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The Effects of Endogenous and Exogenous Progesterone on Ingroup Affiliative Bias

Abby Sibson
University of Arkansas, Fayetteville

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Abby Sibson

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Abstract

Millions of women use hormonal contraceptives around the world and though the physical side effects are thoroughly described in the literature and clinical setting, the psychological effects have been largely ignored until recently. Recent studies have found that the use of hormonal contraceptives has an effect on women's hormones and psychological well-being. The goal of the present research was to expand the current knowledge of the effect of hormonal contraceptives on women's hormones and social behavior by examining how women with differing levels of progesterone due to menstrual cycle fluctuations (follicular or luteal phase) or using hormonal contraceptives (birth control pill or intrauterine device; IUD) may affect who they categorize into their ingroup or outgroup after undergoing a stressor. Though there was generally no support for my hypotheses, in exploratory analyses we found that White women in the luteal phase or that have a hormonal IUD were significantly less likely to categorize Black targets as outgroup members relative to participants in the follicular phase or that take birth control pills. This finding was specific to Black targets and not the other minority targets (Asian and Latino). We also examined changes in progesterone from before and after the stressor to investigate how the progesterone stress response may be different among the four groups of women. Although we did not find predicted effects with the current sample, this project nevertheless advances the understanding of how women's psychology and physiology are affected by hormonal contraceptive use.

Introduction

Endogenous progesterone varies across the menstrual cycle; it is very low during the follicular phase and very high during the luteal phase. This increase in the level of progesterone has been found to affect women's behavior and desire to affiliate; however, the studies that have investigated effects of progesterone on affiliation have not examined hormonal contraceptive users who have exogenous progesterone in their systems. Although excluding hormonal contraceptive users from studies has been very common in the past, it is extremely important that new research includes them given the fact that many women use hormonal contraceptives not not much is known about how hormonal contraceptives effect women's hormones and behaviors. The goal of the current research is to investigate the relationship between the different progesterone levels among the 4 groups (luteal, follicular, pill, and intrauterine device (IUD)) and their desire to affiliate with people of their own race compared to those of other races; this desire to affiliate with a particular group is ingroup bias. This bias may be especially likely after stress, which increases women's overall desire to affiliate.

Hormonal Contraceptive Use

The CDC (2018) reports that 23% of women in the U.S. are currently using either the birth control pill, a hormonal IUD, or contraceptive implant. With a such a large number of women using hormonal contraceptives (HCs) it is very important to assess the psychological and behavioral effects of HCs. Although past research has more thoroughly investigated the physical side effects of hormonal contraceptives (Rosenberg and Waugh, 1998; Rosenberg et al., 1999; Shulman, 2011), the psychological side effects have not been as well investigated. Birth control pills and IUDs are two of the most widely used HCs; birth control pills include either progestogen alone or have both estrogen and progestogen and IUDs contain only progestogen

(Mu and Kulkarni, 2022). Progestogen, also called progestin, is an exogenous synthetic hormone that interacts with progesterone receptors (Haas et al., 2019).

Emerging research investigating the psychological side effects of HC use has found concerning evidence of depression and anxiety among HC users. A study done in Denmark with over a million women found that the use of HCs was associated with the use of antidepressant and a first diagnosis of depression (Skovlund et al., 2016). Another study specifically investigating hormonal IUDs found significant associations with anxiety and sleep problems (Slattery et al., 2018). These findings convey the importance of continued research on the psychological and behavioral effects of different types of HC on women so that clinicians can adequately inform their patients of all the possible side effects.

Progesterone and The Menstrual Cycle

As mentioned above the progestogen used in HC is a synthetic version of progesterone. Progesterone is a female reproductive hormone that changes in concentration throughout the menstrual cycle. Naturally cycling women (i.e., women who are not taking any substance to alter reproductive hormones) typically have 28 day cycles that consist of the follicular phase (days 0 to 14) and luteal (days 14 to 28) phase with ovulation occurring in the middle (day 14) (Monis and Tetrokalashvili, 2021). Throughout the follicular phase progesterone remains low (Sherman and Korenman, 1974); then in the luteal phase progesterone increases to allow the lining of the uterus to thicken for the implantation of the fertilized egg (Haas et al., 2019). If there is no pregnancy than the corpus luteum (the temporary endocrine structure that releases the progesterone) will atrophy and a new cycle to begin.

Progesterone and Women's Behavior

Progesterone physically prepares the body for pregnancy by causing the endometrium to thicken (Haas et al., 2019) during the luteal phase; previous research suggests that progesterone also mediates the behavioral changes seen in women when their progesterone levels are high that have likely been historically useful for overcoming common challenges with pregnancy. Studies have found that when women have higher levels of progesterone they are more sensitive to facial cues that signal contagion and physical threat (Conway et al., 2007), felt more committed to their romantic partner (Jones et al., 2005), and more likely to avoid potential sources of disease (Fleischman & Fessler, 2011). Research has also found that during the luteal phase women had more success in accurately identifying other people's facial expressions and they had an increased attention to social stimuli (Maner & Miller, 2014). These are all examples of how increased levels of progesterone in the luteal phase influence a women's behavior and how they affiliate with others.

Ingroup Bias

With an increased awareness of social stimuli and contagion/physical threats, it is also possible that *who* someone wants to affiliate with may change across the menstrual cycle as well. Specifically, women's desire to affiliate may depend on whether an affiliation partner is more similar or more different from themselves such as being the same or different race from them. This favoritism towards people similar to oneself is called ingroup bias. Researchers have found that this increase of ingroup bias due to pathogen avoidance during pregnancy is directly correlated with increasing progesterone levels (Fleischman & Fessler, 2011). This increase of ingroup bias is likely to be seen in the luteal phase of the menstrual cycle as women in the luteal phase have been found to higher disgust for pathogens (Milkowska et al., 2021). As progesterone levels change throughout the menstrual cycle further research needs to be conducted to

investigate how ingroup bias may differ throughout the menstrual cycle and with women using hormonal contraceptives.

Progesterone and Stress

Stress may be a particularly good context to study effects of progesterone on women's affiliation. One study found that progesterone was positively correlated with cortisol, the stress hormone, in men and women who are using hormonal contraceptives, however this effect was not present in the naturally cycling women (Wirth et al., 2007). Another study found that progesterone did rise in response to stress in naturally cycling women specifically in the follicular phase (Herrera et al., 2016). It is important to note that neither of these studies specifically targeted social stress which is a type of stress that has been shown to have a greater effect on women than men (Kelly et al., 2008). The conflicting findings of these two studies conveys the importance of furthur research investigating how progesterone changes in response to stress throughout the menstrual cycle and while using hormonal contraceptives.

Both progesterone and stress have been shown to have an effect on people's desire to affiliate with others. Although the fight-or-flight response to stress is very well defined in the literature there is another dimension to which people can react to stress called the tend-and-befriend response. The fight-or-flight response describes whether someone is likely to fight off a threat or runaway from a threat (Bracha et al., 2004); tend-and-befriend describes taking care of oneself and their offspring and also expanding their social networks in response to stress (Taylor et al., 2000; Taylor, 2006). Women in particular are more likely to respond to stress along the tend-and-befriend dimension than the fight-or-flight dimension The "befriend" aspect of this theory describes the desire to affiliate with others in times of stress, and this desire to affiliate is directly related to progesterone levels (Schultheiss et al., 2004). Considering this direct link

between progesterone levels and desire to affiliate, and the fact that progesterone is different at different points of the menstrual cycle, it is likely that a women's desire to affiliate in times of stress may differ across their menstrual cycle.

In the current literature of stress research there is very little research that includes women using HC as a comparison group (Wiemers et al., 2013; Kelly et al., 2008); leading to a large gap in the knowledge of potential effects of HC on women's hormones and behavior.

Current Research

This data was collected from a larger study that examined the effects of HCs on women's psychological and physiological responses to stress. This project extends past research by examining differences in ingroup bias among women who have lower progesterone (i.e., who are in the follicular phase of their menstrual cycle), women who have naturally higher progesterone (i.e., who are in the luteal phase of their menstrual cycle), and women who have artificially suppressed progesterone (i.e., who are using hormonal contraceptives) in the context of stress.

Ingroup bias was operationalized by how many targets of a particular race the participant placed into an outgroup, so the more outgroup categorizations made of a race other than the participants own race the more ingroup bias is shown. Tajfel and colleagues' (1971) developed the minimal group paradigm, which allows researchers to investigate biases without the presence of learned stereotypes. In this paradigm, people are randomly assigned to one of two nominal (i.e., minimal) groups, and immediately show a preference for their group and a dislike of the other group. Other research has added to this paradigm to develop a covert measure of bias (Miller et al., 2010; Makhanova et al., 2015). We will use this method to ask women to categorize others as belonging to their part of their ingroup or outgroup as a proxy for social closeness or social distancing, respectively. We predicted that ingroup bias will be directly

related to progesterone levels; luteal will have the highest amount of ingroup bias, then the hormonal contraceptive groups (pill and IUD) and the follicular group will have the lowest amount of ingroup bias.

We also explored whether women in the different groups would demonstrate increases in progesterone following the stressor. We hypothesized that progesterone would increase in response to the stressor for the naturally cycling women but this increase would be blunted in women using hormonal contraceptives.

Method

Participants

The participants in the current study were recruited through the psychology department's subject pool, a database of women who selected to be contacted about future studies, as well as flyers and social media. A total of 115 participants completed the study and 101 of those participants also completed the ingroup bias task. There is a discrepancy between the numbers due to participants beginning the study late and not completing each task. The 115 participants included 28 women in the follicular phase, 23 in the luteal phase, 40 on a birth control pill, and 23 with a hormonal IUD. For the progesterone analysis there is a total of 55 participants who completed both saliva samples (15 follicular, 12 luteal, 17 pill and 11 IUD).

All the participants identified their gender as women. Most participants were 21 years old (M = 21.32, SD = 4.19, range: 18 to 33). The race demographics are as follows: 78.3% White, 7% Asian, 6.1% Black, 2.6% multiracial, 3.5% other, 1.7% did not wish to report, and 0.9% missing. Of these 10.4% identified as Hispanic or Latina. The research used a 1-10 scale to measure how religious the sample was with 1 being not religious at all and 10 being very religious; this sample was more religious than average (M = 5.96, SD = 2.97). A similar scale

was used to measure the political orientation of the sample with 1 being very liberal and 10 being very conservative; this sample was more liberal than average (M = 4.18, SD = 2.25).

To schedule the women who are naturally cycling they will be asked the date of their last period and the average length of their cycle. Researchers then used this information to estimate each participant's next estimated start date and count backward by 5 to 10 days to estimate their luteal phase (i.e. days when progesterone is highest). The follicular phase will be determined using a forward count from the current cycle onset. Naturally cycling participants will be placed in either follicular or luteal groups depending on which window they can be scheduled to sooner to reduce attrition. To ensure the accuracy of the backward and forward counting method researchers will email each participant upon completion of the study to confirm their next period onset date. Participants group will be adjusted if needed based on their actual cycle onset (Gangestad et al., 2016).

Participants that are using birth control pills will be scheduled days 4-21 of their pill pack to ensure they are currently on the active pills. Participants with hormonal IUDs will be scheduled for the week after their period; if they do not have a period then they can be scheduled any time.

Procedure and Materials

When women come into the lab, they first completed an informed consent form. Once completed they were asked to put their phones away to eliminate distractions, and then they began the first section of tasks. They first completed personality assessments for 10 minutes while they adjusted to the lab setting; after the 10-minute habituation period, they provided their first saliva sample.

The participants were then given the prompt for the Trier Social Stress Test (TSST). The TSST is designed to induce social stress to analyze differences in hormones and behavior when a participant is under stress (Kirschbaum et al.,1993, Allen et al., 2017). The TSST begins with a 5-minute anticipation period during which participants are asked to prepare a pitch for their dream job. Next, participants enter the testing period where they perform their pitch in front of two judges who are said to be trained in behavioral analysis but who are actually trained confederates. The judges are trained to not give any verbal or facial feedback to the participant; they are also instructed to tell the participant to keep speaking if they do not speak for the entire 5-minute period. Participants are also told that they are being recorded and instructed to look into the camera when performing the task. In reality, the camera is not on but is only used to increase stress through deception. After the speech portion the participants will be asked to perform an oral arithmetic task that consists of counting backward from 1022 by 13 for 5-minutes. If the participant counts incorrectly, they are asked to start again from 1022. After the participants complete the testing period, they then wait in a private room for 15 minutes to do their second saliva sample. This wait period is meant to ensure that the hormones have time to come to detectable levels in saliva (Mehta et al., 2008).

After providing the saliva sample the participants completed various other tasks that were beyond the scope of the current research before completing the dependent measure of ingroup affiliation bias; this includes a minimal group paradigm (Tajfel et al., 1971). To create the minimal group context, the participants first took a personality test and were told that they were either a green or orange personality type based on their answers, though in reality this was randomly assigned. In our sample of 101 participants there were 51 assigned to the green personality type and 50 assigned to the orange personality type. Then, participants were shown

photographs of individuals of different racial backgrounds and were asked to use their intuition to guess each individual's personality type. These photographs were all drawn from the Chicago Face Database (Ma et al., 2015) and included 5 White men, 5 White women, 5 Black men, 5 Black women, 5 Latino men, 5 Latino women, 5 Asian men, and 5 Asian women; this set of stimuli has been used in prior research on biases in ingroup categorization (Makhanova, 2022). This modification allows researchers to examine which people the participant's may be more likely to affiliate with (or more likely to avoid). If participants are interested in affiliating with a target group, they are predicted to be more likely to put targets who are part of that group in their same minimal personality type (rather than the other/opposite minimal personality type). The desire to affiliate with a target group, place targets on people of that group, exemplifies ingroup bias. For example, in this experiment we believe women will be more likely to place White targets in their in their ingroup and non-White targets in their outgroup.

Once the minimal group paradigm was completed, the participants were then debriefed on the procedure and the elements of deception that were used.

Results

To investigate whether women in different groups (follicular, luteal, pill, IUD) differentially categorized targets as the outgroup depending on target race, we first used a 4 (between-subject: participant group) x 4 (within-subject: target race) general linear model. These analyses only included women who self-identified as White and Not Hispanic. Although there were differences in how the targets were evaluated based on their race, $F(3,216) = 10.63$, $p < .001$, this pattern was not statistically different among women in different groups, $F(9,216) = 1.40$, $p = .190$. That is, the interaction between participant group and target race was not significant. Because data collection for the larger study is still ongoing and thus we only analyzed the results from half of the sample, we still examined how participant group affected

evaluations of targets of each race. We used one-way ANOVA tests to conduct these analyses. We predicted participants would be more likely to place targets of races other than themselves (Black targets, Asian targets, and Latino targets) in the outgroup depending on their progesterone levels; luteal would have the most outgroup categorizations as this is the group with the highest progesterone levels, the next group would be birth control users, and the groups with the least outgroup categorizations would be the follicular group. Looking at figure 1, we found no statistical difference between the participants groups for placing White targets in the out group, $F(3,72) = 0.38$, $p = 0.768$, placing Asian targets in the out group $F(3,72)=0.584$, $p=0.628$, and placing Latino/Hispanic targets in the outgroup $F(3,72)=0.146$, $p=0.932$. However, we did find a statistical difference between the groups for placing Black targets in the outgroup $F(3,72)=4.864$, $p=0.004$. In post-hoc tests to examine which groups were different from each other, we found that the pill group was significantly more likely to place Black targets into the outgroup than the luteal group ($p=0.027$) and the IUD group ($p=0.35$). There was also a trend for the follicular group to place Black targets into the outgroup more than the luteal group ($p = .056$) and the IUD group ($p = .081$).

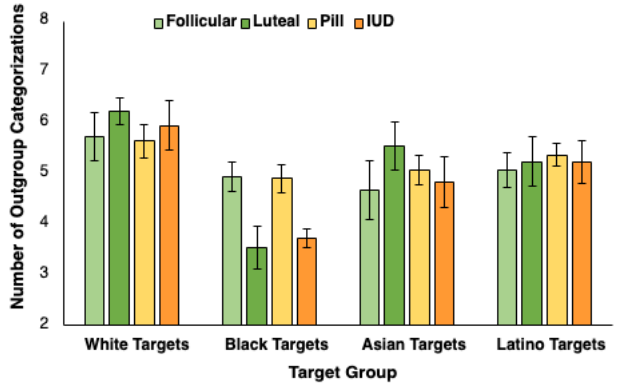

Figure 1: Ingroup Bias Based on Progesterone Levels

Next in figure 2, we examined differences in progesterone, and change in progesterone after the TSST, between participant groups by using one-way ANOVA tests. These analyses included all women. We found that there was significant difference in the Time 1 progesterone levels between the different groups $F(3,53)=8.807$, $p<0.001$. As hypothesized, the luteal group had the highest progesterone compared to the other groups (p's $\leq .001$). The other three groups were not different from each other (p's $\geq .999$). For the change in progesterone, we also did not find significant differences between groups $F(3,51)=0.825$, $p=0.486$.

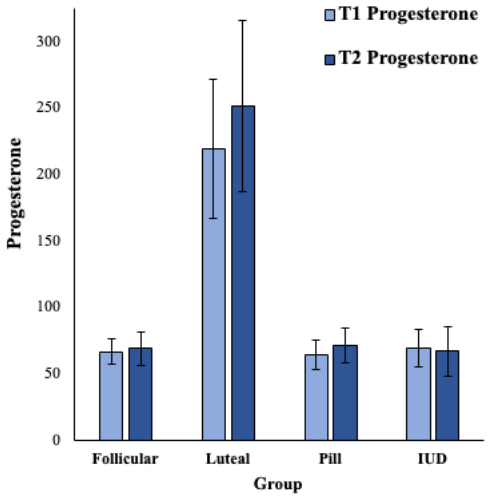

Figure 2: Progesterone Levels of T1 and T2

Finally, we examined whether the change in progesterone was associated with outgroup categorization for targets from the different racial groups. We tested bivariate correlations between outgroup categorizations of White, Black, Asian, and Latino targets and (1) raw progesterone change (Time 2 value minus Time 1 value) and (2) percent progesterone change (raw progesterone change divided by Time 1 progesterone). Outgroup categorizations of White targets and Asian targets were not related to progesterone change (p's $\geq .709$). There was a trend for negative correlation between raw progesterone change and outgroup categorization of Black targets ($r = -.31$, $p = .068$), but there was no correlation with percent progesterone change ($r = .-$

12, p = .481). For Latino targets, raw progesterone change was significantly correlated with outgroup categorization (r = .36, p = .032) and a trend for a correlation with percent progesterone change (r = .31, p = .069). However, these findings should be interpreted with caution because there were only 35 women who were White/Not Hispanic for whom progesterone has been assayed.

Discussion

We used a minimal group paradigm to measure the differences of ingroup bias across 4 groups with differing levels of progesterone (follicular, luteal, pill and IUD) to investigate the relationship between ingroup bias and progesterone. We hypothesized that there would be a direct correlation between progesterone levels and the amount of ingroup bias shown; thus, the group with the highest progesterone (luteal) should have the highest amount of ingroup bias. The data does not support this hypothesis, however from exploratory analyses we did have some major findings. The major finding of this study is that there is a significant difference between how women on the pill as compared to women in the luteal phase of their cycle or women that have an IUD are categorizing faces into their ingroup or outgroup based on race. We found that women on the pill are significantly more likely to place Black faces into their outgroup than women in the luteal phase and women with hormonal IUD; the women in their follicular phase are following a similar trend as the women on the pill though it was not significant. It is important to note that this finding was only present for the Black targets but not the other minority targets so there is different psychological or social process occurring for the Black targets that is not occurring for the Asian or Latino targets. The researcher also found that progesterone was significantly higher during the luteal phase which confirms that the

backward/forward counting method for placing women in either the follicular or luteal group is accurate.

Previous research showed that when women have higher levels of progesterone like when they are pregnant or in the luteal phase of their menstrual cycle they are more likely to recognize and avoid both contagion and physical threats (Conway et al., 2007; Fleischman & Fessler, 2011) ; with increased progesterone women have increased attention to social stimuli (Maner & Miller, 2014). These findings led us to believe that women may be more likely to favor people that are more similar to them (i.e. the same race as them) and choose to affiliate with them to decrease the risks that these behaviors have emerged to combat. This led us to hypothesis that women in the luteal phase would have the most outgroup categorizations (highest ingroup bias); this means the luteal group would have the highest desire to affiliate with people of the same race. However, this is not what we found; we actually found that the luteal group is one of the groups that had the least outgroup categorizations for Black targets compared to White targets. Our findings do not support the previous data; if women with higher progesterone are more likely to behave in ways to avoid pathogens than they should have been more likely to categorize people of their same race into their ingroup.

Why were there differences among the groups with the Black targets but not with the Asian and Latino targets? In recent years there has been large media coverage on the Black lives matter movement in response to police brutality and other inequalities in America; this could potentially lead to a social pressure making people more conscious about being biased towards Black people specifically. This could explain why the researcher found a decrease in the amount of outgroup categorizations for Black targets compared to the other races; these decreases were specifically seen in the luteal and IUD group. Why was there a decrease for the luteal and IUD

groups but not the follicular or pill groups? This would be an interesting topic of future research; there could be a particular mechanism that makes women during their follicular phase and on an IUD have an increased level of social sensitivity leading to a conscious desire to not be bias toward Black targets.

This study pointed out that there are major differences between hormonal IUDs and birth control pills. Though the findings were not significant the researcher found that while stress appeared to cause an increase in progesterone with birth control pills, the data looked like it could potentially cause a decrease in progesterone with hormonal IUDs. This study also found a significant difference in ingroup bias with women on birth control pills and women with hormonal IUDs. These findings show that the type of birth control a woman is on has effects on both her hormones and her social behavior which should be taken into account when considering birth control options as hormonal IUDs and birth control pills are often offered as alternatives of each other. Future research should focus on investigating the difference between how hormonal IUDs and birth control pills effect women's moods, behaviors, and hormones to lead to more informed methods of prescription in the healthcare field.

There were limitations in this study that included having a very small sample in some of the groups, as well as uneven numbers in each group. For example, there were 30 women in the pill group but only 13 in the luteal group. However, assaying for progesterone rather than using the assumed levels of progesterone for each group allowed us to ensure that the naturally cycling women were in the correct groups as this is very tricky to schedule.

In conclusion, we did not find a significant correlation between progesterone and ingroup bias to support our hypothesis; we did however find an increasing effect with White women who are in the luteal phase or that have a hormonal IUD being more likely to place White targets in

the outgroup than Black targets and this effect was not seen with the Latino or Asian targets. Future research could investigate what element of the luteal phase or hormonal IUD is causing this effect that was not seen in the follicular or pill group.

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