid, Ellersten, Marcus, & Nelson, 2002).

Three different facial emotion recognition tasks were created for this study. Each task had 75 faces strategically selected without replacement from the pool of 646 faces. Each task was presented immediately after each emotion induction video. The images of the faces appeared on a black background. Each image had two emotions printed on the left and right bottom corner of the image. One emotion was the correct emotion that the actor was depicting, and one was an incorrect emotion. The participant was asked to press '1' on the keyboard if the face was expressing the emotion on the left or to press '0' on the keyboard if the face was expressing the emotion on the right. The correct answer appeared on the left and right side in random order.

Participants were instructed to respond as quickly as possible to all facial stimuli. The images appeared on the screen until the participant responded. This allowed for a sensitive measure of response time. Outcome measures included both response times and accuracy.

In order to increase the difficulty of this task, the possible response options for the images were strategically selected. Based on a study conducted by Du and Martinez (2011) some emotional expressions are more likely to be confused with other emotional expressions. In their study, participants viewed faces depicting either happiness, sadness, fear, anger, surprise, disgust, or neutral expressions and were asked to pick which of the 7 emotions the face was depicting. Their results indicated that while most participants were accurate in their answers, their incorrect responses showed a consistent pattern of errors for certain emotions. Thus, when looking at faces depicting certain emotions, anger

would be most likely to be confused with disgust, sadness would be most likely be confused with anger, surprise would be most likely to be confused with fear, and disgust would be most likely to be confused with either sadness, fear, or anger. Happy, fear, and neutral facial expressions did not have significant correlations with any other emotion.

For this current study, the images of faces depicting anger, sadness, surprise, and disgust were paired approximately 35% of the time with the response options of the emotion it is most likely to be confused with. Each emotion (calm, neutral, anger, happy, sad, fear, surprise, disgust) had approximately 10 images in each of the 3 tasks. Therefore, an image depicting an angry facial expression would have the response option of disgust 3 or 4 times. Additionally, calm and neutral expressions were the most frequent expressions compared to the other emotions. This was done intentionally for the potential of investigating whether there may be response biases on neutral and calm faces after mood induction.

Emotional GoNogo task. The emotional GoNogo task for this study was the same task as used by Albert, Lopez-Martin, and Carretie (2010) with additional background images chosen specifically for this study in order to use the task for three different blocks of trials. The background images consisted of one positive, one negative, and one neutral image from the IAPS used in the Albert, Lopez-Martin, and Carretie (2010) study as well as two additional positive, neutral, and negative pictures from the IAPS selected for their arousal and valence. This allowed for three pictures for each condition (Positive, Neutral, and Negative) to be used in three blocks. As with the facial emotion recognition task described above, three different blocks of this test were created

in order to present this task after each of the three mood inductions without presenting the exact same stimuli twice.

The images described above were used as background contexts for the task. Two capital letters, either an "*M*" or a "*W*" were displayed for 200ms in yellow ariel font outlined in black in order to stand out clearly from the background. The participants were not told anything about the context of the background picture. The participants were asked to press the space bar as quickly as possible when they see the letter "*M*" appear and to withhold pressing the space button whenever they see the letter "*W*" appear. The instructions were the same regardless of the emotional context of the picture. The background pictures were randomized in each block so that some participants started the task with a neutral background image, some with a positive background image, and some with a negative background image.

Outcome measures included response times and accuracy. Specifically, within the accuracy measure, errors of commission (i.e. responding to an item that required non-response) and errors of omission (i.e. not responding to an item that required a response) were calculated.

Other cognitive measures. Three additional cognitive tasks were administered at the end of each emotion induction (i.e., after the above noted tasks) in order to ensure that the mood induced by the mood induction had dissipated (one at the end of each mood induction): A Navon Task, a Stroop Task, and a Mental Rotation Task. Each of these tasks were presented using the Psychopy Software. The results from these tasks are not reported here as they were collected as a part of a larger study.

Procedure

Screening phase. Following recruitment, participants were directed to a secure website within surveymonkey.com where they were provided with a Letter to Participants (see Appendix E) that included a brief synopsis of the study and the details of what their participation would entail. The participants were then directed to complete the online screening questionnaire, which included the Affect Intensity Scale, the Hamilton Rating Scale for Depression (HRSD), and the Lakehead Inventory of Premenstrual Symptoms (LIPS). The questionnaires were all completed online in one sitting and took approximately 20 to 30 minutes to complete. Upon completion of the screening phase, participants were instructed in a debriefing form (see Appendix F) that if they qualified, they would be contacted for an appointment to come into the Health Hormones and Behaviour laboratory for a session.

Those selected for participation were contacted by email and invited to participate in one laboratory session that would last approximately one hour. The participant's personal details were necessary to schedule the lab session and to link lab data to screening questionnaire data. In order to ensure anonymity, however, all identifying data was deleted once the screening data was collected and the lab session was complete. There is no way to trace back screening and laboratory data to a specific participant.

Laboratory session dates for women were determined by menstrual cycle phase in order to obtain an equal percentage of women in each phase for OC user and nonuser groups. All women were recruited to participate during the late follicular phase (day 11 to 14 or -17 to -14) in order to capture women during periods of high estrogen, or during the mid luteal phase (days 20 to 24 or days -5 to -9) in order to capture free-cycling women

during times of high endogenous estradiol and progesterone. In order to maintain consistency with scheduling and maximize the likelihood of testing OC user and nonuser groups at times when they differ most in terms of endogenous and exogenous hormones, both women using OCs and free-cycling women were scheduled according to their menstrual cycle phase.

Cycle phase counting. In order to determine cycles phases, the backward counting method was employed for this study. The backward counting method controls for variability in menstrual cycle length. Since most of the variation in cycle length occurs due to variation in the follicular phase, the reverse count is more effective. In the backward counting method, the woman's estimate of day 1 of her upcoming cycle is used to predict ovulation. The formula for calculating ovulation using the backward counting method is: F = L – 14 where F is the last day of the follicular phase and L is the length of the cycle. Day -1 is the day before the first day of menstruation. After female participants completed the lab session, they were contacted by email to confirm the start date of their next period.

Laboratory session. Participants came into the laboratory for their scheduled appointment time and were directed into a private quiet room with a computer. Upon completing Consent Form B (Appendix G), the participants read the instructions for the procedures and indicated that they have read and understood what was written. The participants then completed the first Laboratory Questionnaire (Appendix B) which consisted of the PANAS to indicate the participant's baseline affect. Following the baseline PANAS measure, the participants then viewed the first of three mood induction videos paired with the appropriate mood congruent music. The first induction was always

the sad mood condition, the second mood induction was always the happy mood induction, and the third mood induction was always the fear condition. This order of negative-positive-negative allowed the researchers to see more variability from one induction to the next and prevented the participant from having to view two negative inductions in a row. Immediately after each mood induction, the participants began answering the second laboratory questionnaire which consisted of the PANAS, the PEEQ, and the Approach/Avoid questionnaire (Appendix D).

While the mood congruent music continued playing, the participants immediately began the cognitive tasks. In order to prolong the mood induction, the mood congruent music continually played throughout the completion of questionnaires and the first two cognitive tasks. The music eventually faded halfway through the completion of the third task in order to ensure mood dissipated before moving on to the next mood induction. The cognitive and perceptual tasks were presented as follows: After the sad mood induction was the Facial Recognition task, the Emotional GoNogo Task, and the Navon task; after the happy mood induction, the participants completed the Facial Recognition task, the Emotional GoNogo Task, and the Stroop task; and after the fear emotion induction, the participants completed the Facial Recognition task, the Emotional GoNogo Task, and the mental rotation task. All participants completed the tasks in the same order. Before each task, participants were provided with brief instructions on how to complete the task and were required to indicate that they understood the instructions before continuing.

The entire lab session took approximately 45 to 60 minutes. At the very end of the session, a short 2-minute comedic video played. The video was made up of clips of

animals playing with other animals or engaging in playful behaviour. The purpose of this video was to ensure mood from the previous condition had dissipated and to end the laboratory session on a positive, rather than negative mood induction. Upon completing the session, participants were given a debriefing form (Appendix H) that provided further information about the study, as well as information for contacting the researchers or for psychological services, if needed. Participants were then awarded 1.5 bonus points towards their final grade in their participating undergraduate psychology class, if applicable, or with $2 compensation if they were not eligible for bonus marks.

A follow up email was sent out at all female participants subsequent to their participation in the study to confirm the start date of their next period. This confirmation allowed for a more accurate method of collecting menstrual cycle information.

Results

Mood Induction Manipulation Check

In order to investigate the validity of the mood inductions, two sets of six paired sample t-tests were conducted with PANAS PA and PANAS NA as the comparative variables. The first set of six-paired sample t-tests compared post-induction PA scores and NA scores with the most recent pre-induction PA and NA scores. Therefore, total PA scores after the sad induction were compared to total PA scores from baseline, total PA scores after the happy induction were compared to total PA scores after the sad induction, and total PA scores after the fear induction were compared to total PA scores after the happy induction. The procedure was repeated for total NA scores. The second set of six paired sample t-tests compared PA scores after each emotion induction to the PA score at baseline. The same procedure was repeated for total NA scores. As indicated in Table 4

and illustrated in Figure 1, all PA and NA scores showed significant changes (p <.001) in the expected direction following the three mood inductions. That is, the affect changes were as follows: sad mood induction (increase in NA and decrease in PA), happy mood induction (decrease in NA and increase in PA), and fear mood induction (increase in NA and decrease in PA).

Questionnaire Validation and Manipulation Check

The Physical Experiences and Emotions Questionnaire (PEEQ) and the Approach/Avoid Questionnaire were both used in this study as an additional measure of affect subsequent to the mood inductions. PEEQ scores reflect a total sum of all physical sensations experienced subsequent to the mood inductions. Because some physical symptoms such as "feeling lightheaded" or having a "tingling sensation" may be experience when an individual is both happy and scared, it was not ideal to separate physical symptoms into positive and negative categories. Approach/Avoid scores were calculated by using the questions "*the film aroused the want to escape in me*" and "*this film aroused to want to take action in me*". Separate scores were calculated for each avoid (escape) or approach (take action) variable after each emotion induction. Paired sample t-tests and bivariate correlations were conducted on both of these measures.

To investigate the validity of the PEEQ (i.e., its ability to capture or assess change following mood induction) and to further validate the mood induction paradigms (i.e., the ability of the mood induction videos to cause change in physical sensations or experiences), two paired sample t-tests were conducted. Results showed that mean total PEEQ score after the sad induction (M = 52.99, SD = 13.32) was significantly different from the mean total PEEQ score after the happy induction (M = 44.11, SD = 6.73), t(145)

Table 4

Mood Induction Manipulation Checks: Descriptive Data and Paired Sample t-Tests Examining Change in PANAS PA and NA scores after the Three Mood Inductions (n = 147)

Affect Scores	Means (SD)	*t*	*df*	*p*
Baseline PA Sad PA	30.12 (6.13) 21.30 (5.76)	19.00	146	<.001
Baseline NA Sad NA	14.27 (4.44) 22.02 (6.61)	-14.70	146	<.001
Sad PA Happy PA	21.30 (5.76) 32.09 (7.42)	-18.80	145	<.001
Sad NA Happy NA	22.02 (6.61) 11.30 (1.84)	19.66	145	<.001
Happy PA Fear PA	32.09 (7.42) 20.12 (6.09)	19.13	146	<.001
Happy NA Fear NA	11.30 (1.84) 24.60 (8.09)	-20.02	146	<.001
Baseline PA Sad PA	30.12 (6.13) 21.30 (5.76)	19.00	146	<.001
Baseline NA Sad NA	14.27 (4.44) 22.02 (6.61)	-14.70	146	<.001
Baseline PA Happy PA	30.18 (6.09) 32.09 (7.42)	-3.95	145	<.001
Baseline NA Happy NA	14.24 (4.44) 11.30 (1.84)	8.85	145	<.001
Baseline PA Fear PA	30.18 (6.09) 20.12 (6.09)	17.58	145	<.001
Baseline NA Fear NA	14.24 (4.45) 24.60 (8.09)	-14.79	145	<.001

Note. The top of the table examines change in between pre- and post-mood induction affect scores while the bottom examines change in affect scores from baseline after each mood induction. PANAS = Positive and Negative Affect Schedule. PA = Positive Affect. NA = Negative Affect.

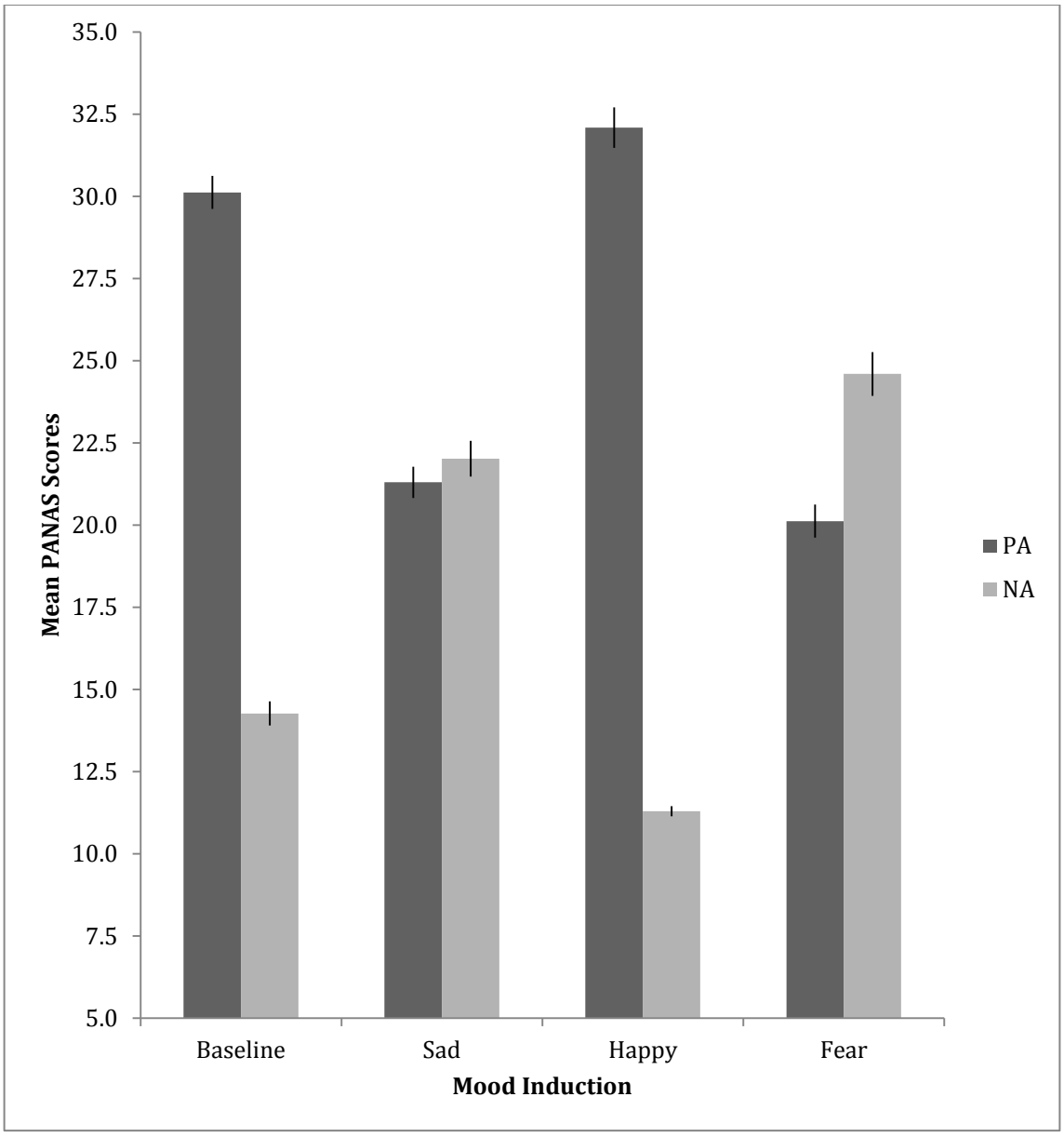

Figure 1. Manipulation Check: Unadjusted Mean Positive Affect (PA) and Negative Affect (NA) Scores at Baseline and after all Three Mood Inductions. Both PA and NA changed in the expected directions after each induction (all $p < .001$). Error bars represent ±1 SEM.

= 9.85, p <.001. Additionally, the mean total PEEQ score after the happy induction was significantly different from the mean total PEEQ score after the fear condition (M = 57.10, SD = 18.37), t(146) = -10.08, p <.001. These results indicated that participants endorsed the highest physical symptoms after the fear condition, followed by the sad condition, with the lowest physical symptoms endorsed after the happy condition. The significantly different PEEQ scores indicate that physical symptoms do indeed differ as a function of the type of induced mood, the PEEQ is able to capture change in physical symptoms, and the three mood-induction videos are able to cause changes in emotional physical symptoms.

Additional bivariate correlations were conducted to investigate the relationship between PEEQ and PANAS PA and NA scores after each emotion induction. After the sad induction, PEEQ scores were significantly correlated with PANAS NA scores, r(147) = .662, p < .001, but not with PANAS PA scores , r(147) = -.97, p = .242. After the happy induction, PEEQ scores were significantly correlated with PANAS PA scores, r(147) = .550, p <.001, but not with PANAS NA scores, r(147) = .090, p =.278. After the fear induction, PEEQ scores were significantly correlated with PANAS NA scores, r(147) = .756, p <.001, but not with PA scores, r(147) = -.142, p = .085. These results indicate that participant's emotional physical sensation scores were correlated with NA scores after the sad and fear conditions, and with the PA scores after the happy condition. These findings suggest the PEEQ may be a useful addition to the PANAS in studies on emotional response to mood primes as the PEEQ may capture emotional physical sensations that are somewhat independent of either PA or NA. The PEEQ may assess increases in arousal level, regardless of whether the mood prime activates positive or

negative affect. For example, endorsing items such as feeling "hot" or "a tingling sensation" may be indicative of arousal from either negative or positive stimuli.

To investigate the validity of the Approach/Avoid measure, four paired sample t-tests were conducted. The first two paired sample t-test showed that want to avoid was significantly higher in the sad condition (M = 2.34, SD = 1.25) compared to the happy condition (M =1.31 SD = 0.720), $t(145) = 8.306$, $p < .001$. The want to avoid was also significantly lower in the happy condition (M =1.31 SD = .720) compared to the fear condition (M =1.67, SD = 1.02), $t(146) = -10.95$, $p < .001$. These results are congruent with Papousek and colleagues (2009) who indicated that negative stimuli are more likely to arouse a feeling of wanting to escape or avoid.

The second set of paired sample t-tests indicated that the want to approach in the happy condition (M = 2.67, SD = 1.19) was significantly higher than in the fear condition (M = 1.67, SD = 1.02), $t(146) = 8.39$, $p < .001$. However, the want to approach in the sad condition (M = 2.81, SD = 1.23) was not significantly different than the want to approach in the happy condition (M =2.67, SD = 1.19), $t(145) = 1.33$, p =.186. Participants were more likely to want to approach after the happy condition compared to after the fear condition. Papousek et al. (2009) found that their cheerfulness film was associated with significantly more approach motivation than the neutral film. The want to approach in the happy condition was higher than the want to approach in the sad condition, however there was no significant difference. This may be reflective of the nature of the sad stimuli used here. In our sad induction, the videos included clips of numerous injustices such as children and animals suffering, as well as people in need. Therefore, the sad induction may have aroused the viewer into wanting to approach in order to take action or help.

Nevertheless, the evidence of different Approach/Avoid measure scores following the different types of mood inductions provides some validity evidence for both the Approach/Avoid measure and the mood induction paradigms.

Validation of a Group: OC Users with Current Negative Mood Side Effects

Women on OCs with current negative mood side effects were determined based on their answers to the questions on the *Emotional symptoms from OCs Questionnaire* from the screening questionnaire. Women who indicated experiencing one or more current negative mood side effect(s) from OCs was considered to be in the OC users with current negative mood side effects group (OC mood group). The mean number of negative mood symptoms the women in the OC mood group (n = 15) endorsed was 4.20 (*SD* = 3.08; range = 1 to 11). The most frequently endorsed OC-related mood symptoms were: more irritable, sadness, more moody, and crying more than usual (see Table 5 for frequencies of endorsed mood symptoms).

In order to provide some evidence for the validity of the classification of our group of OC users with current negative mood side effects (OC mood group), Group (OC no mood, and nonusers) was used as the independent variable and several measure of mood and affect were used as the dependent variables. In the first of two MANCOVAs, measures of affect reaction within the laboratory were used as the dependent variables in order to determine if women in the OC mood group reacted differently than women in the OC no mood group and nonusers. The last MANCOVA used affect measures from the screening questionnaire to determine if the OC mood group differed at baseline in overall mood and affect characteristics such as intensity

Table 5

Frequencies (Percentages) of Current Oral Contraceptive-Related Mood Symptoms Endorsed by the sample of Women Currently Experiencing Negative Mood Side Effects from Oral Contraceptives (n = 15)

Negative Mood Symptom	Frequency (Percentage)
More irritable	9 (60.0)
Sadness	8 (53.3)
More Moody	8 (53.3)
Cried more than usual	8 (53.3)
Lower self-esteem	6 (40.0)
Depression	5 (33.3)
More self-critical	5 (33.3)
Feelings of inferiority	4 (26.7)
Negative mood change	4 (26.7)
More Jealous	2 (13.3)
More pessimistic	2 (13.3)
More sensitive to criticism	1 (6.7)
Less trust in partner	1 (6.7)
More aggressive	0 (0.0)

Note. OCs = Oral Contraceptives.

level, reactivity, and general depressive symptoms compared to the OC no mood and nonuser groups. In all of these analyses, age was used as a covariate (see section titled *Examination of Group Equivalency* below*).* If women on OCs with current negative mood side effects differ on these important measures of affect, it would provide evidence for the validity of the OC mood group.

The first MANCOVA included group (OC mood, OC no mood, and nonusers) as the independent variable and NA and PA mean change scores across the laboratory, as well as mean NA and PA total scores as the dependent variables (see the top panel of Table 6 for the mean scores). There was no overall multivariate group effect, $F(8, 192) = 1.047$, $p = .402$, partial $\eta^2 = .042$, power = .502 . At the univariate level, there was only a weak trend for a group difference on PA total scores, $F(2, 98) = 1.704$, $p = .187$, partial $\eta^2 = .034$, power = .351. The means for PA total scores reveal that the OC mood group had the lowest mean PA score across the laboratory compared to the OC no mood, and nonuser groups (see top panel of Table 6 for the univariate ANCOVA follow-up test results).

The second MANCOVA included group (OC mood, OC no mood, and nonusers) as the independent variable and PANAS PA and NA levels after each emotion induction as the dependent variables (see the bottom panel of Table 6 for the mean scores). There was no significant multivariate group effect, $F(16, 184) = 0.932$, $p = .534$, partial $\eta^2 = .075$, power = .620. Follow up univariate tests, however, showed a trend for PANAS PA after the fear condition, $F(2,98) = 2.597$, $p = .080$, partial $\eta^2 = .050$, power =.507, with the OC mood group showing the lowest PA after the fear induction (see bottom panel of Table 6 for the univariate ANCOVAs). The results from the first two MANCOVAs

Table 6

Means (Standard Deviations) of Scores on the PANAS and Univariate ANCOVA results for Women on OCs with Mood Side Effects (OC Mood; $n = 15$), Women on OCs with No Mood Side Effects (OC No Mood; $n = 35$), and Nonusers ($n = 45$)

Affect Variable	OC Mood	OC No Mood	Nonusers	df	*F*	*p*	Partial η^2	Power
NA Change	11.16 (5.84)	12.15 (6.00)	10.90 (6.05)	2, 98	0.165	.848	.003	.075
PA Change	11.88 (5.42)	11.68 (5.69)	10.17 (5.28)	2, 98	0.636	.531	.013	.154
PA Score	22.86 (4.12)	24.78 (5.01)	25.71 (4.77)	2, 98	1.704	.187	.034	.351
NA Score	19.05 (3.64)	19.19 (4.53)	17.81 (3.23)	2, 98	0.543	.583	.011	.137
NA Baseline	14.93 (4.83)	15.21 (5.45)	13.73 (3.94)	2, 98	0.583	.560	.012	.145
PA Baseline	26.73 (5.81)	29.14 (6.68)	30.36 (5.63)	2, 98	1.844	.164	.036	.376
NA Sad	22.40 (6.36)	23.79 (7.17)	21.69 (5.98)	2, 98	.538	.586	.011	.137
PA Sad	17.73 (5.00)	19.86 (5.68)	21.22 (5.54)	2, 98	1.939	.149	.038	.393
NA Happy	11.93 (2.43)	11.38 (2.02)	11.02 (1.63)	2, 98	1.150	.321	.023	.248
PA Happy	30.47 (7.73)	31.88 (7.52)	30.96 (7.46)	2, 98	0.247	.782	.005	.088
NA Fear	26.93 (6.76)	26.38 (8.68)	24.78 (7.89)	2, 98	0.123	.844	.003	.068
PA Fear^t	16.53 (3.20)	18.19 (5.39)	20.29 (5.48)	2, 98	2.597	.080	.050	.507

Note. OC = Oral Contraceptives. NA = Negative Affect from the Positive and Negative Affect Schedule (PANAS). PA = Positive Affect from the PANAS. NA change = Negative Affect change across the laboratory session. PA change = Positive Affect change across the laboratory session. PA score = Total Positive Affect score. NA Score = Total Negative Affect score. Baseline = scores at baseline. Sad = scores after the sad induction. Happy = scores after the happy induction. Fear = scores after the fear induction. Superscript ^{t} indicates a trend $p < 1$ for OC Mood and Nonusers to differ.

indicate that the group of women on OCs that reported current negative mood side effects did not differ significantly in their emotional reactions to the mood inductions in the laboratory compared to women on OCs with no current negative mood side effects and with nonusers.

Finally, a MANCOVA was run with group (OC mood, OC no mood, and non users) as the independent variable and scores on the Affect Intensity Measure, Hamilton Rating Scale for Depression, Reactivity Subscale of the Mood Survey, Big Five Inventory-Neuroticism Scale, and Behavioural Inhibition System as the dependent variables (see Table 7 for mean scores of the affect measures for each group). Again, results do not show an overall multivariate group effect, $F(16, 132) = 1.095$, $p = .366$, partial $\eta^2 = .117$, power = .696. However, follow up univariate tests showed significant group differences on three of the five measures: the Affect Intensity Measure, the Reactivity Subscale of the Mood Survey, and the Behaviour Inhibition System (see Table 7). There was also a trend for a group effect on the Big Five Inventory-Neuroticism Scale.

The follow up ANCOVAs reveal that the OC mood group had significantly higher mean scores on the Affect Intensity Measure and the Reactivity Subscale of the Mood Survey, and significantly lower mean scores on the Behavioural Inhibition System compared to nonusers (see Table 7). Pairwise comparisons show a trend for the OC mood group to have higher mean scores on the Big Five Inventory-Neuroticism Scale than nonusers.

These results indicate that OC users with current negative mood side effects differ from OC users with no negative mood side effects and from nonusers on some important

Table 7

Means (Standard Deviations) of Scores on Affect Measures from the Screening Questionnaire and Univariate ANCOVA Results for Women on OCs with Mood Side Effects (OC Mood; *n* - 15), Women on OCs with No Mood Side Effects (OC No Mood; *n* = 35), and Nonusers (*n* = 45)

Variable	OC Mood	OC No Mood	Nonusers	df	*F*	*p*	Partial η^2	Power
AIM*	83.71 (9.54)$_a$	77.39 (8.29)	73.97 (12.22)$_a$	2, 72	4.73	.012	.116	.774
HRSD	24.71 (19.43)	18.21 (12.42)	15.91 (11.38)	2, 72	2.041	.137	.054	.408
Mood Reactivity*	23.36 (6.08)$_a$	19.75 (4.80)	19.41 (5.08)$_a$	2, 72	3.235	.045	.082	.599
BFI-N	28.21 (4.51)	25.46 (5.95)	24.06 (6.33)	2, 72	2.390	.099	.062	.468
BIS*	11.21 (2.60)$_a$	12.79 (3.71)	14.03 (3.59)$_a$	2, 72	3.861	.026	.097	.682

Note. OC = Oral Contraceptives. AIM = Affect Intensity Measure. HRSD = Hamilton Rating Scale for Depression. Mood Reactivity = Reactivity Subscale of the Mood Survey. BFI-N = The Neuroticism scale form the Big Five Inventory. BIS = Behavioural Inhibition System. Shared letter subscripts in a row indicate significant differences for the specified groups. $_a$ OC Mood and Nonusers differ.
*p <.05.

self-report measures of affect. Results indicate that overall, OC users with current negative mood side effects report higher affect intensity, more mood reactivity, more behavioural inhibition (such as being easily hurt by criticism, fear of judgment from others), and a trend toward overall higher neuroticism. However, the results only indicated significant group differences between OC users with current negative mood side effects and nonusers and the results did not show significant differences between OC users with current negative mood side effects and OC users without current negative mood side effects. It should be noted that the OC mood group had a small group size of $n = 15$. Therefore, power issues may make it more difficult to find evidence to support the validity of this group with such a small sample size.

Data Screening

Prior to analyses, all variables were inspected for data entry accuracy, outliers, normality, linearity, and homoscedasticity. All variables were screened separately for the three groups (e.g., OC users, nonusers, and men). Outliers were identified based on *z*-score values of $\geq |3.29|$ (Tabachnick & Fidell, 2001). Skewness and kurtosis values that differed significantly from zero were considered non-normal (Tabachnick & Fidell, 2001). As confirmation of normality, visual inspections of histograms were also completed and all distributions looked reasonably normally distributed. Given that the outliers appeared to represent accurate extreme data points, we decided not to simply delete outliers. Instead, the decision was made to run each analysis twice, once with outliers included, and once with outliers removed. This was done to satisfy any concerns about statistical assumptions as well as maximizing available data. As the results were

very similar in analyses with and without outliers, the results presented here exclude outliers and the number of outliers are noted.

Statistical Considerations

For all of the main analyses, and examination of group equivalency, a significance level of .05 was used. Pillai's criterion was used to evaluate multivariate significance. All group comparisons were analyzed using MANCOVAs and follow-up univariate ANCOVAs. The Bonferroni adjustment was used for follow-up pairwise comparisons. All means reported are untransformed unadjusted means, unless otherwise indicated. For all significant results involving group differences between OC users and men, follow up tests were run to examine sex differences on the same dependent variables. If there were no sex differences between men and women on certain dependent variables that showed differences between OC users and men, it indicates that OC use, rather than sex, was likely the driving force behind the group difference.

Examination of Group Equivalency

The three groups (OC users, nonusers, and men) were examined for equivalency in the following variables: time of laboratory session, age, caffeine consumption, alcohol consumption, hours of sleep, handedness, and self-reported effort and enjoyment of laboratory tasks (see top panel of Table 8 for means and standard deviations). Univariate ANOVAs and chi-square analyses were used to examine group equivalency on the continuous and categorical variables, respectively. The groups only differed significantly in age, $F(2, 139) = 3.415$, $p = .036$, and pairwise comparisons revealed that OC users were significantly younger than non-users (see Table 8). Due to these group differences, age was used as a covariate in all subsequent group analyses.

Table 8

Unadjusted Means (Standard Deviations) or Frequencies (Percentages) of 10 Variables Used to Examine Group Equivalency between OC Users, Nonusers, and Men

Variable	OC Users (n = 57)	Nonusers (n = 45)	Men (n = 38)
		Means (SD)	
Age*	20.75(2.81)$_a$	22.82(5.94)$_a$	22.37(3.44)
Caffeine	0.574 (0.881)	1.06(2.00)	0.730(1.04)
Alcohol	0.345(1.00)	0.250(0.673)	0.243(0.796)
Hours of Sleep	7.44(1.21)	7.37(1.07)	7.05(1.29)
Handedness	1.48(1.02)	1.50(1.05)	1.35(1.09)
Effort in Session	16.91(2.32)	16.78(3.08)	17.04(2.51)
Enjoyment in Session	17.26(3.85)	16.96(3.59)	17.23(3.00)
Time of Session	12:03(1:58)	12:08(2:03)	13:04(2:06)
		Frequencies (Percentages)	
Cycle Phase 1			
Early Follicular	1(1.7)	2(4.7)	
Mid Follicular	2(3.4)	2(4.7)	
Late Follicular	17(29.3)	11(25.6)	
Early Luteal	4(6.9)	7(16.3)	
Mid Luteal	28(48.3)	14(32.6)	
Late Luteal	4(6.9)	7(16.3)	
Cycle Phase 2			
Follicular	20(34.5)	15(34.9)	
Luteal	36(62.1)	28(65.1)	

Note. OC = Oral Contraceptive. Cycle Phase 1 = Cycle phase partitioned into 6 different categories. Cycle Phase 2 = Cycle phase partitioned into 2 overarching categories. Shared letter subscripts in a row indicate significant differences for the specified groups, $_a$ OC users and Nonusers differ.
* $p < .05$

In order to ensure that cycle phase was not a potential limitation of the design and that OC users and nonusers were equally likely to be tested during the different menstrual cycle phases, group equivalence on this variable was examined. The two groups did not differ when testing in the follicular versus luteal phase was examined, χ^2 (2, N = 142) = 1.520, p =.468. Similarly, when cycle phase was partitioned into six categories that differ in hormone levels (early follicular, mid follicular, late follicular, early luteal, mid luteal, and late luteal) the OC user and nonuser group also did not differ in terms of the likelihood of being tested in a particular cycle phase, χ^2 (6, N = 101) = 7.868, p =.248 (see bottom panel of Table 8 for frequencies and percentages). This indicates that OC users and nonusers were tested during similar times in their menstrual cycle. Furthermore many of the nonusers were tested during the highest hormone times (i.e., 25.6% during late follicular phase and 32.6% during the mid luteal phase) which maximizes the sensitivity of the design and decreases the likelihood of a Type II error.

Main Analyses

Hypothesis 1: OC users will show blunted positive affect reactivity across the laboratory session compared to nonusers and men. The data for *hypothesis 1* were screened for normality. Assumptions of normality were met and no outliers were found. A 3-group MANCOVA with group (OC users, non-users, and men) as the independent variable, and mean Positive Affect (PA) change and mean Negative Affect (NA) change scores as the dependent variables. The group means and standard deviations are found in the top of Table 9. Results indicate an overall multivariate group effect, F(4, 270) =2.413, p = .049, partial η^2 = .035, power = .690. Follow-up univariate ANCOVAs showed no group effect for mean PA change, F(2, 135) = 0.833, p =.437, η^2 = .012, power = .190,

but a significant group effect for mean NA change, $F(2, 135) = 3.787$, $p = .025$, partial $\eta^2 = .053$, power = .682. Planned post-hoc tests found that men had significantly less mean NA change than OC users, *Mean Difference* = 3.103, *SE* = 1.194, $p = .031$, and a trend for less NA change for men compared to nonusers, *Mean Difference* = -2.707, *SE* = 1.235, $p = .09$.

In order to examine group differences in affect level (as opposed to the above examination of affect variability or change), another MANCOVA was run using mean PA and mean NA scores as the dependent variables (see the bottom panel of Table 9 for means and standard deviations). Each mean score was calculated from the four affect measures across the laboratory session. Results indicated an overall multivariate group effect, $F(4, 270) = 7.259$, $p < .001$, partial $\eta^2 = .097$, power = .996; and significant univariate main effects for both mean PA score, $F(2, 135) = 8.463$, $p < .001$, partial $\eta^2 = .1121$, power =.962; and mean NA score, $F(2, 135) = 4.885$, $p = .009$, partial $\eta^2 = .067$, power =.796. Post-hoc Bonferroni contrasts show that men have higher mean PA scores than OC users, *Mean Difference* = 4.070, *SE* = 1.00, $p < .001$, and non users, *Mean Difference* = 2.873, *SE* = 1.036, $p = .019$. Post-hoc Bonferroni contrasts also show that men have lower mean NA scores than OC users, *Mean Difference* = -2.347 *SE* = 0.755, $p = .007$. There were no significant differences between men and nonusers in mean NA score. See Figure 2 for a graphical depiction of NA and PA change scores as a function of group, and Figure 3 for a graphical depiction of and mean PA and NA scores as a function of group.

Table 9

Means and Standard Deviations for Hypothesis 1 Variables: Mean Positive and Negative Affect Scores and Change Scores Across the Laboratory Session as a Function of Group

Variable	OC users (n = 56)	Nonusers (n = 45)	Men (n = 38)	Women (n = 106)
PA Change	11.77 (5.62)	10.17 (5.28)	10.20 (5.22)	10.87 (5.48)
NA Change*	11.99 (5.86)$_a$	10.90(6.05)^t	8.33 (5.12)$^t_{a,c}$	11.40 (5.91)$_c$
PA Score **	24.19 (4.84)$_a$	25.71 (4.77)$_b$	28.51 (4.46)$_{a,b,c}$	24.96 (4.91)$_c$
NA Score*	19.19 (4.32)$_a$	17.81 (3.24)	16.38(3.18)$_{a,c}$	18.53 (3.90)$_c$

Note. OC = oral contraceptives, PA = positive affect and NA = negative affect as determined by scores on the Positive and Negative Affect Scale (PANAS). Shared letter subscripts in a row indicate significant differences for the indicated groups: $_a$ OC users and men differ, $_b$ non users and men differ, $_c$ males and females differ. Shared ^{t} superscripts in a row indicate a trend towards a significant difference between groups, $p <$ .10. *p <.05. ** p < .001.

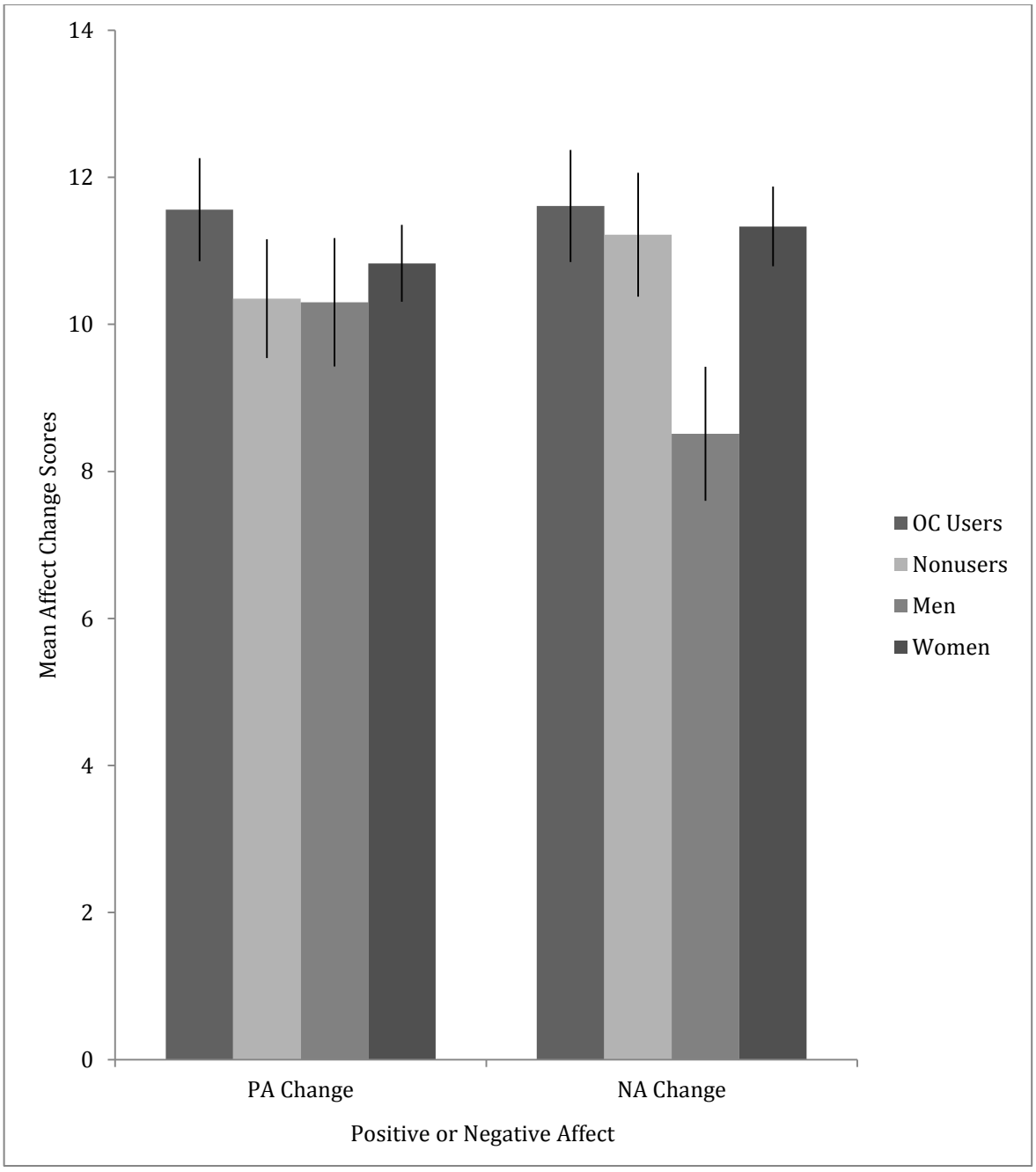

Figure 2. Adjusted Mean Positive Affect (PA) and Negative Affect (NA) Change Scores as a Function of Group in Response to Mood Primes. Men had lower mean NA change compared to OC users (p = .031) and Women as a whole (p = .009) across the laboratory session. Error bars represent ±1 SEM.

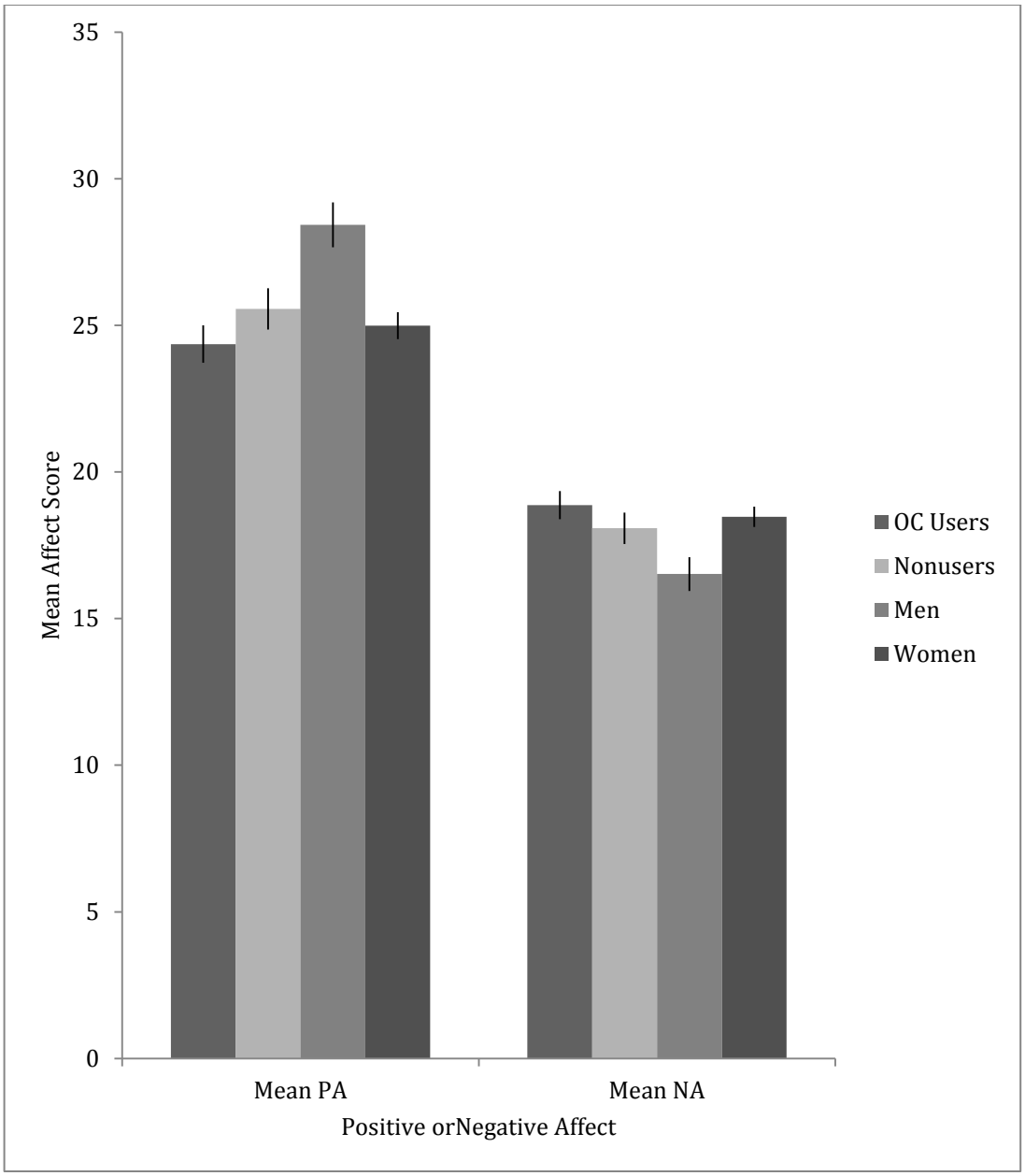

Figure 3. Adjusted Mean Positive Affect (PA) and Negative Affect (NA) Scores as a Function of Group in Response to Mood Primes. Groups differed with men experiencing higher mean PA than OC users ($p < .001$), Nonusers ($p = .019$), and Women ($p < .001$), and with men experiencing lower NA than OC users ($p = .007$), and Women as a whole ($p = .005$). Error bars represent ±1 SEM.

One important finding of the Jarva and Oinonen (2007) study, was that duration of OC use was related to the observed blunting of PA. The women in their study that were taking OCs for less than 24 months showed the highest level of PA blunting. Therefore, additional analyses were run for the current study to examine whether duration of OC use was related to mean PA and NA change scores across the laboratory session (see top panel of Table 10 for means and standard deviations). A MANCOVA was run using OC users with group (OC use duration ≤23 months, OC use duration ≥ 24 months, nonusers, and men) as the independent variable and all four affect scores as the dependent variables (i.e. PA and NA scores and PA and NA change scores).

Results from the MANCOVA indicated an overall multivariate group effect, $F(12, 384) = 3.336$, $p < .001$, partial $\eta^2 = .094$, power = .996. Follow-up univariate tests show significant group differences for mean PA scores, $F(3, 129) = 5.889$, $p = .001$, partial $\eta^2 = .120$, power = .950; mean NA scores, $F(3, 129) = 4.309$, $p = .006$, partial $\eta^2 = .091$, power = .57, and NA mean change, $F(3, 129) = 3.045$, $p = .031$, partial $\eta^2 = .066$, power = .704. There were no significant group differences for PA change, although there was a weak trend, $F(3, 129) = 1.989$, $p = .119$, partial $\eta^2 = .044$, power = .502.

Pairwise comparisons show that for mean PA score, men have higher PA levels compared to OC users on OCs for 23 months or less, *Mean Difference* = 5.205, *SE* = 1.304, $p = .001$; and non users, *Mean Difference* = 2.867 *SE* = 1.029, $p = .037$; and a trend for higher mean PA score compared to OC users on OCs for 24 months or more, *Mean Difference* = 2.801, *SE* = 1.138, $p = .091$. For mean NA levels, men had significantly lower NA score compared to OC users who were taking OCs for 24 months or more, *Mean Difference* = -2.997, *SE* = .853, $p = .004$. For NA change, men had

Table 10

Means (Standard Deviations) for Mean Positive Affect (PA) and Mean Negative Affect (NA) Change Scores and Mean NA and PA Scores as a Function of Group (short OC duration, long OC duration, nonuser, and men) Use Duration

Variable	OC use ≤ 23months (n = 20)	OC use ≥ 24months (n = 31)	Nonusers (n = 45)	Men (n = 38)
PA Change[t]	10.35 (5.12)	13.08 (5.42)	10.17 (5.28)	10.20 (5.22)
NA Change*	12.15 (5.01)	12.58 (6.44)$_c$	10.89 (6.05)	8.33 (5.12)$_c$
PA Score**	23.04 (3.99)$_a$	25.52 (5.19)[t]	25.71 (4.77)$_b$	28.51 (4.46)[t]$_{a,b}$
NA Score*	18.99 (3.99)	19.76 (4.50)$_c$	17.81 (3.24)	16.38 (3.18)$_c$

Note. OC = Oral contraceptives. PA Change and NA Change = mean change score in Positive Affect, or Negative Affect, respectively. PA score and NA score = mean Positive Affect score and mean Negative Affect score. NA and PA are calculated using the Positive and Negative Affect Schedule (PANAS). Shared letter subscripts in a row indicate significant differences for the indicated groups: $_a$ OC users on OCs for 23 months or less and men differ, $_b$ Nonusers and men differ, $_c$ OC users on OC for 24months or more and men differ, Super script [t] denotes a trend for group differences, $p < 1.0$.
* $p < .05$ ** $p < .001$

significantly lower NA change compared to OC users who were taking OCs for 24 months or more, *Mean Difference* = - 3.790, *SE* =1.369, *p* =.039. For PA change, there was a weak trend for women on OCs for 24 months or more to have more PA change compared to nonusers, *Mean Difference* = 2.833, *SE* = 1.208, *p* = .123, and men, *Mean Difference* = 2.892, *SE* = 1.259, *p* = .139. See Figure 4 for a graphical depiction of the mean affect scores as a function of OC length.

Along with potential differences in affect reactivity as a function of length of OC use, previous research has also indicated mood side effects may differ depending on type of synthetic progesterone in certain OCs: drospirenone (new generation), levonorgestrel or norethindrone (second generation) and gestodene, desogestrel, or norgestimate (third generation) (Wharton et al., 2008). Furthermore, it follows that PA and NA mean change may also differ depending on whether OCs are monophasic or triphasic. For example, one may expect more variability in those individuals taking a triphasic OC than those taking monophasic OCs. Therefore, additional analyses were run to examine whether OC composition affected mood responsivity in the laboratory (see top panel of Table 11 for means and standard deviations for mean PA and NA change for the various OC user groups and the nonusers).

A 4-group MANCOVA was run to compare participants taking the three differing generations of OCs (new, second, and third) and nonusers on mean PA and NA change across the laboratory session (see means and SDs in Table 11). Results showed no evidence of a multivariate group effect, $F(6, 190) = 1.077$, $p = .378$, partial $\eta^2 = .033$, power = .419. However, because the sample size for new generation was so low, $n = 3$,

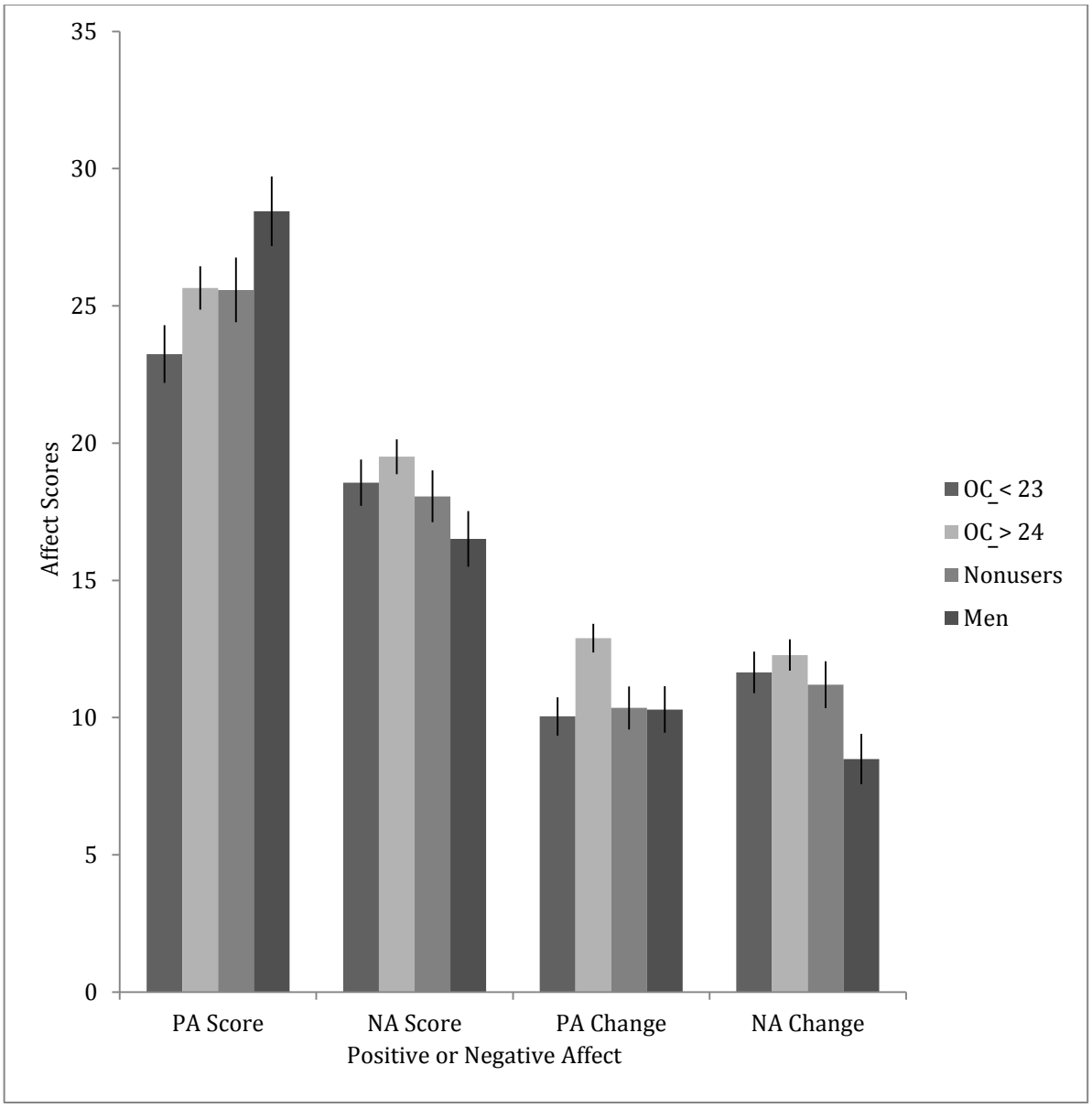

Figure 4. Adjusted Mean Positive Affect (PA) and Negative Affect (NA) Scores and Change Scores Following Mood Primes as a Function of Group. Groups differed with men experiencing: (a) higher mean PA than OC users taking OCs for 23 months or less (p = .001) and Nonusers (p = .037), (b) lower NA score than OC users on OCs for 24 months or more (p = .004), and (c) less NA change compared to OC users on OCs for 24 months or more (p = .039). Error bars represent ±1 SEM.

the analysis were re-run using only second and third generation OC users and nonusers as the independent variables and PA and NA change as the dependent variables. Again, there was no evidence of a multivariate group effect, F(4, 192) = 1.696, p = .153, partial η^2 = .034, power = .514. Another 3-group MANCOVA was run to compare participants taking monophasic OCs, triphasic OCs, and nonusers on their mean PA and NA change scores (see means in Table 11). Results showed no significant group effect, $F(4, 192) = 1.9929$, $p = .107$, partial $\eta^2 = .039$, power = .575. These analyses suggest that PA and NA change or affect reactivity was not influenced by type of OC.

Finally, to further examine the significance of group differences on the dependent variables, a MANCOVA was run using sex as the independent variable and mean NA and PA change scores, and mean NA and PA scores as the dependent variable (see Table 11 for means and standard deviations for NA and PA change and PA and NA scores for men and women). Results show an overall significant multivariate group effect, $F(4, 138) = 7.438$, $p < .001$, partial $\eta^2 = .177$, power = .996. Follow-up univariate tests show significant sex differences for NA mean change, $F(1, 141) = 7.074$, $p = .009$, partial $\eta^2 = .048$, power = .752; mean PA score, $F(1, 141) = 14.337$, $p < .001$, partial $\eta^2 = .092$, power = .964; and mean NA score, $F(1 , 141) = 8.197$, $p = .005$, partial $\eta^2 = .055$, power = .812, but not for PA mean change score, $F(1, 141) = .256$, $p = .614$, partial $\eta^2 = .002$, power = .079. Planned pairwise comparisons show that men had significantly lower NA mean change (*Mean Difference* = -2.811, *SE* =1.057, $p = .009$), higher mean PA mean scores, (*Mean Difference* = 3.421, *SE* = .094, $p < .001$) and lower mean NA scores (*Mean Difference* = -1.923, *SE* = .672, $p = .005$) compared to women. Given these sex

Table 11

Means (Standard Deviations) for Mean Positive Affect (PA) and Mean Negative Affect (NA) Scores and Change Scores as a Function of OC User groups (first generation user, second generation user, third generation user, monophasic user, triphasic user, Nonuser)

Variable	First Generation (n =3)	Second Generation (n=32)	Third Generation (n =20)	Monophasic (n = 45)	Triphasic (n = 10)	Nonuser (n =45)
PA Change	9.00 (9.06)	11.94 (4.52)	11.87 (5.82)	12.11 (5.01)	10.13 (6.05)	10.17 (5.28)
NA Change	9.56 (6.36)	10.78 (5.81)	13.70 (5.67)	11.25 (5.92)	14.13 (5.23)	10.90 (6.05)
PA Score	24.50 (3.25)	23.76 (4.86)	26.46 (5.08)	25.71 (4.78)	25.76 (5.73)	25.71 (4.78)
NA Score	16.42 (4.04)	18.67 (4.29)	20.08 (4.46)	18.91 (4.60)	19.73 (3.21)	17.81 (3.24)

Note. OC = Oral contraceptive. PA Change and NA Change = mean change score in Positive Affect, or Negative Affect, respectively. PA score and NA score = mean Positive Affect score and mean Negative Affect score. NA and PA are calculated using the Positive and Negative Affect Schedule (PANAS).

differences, the above findings suggest that the sex differences on NA change, mean PA, and mean NA may be driven by the OC user group as their scores are more extreme than the nonusers on all three of these affect variables (See Figure 2 for a graphical depiction of NA and PA change scores as a function of group, and Figure 3 for a graphical depiction of and mean PA and NA scores as a function of group).

Overall, Hypothesis 1 was not supported, as the results indicated no evidence of reduced PA reactivity across the lab session among OC users compared to nonusers and men. Instead, the results revealed no significant differences in PA reactivity between groups. However, results did show sex differences for NA reactivity (women > men) and that OC users had higher NA reactivity across the lab session compared to men. Furthermore, the largest sex difference effects were found for NA reactivity were found in OC users taking OCs 24 months or longer. Results also showed a sex difference in PA level and NA level. Men had overall higher mean PA scores than both OC users and nonusers, especially OC users that have been taking OCs for 23months or less. Men had lower mean NA scores than women as a whole and to the OC users, especially OC users that have been taking OCs for 24months or more.

Hypothesis 2: Women on OCs with current negative mood side effects will have quicker reaction times when identifying negative facial expressions, especially after the negative mood inductions, and have overall more facial emotion recognition errors compared to women on OCs with no current negative mood side effects, nonusers, and men. Data for *Hypothesis 2* was screened for normality. There were 7 outliers detected and removed from the analyses.

To determine if women on OCs with current negative mood side effects had quicker reaction times to negative faces compared to women on OCs with no current negative mood side effects, nonusers, and men, a 4-group ANCOVA was conducted with group as the independent variable and mean response times to all negative faces (across the three mood inductions) as the dependent variable (see descriptive data in top panel of Table 12). Analysis revealed an overall significant group effect for mean response time to negative faces $F(3, 128) = 3.85$, $p = .011$ partial $\eta^2 = .083$, *power* = .812. Post-hoc Bonferroni contrasts showed that men had significantly slower mean response times than OC users with no negative mood side effects, *Mean Difference* = 0.246, *SE* = 0.77, $p = .01$. Therefore, results did not support the hypothesis that women on OCs with current negative mood side effects would have the quickest response times to negative faces. Instead women on OCs with no negative mood side effects showed the fastest mean response times to negative faces (although the three groups of women did not differ significantly).

It was also predicted that the effect of negative faces on response times would be strongest during the negative mood induction. Therefore, a MANCOVA was conducted with group (women on OCs with current negative mood side effects, women on OCs with no current negative mood side effects, nonusers, and men) as the independent variable and mean response times to negative faces after each mood induction (sad, happy, and fear) as the three dependent variables (see second panel of Table 12 for means). Analysis reveals a significant overall multivariate group effect $F(9, 384) = 2.164$, $p = .024$, partial $\eta^2 = .048$, *power* = .886. Follow up univariate analyses show significant group difference in mean response times to negative faces in the sad condition, $F(3,128) = 4.846$, $p = .003$,

Table 12

Means (and Standard Deviations) for Hypothesis 2 Variables (Mean Response Time (RT) (ms) to Recognize Negative Emotional Expressions, Total Errors, and Total Correct) as a Function of Group

Variable	OC Mood (n = 15)	OC No Mood (n = 39)	Nonusers (n = 43)	Men (n = 36)
Mean $RT_{Overall}$*	1.81 (.223)	1.63 (.235)$_a$	1.75(.370)	1.91(.427)$_a$
Mean RT_{sad}*	1.91 (.246)	1.67 (.281)$_a$	1.77 (.375)$_b$	2.00 (.492)$_{a,b}$
Mean RT_{happy}	1.80 (.257)	1.69 (.306)	1.76 (.380)	1.90 (.387)
Mean RT_{fear}*	1.73 (.255)	1.53 (.242)$_a$	1.71 (.455)	1.84 (.453)$_a$
Total Errors	16.93 (6.39)	22.49 (9.13)	22.37 (11.05)	19.31 (6.21)
Total $Correct_{sad}$	68.60 (2.70)	67.49 (3.24)	66.74 (3.53)	68.31 (3.13)
Total $Correct_{happy}$	69.87 (2.07)	67.56 (2.81)	68.19 (4.21)	68.61 (2.27)
Total $Correct_{fear}$	69.60 (2.97)	67.46 (4.42)	67.70 (5.35)	68.78 (4.34)

Note. All response times are in milliseconds. OC = Oral Contraceptives. The subscripts $_{sad, happy, fear}$ all refer to response times or correct responses after the sad, happy, or fear mood inductions, respectively. Shared letter subscripts in a row indicate significant differences for the indicated groups: $_a$ OC users with no mood side effects and men differ, $_b$ Nonusers and men differ.
* $p < .05$.

partial η^2 = .102, *power* = .898; and the fear condition, $F(3,128) = 3.474$, $p = .018$, partial $\eta^2 = .075$, *power* = .766. No group difference was found for mean response times to negative faces in the happy condition, $F(3, 128) = 1.997$, $p = .118$, partial $\eta^2 = .045$, power = .504.

However, planned post-hoc tests show that, for the sad mood induction, men had slower mean response time to negative faces than OC users with no negative mood side effects, *Mean Difference* = 0.278, *SE* = .084, $p = .007$; and non-users, *Mean Difference* = 0.236, *SE* =.081, $p = .027$. After the fear induction, men also showed slower mean response times to negative faces compared to OC users with no negative mood side effects, *Mean Difference* = 0.277, *SE* = .087, $p = .011$.

It was also hypothesized that women on OCs with current negative mood side effects would make overall more errors than OC users with no mood side effects, nonusers and men, especially after the negative mood inductions. An ANCOVA was conducted with group as the independent variable (OC users with negative mood side effects, OC users with no negative mood side effects, non users, and men) and overall error score as the dependent variable (see descriptive data in bottom panels of Table 12). There was no significant univariate group effect for errors overall, $F(3, 128) = 2.33$, $p = .077$, partial $\eta^2 = .052$, *power* = .574, and no significant multivariate group effect for overall number of correct responses after each emotion induction, $F(9, 384) = 1.419$, $p = .178$, partial $\eta^2 = .032$, *power* = .683.

The hypothesis that OC users with current negative mood side effects would have quicker response times to negative faces, and make overall more errors especially after negative mood induction was not supported. However, because the group of women

Table 13

Means (Standard Deviations) for Mean Response Time (RT) to Negative Emotional Faces as a Function of Group

Variable	OC users (n = 53)	Nonusers (n = 43)	Men (n =36)	Women (n = 101)
Mean RT*	1.67 (0.24)$_a$	1.75 (0.37)	1.91 (0.43)$_{a,c}$	1.72 (0.30)$_c$
Mean RT$_{sad}$*	1.73 (0.29)$_a$	1.77 (0.37)$_b$	2.00 (.49)$_{a,b,c}$	1.76 (0.33)$_c$
Mean RT$_{happy}^t$	1.71 (0.29)	1.76 (0.38)^t	1.90 (3.87)^t_c	1.75 (0.33)$_c$
Mean RT$_{fear}$*	1.57 (0.25)$_a$	1.71 (0.45)	1.84 (.45)$_{a,c}$	1.64 (0.36)$_c$
Total Errors	21.21 (8.63)	22.37 (11.05)	19.31 (6.21)	21.43 (9.70)
Total Correct$_{sad}^t$	67.68 (3.02)	66.74 (3.53)^t	68.31 (3.13)^t	67.40 (4.00)
Total Correct$_{happy}$	68.11 (2.75)	68.19 (4.21)	68.61 (2.27)	68.26 (3.43)
Total Correct$_{fear}$	68.00 (4.18)	67.70 (5.54)	68.11 (4.36)	67.91 (4.72)

Note. OC = Oral Contraceptives. The Subscripts $_{sad, happy, fear}$ refer to the mean response times subsequent to the indicated mood induction. Shared letter subscripts in a row indicated significant differences for the indicated groups: $_a$ OC users and men differ, $_b$ mean and nonusers differ, $_c$ men and women differ. The superscript ^{t} indicates a trend towards significant group differences, $p < .1$.
* $p < .05$.

using OCs with current negative mood side effects was small (n = 15), the analyses were re-run using only three groups (i.e., OC users, non users, and men) to examine whether there was an association between OC use and response time to negative faces and overall facial emotional recognition errors (see means in Table 13).

An ANCOVA was run using group (OC users, non users, and men) as the independent variable and mean response time to negative faces as the dependent variable. There was an overall univariate effect $F(2, 128) = 4.290$, $p = .016$, partial $\eta^2 = .063$, *power* = .739. Planned post hoc comparisons indicated that OC users had significantly faster mean response times to negative faces than men, *Mean Difference* =.203, $p = .018$ (see top panel of Table 13 for means).

The above finding was examined further by looking at whether mean response times to negative faces differ depending on type of mood induction. A MANCOVA was run with group (OC users, non users, and men) and mean response times to negative faces after each emotion induction (sad, happy, and fear) as the dependent variables (see means in Table 13). There was an overall multivariate group effect $F(6, 254) = 2.439$, $p = .026$, partial $\eta^2 = .054$, power = .821; and significant follow-up univariate group effects for the sad condition, $F(2,128) = 4.985$, p =.008, partial $\eta^2 = .072$, *power* = .805; and the fear condition, $F(2, 128)$ =3.984 $p = .021$, partial $\eta^2 = .059$, *power* = .705. There was no significant group effect difference for mean response times after the happy induction, $F(2, 128) = 2.552$, p =.082, partial $\eta^2 = .038$, power =.502, although there was a trend. Planned post hoc comparisons show significant differences in mean response time to negative faces between men and OC users after sad mood induction, *Mean Difference* = 2.18, *SE* = 0.08, $p = .022$; and after the fear mood induction, *Mean Difference* = 2.32, *SE*

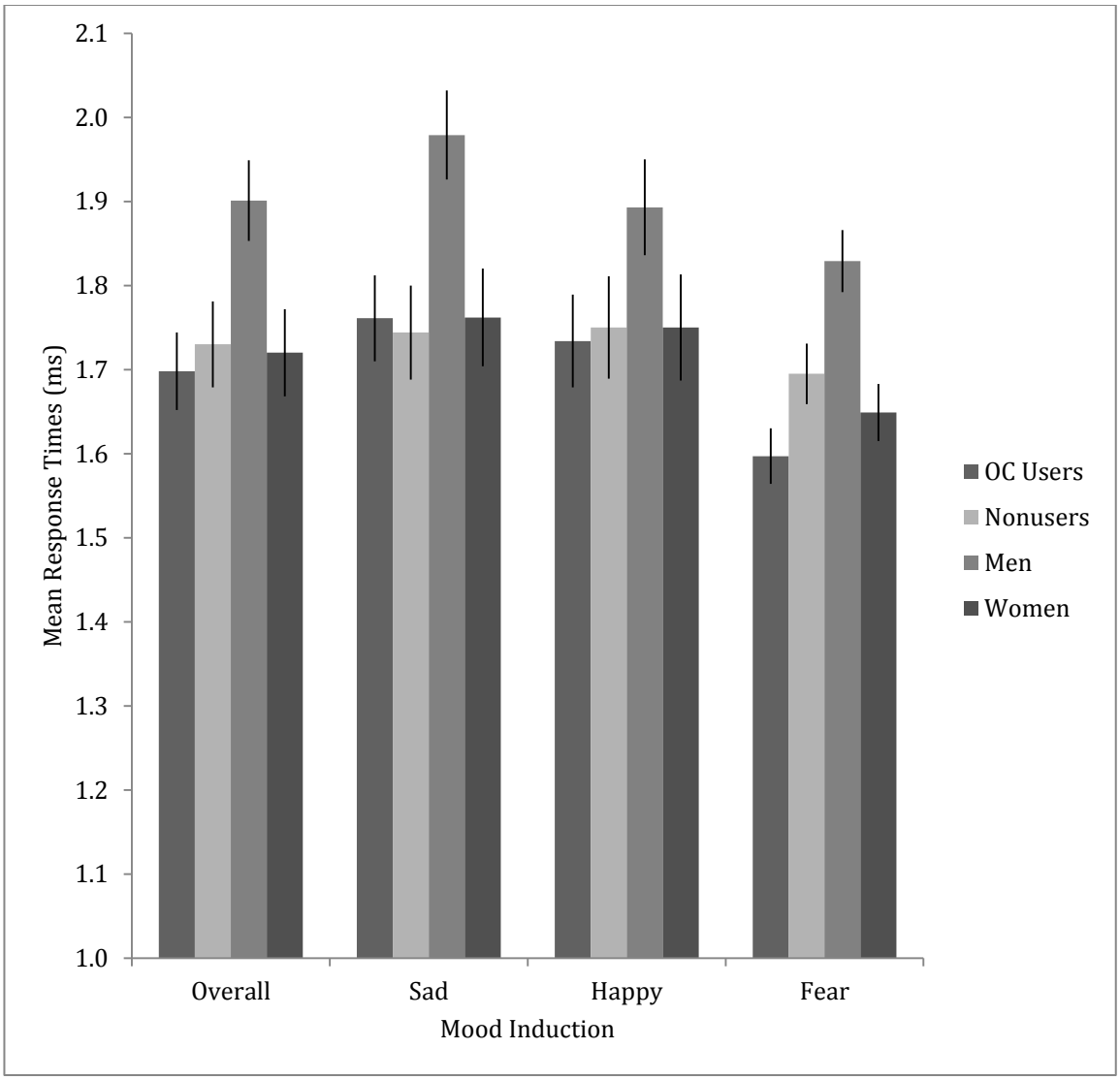

Figure 5. Adjusted Mean Response Times (in milliseconds) to Recognize Negative Emotional Facial Expressions as a Function of Group (OC users, nonusers, men, women). Groups differed with men having slower overall response times compared to OC users (p = .018) and women as group (p = .006); and with men having slower response times after the sad condition compared to OC users (p = .022), nonusers (p = .015), and women (p = .002), after the fear condition compared to OC users (p = .017), and women (p =.016), and after the happy condition compared to women (p =.033). Error bars represent ±1 SEM.

= 0.082, p = .017. Men also showed a significant difference in mean response time to negative faces compared to nonusers after the sad mood induction, *Mean Difference* =.236 *SE* = 0.083, p = .015. See Figure 5 for a graphical depiction of mean response times as a function of group.

The three groups (OC users, non users, and men) were further examined to determine if there were group differences in overall incorrect responses for the face emotion recognition task (see bottom panels of Table 13). A 3-way ANCOVA revealed no significant difference in overall incorrect responses between groups, $F(2, 128) = 1.296$, p = .277, partial η^2 = .020, *power* = .277. Additionally, a MANCOVA with group (OC users, non users, and men) as the independent variable and overall correct scores after each emotion induction (sad, happy, fear) as the dependent variables was conducted. There were no significant difference in overall correct responses after each emotion induction $F(6,254) = 1.31$, p =.344, partial η^2 = .026, *power* = .444.

There was unequal variance across groups for the mean response times to negative faces after each mood condition, Box's M Test of equality of covariance matrices, $F(12, 65336.924) = 3.496$, $p < .001$. Therefore, to check on the validity of the above findings, a non-parametric Kruskal-Wallis test was run to ensure significant results were not due to inequality of variance. Results from the non-parametric test confirmed group differences in mean response times to negative faces after the sad mood condition (p = .012) and group differences in mean response times to negative faces after the fear mood condition (p = .003).

Finally, the response time dependent variables were further analyzed to determine if there were overall sex differences in the above analyses that demonstrated significant

results. An ANCOVA was performed using sex (male, female) as the independent variable and overall mean response time to negative faces as the dependent variable. An overall sex difference was found, $F(1, 134) = 7.881$, $p = .006$, partial $\eta^2 = .056$, power = .796 with men showing significantly slower response times than women when identifying negative emotional expressions, *Mean Difference* = 0.179, *SE* = 0.64, $p = .006$. (See top of Table 13 for means and standard deviations).

A MANCOVA was also run with sex (male, female) as the independent variable and mean response times to negative faces after each mood induction (sad, happy, fear) as the three dependent variables. An overall significant multivariate group effect was found as expected given the above finding, $F(3, 132) = 3.256$, $p = .024$, partial $\eta^2 = .069$, power = .736. Follow up univariate analyses showed that men had significantly slower response times to negative faces than women after the sad induction, $F(1, 134) = 9.504$, $p = .002$, partial $\eta^2 = .066$, power = .865; after the fear induction, $F(1, 134) = 6.00$, $p = .016$ partial $\eta^2 = .043$, power = .682, and after the happy induction, $F(1, 134) = 4.643$, $p = .033$, partial $\eta^2 = .033$, power = .571. See Figure 5 for a graphical depiction of mean response times as a function of group.

In summary, our sample of women on OCs with current negative mood side effects was likely not large enough to adequately test the hypothesis related to negative mood side effects. Instead, all OC users were examined together regardless of current mood side effects. Results indicated that OC users had quicker response times to negative faces compared to men. When response times were examined as a function of mood induction type, men showed slower response times than both OC users and nonusers after the sad induction, and slower response times than OC users after the fear

induction. There were no group differences in response times after the happy induction, or in overall correct or incorrect scores. Examination of sex differences paralleled these results, however, a sex difference was found in reaction times to negative faces for all three mood conditions.

Hypothesis 3: OC users will make overall more errors of commission on the GoNogo task compared to nonusers and men, especially during the positive mood induction. Data for *Hypothesis 3* was screened for normality. There were 3 outliers detected and removed from the analyses.

To determine if OC users had higher errors of commission on the GoNogo task compared to nonusers and men, an ANCOVA was run with group (OC users, nonusers, and men) as the independent variable and total errors of commission as the dependent variable (see Table 14 for means and standard deviations). There was no overall significant univariate group effect, however there was a trend, $F(2, 125) = 2.778$, $p = .066$, partial $\eta^2 = .043$, *power* = .539. An examination of the pairwise comparisons reveal a trend for OC users to have more errors of commission than men, *Mean Difference* = -5.387, *SE* = 2.344, $p = .070$.

To examine if errors of commission differ as a function of the mood priming types, a MANCOVA was conducted with group (OC users, nonusers, and men) as the independent variable and total errors of commission after each emotion induction (sad, happy, fear) as the three dependent variables (see means in bottom panel of Table 14). There was not a significant multivariate group effect, $F(6, 248) = 1.253$, $p = .280$, partial $\eta^2 = .029$, *power* = .489. However, as predicted, follow up univariate tests reveal a

Table 14

Means (Standard Deviations) of Errors of Commission on the GoNogo task as a Function of Group for Hypothesis 3

Variable	OC Users (n = 51)	Nonusers (n = 43)	Men (n = 35)	OC Mood (n =15)	OC No Mood (n = 37)	Women (n = 99)
Total Errors^{t}	17.71 (12.70)^{t}	14.05 (9.44)	12.09 (7.74)^{t}	13.07 (12.26)	19.30 (12.54)	16.13 (11.91)
$Errors_{sad}$	6.31 (5.14)	4.81 (3.44)	4.57 (3.39)	3.73 (4.13)$_{b}$	7.22 (5.21)$_{b}$	5.58 (4.53)
$Errors_{happy}$*	4.55 (4.36)$_{a}$	3.58 (2.92)	2.51 (2.86)$_{a,c}$	3.93 (4.18)	4.76 (4.41)	4.24 (4.03)$_{c}$
$Errors_{fear}$	6.84 (5.44)	5.65 (4.73)	5.00 (3.15)	5.40 (5.04)	7.32 (5.53)	6.31 (5.27)

Note. OC = Oral Contraceptives. OC Mood = Oral contraceptives users with current negative mood side effects. OC No Mood = OC users with no current negative mood side effects. $Errors_{sad}$ = errors of commission after the sad mood induction, $Errors_{happy}$ =errors of commission after the happy mood induction, $Errors_{fear}$ = Errors of commission after the fear mood induction. Shared letter subscripts in a row indicate significant differences for the indicated groups. $_{a}$ OC users and Men differ, $_{b}$ OC Mood and OC No Mood differ, $_{c}$ males and females differ. ^{t} denotes a trend for a difference between OC users and men, $p < .1$.

* $p < .05$

significant group difference in errors of commission after the happy induction $F(2, 125) = 3.348$, $p = .038$, partial $\eta^2 = .051$, *power* = .624; but not after the sad induction, $F(2, 125) = 1.930$, $p = .149$, partial $\eta^2 = .030$, power = .394; or after the fear induction, $F(2, 125) = 1.334$, $p = .267$, partial $\eta^2 = .021$, power = .284. Planned post hoc comparisons reveal that OC users made more commission errors than men after the happy mood induction, *Mean Difference* = 2.053, *SE* = .795, $p = .033$. See Figure 6 for a graphical depiction of errors of commission as a function of group.

For both of the above analyses, the tests of Equality of Error Variances indicated significant results. Therefore, nonparametric Kruskal-Wallis tests were conducted to verify that the results were not due to inequality of variance between groups. For the ANCOVA with overall errors of commission as the dependent variable, the Levene's Test of Equality of Error variance indicated unequal error variance, $F(2, 126) = 6.324$, $p = .002$. However, results of the nonparametric tests support the ANCOVA result in that there was not a significant group difference in overall errors of commission ($p = .340$). For the MANCOVA, with errors of commission after each mood induction as the dependent variables, the Box's M Test of Equality of Covariance Matrices indicated significant error variance, *Box's M* = 39.076, $F(12, 62606.70) = 3.141$, $p < .001$. However, results of the nonparametric test supported the above result of a significant group difference on errors of commission after the happy induction ($p = .048$) but not after the fear induction ($p = .456$), or the sad induction ($p = .621$).

Because errors of commission are more likely to be made in positive mood contexts (Albert, Lopez-Martin, & Carretie, 2010), the current mood of the participant may further influence performance on the GoNogo task. Therefore, follow up *t*-tests were

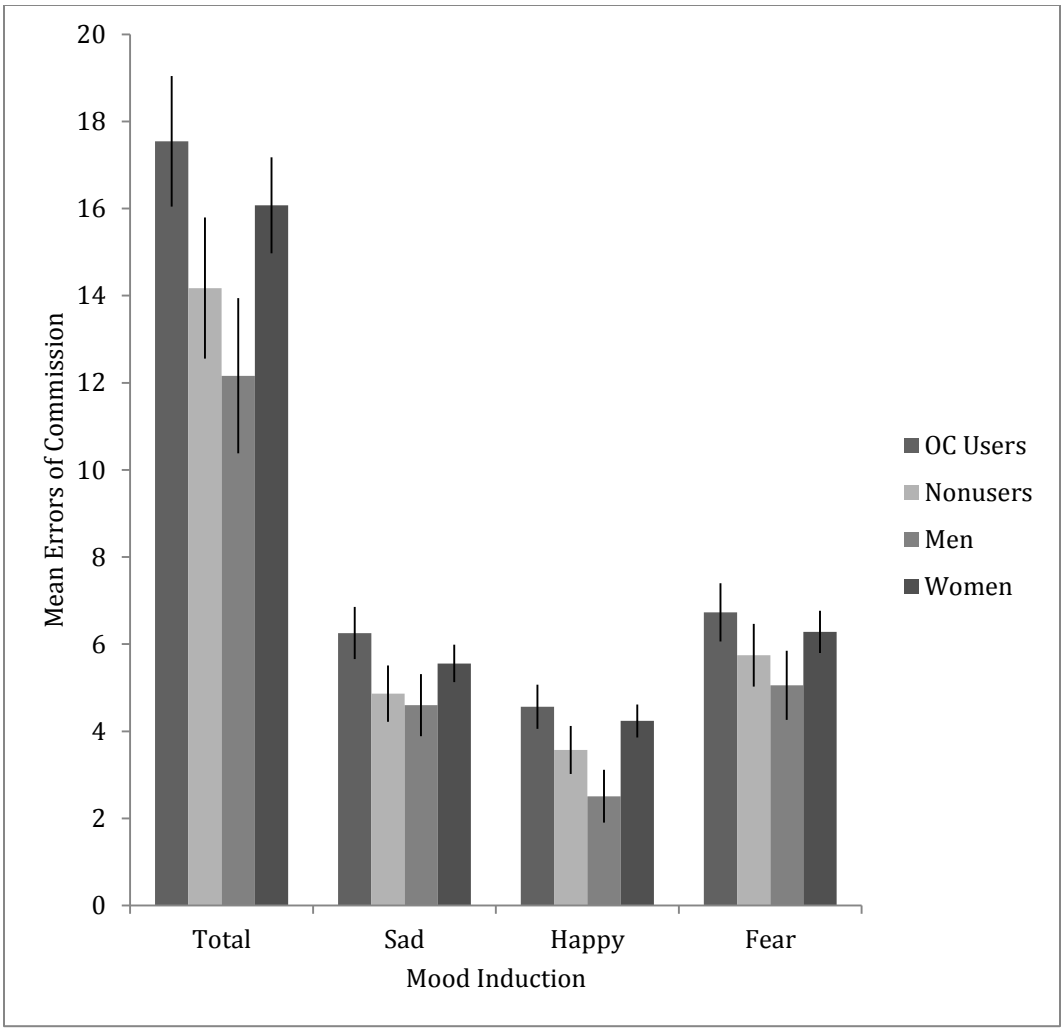

Figure 6. Adjusted Means for Errors of Commission Overall (total) and After Each Mood Induction Type as a Function of Group. The groups differed with men having significantly fewer errors of commission compared to OC users (p = .033) and women (p =.024) in the happy condition. Error bars represent ±1 SEM.

conducted to specifically examine if errors of commission on the GoNogo task would be higher in OC users with no current negative mood side effects compared to OC users with negative mood side effects (see middle of bottom panel in Table 14).

Results from the t-tests revealed that there were no group differences in overall errors of commission, $t(50) = -1.634$, $p = .109$; errors of commission after the happy mood induction, $t(50) = -.619$, $p = .539$; or error of commission after the fear induction, $t(50) = -1.165$, $p = .249$. However, errors of commission after the sad mood induction revealed a significant group difference, $t(50) = -2.545$, $p = .016$, where OC users with current negative mood side effects had significantly fewer errors of commission after the sad mood induction compared to OC users with no negative mood side effects. See Figure 7 for a graphical depiction of errors of commission for the OC users with mood and without mood side effects

Finally, data were analyzed to determine if there were any overall sex differences in errors of commission on the GoNogo task after the mood inductions. A MANCOVA was run with sex (male, female) as the independent variable and errors of commission after each mood induction (sad, happy, fear) as the dependent variables (see Table 14 for means and standard deviations). There was no significant multivariate group effect, $F(3, 129) = 1.774$, $p = .155$, partial

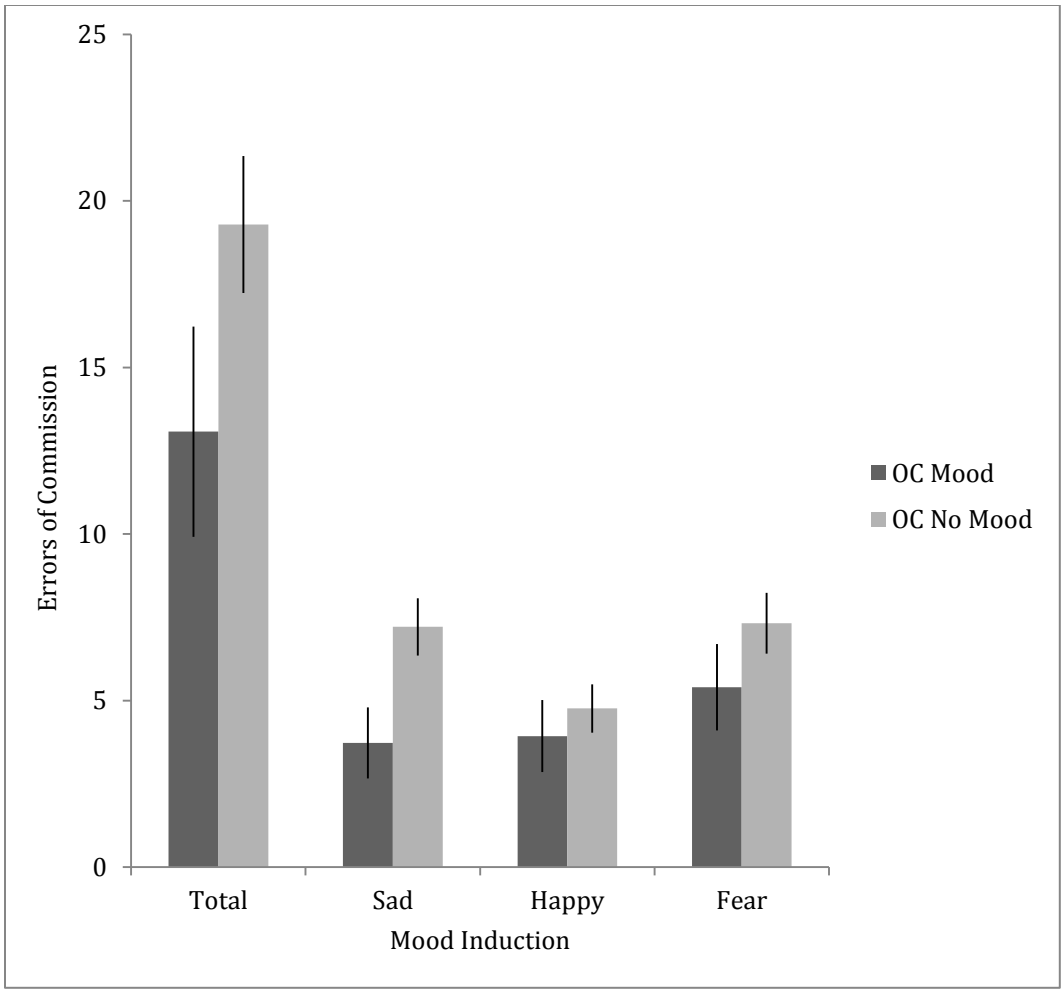

Figure 7. Errors of Commission on the GoNogo task overall (Total), and after each of three Mood Inductions as a function of Group [OCs users with Current Negative Mood Side Effects (OC Mood), and OC Users with No Negative Mood Side Effects (OC No Mood)]. The OC Mood group made fewer commission errors than the OC No Mood (p = .016) group in the sad condition. Error bars represent ±1 SEM.

η^2 = .040, power = .454. Follow up univariate tests, however, revealed significant sex differences for errors of commission after the happy induction, $F(1,131) = 5.21$, $p = .024$, partial η^2 = .038, power = .621. Men had fewer errors of commission compared to women after the happy mood induction, *Mean Difference* = -1.702, *SE* = 0.745, p =.024. No significant sex differences were found for errors of commission after the sad condition, $F(1 ,131) = 1.21$, p =.273, partial η^2 = .009, power = .194; or after the fear condition $F(1, 131) = 1.603$, p = .208, partial η^2 = .012, power = .242 (See Figure 6 above).

To summarize, *hypothesis 3* was partially support by the results. Although there was no significant group difference for overall errors of commission, there was a trend for OC users to make more errors of commission compared to men. Also, the results supported the hypothesis that OC users would make more errors of commission after the happy mood induction. There were only significant group differences between OC users and men, however, and no significant differences between OC users and nonusers on errors of commission. Additional analyses also revealed that OC users with current negative mood side effects made significantly fewer errors of commission than OC users with no negative mood side effects after the sad mood induction. Finally, there was a significant sex difference showing that men made significantly fewer errors of commission compared to women after the happy condition.

Hypothesis 4: OC users differ in their overall performance on the cognitive and perceptual tasks as a function of the mood primes compared to nonusers and men. Data for *Hypothesis 4* was screened for normality. There were 7 outliers detected and removed from the analyses.

In order to examine group differences in performance on the cognitive tasks, a 3-way multivariate analysis was conducted to determine if the groups (OC users, nonusers, and men) differed in their overall performance on the two cognitive tasks (facial emotion recognition and GoNogo task) as a function of the mood inductions. Group was used as the independent variable and total performance scores were used as the dependent variables. Total performance scores were derived from total correct scores from the facial emotion recognition task and total scores from the Go Nogo task after each emotion induction (sad, happy and fear), resulting in six scores: Total correct score on the facial emotions recognition task after the sad mood induction, total correct scores on the GoNogo task after the sad mood induction, total correct score on the facial emotions recognition task after the happy mood induction, total correct scores on the GoNogo task after the happy mood induction, total correct score on the facial emotions recognition task after the fear mood induction, and total correct scores on the GoNogo task after the fear mood induction. These scores were then converted into z-scores. The means for the two scores for each induction were

then added together to create 3 scores: overall mean performance after the sadness induction, overall mean performance after the happy induction, and overall mean performance after the fear induction (see Table 15 for means and standard deviations).

A MANCOVA was run with group (OC users, nonusers, and men) as the independent variable and overall mean performance scores after each emotion induction (sad, happy, fear) as the dependent variable. The analysis showed there was not a significant overall multivariate group effect for performance on the cognitive tasks after each mood inductions, F (6, 244) = 0.927, p = .476 partial η^2 = .022, *power* = .364. To explore overall performance on the tasks regardless of mood side effects, a follow up ANCOVA was conducted with group (OC users, nonusers, and men) as the independent variable and overall total mean performance (mean of the performance z-scores across each mood induction) as the dependent variable. Results revealed no significant univariate effects, F(2, 123) = 1.374, p = .257, partial η^2 = .022, power = .291.

Finally, sex differences were examined. A 3-way MANCOVA was conducted with sex (male, female) as the independent variable and total performance scores after each mood induction (sad, happy, fear) as the three dependent variables. There was no overall multivariate group effect F(3, 127) = .719, p = .542, partial η^2 = .017, power = .200.

Table 15

Means (and Standard Deviations) of the Total Performance z-Scores on Cognitive Tasks Performed after Three Mood Inductions (sad, happy, fear) as a function of group (OC users, Nonusers, Men, Women) for Hypothesis 4

Variable	OC Users (n = 50)	Nonusers (n = 42)	Men (n =35)	Women (n = 97)
$Performance_{sad}$	-.014 (.817)	.046 (.551)	.225 (.520)	.023 (.743)
$Performance_{happy}$	-.008 (.650)	.157 (.492)	.223 (.438)	.062 (.621)
$Performance_{fear}$	-.051 (.852)	.105 (.600)	.163 (.490)	.021 (.767)
$Performance_{overall}$	-.024 (.698)	.102 (.407)	.204 (.385)	.035 (.623)

Note. OC = Oral contraceptives. The subscripts below Performance: $_{sad, happy, fear}$ refer to performance on two cognitive and perceptual tasks (i.e., Facial Emotions Recognition task and GoNogo task) after each emotion induction; sad, happy, fear, or overall performance, respectively.

Overall, the hypothesis that OC users differ compared to nonusers and men in their overall performance on the cognitive and perceptual tasks as a function of mood prime was not supported. Instead no group differences were found in overall performance on the cognitive and perceptual tasks.

Discussion

Summary of the Results

Hypothesis 1 was not supported, as the results indicated no evidence of reduced PA reactivity across the lab session among OC users compared to nonusers and men. However, results did show that OC users and women as a group had higher NA reactivity across the lab session compared to men, and higher mean NA scores compared to men. The higher NA reactivity and higher NA scores in OC users compared to men appears to be due to particularly high NA and NA reactivity in longer term OC users (i.e., > 23 months) as opposed to shorter duration users (i.e., < 24 months). Results also showed that men had overall higher mean PA scores than OC users, nonusers, and women, especially OC users that have been taking OC users for 23 months or less. No differences were found in NA and PA reactivity as a function of type of OC (e.g., phasic formulation or progesterone generation).

For Hypothesis 2, results did not support the hypothesis that OC users with current negative mood side effects would have quicker response times and

have overall more errors on the facial emotion recognition task than OC users with no negative mood side effects, nonusers, and men. OC users with negative mood side effects and OC users with no mood side effects were collapsed onto one OC users group for analyses. Results indicated that OC users had the quickest response times to negative faces compared to men. When response times were examined as a function of mood induction type, men had slower response times compared to both OC users and nonusers after the sad induction, and slower response times than OC users after the fear induction. There were no group differences in response times after the happy induction, or in overall correct or incorrect scores. Examination of sex differences paralleled these results (women faster than men in response times to negative faces), but only after the happy mood induction condition.

Results for Hypothesis 3 showed partial support for the hypothesis that OC users would make more errors of commission, especially after the positive mood induction compared to nonusers and men. There were no significant group differences for overall errors of commission, however there was a trend for OC users to make more errors of commission compared to men. Also, the results supported the hypothesis that OC users would make more errors of commission after the happy mood induction. There were only significant group differences between OC users and men, however, and no significant differences between OC

users and nonusers on errors of commission. Additional analyses also revealed that OC users with current negative mood side effects made significantly fewer errors of commission than OC users with no negative mood side effects after the sad mood induction. Finally, there were significant sex differences showing that men have lower errors of commission compared to women after the happy condition.

Finally, for *Hypothesis 4*, the hypothesis that OC users would differ compared to nonusers and men in their overall performance on the cognitive and perceptual tasks as a function of mood prime was not supported. Instead no group differences were found in overall performance on the cognitive and perceptual tasks.

Men Had Lower NA Scores, Lower NA Reactivity, and Higher PA Scores Compared to Women Using OCs and all Women (both OC Users and Nonusers)

Hypothesis 1 was an attempt to replicate the findings in the Jarva and Oinonen study (2007). The hypothesis was also based on evidence that women on OCs have been shown to have lower levels of endogenous neurosteroids (both progesterones and estrogens) (Folessa et al. 2002) and a blunting of the cortisol response (Kirschbaum, Pirke & Hellhammer, 1995). Thus, the logic followed,

that women on OCs may have a blunting of affect as a result of the blunting of neurosteroids and cortisol.

The results indicated no evidence of reduced PA reactivity across the lab session among OC users compared to nonusers and men. Instead, the results revealed no significant differences in PA reactivity between groups. An examination of the Jarva and Oinonen (2007) study revealed several important differences from this current study that could explain the discrepancy in results. The Jarva and Oinonen study induced different types of moods and used different mood induction methods than this current study. Jarva and Oinonen (2007) induced positive affect by having the participants view a comedic video, jealousy by having participants read and visualize a script designed to induce jealousy, social ostracism by having the participants play a Cyberball game in which they were systematically excluded, and parental feelings by having participants view a slide show of human babies. Additionally, the methods of mood induction in their study were varying in format (i.e. reading a vignette, watching a video, or playing a game) whereas the methods of mood induction in our current study were consistent in format (i.e. emotional videos paired with mood congruent music). Therefore, the mood induction methods in the Jarva and Oinoen (2007) study may not be directly comparable to the mood induction methods used in this current study. It is possible that a blunted PA response in OC users is more easily

demonstrated when a variety of mood priming techniques are used or when some specific types of emotions are primed.

As an example, the Jarva and Oinonen (2007) finding of a blunting of PA among OC users compared to nonusers and men may have been due to the fact that women on OCs may not have reacted as strongly positively to the slideshow aimed at inducing parental feelings. It can be presumed that most women on OCs do not have any current desire to get pregnant and, therefore, may not have felt as positively as other groups towards pictures of human babies. The positive mood induction used in our study evoked a variety of different positive emotions rather than comedy and parental feelings. The happy induction for this current study included videos of humans of all ages and races laughing, people winning game shows and celebrating, and families being re-united with pets that were excited to see them. Therefore, our positive mood induction was more general, and not targeted to parental feelings, which may explain the lack of difference in PA reactivity between groups in our study.

Despite not being able to replicate the Jarva and Oinonen (2007) finding of blunted PA in OC users, the results from analyses related to the first hypothesis did reveal some noteworthy findings worth discussing. First, the results indicated that OC users had higher NA reactivity compared to men and higher mean NA scores than men. The higher NA reactivity and higher mean NA scores compared

to men were also especially found among women who were taking OCs for 24 months or more. This demonstrates that overall, OC users endorsed higher feelings of negativity, distress, and unpleasant mood states throughout the study, and had greater change in their negativity scores from one induction to the other, especially if OC users were taking OCs for 24 months or longer. On the other hand, the lower levels of negative affect endorsed by men indicate that men felt overall more calm and secure throughout the study and from one mood induction to the other.

The findings of OC users and negative affect are somewhat consistent with previous research on OCs and affect when OC type is taken into consideration. Interestingly, although we did not find significant differences in PA or NA reactivity as a function of type of OC, most of the women in the OC group were on a second generation OC containing levonorgestrel or norethindrone progesterones (n =32). Previous research has indicated that levonorgestrel containing OCs are most highly associated with negative mood side effects (Gingnell at al., 2013; Kurshan & Epperson, 2006). On the other hand, for this current study, only a few women were taking new generation OCs containing drospirenone progesterone (n = 3). In their review, Kurhsan and Epperson (2006) found that new generation pills containing drospirenone progesterone were related to positive mood side effects. Therefore, it is possible that the OC users in this

current study were ones that were most susceptible to negative affect. Moreover, the longer the women have been taking the OC (i.e. 24 months or longer) the more pronounced the negative affect may be. Jarva and Oinonen (2007) did not investigate generation of OCs or type of progesterone in OCs as it related to PA and NA variability (reactivity). Therefore, it is not known if there is a certain progesterone component found in certain types of OCs that may be related to a blunting of PA. Future research should continue to investigate the varying reactions to emotional stimuli as a function of OC type.

Additionally, along with OC users showing higher NA reactivity and higher mean NA score compared to men, the results showed that OC users and nonusers had overall lower mean PA scores than men. Lower PA scores are indicative of feeling of low mood and lethargy whereas higher PA scores are indicative of feelings of high energy, concentration, and pleasurable engagement (Watson, Clark, & Tellegen, 1988). This result is interesting because, at face value, it may suggest that men experience more positive affect than women (both OC users and nonusers). However, previous research has demonstrated minimal sex differences in self-reported positive affect with some studies finding women having higher PA than men and women generally experiencing all emotions more intensely than men (Fujita, Diener, & Sandvik, 1991; Grossman & Wood, 1993; Kring and Gordon, 1998). Therefore, instead of indicating that men are generally

more positive than women, the results may instead indicate a unique way in which men react to negative stimuli compared to women.

In this current study, along with higher mean PA scores, men also had lower mean NA scores than OC users and women. This may suggest that men are less likely to endorse negative reactions to negative mood inductions, possibly due to a social desirability effect or a social-cultural response set. For example, a study by Kring and Gordon (1998) had men and women view happy, sad, and fear related movie clips and complete the Bem Sex Role Inventory to collect information about gender roles, masculinity, and femininity. They found men were more likely to be higher in elecotrodermal reactivity (as measured by skin conductance tests) but lower on facial emotion expressions compared to women which, as the researchers described, indicated internalizing emotions. Additionally, they found that more androgynous men were more facially expressive during mood inductions compared to more masculine men. This suggests that that socio-cultural gender roles may influence emotion expression.

Furthermore, there is evidence that emotion suppression may be reflected in performance on cognitive and perceptual tasks. Pu, Schmeichel, and Damaree (2009) found that participants who were suppressing their emotions during a negative emotional video performed worse on verbal and spatial working memory tasks than those who did not suppress emotions and than those in the neutral film

condition. Pu, Schmeichel, and Damaree (2009) explained that emotion suppression taxes one's cognitive resources and thus may explain differing performances on tasks compared to individuals that did not suppress emotions. While men did not perform worse on the tasks in this current study, perhaps their differing response times compared to women (on the Facial emotion recognition tasks: see Hypothesis 2) may be indicative of more cognitive effort required when suppressing emotional reactions.

In order to investigate whether or not men suppress their negative emotional reactions to mood inductions, future studies should include more sensitive measures of emotion or physiological measures that reflect emotion, rather than explicit self-report measures such as the PANAS. This current study included the Physical Experiences of Emotions Questionnaire (PEEQ) as a measure designed to capture physical sensations after each emotion induction. It may be valuable to examine men's physical symptoms after the mood inductions. Perhaps men do not differ in their physical responses to the mood inductions compared to OC users and nonusers, but only their self-reported emotional reactions differ. If this were the case, it may lend support for the idea that men are experiencing the mood inductions similarly to the other groups of women, however they are suppressing or downplaying their self-reported emotional reactions. Additionally, future research should compare response times to each of

the items on the PANAS among groups. If men, for example, take longer when responding to certain PANAS items related to the mood induction, it may also lend support for the idea that men are suppressing their emotional reactions.

Furthermore, the higher NA scores and higher NA reactivity in OC users compared to men was strongest for women that have taken OCs for 24 months or more whereas the lower mean PA scores for OC users compared to men was strongest in OC users that have been using OCs for 23 months or less. These results indicate that perhaps lower PA may affect OC users during the beginning of OC use, whereas higher negative affect level and reactivity may develop later, after prolonged use. However, an examination of the means reveals that the earlier OC users and later OC users do not differ significantly from each other, and their mean scores on the PA and NA variables are not significantly different from one another. While it may therefore be valid to include OC users of varying lengths in one group, one should keep in mind that the survivor effect is more likely apply to the longer-term than the shorter-term users and the longer-term users are more likely to be women who have not experienced mood problems due to OC use.

As noted above, there was no support for the hypothesis that OC use is associated with a blunting of PA. While various explanations for the finding are discussed above, it is important to note that the failure to find support for this hypothesis may be due to an absence of an effect. Given the noted strengths of the

current study, it is possible that the previous finding of blunted PA in OC users from the Jarva and Oinonen (2007) study was a spurious finding or a Type I error.

Men Had Slower Response Times Compared to Women Using OCs with No Mood Side Effects, and Women Using OCs in General, Especially After Negative Mood Inductions

The second hypothesis was based on the findings from Gingnell et al. (2013) who found that women on OCs with current negative mood side effects had quicker response times for angry and fearful faces. Moreover, Gingnell et al. (2013) found that when women on OCs with current negative mood side effects were viewing negative faces, there was lower activity in brain areas responsible for emotional distraction, and processes related to executive control and social interactions such as response inhibition and empathy (the inferior frontal gyri) (Hampshire et al., 2010; Liakakis et al. 2011; Wang et al., 2008). Thus, it was hypothesized that for this current study, women on OCs with current negative mood side effects would have quicker response times to negative faces. Faster response times to negative faces were then hypothesized to be further pronounced after negative mood induction. Moreover, it was predicted that they would make overall more facial emotion recognition errors compared to OC users with no negative mood side effects, nonusers, and men.

Our results did not show that women on OCs with current negative mood side effects had quicker response times to negative faces and overall more errors on facial recognition task than the other groups. There are some methodological differences that may explain the discrepancy in the findings between the current study and that of Gingnell et al. (2103). For example, the Gingnell at el. (2013) study did not induce mood prior to administering their facial identification task. Therefore the inconsistent findings related to response times to negative faces between the current study and the Gingnell et al. (2013) study may be due to the fact that the OC users with current negative mood side effects respond differently to negative faces when mood is induced. Data from Gingnell et al. (2013) indicated that women on OCs with current negative mood side effects showed brain patterns indicative of low emotional distraction when viewing angry and fearful faces. In their study, however, there were no other distractions or mood-related stimuli beyond the presentation of negative faces. In this current study, the facial emotion recognition task was administered immediately after a highly emotional video, and music continued playing throughout the task. Therefore, the current study had far more emotional distractions that could have washed out the effects related to low emotional distraction as seen in Gingnell et al. (2013).

Additionally, the Gingnell et al. (2013) facial task differed from the facial task in this current study. Gingnell et al. (2013) required their participants to view

a target face, and then choose out of two other faces which one matched the emotion expressed in the target face. Therefore, their participants were required to make nonverbal judgments about the emotional likeness of two faces, rather than choose between two verbal labels of emotions. The two facial tasks may have been tapping into different brain processes, one with a verbal component and one without a verbal component. Interestingly, previous research has indicated that hormones are related to brain lateralization patterns during cognitive tasks. For example, Hausmann et al. (2000) found that during low progesterone phase (early follicular phase) women showed lateralization on tasks for which lateralization is typically found, such as a verbal task, whereas during high progesterone phase (mid luteal phase), women show less lateralization on tasks where lateralization is typically found. Furthermore, it has been found that women on OCs have overall lower levels of neurosteroids (including progesterones) compared to naturally cycling women (Folessta et al., 2002; van Heusdan, & Fauser, 1999). Therefore, it follows that women on OCs may be more likely to show lateralization on tasks where lateralization is typically found such as verbal tasks or visual spatial tasks (Hausmann et al., 2000). Incidentally, the Gingnell et al. (2013) facial emotion recognition task may have been tapping into right brain processes, while the facial emotion recognition task in the current study may have been tapping more into left brain processes. Future research should examine if effects of OCs on

emotional expression identification are more likely using facial emotion expression recognition tasks that focus more activation on the right hemisphere as opposed to those with relatively higher left hemisphere activation (as in language or verbal tasks). It is possible that a tasks' relative activation of the right versus left hemisphere may be related to the likelihood that OC use and emotional side effects affect performance.

Aside from methodological differences, there were also group differences between the current study and the Gingnell et al. (2013) that may also explain the discrepancy in the results. Gingnell et al. compared OC users with current negative mood side effects to nonusers with previous negative mood side effects from OCs. On the other hand, this current study had OC users with no negative mood side effects, nonusers, and men as the comparison groups. Therefore, the results of quicker response times to negative faces and possible differences in emotional distraction among OC users with current negative mood side effects may only be relevant when compared to nonusers with previous negative mood side effects from OCs.

It is important to note, however, that this current study had a number of methodological similarities and strengths compared to the Gingnell et al. (2013) study. The current study included women in the group with current negative OC mood side effects if they endorsed one negative emotional symptom from a list of

14 negative symptoms. In the Gingnell et al. (2013) study, the women on OCs with current negative mood side effects were determined by a semi-structured interview in which the women were required to endorse at least one of the following symptoms as a result of OC use: depressed mood, decreased interest in usual activities, anxiety, mood swings, and irritability. Therefore, the criteria for inclusion in the group of current OC users with negative mood side effects were similar for both studies. However, for this current study, participants had a longer list of negative mood side effects to select. Therefore, the OC users with current negative mood side effects in our study may be a more robust or representative sample of women on OCs with current negative mood side effects.

Additionally, the sample of women on OCs with current negative mood side effects for both studies was similarly small. For the current study, the sample size for women on OCs with current negative mood side effect was $n = 15$. For the Gingnell et al. (2013) study, their sample size for women on OCs with current negative mood side effects was $n = 17$ and their sample size for women on placebo with previous negative mood side effects from OCs was $n = 18$. Therefore both sample sizes may not have been large enough to detect an effect if it exists. This increases the likelihood of both Type I and Type II errors. In fact, an examination of the response time means for this current study indicates that the response times for OC users with current negative mood side effects were in the

opposite direction than was expected. Although non-significant, OC users with current negative mood side effects in this current study had the slowest response times to negative faces after men. Therefore, even if the current study included a larger sample of OC users with current negative mood side effects, there still may not have been a significant effect. Instead, it is possible that OC users with current negative mood side effects in fact do not typically show faster response time to negative faces and that the results from the Gingnell et al. (2013) may instead be spurious findings (i.e., a Type I error).

Nevertheless, because the sample of OC users with current negative mood side effects was small, the analyses were re-run by grouping all OC users together regardless of current mood side effects. When OC users were compared to nonusers and men, an interesting pattern was found that approached the hypothesis of OC use being associated with response times to negative faces. OC users had the quickest response times to negative faces and were significantly faster than men. Moreover, when response times were examined as a function of mood induction, men showed the slowest response times compared to both OC users and nonusers after the sad induction, and slower response times than OC users after the fear induction. There were no group differences in response times after the happy induction. Because there were no group differences in response time after the positive (happy) mood induction, the results suggest that response

times in specific groups (i.e., OC users versus men) were indeed influenced by negative mood primes, especially the fear induction. This may indicate that OC users differ in some important way in their fear response compared to men and nonusers.

No previous research appears to have specifically examined differences in fear response as a function of OC use. However, previous research has examined stress and cortisol responses in women on OCs. Previous studies have indicated that women on OCs have an attenuated cortisol response (i.e., Kirschbaum, Pirke & Hellhammer, 1995; Het & Wolf, 2007) and that cortisol enhances fear conditioning (Merz et al., 2012). If women on OCs would have weaker a cortisol response and a weaker conditioned-unconditioned stimulus differentiation, then women taking OCs would be less able to implicitly or automatically differentiate relevant fearful stimuli from irrelevant stimuli and may thus overreact to irrelevant stimuli. Faster response times after the fear condition, therefore, may be a manifestation of this overreaction to stimuli. Future research should further investigate how OC users may differ from other groups in their response to fear as well as other negative emotions.

Examination of sex differences was similar to the results found when investigating OC users, nonusers, and men. Men showed overall significantly slower response times to negative faces than women regardless of mood

induction, and men showed significantly slower response times to negatives faces after all the mood inductions (sad, happy, and fear) compared to women. Because sex differences were found, it is difficult to determine if the above differences between OC users and men are driven by OC use itself or if the difference are simply indicative of an overall sex difference. However, there were no significant differences between men and nonusers on overall response times, and response times after the fear mood induction. Therefore, on variables where men and women differ, but men and nonusers do not, the sex differences found may appear because the OC users group is driving those differences. Indeed, results reveal important differences specifically between OC users and men that are consistent across hypotheses.

For instance, men showed less NA reactivity, endorsed lower mean NA scores, and responded more slowly to identify negative facial expressions as compared to OC users. Two possible explanations for these group differences in response times to negative faces are discussed below. First, men's longer response times to negative faces may be indicative of the fact that they are responding to mood incongruent stimuli whereas OC users' faster response times may be indicative of responding to more mood congruent stimuli. Second, men's longer response times may be indicative of more cognitive effort required when suppressing emotions (as discussed above in Hypothesis 1), whereas OC users'

faster response times may be indicative of higher emotional reactivity compared to men.

First, the possibility that men's longer response times are indicative of responding to mood incongruent stimuli will be discussed. Previous research has indeed found a link between faster response times and mood congruent stimuli and longer response times and mood incongruent stimuli (Albert, Martin, & Carretie, 2010; Cavanagh & Geisler, 2006; Gasbarri et al., 2008). Along with lower NA scores, and lower NA reactivity, as discussed above, men also endorsed higher mean PA scores compared to OC users, and women. Therefore, men generally endorsed more positive affect throughout the study and may have taken longer to respond to the negative faces because of the cognitive effort required to respond to mood incongruent stimuli. On the other hand, OC users and women as a group endorsed higher NA scores and NA reactivity across the laboratory session. Therefore, their shorter response times for the negative faces may be indicative of the relative ease of responding to mood congruent stimuli. In order to test this hypothesis, an ANCOVA was run with group (OC users, nonusers, and men) as the independent variable, response times to negative faces as the dependent variable, and NA scores, PA scores, NA change and PA change scores as four new covariates. Age was also used as a covariate consistent with the above analyses. Results indicated that the univariate group effect remained, $F(2, 131) =$

4.098, p =.019, partial η^2 = .059, power = .718. Therefore, when affect is controlled for, group differences in response times remain. Thus, the slower response times seen in men compared to OC users cannot necessarily be explained by group differences in affect which would play a role in the extent to which the groups differed in exposure to mood incongruent or mood congruent stimuli.

Moreover, in order to further determine if response times are a function of mood incongruent or congruent stimuli, response times to positive faces would also have to be examined. Since men had higher PA scores, their response times may be faster for positive faces compared to their response times to negative faces. Moreover, since OC users had higher NA scares, their response times may be slower for positive faces relative to their response times to negative faces. Future research should be conducted in order to examine how OC users, nonusers, and men differ in their responses to negative and positive faces subsequent to mood induction. However, if it was found that men had slower response times and OC users had faster response times regardless of whether facial expressions were negative or positive, then the theory that response times are due to mood congruent or incongruent stimuli would not be supported. Instead, it may then lend support to the possibility that men's longer response times to faces (both positive and negative) are reflective of men suppressing their emotional reaction,

thus using more cognitive effort, and resulting in longer response times (Grossman & Wood, 1993; Kring and Gordon, 1998; Pu, Schmeichel, & Damaree, 2009). Additionally, it may provide support for the possibility that OCs users are generally more emotionally reactive to emotional stimuli resulting in faster response times regardless of whether the faces are negative or positive.

As discussed above with reference to hypothesis 1, Pu, Schmeichel, and Damaree (2009) explained that emotion suppression taxes one's cognitive resources and thus may explain differing performances on tasks compared to individuals that do not suppress emotions. Therefore men's slower response times to negative faces compared to women may indicate that men are suppressing their emotional reaction to negative stimuli, which requires more cognitive effort, and therefore are taking longer to respond to the stimuli. In order to investigate this speculative possibility, however, future studies should have OC users, nonusers, and men perform similar tasks at baseline, and then compare their performance on the same tasks after mood inductions. If men do not show a delay in response times at baseline, but do show a delay in response after mood inductions, it may provide evidence to support the theory that slower response times in men are related to emotion suppression. Similarly, if OC users do not show faster response times at baseline, but do show faster response times after mood inductions, it may

provide evidence to support the possibility that faster response times are related to higher emotional reactivity.

Despite the group differences found in response times, there were no group differences in overall correct scores or overall errors. The theory behind the hypothesis that there would be a group difference in correct responses was based on the Gingnell et al. (2013) study that indicated that the women on OCs with current negative mood side effects showed higher activity in the left insula (related to emotional distraction) when viewing the negative faces. One limitation of the current study, however, is that MRI scans were not used. Therefore, it is difficult to determine if the facial emotion recognition tasks tapped into the intended brain areas (i.e. the left insula) as in the Gingnell et al. (2013) study.

An additional explanation for a lack of significant difference in performance on this task is that facial emotion recognition tasks are relatively easy to complete for most adults. The task used for this current study included faces that expressed emotions that had high inter-rater reliability for identification. Moreover, the task only provided two possible options for the emotion. Although this task was created by systematically choosing response options with the intention of making the task slightly more difficult, the emotions expressed in the images may have been too obvious resulting in a ceiling effect. Overall, the participants got 90.53% of the answers correct on the facial emotion

recognition task across all mood inductions. In order to make the task more difficult for the future, it might be a good idea to add more response options, or only use facial expressions that tend to be more ambiguous such as surprise or disgust. Also, as discussed previously, the current task included a verbal component that required participants to choose a verbally labeled emotion response option for each facial expression, whereas the participants in the Gingnell at al. (2013) study were required to use their nonverbal skills to match faces based on expression. This methodological difference may also account for the different results between the two studies.

Although no overall group differences in number of correct or incorrect response were found, it would be interesting to analyze the errors that were made in order to determine if there was a response bias. For example, when women on OCs did make errors on the facial emotion task, it would be interesting to investigate if they were more likely to incorrectly choose a negative emotion (as opposed to a positive emotion) for a neutral face. Furthermore, it would be interesting to investigate the pattern of response times. As mentioned above, because men demonstrated longer response times than women, especially OC users, it would be interesting for future studies to examine if men also had longer response times when viewing positive faces compared to women in general, as well as OC users, and non users.

Women on OCs Make More Errors of Commission on the GoNogo task than Men, Especially During the Positive Mood Induction

Hypothesis 3 was based on previous evidence suggesting that it is more difficult to inhibit a response when the background image on a GoNogo task was a positive image, rather than a negative or neutral image (Albert, Lopez-Martin, & Carretie, 2010), and that women on OCs tend to have lower levels of PPI which may be indicative of GABAeric disturbances (Borgstrom et al., 2008; Follesa et al., 2002; Schultheiss, Patalakh, & Rosch, 2012) and difficulty in filtering out unnecessary stimuli compared to nonusers and men (Borgstrom et al 2008; Holloway, Beck, & Servatius, 2011). Therefore, it was hypothesized that women on OCs would make overall more errors of commission than nonusers and men, especially after the positive mood induction.

Results from the analyses show partial support for hypothesis 3. There was no significant group difference in overall errors of commission. However there was a trend in the expected direction with OC users making more errors of commission than men. Indeed, this trend became significant when commission errors were examined after each emotion induction. Women on OCs made significantly more errors of commission than men after the happy mood induction. Albert, Lopez-Martin, and Carretie (2010) concluded, in their study, that withholding a prepared response (i.e. not pressing the space bar when you see

a W) within a positive context consumes greater inhibitory resources than within a negative context. Therefore, examining errors of commission after positive mood induction was a more sensitive method of examining differences in inhibitory response between groups.

The results from this current study suggest that women on OCs may be more impulsive and have a harder time inhibiting their responses compared to men. Additionally, the results from this third hypothesis are congruent with other findings from tests of the previous hypotheses in that all three findings show that women on OCs are more highly reactive then men. Higher mean NA level, higher NA reactivity across the laboratory session, faster response times to negative emotional faces, and higher errors of commission on a task of inhibition all lend support to the possibility that OC users may be a more reactive group than men. If OC users are indeed a more reactive group, it makes sense that they would have a decreased ability to inhibit their responses compared to men. Indeed previous literature on both clinical and non-clinical populations has linked high emotional reactivity with more difficulty inhibiting responses or more activated states and low emotional reactivity with more inhibited states (Hare, Tottenham, Galvan, Voss, Glover, & Casey, 2008; Henry, M'Bailara, Desage, Gard, Misdrahi, & Vieta, 2007).

Interestingly, previous studies have indicated a possible mechanism underlying lower levels of inhibition or reactivity among women on OCs. Past studies have found that OCs are related to GABAergic disturbances which are, in turn, related to inhibitory processes. For example, Schultheiss, Patalakh, and Rosch (2012) explained that progesterone influences cognition, emotion, and behaviour by binding to the GABA receptors, which have an inhibitory effect on neural signal transmission. Also, it has been shown that levonorgestrel OCs (second generation OC) have resulted in decreased levels of progesterone and its $GABA_A$ receptor-active metabolite allopregnanolone in both rats and women (Follessa et al., 2002). Therefore, certain OCs have been shown to reduce $GABA_A$ receptor-active metabolites and decrease inhibitory responses. Moreover, alterations in GABAergic systems have been shown to contribute to deficits in inhibitory responses such as deficits in PPI (Borgstrom et al., 2008).

Indeed, our results indicated that women on OCs had lower inhibition compared to men. Moreover, the majority of women in the current study were taking a levonorgestrel OC (second generation OC). Therefore, differences in GABAergic processes may have been the underlying mechanism behind the differences in inhibitory responses between men and OC users in this study. Future research should investigate GABAergic processes as a potential underlying mechanism for inhibitory responses. For example, future research could have one

group of women on OCs take a $GABA_A$ receptor metabolite allopregnanolone, and one group of women on OCs take a placebo. If group differences appeared in responses of inhibition, it would support the idea that GABAergic processes are a potential underlying mechanism for the differing inhibitory responses found between groups of women, and men.

Along with group differences between OC users and men, results from the current study also revealed differences between groups of OC users. Indeed, OC users with current negative mood side effects had significantly fewer errors of commission after the sad mood induction compared to OC users with no negative mood side effects. These results are interesting because they suggests that OC use may differentially affect response inhibition depending on mood side effects. An examination of the trends indicates that OC users with negative mood side effects also had more correct responses overall, and higher mean correct responses after the sad mood induction compared to OC users with no negative mood side effects. Therefore, women on OCs with current negative mood side effects outperformed women on OCs with no current negative mood side effects on the GoNogo task.

One possible explanation for OC users with current negative mood side effects outperforming OC users with no current negative mood side effects is that response inhibition is easier when the emotional context of the response inhibition is negative or neutral (i.e. the respondent is required to inhibit a response while

viewing a negative or neutral photograph) (Albert, Lopez-Martin, & Carretie, 2010). Furthermore, previous research has correlated depression and depressed mood with psychomotor retardation and delayed responses to stimuli (see review by Lecrubier, 2005). Therefore, when individuals are currently experiencing negative mood side effects, they may outperform others on tasks of response inhibition, especially after a sad mood induction. Also, because OC users with negative mood side effects only showed lower errors of commission during the sad emotion induction, it indicates that OC users with negative mood side effects were able to outperform OCs users with no negative mood side effects only when the mood induction was congruent with their current mood. For example, most women on OCs with current negative mood side effects in this current study endorsed symptoms related to sad mood such as: cried more than usual, more moody, and sadness. All of these symptoms could have been especially enhanced after the sad mood induction.

Future research should also include an analysis of response times on the GoNogo task. Longer response times, for example, may be related to fewer errors of commission. If OC users with current negative mood side effects showed longer response times compared to OC users with no negative mood side effects, it may lend support for the idea that OCs users with current negative mood side effects were slower in their responses possibly due to a psychomotor delay related

to negative mood symptoms. Moreover, if men show longer response times compared to OC users, it may indicate that men were suppressing their emotions, thus using more cognitive effort and slowing their response times to the stimuli in the GoNogo task. To test these possibilities two MANCOVAs were run (using age a covariate). For the first MANCOVA, group (OC users with negative mood side effects, and OC users with no negative mood side effects) was the independent variable, and mean response times after each emotion induction (sad, happy, fear) was the dependent variable. Results indicate a trend for an overall multivariate effect, $F(3, 48) = 2.244$, $p = .095$, partial $\eta^2 = .123$, power = .534. Follow up univariate tests confirm that mean response times for women on OCs with current negative mood side effects ($M = 0.398$ $SD = 0.041$) were significantly longer than response times for women on OCs with no negative mood side effects ($M = 0.372$, $SD = 0.032$) only after the sad mood induction, $F(1, 50) = 6.789$, $p = .012$, partial $\eta^2 = .120$, power = .724.

For the second MANCOVA, group (OC users, nonusers, and men) were the independent variable and mean response times on the GoNogo task after each emotion induction (sad, happy, fear) were the dependent variables. Interestingly, despite men's lower errors of commission, there were no group differences on overall response times, $F(2, 127) = 2.293$, $p = .105$, partial $\eta^2 = .035$, power = .459, or response times after each emotion induction, $F(6, 252) = 1.371$, $p = .227$,

partial η^2 = .032, power = .532. Therefore, if men are indeed suppressing their emotional reaction to the mood induction stimuli, the suppression is not reflected in longer response times.

Finally, sex differences were found in the current study with men showing significantly lower errors of commission compared to women after the happy induction. These results parallel the above results that found women on OCs had higher errors of commission than men after the happy mood induction. Therefore, since men and nonusers did not differ significantly in their errors of commission after the happy induction, this suggest that the sex difference found may be driven by the OC user group.

It would be interesting to further investigate the sex differences in inhibitory responses as they related to GABAergic systems as discussed above. For example, future studies could test levels of progesterone (or specifically allopregnanolone which has been shown to bind to a $GABA_A$ receptor) in women and men. If lower levels of $GABA_A$ receptor progesterones are found in women compared to men, it may support the idea that these progesterones are the potential mechanisms behind inhibitory responses. Moreover, it would be expected that levels of $GABA_A$ receptor progesterones would differ between OC users and nonusers, with OC users having the least amount (Folessa at al., 2002). Future studies should further investigate the differences in inhibitory responses

between men, nonusers, and OC users using tasks of inhibition such as the GoNogo task and other known tasks that tap into inhibitory processes such as a Stroop task.

One limitation for this current study was that there were no baseline measures for inhibitory responses without the influence of mood induction. Therefore, it is difficult to conclude that group difference on the GoNogo tasks would occur without mood induction. Future studies could include a baseline measure of inhibition. Therefore, scores after each subsequent mood condition could be compared to the baseline measure and potentially be a more sensitive measure of how response inhibition is influenced by mood induction.

Women Taking OCs Do Not Differ in their Overall Performance on the Cognitive and Perceptual Tasks as a Function of the Mood Primes Compared to Women Not Taking OCs and Men

Hypothesis 4 was an exploratory hypothesis based on previous research that indicated group differences in performance on various cognitive and perceptual tasks across many studies as a function of mood prime. For example, positive mood induction has been shown to improve performance on cognitive tasks (Brand & Opwis, 2007; Fried et al., 2001; & Lesiuk, 2010). However, positive mood may also be related to worse performance and more errors on certain tasks, such as a task of inhibition (Albert, Lopez-Martin, & Carretie,

2010). Moreover, previous research has shown differing performance on cognitive tasks based on hormones. For example, women on second generation OCs outperformed women on first generation OCs on a mental rotation task (Wharton et al., 2008) and post-menopausal women taking estrogen replacement therapy (ERT) outperformed post-menopausal women with no ERT on tasks of working memory and attention. No previous research has examined overall performance on both a facial emotion recognition task and a GoNogo task as a function of OC use.

Results from this current study did not support the hypothesis that groups would differ in their performance on the cognitive and perceptual tasks as a function of mood prime. Instead, results indicated no difference in overall performance on the cognitive and perceptual tasks between OC users, nonusers and men, or between men and women regardless of mood induction. Indeed, many other studies have failed to find differences between men and women on overall performance on cognitive tasks such as tasks of calculation, mental rotation tasks, spatial attention, word generation and motor tasks (Bell, Willson, Wilman, Dave, & Silverstone, 2006; Kucian, Loenneker, Dietrich, Martin, &Von Aster, 2005; Rumberg et al., 2010).

Additionally, some previous studies found that negative mood had a more complex effect on cognition. For example, rather than negative mood influencing

overall correct and incorrect responses, Spering, Wagener, and Funke (2005) found that positive and negative mood influenced their participants strategies used to complete the tasks. Therefore, lack of differences between OC users, nonusers and men on the tasks of cognition and perception may be due the fact that overall correct scores was not the most sensitive measure to use when looking for group differences on performance. Evidence from the results of the previous hypotheses, for example, indicated that overall mean response times, rather than overall correct responses, was a more sensitive measure of group differences on the facial emotions recognition task. Additionally, overall number of errors of commission, rather than total number of correct responses, was shown to be a more sensitive measure of group differences for the GoNogo task.

The cognitive and perceptual tasks chosen for this study were based on previous research that indicated group differences on performance as well as evidence that each task tapped into specific brain areas related to hormone use. For example, the inferior frontal gyrus was shown to be activated in different ways depending on hormones during performance on both a task of facial emotion recognition (Gingnell et al., 2013) and a GoNogo task (Bannbers, et al., 2012). However, one limitation of this current study is that information from MRI or fMRI scans were not collected. Therefore, it cannot determine if the tasks were tapping into the intended regions of the brain.

Another explanation for lack of group differences in overall performance on the cognitive and perceptual tasks is that there may have been too much variance within groups. Indeed, many studies do not find differences between groups of women when all OC users are put into one category. The differing effects of current OC type (i.e. second or third generation OCs) and differing effects of mood side effects from OCs could lead to high group variance that may ultimately wash out differences between OC users and nonusers. Although this current study made all efforts to reduce reactivity within and between groups by examining group equivalency, controlling for age, and by examining Box's M and Levene tests for errors of covariance, there may have still be variance within the groups that influenced the lack of differences found, specifically between OC users and nonusers. Future research should continue examining the overall group differences in performance on cognitive tasks as a function of mood prime. More participants are required, however, in order to further investigate how OC mood effects, OC type, for example, may further influence performance on cognitive and perceptual tasks.

Limitations of The Current Study

There were seven limitations to this study that are worth addressing. Firstly, one limitation of this study is regarding the representativeness of the sample. Almost all of the participants in the study were young university students

taking a psychology course. Therefore, this sample may not be representative of the larger population of Canada and findings may not be generalizable to nonstudents. Moreover, the mean age of participants in this study was 22 years old, therefore the results on emotional reactivity and inhibition may not be applicable for men and women older in age. However, it is worth noting the early 20s is a time of high OC use and thus the sample is a relevant one. The majority of the sample was made up of individuals of Caucasian, or European heritage (84.4%), who were university educated (65.6%). Although effort to recruit outside of the University setting was made, the majority of the participants still fell within the general age, ethnicity, and education level.

Secondly, another limitation of the current study is that the sample size of women on OCs with current negative mood side effects was small (n = 15) and may not have been powerful enough to provide a representative sample of women on OCs with current negative mood side effects. Moreover, women that endorsed as few as one current negative emotional symptom from OCs were included in the OC mood group. This may not have been a sensitive enough criterion to truly capture women with current negative mood side effects. Additionally, not all negative mood side effects are equal. If one individual endorsed feeling "cried more than usual" for example, they may not be experiencing negative mood in the same way as another individual that endorsed feeling "depressed". Furthermore,

some of the negative mood side effects were qualitatively different such as "lower self-esteem" or "more self-critical" which represent general negative views towards the self, "pessimistic" which represents a general negative worldview, and "less trust in partner" which may represent a negative view towards others, or someone specific. Nevertheless, the examination of validity of this group indicated that these women did indeed differ from OC users with no mood side effects on some other independent important measures of affect at baseline (i.e., the affect intensity measure, the Hamilton rating scale for depression, and the behavioural inhibition system subscale). Also, it is important to note that neither the criteria for negative mood side effects nor the sample size were vastly different from other established studies. For example, the Gingnell et al. (2013) study also had one negative mood side effect as their minimum inclusion criteria for the current negative mood side effects on OCs group and they had a sample size of $n = 17$ for their negative mood side effect group.

A third limitation was that there were not enough women in this sample that were taking a new generation OC ($n = 3$). Previous research has indicated that this group of women differs most significantly from women taking second and third generation OCs. Future studies should continue to recruit women on OCs and examine differences within the OC group as a function of OC type.

A fourth limitation to this study is that general premorbid measures of disinhibition or impulsivity were not collected (i.e., measures prior to OC use). When examining the differences in inhibition between OC users and other groups an important caveat is that OC users may represent a generally more impulsive or disinhibited group of women compared to nonusers and men. Therefore, rather than the results indicating a possible underlying mechanisms of GABAergic disturbances, another possibility is that that the OC user group is generally more impulsive. Nevertheless, the OC users did not differ significantly from nonusers and only differed from the men. There do not appear to be any studies using cognitive measures that suggest that OC users are a more impulsive or disinhibited group than men. However, it is possible that women who choose to use OCs do so because they are concerned about their own ability to inhibit or stop sexual activity in order to use a condom. Regardless, if higher disinhibition in OC users is replicable, it will be important for future research in the area to rule out premorbid impulsivity or disinhibition as a potential confound. No

A fifth limitation is related to the measures of emotional reactivity. While this study did include a well-established measure of affect, the PANAS, the analysis of emotional reactions to the mood inductions may have been improved if other, subtler or implicit measure of affect were also included. It may be that self-reported measures that inquire about explicit emotional reactions may not be

the most sensitive measure of affect especially in groups where the individuals may be more likely to suppress their emotions. For example, men may be more likely to endorse physical rather than affect symptoms after a mood induction. Future studies should include physical sensations and approach/avoid reactions as well as physiological measures of affect such as heart rate and galvanic skin response in the analysis as additional measure of affect. These measures may resolve bias towards those who are reluctant to endorse NA and PA symptoms.

A sixth limitation to this study was that brain imaging (e.g., MRI) was not used to track brain changes and brain differences between groups as a function of the mood primes and the cognitive and perceptual tasks. Therefore, the researchers cannot know if the relevant targeted brain areas were in fact activated during the tasks.

Finally, a seventh limitation of the study is that there were no baseline comparisons for the cognitive tasks because each cognitive task was presented after a mood condition. Therefore, there was no baseline measure of cognitive performance with which the researcher could use to further examine cognitive performance as a function of mood primes. Future studies should include a baseline measure of cognitive tasks in order to investigate changes in performance based on different mood inductions. For example, if men do not show a delay in facial emotion recognition response times at baseline, but do show a delay in

facial emotion recognition response times after mood inductions, it may provide evidence towards the theory that slower response times are related to emotion suppression.

Strengths of The Current Study

There were also five noteworthy strengths of this current study. Firstly, this study was the first to explore differences between OC users, OC users with current negative mood side effects, nonusers, and men on measures of cognitive performance as a function of mood primes. The combination of looking at cognition within the context of different moods provides some ecological validity to the design. Indeed, outside of the laboratory setting, one may expect to experience a variety of different emotions throughout the day or over a period of time. Furthermore, individuals are often required to make social judgments based on facial emotion expressions or make quick inhibitory or excitatory decisions such as while driving. Understanding how various emotional experiences influence these everyday processes, and the role exogenous hormones can have on these effects, may be an integral part of deciding on a hormonal contraceptive method.

A second strength of this study was that, despite the limitations of the small sample of current OC users with mood side effects, the researchers were able to collect data on a relatively large sample size ($N = 149$) including relatively

large and equal numbers of OC users (n = 57), nonusers (n = 45), and men (n = 38). Additionally, the groups were relatively equal on several baseline measures such as time of laboratory session, alcohol and caffeine consumption, hours of sleep, and self-reported effort and enjoyment of laboratory tasks. This evidence of group equivalency lends support for the subsequent results. Since groups were shown to be relatively equal on all measures, it can be determined with higher confidence that the group differences found in our analyses were reflective of true group differences rather than the result an external factor such as time of day or alcohol use.

A third strength of this study is that it included OC type (i.e., phasic type and generation), as well as a subgroup of women on OCs with current negative mood side effects. Although there were no noteworthy differences between the groups, previous research has indicated that these groups do differ on mood and cognitive tasks. It is important for future studies examining OCs to collect information on OC type and OC mood side effects and to use the variables as factors in the analyses.

A fourth strength of this study is that an examination of the validity of the mood induction revealed that the mood induction video did induce the intended mood change as determined by levels of PA and NA, direction of change, scores from the PEEQ, and the approach/avoid measure. The validity of the mood

induction was an integral strength in this study as it indicates that the participants reacted to the inductions in the appropriate and predicted ways. This provides us with confidence that cognition or performance was in fact examined within the context of particular types of mood (i.e., sadness, happiness, fear). Moreover, the mood congruent music played throughout the videos and into the cognitive tasks. This was a strength in the design of the study as it helped ensure mood was prolonged for as long as possible, thus increasing the chances that performance on the cognitive and perceptual tasks were influenced by the mood primes.

Finally, a fifth strength in this study is that it included two qualitatively different negative mood primes: sadness and fear. Previous OC mood studies have typically included sad mood as a measure of negative affect. However, previous research has also indicated that negative affect is variable, and instead may be more complicated depending on the type of negative affect. Therefore, by including two measures of negative affect, the researchers were able to analyze group differences across a wide array of emotions.

Summary and Conclusions

Previous research has indicated that women taking OCs have inconsistent emotional responses to OCs (Oinonen & Mazmanian, 2002). Additionally, it has been established that there are some structural brain differences between OC users, nonusers, and men (Protopopescu et al., 2008; Pletzer, Kronbichler,

Aichhorn, Bergmann, Ladurner & Kerschbau, 2010) and group differences in performance on certain cognitive tasks (Borgstrom et al., 2008; Follesa et al., 2002; Gasbarri et al., 2008; Gingnell et al., 2013; Holloway, Beck, & Servatius, 2011; Kimura, 1996; Torres, Gomez-Gil, Vidal, Puig, Boget & Salamero, 2006; Wharton et al., 2008).

The results of this study were that OC users had higher NA reactivity to the mood primes and higher NA scores than men. OC users also had faster response times when identifying negative emotional facial expressions compared to men after the negative mood inductions. OC users also had more errors of commission during the GoNogo task compared to men after the positive mood induction. Taking all the results together, they suggest that OC users were more emotionally reactive to the mood inductions (higher NA and NA reactivity), faster to respond to negative facial expressions, and had a lower ability to inhibit responses (higher errors of commission on the GoNogo task) compared to men.

Some evidence suggests that the reactivity and the impulsivity of the OC users seen in this study may be explained by GABAergic disturbances (Borgstrom et al., 2008; Follessa et al., 2002; Schultheiss, Patalakh, & Rosch, 2012). Alternatively, the lower reactivity of men in this study may be explained by the cognitive effort required when suppressing emotions (Pu, Schmeichel, & Damaree, 2009). In order to investigate both of these possibilities future studies

should use designs aimed at tapping into both reactivity and suppression. For example, future studies should include facial emotion recognition tasks and tasks of inhibition at baseline as well as after mood inductions. Therefore, researchers may be able to determine if men differ in their response times and inhibition at baseline, or only after mood inductions. Also, in order to identify GABAergic processes as a possible mechanism for reactivity in OC users, future research might include known GABAergic blockers to give to women on OCs to determine group differences as a function of GABAergic activities. Indeed, future research is needed to investigate whether OC reactivity is related to GABAergic disturbance and if men's low reactivity is related to active emotional suppression.

This current study was the first to investigate group differences between OC users, nonusers and men on their performance on cognitive and perceptual tasks as a function of mood primes. Results from this study further contributed to the literature on OC use and its possible influences on affect and cognition. Additionally, results from this study may lend preliminary support towards the theory that OC side effects (e.g., emotional and cognitive changes) are related to OC-related changes in GABAergic processes.

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Appendix A

SCREENING QUESTIONNAIRE

Today's date (dd/mm/yyyy): _____

1. What is your age _____

a. Are you 45 years of age or older?

YES NO

b. Are you a woman who is going through, or has gone through menopause?

YES NO MAYBE NOT APPLICABLE, I AM MALE

c. Are you a woman who has had her period (menses) in the last 12 months?
(*Select "NO" ONLY IF you HAVE NOT had your period in the last 12 months or more*)

YES NO NOT APPLICABLE, I AM MALE

d. Are you currently taking any hormonal contraceptives other than oral contraceptives (e.g., contraceptive patch, vaginal ring, DepoProvera, hormonal implants, etc.) ?

YES NO NOT APPLICABLE, I AM MALE

e. Have you taken any emergency contraception pill (i.e. Plan B) in the last 6 months?

YES NO NOT APPLICABLE, I AM MALE

2. Please choose the response that best represents your ethnic background. If you need to select more than one response, then select "other" and please specify.

Caucasian/White	_____	Middle Eastern	_____
African-Canadian/American/Black	_____	East Indian	_____
First Nation/Aboriginal/American Indian	_____	European	_____
Hispanic/Latino	_____	Asian	_____
Other (please specify)	_____		

3. Please check the box that best describes the **highest level of education** that you have completed:

[ ] some elementary	[ ] completed high school	[ ] some university
[ ] completed grade 8	[ ] some college	[ ] completed a university degree
[ ] some high school	[ ] completed college	[ ] some graduate studies
		[ ] completed a graduate degree

5. Are you currently taking any antidepressant medication(s)?

YES NO

If YES, what medication(s) are you taking? (please specify)

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6. Are you currently taking any medication(s) other than antidepressants?

YES NO

If YES, what medications are you taking? (please specify)

---

7. Have you ever been diagnosed with or treated for depression?

YES NO MAYBE

8. Have you ever been diagnosed with or treated for bipolar disorder or manic depression?

YES NO MAYBE

9. Please list any medical or psychological conditions that you have been diagnosed with (e.g. hypothyroidism, depression, asthma, cancer, diabetes, etc.)

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10. Below are a number of statements about your experience of moods. We would like you to consider your usual behaviour OVER THE PAST TWO MONTHS when you respond. Using the scale, indicate the appropriate number below each question and try to be as honest as you can.

a) I may change from happy to sad and back again several times in a single week.

Strongly Disagree	Moderately Disagree	Somewhat Disagree	Somewhat Agree	Moderately Agree	Strongly Agree
1	2	3	4	5	6

b) Compared to my friends, I'm less up and down in my mood states.

Strongly Disagree	Moderately Disagree	Somewhat Disagree	Somewhat Agree	Moderately Agree	Strongly Agree
1	2	3	4	5	6

c) Sometimes my mood swings back and forth very rapidly.

Strongly Disagree	Moderately Disagree	Somewhat Disagree	Somewhat Agree	Moderately Agree	Strongly Agree
1	2	3	4	5	6

d) My moods are quite consistent; they almost never vary.

Strongly Disagree	Moderately Disagree	Somewhat Disagree	Somewhat Agree	Moderately Agree	Strongly Agree
1	2	3	4	5	6

e) I'm a very changeable person.

Strongly Disagree	Moderately Disagree	Somewhat Disagree	Somewhat Agree	Moderately Agree	Strongly Agree
1	2	3	4	5	6

f) I'm not as "moody" as most people I know.

Strongly Disagree	Moderately Disagree	Somewhat Disagree	Somewhat Agree	Moderately Agree	Strongly Agree
1	2	3	4	5	6

a) If 1 = hardly ever and 99 = extremely frequently, how frequently do your moods change? ____

b) If 1 = not at all and 99 = extremely intensely, how intensely do you react to mood experiences? ___

11. The following questions refer to emotional reactions to typical life events. Please indicate how YOU react to these events by selecting a number from 1 (Never) to 6 (Always). Please base your answers on how YOU react, NOT on how you think others react or how you think a person should react. Please consider your reactions over the PAST TWO MONTHS in particular:

a) When I feel happiness, it is a quiet contentment

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

b) When a person in a wheelchair can't get through a door, I have strong feelings of pity

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

c) I get upset easily

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

d) When I succeed at something, my reaction is calm contentment

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

e) I get really happy or really unhappy

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

f) I'm a fairly quiet person

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

g) When I'm happy, I feel very energetic

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

h) Seeing a picture of some violent car accident in a newspaper makes me feel sick to my stomach

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

i) When I'm happy, I feel like I'm bursting with joy

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

j) I would be very upset if I got a traffic ticket

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

k) Looking at beautiful scenery really doesn't affect me much

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

l) The weather doesn't affect my mood

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

m) Other tend to get more excited about things than I do

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

n) I am not an extremely enthusiastic individual

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

o) 'Calm and cool' could easily describe me

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

p) When I'm feeling well it's easy for me to go from being in a good mood to being really joyful

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

q) When I worry, it is so mild that I hardly notice

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

r) I get overly enthusiastic

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

s) My happy moods are so strong that I feel like I'm 'in heaven'

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

t) When something bad happens, other tend to be more unhappy than I

Never	Very Rarely	Rarely	Occasionally	Very Frequently	Always
1	2	3	4	5	6

12. Compared to how you feel when you are in an even or normal mood state, how would you rate yourself on the following items during the past 2 weeks ?

I have been feeling:

a) Down and depressed

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

b) Less interesting in doing things

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

c) Less interested in sex

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

d) Less interested in eating

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

e) That I've lost some weight

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

f) That I can't fall asleep at night

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

g) That my sleep is restless

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

h) That I wake up too early

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

i) Heavy in my limbs or aches in back, muscles, or head, more tired than usual

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

j) Guilty or like a failure

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

k) Tense, irritable, or worried

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

l) Sure I'm ill or have a disease

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

m) That my speech and thoughts are slow

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

n) fidgety, restless, or antsy

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

o) that morning is worse than evening

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

p) that evening is worse than morning

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

q) physical symptoms when worried

Not at all	just a little	more than just a little	quite a bit/ moderately	marked or severely
1	2	3	4	5

13. Please use the following scale to indicate which hand you use for each activity

a) Writing

Always Left		Both		Always Right
1	2	3	4	5

b) Throwing

Always Left		Both		Always Right
1	2	3	4	5

c) Using scissors

Always Left		Both		Always Right
1	2	3	4	5

d) Using a toothbrush

Always Left		Both		Always Right
1	2	3	4	5

e) Using a knife without a fork

Always Left		Both		Always Right
1	2	3	4	5

f) Using a spoon

Always Left		Both		Always Right
1	2	3	4	5

g) Striking a match

Always Left		Both		Always Right
1	2	3	4	5

14. Read each statement and decide whether it is an accurate statement about you

a) Sometimes I cannot remember who I am

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

b) I have vision in which I see myself forced to commit crimes

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

c) Since the day I was born, I was destined to be unhappy

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

d) I think I have three or four completely different personalities inside of me

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

e) People don’t understand how much I suffer

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

f) Every once in a while, I totally loose my memory

False, Not at all true	Slightly true	Mainly true	Very true

1	2	3	4

g) Sometimes my vision is only in black and white

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

h) I don't have any good memories from my childhood

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

i) I have severe psychological problems that began very suddenly

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

j) Sometimes I let little things bother me too much

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

k) Sometimes I'll avoid someone I really don't like

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

l) I sometimes complain too much

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

m) Sometimes I'm too impatient

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

n) I don't take criticism very well

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

o) Sometimes I put things off until the last minute

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

p) I sometimes make promises I can't keep

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

q) There have been times when I could have been more thoughtful than I was

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

r) I rarely get in a bad mood

False, Not at all true	Slightly true	Mainly true	Very true
1	2	3	4

15. Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who *likes to spend time with others*? Please indicate under each statement the extent to which you agree or disagree with that statement**.** . Please consider your characteristics over the PAST TWO MONTHS in particular

I am some who:

a. is depressed, blue

disagree strongly	disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1	2	3	4	5

b. is relaxed, handles stress well

disagree strongly	disagree a little	Neither agree nor disagree	Agree a little	Agree strongly

1	2	3	4	5

c. can be tense

disagree strongly	disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1	2	3	4	5

d. worries a lot

disagree strongly	disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1	2	3	4	5

e. is emotionally stable, not easily upset

disagree strongly	disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1	2	3	4	5

f. can be moody

disagree strongly	disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1	2	3	4	5

g. remains calm in tense situtations

disagree strongly	disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1	2	3	4	5

h. gets nervous easily

disagree strongly	disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1	2	3	4	5

16. Each item of this next questionnaire is a statement that a person may either agree with or disagree with. For each item, indicate how much you agree or disagree with what the item says. Please respond to all the items; do not leave any blank. Choose only one response to each statement. Please be as accurate and honest as you can be. Respond to each item as if it were the only item. That is, don't worry about being "consistent" in your responses. Please consider how you have been feeling over the PAST TWO MONTHS in particular

a. A person's family is the most important thing in life.

1	2	3	4
Very true for me	somewhat true for me	somewhat false for me	very false for me

b. Even if something bad is about to happen to me, I rarely experience fear or nervousness.

1	2	3	4
Very true for me	somewhat true for me	somewhat false for me	very false for me

c. I go out of my way to get things I want.

1	2	3	4
Very true for me	somewhat true for me	somewhat false for me	very false for me

d. When I'm doing well at something I love to keep at it.

1	2	3	4
Very true for me	somewhat true for me	somewhat false for me	very false for me

e. I'm always willing to try something new if I think it will be fun.

1	2	3	4
Very true for me	somewhat true for me	somewhat false for me	very false for me

f. How I dress is important to me.

1	2	3	4
Very true for me	somewhat true for me	somewhat false for me	very false for me

g. When I get something I want, I feel excited and energized.

1	2	3	4
Very true for me	somewhat true for me	somewhat false for me	very false for me

h. Criticism or scolding hurts me quite a bit.

1	2	3	4
Very true for me	somewhat true for me	somewhat false for me	very false for me

i. When I want something I usually go all-out to get it.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

j. I will often do things for no other reason than that they might be fun.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

k. It's hard for me to find the time to do things such as get a haircut.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

l. If I see a chance to get something I want I move on it right away.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

m. I feel pretty worried or upset when I think or know somebody is angry at me.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

n. When I see an opportunity for something I like I get excited right away.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

o. I often act on the spur of the moment.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

p. If I think something unpleasant is going to happen I usually get pretty "worked up."

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

q. I often wonder why people act the way they do.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

r. When good things happen to me, it affects me strongly.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

s. I feel worried when I think I have done poorly at something important.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

t. I crave excitement and new sensations

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

u. When I go after something I use a "no holds barred" approach.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

v. I have very few fears compared to my friends.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

w. It would excite me to win a contest.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

x. I worry about making mistakes.

1 2 3 4
Very true for me somewhat true for me somewhat false for me very false for me

17. Stress can be experienced as a result of both positive and negative life events and can be defined as physical or emotional strain/tension. Compared to other people your age and sex, to what extent did you experience . . .

Stressful negative life events in the *past year*?

Much Less			Average			Much More
1	2	3	4	5	6	7

Stressful positive life events in the *past year*?

Much Less			Average			Much More
1	2	3	4	5	6	7

Stressful negative life events in the past *two months*?

Much Less			Average			Much More
1	2	3	4	5	6	7

Stressful positive life events in the *past two months*?

Much Less			Average			Much More
1	2	3	4	5	6	7

18. What is your sex ?

Male Female

19. Reproductive Questions:

a) Have you ever been pregnant? (Only say YES if you were 100% sure)

YES NO

b) If yes, how many times have you been pregnant? _____

c) How many children have you given birth to? _____

b) Are you currently pregnant?

YES NO MAYBE

20. Some women experience changes in mood and physical functioning **during the week prior to their menstrual period**. As best as you can, please indicate the frequency,

severity, and level of impairment encountered for the following 11 symptoms during **your pre-menstrual phase over the past year.**

1. Markedly depressed mood, feelings of hopelessness, or self-deprecating thoughts during the week prior to my menstrual period?

a. Number of menstrual cycles in which the above symptom(s) have been experienced during the premenstrual phase over the past 12 months

0 1 2 3 4 5 6 7 8 9 10 11 12

b. To what extent do these symptoms cause impairment in work, school, or occupational functioning:

1-not at all 2- a little 3- moderately 4- quite a bit 5- extremely

c. Please rate the degree of severity of these symptoms:

1- not at all severe 2- mild 3- moderate 4-severe 5-extremely severe/debilitating

2. Marked anxiety, tension, or feelings of being "keyed up," or "on edge?" during the week prior to my menstrual period

a. Number of menstrual cycles in which the above symptom(s) have been experienced during the premenstrual phase over the past 12 months

0 1 2 3 4 5 6 7 8 9 10 11 12

b. To what extent do these symptoms cause impairment in work, school, or occupational functioning:

1-not at all 2- a little 3- moderately 4- quite a bit 5- extremely

c. Please rate the degree of severity of these symptoms:

1- not at all severe 2- mild 3- moderate 4-severe 5-extremely severe/debilitating

3. Affective lability (e.g. feeling suddenly sad or tearful, or increased sensitivity to rejection) during the week prior to my menstrual period?

a. Number of menstrual cycles in which the above symptom(s) have been experienced during the premenstrual phase over the past 12 months

0 1 2 3 4 5 6 7 8 9 10 11 12

b. To what extent do these symptoms cause impairment in work, school, or occupational functioning:

1-not at all 2- a little 3- moderately 4- quite a bit 5- extremely

c. Please rate the degree of severity of these symptoms:

1- not at all severe 2- mild 3- moderate 4-severe 5-extremely severe/debilitating

4. Persistent and marked anger or irritability, or increased interpersonal conflicts during the week prior to my menstrual period?

a. Number of menstrual cycles in which the above symptom(s) have been experienced during the premenstrual phase over the past 12 months

0 1 2 3 4 5 6 7 8 9 10 11 12

b. To what extent do these symptoms cause impairment in work, school, or occupational functioning:

1-not at all 2- a little 3- moderately 4- quite a bit 5- extremely

c. Please rate the degree of severity of these symptoms:

1- not at all severe 2- mild 3- moderate 4-severe 5-extremely severe/debilitating

5. Decreased interest in usual activities (e.g. work, school, friends, hobbies) during the week prior to my menstrual period?

a. Number of menstrual cycles in which the above symptom(s) have been experienced during the premenstrual phase over the past 12 months

0 1 2 3 4 5 6 7 8 9 10 11 12

b. To what extent do these symptoms cause impairment in work, school, or occupational functioning:

1-not at all 2- a little 3- moderately 4- quite a bit 5- extremely

c. Please rate the degree of severity of these symptoms:

1- not at all severe 2- mild 3- moderate 4-severe 5-extremely severe/debilitating

6. A subjective sense of difficulty concentrating during the week prior to my menstrual period?

a. Number of menstrual cycles in which the above symptom(s) have been experienced during the premenstrual phase over the past 12 months

0 1 2 3 4 5 6 7 8 9 10 11 12

b. To what extent do these symptoms cause impairment in work, school, or occupational functioning:

1-not at all 2- a little 3- moderately 4- quite a bit 5- extremely

c. Please rate the degree of severity of these symptoms:

1- not at all severe 2- mild 3- moderate 4-severe 5-extremely severe/debilitating

7. Lethargy, easy fatigability, or marked lack of energy during the week prior to my menstrual period?

a. Number of menstrual cycles in which the above symptom(s) have been experienced during the premenstrual phase over the past 12 months

0 1 2 3 4 5 6 7 8 9 10 11 12

b. To what extent do these symptoms cause impairment in work, school, or occupational functioning:

1-not at all 2- a little 3- moderately 4- quite a bit 5- extremely

c. Please rate the degree of severity of these symptoms:

1- not at all severe 2- mild 3- moderate 4-severe 5-extremely severe/debilitating

8. Marked change in appetite, overeating, or specific food cravings during the week prior to my menstrual period?

a. Number of menstrual cycles in which the above symptom(s) have been experienced during the premenstrual phase over the past 12 months

0 1 2 3 4 5 6 7 8 9 10 11 12

b. To what extent do these symptoms cause impairment in work, school, or occupational functioning:

1-not at all 2- a little 3- moderately 4- quite a bit 5- extremely

c. Please rate the degree of severity of these symptoms:

1- not at all severe 2- mild 3- moderate 4-severe 5-extremely severe/debilitating

9. Sleeping too much or too little during the week prior to my menstrual period?

a. Number of menstrual cycles in which the above symptom(s) have been experienced during the premenstrual phase over the past 12 months

0 1 2 3 4 5 6 7 8 9 10 11 12

b. To what extent do these symptoms cause impairment in work, school, or occupational functioning:

1-not at all 2- a little 3- moderately 4- quite a bit 5- extremely

c. Please rate the degree of severity of these symptoms:

1- not at all severe 2- mild 3- moderate 4-severe 5-extremely severe/debilitating

10. A subjective sense of being overwhelmed or out of control during the week prior to my menstrual period?

a. Number of menstrual cycles in which the above symptom(s) have been experienced during the premenstrual phase over the past 12 months

0 1 2 3 4 5 6 7 8 9 10 11 12

b. To what extent do these symptoms cause impairment in work, school, or occupational functioning:

1-not at all 2- a little 3- moderately 4- quite a bit 5- extremely

c. Please rate the degree of severity of these symptoms:

1- not at all severe 2- mild 3- moderate 4-severe 5-extremely severe/debilitating

11. Other physical symptoms, such as breast tenderness or swelling, headaches, joint or muscle pain, or sensations of "bloating" or weight gain during the week prior to my menstrual period?

a. Number of menstrual cycles in which the above symptom(s) have been experienced during the premenstrual phase over the past 12 months

0 1 2 3 4 5 6 7 8 9 10 11 12

b. To what extent do these symptoms cause impairment in work, school, or occupational functioning:

1-not at all 2- a little 3- moderately 4- quite a bit 5- extremely

c. Please rate the degree of severity of these symptoms:

1- not at all severe 2- mild 3- moderate 4-severe 5-extremely severe/debilitating

21. a. What is the average length of your menstrual cycle right now (i.e., How many days are there from the first day of one period to the first day of your next period – (most people range between 25 and 35)? _____ days

b. What is your average length of menstruation/bleeding **when you are not taking oral contraceptives**? (i.e., how many days does your period last? Most people's periods last between 1 and 10 days.) _____ days

c. Which statement best describes your menstrual cycle **when you are not taking oral contraceptives**?

[ ] I never have my period.
[ ] My period is very unpredictable. Sometimes very few days pass before I get my next period, sometimes months pass before I get my next period.
[ ] My period is somewhat unpredictable. I usually get my period within four to seven days of when I expect it.
[ ] My period is somewhat predictable. I usually get my period within two or three days of when I expect it.
[ ] My period is very predictable. I can predict within one day when my next period will start.

d. How old were you when you first started menstruating (started your period)?

_____ years old

e. Using the calendars below, please **indicate** the **first** day of your **last** menstrual period. If you are not completely sure, please estimate the day that you believe you started menstruating on.

September 2013

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October 2013

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November 2013

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

December 2013

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

January 2014

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February 2014

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

March 2014

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

f. How confident are you that the above-indicated day was the first day of your last period?

0%		25%		50%		75%		100%
0	1	2	3	4	5	6	7	8

g. Using the calendars below, please **indicate** your estimation of the **first** day of your **NEXT** menstrual period. If you are not completely sure, please estimate the day that you believe you will start menstruating on.

September 2013

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

October 2013

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26

29 30

27 28 29 30 31

November 2013

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

December 2013

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

January 2014

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February 2014

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

March 2014

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

h. How confident are you that the above-indicated day is the day that you will next get your period? (Circle the best response)

0% 25% 50% 75% 100%

0 1 2 3 4 5 6 7 8

i. Are you currently menstruating today and if so, how many days have menstruated?

1 2 3 4 5 6 7 8 9 10 more than 10

22. Have you ever taken Oral Contraceptives (the birth control pill)?

YES NO

a.i. If you have ever taken Oral Contraceptives, look at the following side effects that some people might experience when taking Oral Contraceptives. Indicate any of the following **Physical side effects that you experienced** when taking Oral Contraceptives. Please indicate what **OC brand** you were taking when you experienced the side effect and what action you took as a result of the symptom.

Nausea/Vomiting: YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:

___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Headaches: YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:

___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Breast size increase YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:

___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Breast size decrease YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Decreased ability to orgasm YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Weight loss YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Increased ability to orgasm YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use

___No action taken, symptoms continue now

Weight gain YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Increased sex drive/arousal YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Decreased sex drive/arousal YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Fewer menstrual cramps YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom

___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

More menstrual cramps YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Tiredness/fatigue YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Dizziness/Faintness YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use

___No action taken, symptoms continue now

High blood pressure YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Painful or tender breasts YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Irregular heartbeat YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Swelling of breast or abdomen YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom

___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Clearer complexion YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Complexion Problems (e.g., acne) YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Complete loss of periods YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Heavier periods (↑ bleeding) YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use

___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Lighter periods (↓ bleeding) YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Breakthrough bleeding (bleeding between periods) YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Slept more than usual YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Slept less than usual YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:

___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

a.ii. If you <u>have ever taken</u> Oral Contraceptives, look at the following side effects that some people might experience when taking Oral Contraceptives. Indicate any of the following **Emotional side effects that you experienced** when taking Oral Contraceptives. Please indicate what **OC brand** you were taking when you experienced the side effect and what action you took as a result of the symptom.

Positive Mood change YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:

___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Negative mood change YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:

___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

More jealous YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:

___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

More moody YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:

___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Less jealous YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:

___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Less moody YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:

___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use

___No action taken, symptoms continue now

Depression YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Sadness YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Lower self-esteem YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

More pessimistic YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom

___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

More optimistic YES NO If yes, which brand: _____
If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Higher self-esteem YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

More irritable YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Less irritable YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use

___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Cried more than usual YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Cried less than usual YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Feelings of inferiority YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

More sensitive to criticism YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Less sensitive to criticism YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

More self-critical YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Less self-critical YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

More content/happy YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

More aggressive YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Less aggressive YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

Less trust in partner (fidelity) YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use

___No action taken, symptoms continue now

More trust in partner (fidelity) YES NO If yes, which brand: _____

If yes, what action did you take as a result of this symptom?:
___ Discontinued Oral Contraceptive use
___ Switched OC brand because of this symptom
___ Experienced symptom but did not change OC use
___No action taken, symptoms continue now

b. I believe that oral contraceptives have affected my mood

Very Negatively	Slightly Negatively	In no way at all	Slightly Positively	Very Positively
0	1	2	3	4

c. Have you ever stopped oral contraceptive use due to reasons other than physical or emotional symptoms?

YES NO If yes, indicate the reason:

Sexual relationship ended YES NO
Desire to become pregnant YES NO
Concerned about hormones YES NO
Too hard to use YES NO
Medical condition (Specify:) YES NO
Too expensive YES NO

d. Have negative mood side effects ever influenced you to stop taking oral contraceptives? (Circle best answer)
Yes No Somewhat

e. If you have ever discontinued oral contraceptives due to mood side effects, approximately how many days or months did you experienced these negative mood side effects before discontinuing use?
_____ months and _____ days

f. Do you have a biological mother or sister who has experienced negative mood effects while taking oral contraceptives? (Circle answer):

YES NO UNSURE

g. At what age did you first start using oral contraceptives? _____ years

h. Why did you **start** taking oral contraceptives? (Check all that apply)

[ ] Birth Control [ ] Treat acne
[ ] For cycle regularity [ ] Other: _____
[ ] Due to a hormonal medical condition (Specify): _____
[ ] I was taking another medication that could have produced birth defects

i. For how long have taken oral contraceptivesI in total (i.e. the total amount of time you have taken on any/all brands of OCs)?

_____ years and _____ months

j. How many different types/brands of oral contraceptives have you taken? _____ types/brands

k. Please select all of the different types of oral contraceptives you have used? (select all that apply)

[ ] Alesse [ ] Apri [ ] Aviane

[ ] Brevicon 0.5/35 [ ] Brevicon 1/35 [ ] Cyclen

[ ] Demulen 50 [ ] Demulen 30 [ ] Linessa

[ ] Lo-Femenal [ ] Loestrin 1.5/30 [ ] Marvelon

[ ] Micronor [ ] Min-Ovral [ ] Minestrin 1/20

[ ] Next Choice [ ] Norlevo [ ] Ortho 0.5/35

[ ] Ortho 1/35 [ ] Ortho 10/11 [ ] Ortho 7/7/7

[ ] Ortho-Cept [ ] Portia [ ] Seasonique

[ ] Seasonale [ ] Select 1/35 [ ] Synphasic

[ ] Tri-Cyclen [ ] Tri-Cyclen Lo [ ]Triquilar

[ ] Yasmin [ ] Yaz

[ ] Other (please specify): _____

l. If you have **previously taken OCs** but are not taking them right now, how many years and months has it been **since you last took OCs**?

_____ years and _____months

m. Have you ever taken a contraceptive that contained hormones but that was not taken orally or by mouth? (e.g., contraceptive patch, vaginal ring, DepoProvera, hormonal implants, etc.)?

YES NO UNSURE

23. Are you currently taking oral contraceptives?

YES NO

a. If NO, how long has it been since you last took OCs?

_____ years and _____months ___ I am still currently using Oral Contraceptives

b. If NO, how long has it been since you last took ANY hormonal contraceptive? (e.g., contraceptive patch, vaginal ring, DepoProvera, hormonal implants, etc.)

_____ years and _____months ___ I am still currently taking a hormonal contraceptive

24. If you are currently taking OCs, for how many years and months have you been taking your **current** OC?

_____ years and _____ months

b. Why are you currently taking OCs? (Check all that apply)

[ ] Birth Control [ ] Treat acne
[ ] For cycle regularity [ ] Other: _____
[ ] Due to a hormonal medical condition (Specify): _____
[ ] I am currently taking another medication that could produce birth defects

b. Please indicate the type of OC you are currently taking.

[ ] Alesse [ ] Apri [ ] Aviane

[ ] Brevicon 0.5/35 [ ] Brevicon 1/35 [ ] Cyclen

[ ] Demulen 50 [ ] Demulen 30 [ ] Linessa

[ ] Lo-Femenal [ ] Loestrin 1.5/30 [ ] Marvelon

[ ] Micronor [ ] Min-Ovral [ ] Minestrin 1/20

[ ] Next Choice [ ] Norlevo [ ] Ortho 0.5/35

[ ] Ortho 1/35 [ ] Ortho 10/11 [ ] Ortho 7/7/7

[ ] Ortho-Cept [ ] Portia [ ] Seasonique

[ ] Seasonale [ ] Select 1/35 [ ] Synphasic

[ ] Tri-Cyclen [ ] Tri-Cyclen Lo [ ]Triquilar

[ ] Yasmin [ ] Yaz

[ ] Other (please specify): _____

24. Do you believe Oral Contraceptives are currently affecting your mood in a **negative** way?

YES NO

Appendix B

Laboratory Questionnaire

---

1. Today's date (dd/mm/yyyy): _____
2. Age: _____
3. Has anything happened during the course of the day that may have affected your mood (either negatively or positively)?

YES NO

4. How many hours of sleep did you get last night? _____hours

1. 5. During the past 24 hours, how many minutes were you physically active at a moderate to intense level?

    [ ] 0 minutes
    [ ] 1 to 15 minutes
    [ ] 16 to 30 minutes
    [ ] 31 to 45 minutes
    [ ] 46 or more minutes

6. Have you taken any drugs/medications today (other than oral contraceptives)? If so list the amount and the brand.

_____

_____

7. Did you consume any caffeine today (e.g. coffee, tea, soft drinks)?
YES NO

a. If yes, how much did you drink? (One cup is equal to 250 mL)

[ ] 1-3 cups [ ] 4-7 cups [ ] 8-12 cups [ ] 12 or more cups

8. Did you consume any alcohol in the last 24 hours?
YES NO

a. If yes, how many drinks did you consume? (e.g. ONE drink is equal to 1oz of distilled alcohol i.e. vodka rum, whiskey etc., a 5oz glass of wine, or a 12oz bottle of beer)

Please indicate: _____

c. If yes, have you had any drinks today (since waking up)?
YES NO

d. If yes, how many drinks did you consume? (e.g. ONE drink is equal to a 1oz distilled alcohol i.e. vodka rum, whiskey etc., 5oz glass of wine, or12oz bottle of beer)

Please indicate: _____

9. Circle the response that best describes the extent to which you agree/disagree with the following statements:

a. During the session, I craved a lot more excitement than the tasks provided.

Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
1	2	3	4	5

b. During the session I got bored

Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
1	2	3	4	5

e. During the session I had very little patience when performing the tasks.

Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
1	2	3	4	5

d. During the session I would have preferred tasks that were more exciting and unpredictable.

Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
1	2	3	4	5

e. During the session, I enjoyed the tasks that I was given.

Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
1	2	3	4	5

f. During the session I performed the tasks conscientiously.

Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
1	2	3	4	5

g. I did the tasks carefully, since I wanted to do things right the first time.

Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
1	2	3	4	5

h. I was not as dependent or reliable performing the tasks as I should have been.

Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
1	2	3	4	5

i. Since I made a commitment, I could be relied upon to complete the tasks to the best of my ability.

Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
1	2	3	4	5

10. What is your sex?

MALE FEMALE

11. Using the calendars below, please **indicate** the **first** day of your **last** menstrual period. If you are not completely sure, please estimate the day that you believe you started menstruating on.

September 2013

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October 2013

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November 2013

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

December 2013

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

January 2014

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February 2014

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

March 2014

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

a. How confident are you that the above-indicated day was the first day of your last period?

0%		25%		50%		75%		100%
0	1	2	3	4	5	6	7	8

b. Using the calendars below, please **indicate** your estimation of the **first** day of your **NEXT** menstrual period. If you are not completely sure, please estimate the day that you believe you will start menstruating on.

September 2013

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October 2013

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November 2013

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

December 2013

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

January 2014

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11

February 2014

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8

12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

March 2014

S	**M**	**T**	**W**	**T**	**F**	**S**
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

c. How confident are you that the above-indicated day is the day that you will next get your period? (Circle the best response)

0%		25%		50%		75%		100%
0	1	2	3	4	5	6	7	8

d. Are you currently menstruating today and if so, how many days have menstruated?

Please indicate: _____

e. Please indicate which statement best describes your current use of oral contraceptives (i.e. The birth control pill)

_____ I have never used oral contraceptives
_____ I have used Oral contraceptives in the past, but I stopped taking oral contraceptives MORE than 2 months ago
_____ I have used oral contraceptives in the past, but I stopped taking oral contraceptives LESS than 2 months ago
_____ I am currently using oral contraceptives, and I have been using Oral contraceptives for MORE than 2 months
_____ I am currently using oral contraceptives, and I have been using Oral contraceptives for LESS than 2 months
_____ I am current using a hormonal contraceptive other than oral (e.g., contraceptive patch, vaginal ring, DepoProvera, hormonal implants, etc.)

Appendix C

LABORATORY QUESTIONNAIRE A: Positive and Negative Affect Scale

(PANAS)

1. This scale consists of a number of words to describe different feelings and emotions. Read each item and indicate **to what extent you feel this way right now**, that is, at the present moment.

a. Interested

1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

b. Distressed

1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

c. Excited

1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

d. Upset

1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

e. Strong

1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

f. Guilty

1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

g. Scared

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

h. Hostile

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

i. Enthusiastic

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

j. Proud

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

k. Irritable

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

l. Alert

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

m. Ashamed

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

n. Inspired

1	2	3	4	5

Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

o. Nervous

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

p. Determined

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

q. Attentive

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

r. Jittery

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

s. Active

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

t. Afraid

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

Appendix D

LABORATORY QUESTIONNAIRE B: PANAS, PEEQ, and Approach/Avoid questionnaire

1. This scale consists of a number of words to describe different feelings and emotions. Read each item and indicate **to what extent you feel this way right now**, that is, at the present moment.

a. Interested

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

b. Distressed

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

c. Excited

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

d. Upset

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

e. Strong

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

f. Guilty

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

g. Scared

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

h. Hostile

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

i. Enthusiastic

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

j. Proud

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

k. Irritable

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

l. Alert

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

m. Ashamed

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

n. Inspired

1	2	3	4	5

Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

o. Nervous

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

p. Determined

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

q. Attentive

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

r. Jittery

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

s. Active

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

t. Afraid

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

2. Please indicate the degree to which you experienced the following while watching the slideshow

a. Numbness or tingling

1	2	3	4	5

Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

b. Feeling hot
1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

c. Felt dizzy or lightheaded
1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

d. Heart Pounding or racing
1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

e. Feelings of choking
1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

f. Hands trembling
1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

g. Shaky
1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

h. Difficulty breathing
1 2 3 4 5
Very Slightly A Little Moderately Quite a Bit Extremely
Or Not at All

i. Indigestion or discomfort in abdomen

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

j. Faint

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

k. Face flushed

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

l. Sweating

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

m. Feeling of floating/Feeling light in weight

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

n. Feeling of sinking/feeling heavy

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

o. Tightness in chest

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

p. Energized

1	2	3	4	5
Very Slightly	A Little	Moderately	Quite a Bit	Extremely

Or Not at All

q. Drained of energy/fatigue

1	2	3	4	5
Very Slightly	A Little	Moderately	Quite a Bit	Extremely

Or Not at All

r. Smiling

1	2	3	4	5
Very Slightly	A Little	Moderately	Quite a Bit	Extremely

Or Not at All

s. Tense muscles

1	2	3	4	5
Very Slightly	A Little	Moderately	Quite a Bit	Extremely

Or Not at All

t. Relaxed muscles

1	2	3	4	5
Very Slightly	A Little	Moderately	Quite a Bit	Extremely

Or Not at All

u. Stomach tightened

1	2	3	4	5
Very Slightly	A Little	Moderately	Quite a Bit	Extremely

Or Not at All

v. Nauseous

1	2	3	4	5
Very Slightly	A Little	Moderately	Quite a Bit	Extremely

Or Not at All

w. Fidgety/Restlessness

1	2	3	4	5
Very Slightly	A Little	Moderately	Quite a Bit	Extremely

Or Not at All

x. Hollow /empty

1	2	3	4	5

Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

y. Goosebumps

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

z. Shivering

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

aa. Felt a lowering in heart rate

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

bb. Felt an increase in blood pressure

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

cc. felt a decrease in blood pressure

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

dd. Felt sick

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

ee. glowing or radiating “good energy”?

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

ff. radiating bad energy

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

3. Please indicate what affect the slideshow had on you personally

a. The film aroused an unpleasant feeling in me

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

b. The film aroused a pleasant feeling in me

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

c. This film aroused the want to escape in me:

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

d. This film aroused the want to take action in me:

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

e. The film infected me with excitement

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

f. The film aroused my interest

1	2	3	4	5
Very Slightly Or Not at All	A Little	Moderately	Quite a Bit	Extremely

not.

Appendix E

Consent Form A: Letter to Participants

SEX, HORMONES, AND EMOTIONS STUDY

Dear potential participant,

You are being invited to participate in the Sex, Hormones, and Emotions Study. The purpose of this study is to examine how sex and hormones influence emotions and cognition. This study is being conducted by Ms. Nicole Keir and Dr. Kirsten Oinonen from the Health Hormones and Behaviour Laboratory (HHABLAB) in the Department of Psychology at Lakehead University. A part of this project will be used to complete a Master's thesis for Nicole Keir. Additional exploratory research questions in the same area may also be examined. The study will consist of a screening questionnaire and one laboratory session. The screening questionnaire is completed online and will take approximately 30 minutes to complete. Upon completion of the screening questionnaire, you will receive one 0.5 bonus point towards your Undergraduate Psychology mark, if relevant. The questionnaire will be used to select participants for the main study. If you are eligible to participate in the main study, you will be invited to a laboratory session taking place in the Health Hormones and Behaviour lab on Lakehead University Campus. During this laboratory session, you will be required to watch three emotional videos, and complete various cognitive tasks such as a facial recognition task. Those who participate in the lab session will be awarded an additional 1 bonus points towards their final mark in their Undergraduate Psychology course, if relevant.

For participants that are not eligible for bonus marks, they will be provided with $2 for their participation in the laboratory portion of this study. This $2 can be used to cover parking expenses at Lakehead University or can be kept for personal use. Additionally, all participants in the laboratory portion of this study will be entered into a draw to win one of two $50 gift certificates to a local restaurant and/or a bookstore chain.

The researchers will also be collecting additional information for use in future studies. For example, those who participate in the laboratory portion of this study will be presented with an option on the consent form to provide a saliva DNA swab sample. The DNA portion of the study is completely optional and further details will be presented during the laboratory session.

Both sessions involve answering personal questions about your health, reproductive history, emotions, and personality. Benefits to participation in this research project involve a better understanding of the processes of psychological research, possible benefits from personal insight, as well as a general contribution to the field of psychology and the area of hormones, emotion, and cognition. There are no obvious risks involved in participating in this study. However, some participants may feel uncomfortable answering personal questions or have new positive or negative thoughts about oneself after answering the questions (i.e., new personal insight).

Participants will also likely experience increases in positive mood and negative mood throughout the lab session. However, such mood changes are likely comparable to mood change one would experience as a result of exposure to television or other media. You are not required to answer all questions and can skip any question that makes you uncomfortable. This study is open to Lakehead University students 16 years or older as well as members of the general public who are 18 years or older.
Participation in this experiment is voluntary and you may withdraw at any time without explanation and without penalty. All records of your participation will be kept in strict confidence and any reports of the study will not identify you as a participant. Individuals who meet specific criteria will be asked to participate in the study.

Therefore, we have asked for your name, telephone number, and email address. This information is required so you can be contacted to participate in the laboratory session and so your responses from the screening questionnaire can be linked to the data from the laboratory session. Your information will only be used to contact you for the laboratory session and will not be given out to any third parties. Once the study is complete, all identifying information, including email, will be removed. At that point, no one, including the researchers, will be able to connect any information gathered to a specific individual. There is no obligation to provide an email address or any other identifying information, however such information is required if you are a student at Lakehead University in Introductory Psychology and you wish to receive bonus points. All identifying information will be removed once bonus points have been recorded.

As per university requirements, all data will be stored for at least five years by Dr. Oinonen at Lakehead University and remain anonymous and confidential. If you have any questions or concerns regarding this study please contact Nicole Keir or Dr. Kirsten Oinonen. This study has been approved by the Lakehead University Ethics Board (807-343-8283 or research@lakeheadu.ca) and they can also be contacted about any concerns.

Upon completion of the study, interested participants are welcome to contact one of the researchers to request a summary of the results. Thank you very much for your time. We very much appreciate your contribution to our research.

Nicole Keir, H.B.A.
M.A. Student Associate
Lakehead University
955 Oliver Road
Thunder Bay, Ontario P7B 5E1
email: nkeir@lakeheadu.ca

Dr. Kirsten Oinonen Ph.D., C. Psych.
Professor Department of Psychology
Lakehead University
955 Oliver Road
Thunder Bay, Ontario P7B 5E1
email: koinonen@lakeheadu.ca
(807) 343-8096

Appendix F

DEBRIEFING FORM A: SEX, HORMONES, AND EMOTIONS STUDY

Thank you for participating in the screening phase of our study on Sex, Hormones and Emotions. The study is being conducted by Dr. Oinonen, and Ms. Nicole Keir at Lakehead University. The data you have contributed will be used as part of Nicole Keir's Master's thesis. It may also be used to examine additional exploratory research questions in the laboratory. If you are selected to participate in the second part of the study, you will be contacted by Nicole in the next three weeks. Participants in the next phase will receive one additional bonus mark toward their final grade in the participating Undergraduate Psychology course, if relevant. If you are chosen for the next phase, you will be asked to come into the laboratory for a session lasting approximately 1 hour where you will be required to watch three separate slide shows of pictures, and complete various cognitive tasks such as a facial recognition task.

All participants will be provided with $2 for their participation in the laboratory portion of this study. This $2 can be used to cover parking expenses at Lakehead University or can be kept for personal use. Additionally, all participants in the laboratory portion of this study will be entered into a draw to win one of two $50 gift certificates to a local restaurant and/or a bookstore chain.

Please be assured that once participants have been selected for the study and their responses from both phases are linked, any identifying information (e.g., names) will be removed from the data file and there will be no way to identify your responses. All of your responses will be coded to conceal your identity on the questionnaires and all data will remain anonymous. If you have any questions, please feel free to contact Dr. Oinonen at the contact information below. If you would like to receive a summary of the results of the study, please email one of the researchers and, upon completion of the study, a summary of the results will be emailed to you. Please note that providing your email address does not jeopardize your anonymity.

This study has been approved by the Lakehead University Research Ethics Board. If you have any questions related to the ethics of the research and would like to speak to someone outside of the research team please contact Sue Wright at the Research Ethics Board at 807-343-8283 or research@lakeheadu.ca.

Thank you very much for your time. We very much appreciate your contribution to our research.

Nicole Keir, H.B.A.
M.A. Student
Lakehead University
955 Oliver Road
Thunder Bay, Ontario P7B 5E1

Dr. Kirsten Oinonen Ph.D., C. Psych.
Associate Professor
Department of Psychology
Lakehead University
955 Oliver Road

email: nkeir@lakeheadu.ca

Thunder Bay, Ontario P7B 5E1
email: koinonen@lakeheadu.ca
(807) 343-8096

Appendix G

CONSENT FORM B: SEX, HORMONES, AND EMOTIONS STUDY

I agree to participate in this study that is investigating the influence of sex and hormones on emotions. I understand that my participation is entirely voluntary: I can leave the experiment at any time and this will have no bearing on any remuneration I will receive, nor will it have any undesirable consequences.

The following points have been explained to me:

1. I have been selected to participate in a laboratory session at the HHAB Lab in the Department of Psychology at Lakehead University so that I may contribute to the understanding of how sex and hormones influence emotional responses and functioning.
2. The procedure will be as follows: During an approximately hour-long session, I will watch three emotionally-based videos. Before and after each video, I will fill out questionnaires where I will be asked to indicate my current mood state. Additionally, after each slide show, I will perform three cognitive and perceptual tasks such as an emotion recognition task.
3. I will be asked to respond to questions of a personal nature that include, but are not limited to, the following: personal health, mood, behaviour, and the menstrual cycle (for women).
4. I am a volunteer and can withdraw at any time from this study and I may choose to not answer any question or part in the study
1. There are no known serious risks involved in participating in this study. However, experiencing positive and negative changes in mood will likely occur during the session. The benefits I may expect from the study are: (a) an appreciation of research on health and hormones, (b) an opportunity to contribute to scientific research, (c) possible insight into myself, and (d) course credit (up to 1.5 bonus points for undergraduate psychology students). **(e) Monetary compensation in the amount of $2 will be awarded to those who do not qualify for bonus marks. The $2 can be used for Parking Expenses or for other, personal use (f) each participant will have the potential to win one of two $50 gift certificates to a local restaurant and/or bookstore chain**
5. All of the data collected will remain strictly confidential. My responses will not be associated with my name. Instead, my data will be associated with a code number when the researchers store the data.
6. The data will be stored securely for at least 5 years by Dr. Oinonen and Lakehead University
7. For the duration of the study, the researchers and I will have ongoing communication via the e-mail address(es) or the telephone number that I have provided below. This information will not be used for any other reason.
8. Upon completion of my participation, I will receive a more detailed written explanation about the rationale underlying this experiment.
9. The experimenter(s) will answer any other questions about the research either now or during the course of the experiment (other than specific questions about the hypotheses). If I have any other questions or concerns, I can address them to

the experimenter(s) Nicole Keir (nkeir@lakeheadu.ca) or to the research director, Dr. Kirsten Oinonen 807-343-8096, (koinonen@lakeheadu.ca).

10. I am interested in receiving a summary of the results upon completion of the study: ☐ yes ☐ no

    If yes, please indicate your email address: _____

I have read and understood the above information and agree to participate in this study on Sex, Hormones and Emotions:

Yes ☐ No ☐

Name: _____

Signature: _____

12. There is preliminary evidence suggesting that some hormonal-related alleles are related to hormonal and behavioural experiences. As a result we are interested in obtaining a saliva swab from participants in order to conduct additional research on hormonal-related alleles. This would involve the researchers taking an oral sample swab on the inside of your cheek. Please indicate if you are willing to provide a DNA swab. Please note that ALL of the above criteria from 1-11 apply. Your DNA sample will remain anonymous and will be stored at Lakehead University by Dr. Oinonen for up to 5 years. Declining consent for the DNA sample does NOT affect your participation in the overall study. You may decline consent for DNA sample and continue with the rest of the study with no consequences.

I have read and understood the above information and agree to participate in this DNA portion of study on Sex, Hormones, and Emotions:

Yes ☐ No ☐

Name: _____
Signature: _____

Due to pending Biosafety approval, the researchers may not be able to collect the DNA sample at this time. If the DNA sample cannot be collected in the laboratory today, I agree to be contacted in the future for DNA sampling.

Yes ☐ No ☐

Name: _____
Signature: _____
Contact email _____
OR Contact phone _____

Appendix H

Debriefing Form B: SEX, HORMONES, AND EMOTIONS STUDY

We appreciate your participation in our study, and thank you for spending your time to help us with our research. The purpose of this study was to investigate how sex and hormones influence emotions and cognition. Additionally, we are further interested in how hormones, specifically oral contraceptives (OCs), influence emotional reactivity as well as perception and cognition. In particular, we wanted to see how emotion induction (via emotionally charged slide shows) combines with hormonal factors such as OCs or sex to influence cognition. Previous research has suggested that there may be sex differences in emotional responses and that use of OCs may affect how women respond. Please see the references below if you are interested in reading more about this issue.

In case you have any concerns about your mood and would like to see a mental health professional, we have provided you with a list of such resources on the attached sheet.

Given that this study involves some aspects of which you were not fully informed at the start, **it is very important that you not discuss your experiences with other students until the end of the term**. If participants have prior knowledge of our specific predictions it could influence the results, and the data we collect would not be useable. Since you will be given a copy of this feedback to take home, please do not make it available to other students. If you do not keep this form, please dispose of it rather than leaving it somewhere where other students might read it.

Please feel free to discuss with the experimenter any feelings you have about the study right away. We ask that you do not discuss this study with any other students as we do not want to diminish the mood induction effects of the slide shows. **Therefore, it is very important that you do not discuss your experiences with other students until the end of the term**. Should you have further questions, do not hesitate to contact Nicole Keir or Dr. Kirsten Oinonen, using the information listed below. This study was approved by the Lakehead University Research Ethics Board and they can also be contacted about any concerns (807-343-8283 or research@lakeheadu.ca).

We hope that you have enjoyed participating in our study, and thank you very much for your assistance. As noted on the consent form, you will receive a summary of the results of the study at its completion if you have indicated an interest.

Principal Investigators:

Nicole Keir, H.B.A.
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Mental Health Resource Sheet

Sometimes people can sometimes feel upset when thinking about their mood. Thus, it is possible that something occurred during your participation in the study that may have upset you. If you feel as though you would like to talk to a mental health practitioner for any reason please consider the resources listed below:

- Lakehead University Health and Counseling Centre: 343-8361
- Family Services Thunder Bay: 626-1880
- Catholic Family Development Centre: 345-7323
- Emergency services are available at the Thunder Bay Health Sciences Centre
- Thunder Bay Crisis Response (24 hours): 346-8282.

The following are some references in case you are interested in reading more about research that is related to the study that you just participated in:

Gingnell, M., Engman, J., Frick, A., Moby, L., Wikström, J., Fredrikson, M., & Sundström-Poromaa, I. (2013). Oral contraceptive use changes brain activity and mood in women with previous negative affect on the pill—A double-blinded, placebo-controlled randomized trial of a levonorgestrel-containing combined oral contraceptive. *Psychoneuroendocrinology*, *38*(*7*), 1133-1144.

Jarva, J. A., & Oinonen, K. A. (2007). Do oral contraceptives act as mood stabilizers? Evidence of positive affect stabilization. *Archives of women's mental health*, *10*(*5*), 225-234.

Rumberg, B., Baars, A., Fiebach, J., Ladd, M. E., Forsting, M., Senf, W., & Gizewski, E. R. (2010). Cycle and gender-specific cerebral activation during a verb generation task using fMRI: comparison of women in different cycle phases, under oral contraception, and men. *Neuroscience research*, *66*(*4*), 366-371.

Appendix I

Class-Wide Email Announcement

Study on Sex, Hormones, and Emotion

You are invited to participate in a psychology study looking at individual differences with respect to sex, hormones and emotion. We are seeking both Female and Male participants to complete a 30-minute screening questionnaire and one lab sessions that will be 60 minutes in duration. If you wish to complete the screening questionnaire using a hard copy, please contact the researchers at nkeir@lakeheadu.ca. If you would like to complete the questionnaire online, please click on the link listed below.

Introductory Psychology students will receive a one-half bonus point for completing the screening questionnaire and one bonus point for the lab session completed (for up to 1.5 bonus points). **Participants that do not qualify for bonus marks will be provided with $2 for their participation in the laboratory portion of this study. This $2 can be used to cover parking expenses at Lakehead University or can be kept for personal use. Additionally, all participants in the laboratory portion of this study will be entered into a draw to win one of two $50 gift certificates to a local restaurant and/or a bookstore chain.**

This study has been reviewed and approved by the Lakehead University Research Ethics Board.

Please follow the link below to participate in the online screening questionnaire:

https://www.surveymonkey.com/s/sexhormonesandemotions

If you have any questions regarding this study please email Nicole Keir at nkeir@lakeheadu.ca.

Thank-you, your time and participation is greatly appreciated.

Sincerely,

Nicole Keir, H.B.A.
M.A. Student
Department of Psychology
Lakehead University
955 Oliver Road
Thunder Bay, Ontario P7B 5E1
email: nkeir@lakeheadu.ca

Dr. Kirsten Oinonen Ph.D., C. Psych
Associate Professor
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email: koinonen@lakeheadu.ca

Appendix J

General Recruitment Poster

Are YOU currently taking **ORAL CONTRACEPTIVES** (the Birth Control Pill?) OR are YOU currently taking **NO HORMONES**?

If so, researchers in the department of Psychology are looking for **YOU** to participate in a study on **SEX, HORMONES, & EMOTIONS!**

Participants will complete ONE short screening questionnaire and participate in ONE laboratory session where they will complete a variety of fun emotional and perceptual tasks.

All participants will receive $2* and will be entered into a draw to win 1 of 2 $50 gift certificates to a local bookstore or restaurant chain!
*Participants who qualify for BONUS POINTS towards their psychology grade will receive up to 2.0 bonus points rather than the $2

For more information and details on how to participate please email:
nkeir@lakeheadu.ca

This is a GREAT way to contribute to health and hormone research!!

Take a picture of this poster to help you remember!

OR SCAN this QR code to take you straight to the screening questionnaire!

This study has received ethical approval by the Lakehead University Research Ethics Board

Appendix K

Targeted Recruitment Poster

ARE YOU currently experiencing **CHANGES IN YOUR MOOD from Oral Contraceptives** (The Birth control pill)?

If so, researchers in the department of Psychology are looking for **YOU** to participate in a study on **SEX, HORMONES, & EMOTIONS!**

Participants will complete ONE short screening questionnaire and participate in ONE laboratory session. In the session, participants will complete a variety of interesting emotional and perceptual tasks.

All participants will receive $2* and will be entered into a draw to win 1 of 2 $50 gift certificates to a local bookstore or restaurant chain!
*Participants who qualify for BONUS POINTS towards their psychology grade will receive up to 2.0 bonus points rather than the $2

For more information and details on how to participate please email:
nkeir@lakeheadu.ca

This is a GREAT way to contribute to health and hormone research!!

Take a picture of this poster to help you remember!

OR SCAN this QR code to take you straight to the screening questionnaire!

This study has received ethical approval by the Lakehead University

Research Ethics Board

Appendix L

Personal Email Announcements to Non-Lakehead Student Individuals

Study on Hormones and Cognition

You are invited to participate in a psychology study being conducted at Lakehead University looking at investigating individual differences with respect to sex, homrones, and emotions**.** We are looking for men and women who are 18 years of age or older, to complete a screening questionnaire and ONE lab session. The screening questionnaire will take 30 minutes and can be completed using the link below.

Following completion of the screening questionnaire, participants will be contacted via email and asked to participate in ONE lab sessions that will take 60 minutes to complete. The lab session will involve completing a variety of interesting emotional and perceptual tasks and short questionnaires in the Health Hormones and Behaviour Laboratory (HHABLAB) in the department of Psychology at Lakehead University. All responses will be kept anonymous and confidential.

All participants will be provided with $2 for their participation in the laboratory portion of this study. This $2 can be used to cover parking expenses at Lakehead University or can be kept for personal use. Additionally, all participants in the laboratory portion of this study will be entered into a draw to win one of two $50 gift certificates to a local restaurant and/or a bookstore chain.

This study has been reviewed and approved by Lakehead University Research Ethics Board.

Please follow the link below to participate in the online questionnaire:
insert link here

If you have any questions regarding this study please email Nicole Keir at nkeir@lakeheadu.ca.

Thank-you, your time and participation is greatly appreciated.

Sincerely,

Nicole Keir, H.B.A.
M.A. Student
Department of Psychology
Lakehead University
955 Oliver Road
Thunder Bay, Ontario P7B 5E1
email: nkeir@lakeheadu.ca

Dr. Kirsten Oinonen Ph.D., C. Psych
Associate Professor
Department of Psychology
Lakehead University
955 Oliver Road
Thunder Bay, Ontario P7B 5E1
email: koinonen@lakeheadu.ca

Appendix M

REB Approval Letter

Lakehead
UNIVERSITY

Office of Research Services

Tel 807-343-8934
Fax 807-346-7749

February 10, 2014

Principal Investigator: Dr. Kirsten Oinonen
Student Investigator: Nicole Keir
Department of Psychology
Lakehead University
955 Oliver Road
Thunder Bay, ON P7B 5E1

Dear Dr. Oinonen and Ms Keir:

Re: REB Project #: 105 13-14 / Romeo File No: 1463679
Granting Agency: N/A
Granting Agency Project #: N/A

On behalf of the Research Ethics Board, I am pleased to grant ethical approval to your research project titled, "REB Project Title: Sex, Hormones, and Emotions Study (Thesis title: The Effects of Oral Contraceptives on Emotional Reactivity and Cognition)".

Ethics approval is valid until February 10, 2015. Please submit a Request for Renewal form to the Office of Research Services by January 10, 2015 if your research involving human subjects will continue for longer than one year. A Final Report must be submitted promptly upon completion of the project. Research Ethics Board forms are available through the Romeo Research Portal at:

http://romeo.lakeheadu.ca

During the course of the study, any modifications to the protocol or forms must not be initiated without prior written approval from the REB. You must promptly notify the REB of any adverse events that may occur.

Best wishes for a successful research project.

Sincerely,

Dr. Richard Maundrell
Chair, Research Ethics Board

/scw