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The Effect of Oral Hormonal Contraceptives on the Ease of Recall of an Emotional Autobiographical Memory

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Abstract

Over 100 million people worldwide use oral hormonal contraception (OC), and yet there is still little knowledge surrounding the consequences of contraceptives on the human brain. In particular, the intersection of autobiographical memories, stress, and OC is important to study for real-world applicability. Previous research has shown that women on OC demonstrate a negativity bias when recalling an event by reporting more information for negative experiences compared to other emotional situations. This negativity bias could be an indication of the ease of recall which is defined by the speed, accuracy, and intensity of the memory search. The present study examined the reported ease of autobiographical recall of OC users compared to those who are naturally cycling (NC) for negative and neutral events. It was predicted that those on OC would report an easier time recalling a stressful event and report less difficulty for the neutral event compared to NC women. There were no significant differences between those who are NC and on OC in terms of ease of recall ratings for either event. However, within NC women rated remembering negative events more easily than neutral. Suggestions for future studies are discussed.

Introduction

Oral hormonal contraceptives (OC), otherwise known as the “pill”, provide an effective option for contraception and safe long-term family planning as well as for managing cycle-related physiological symptoms. The pill was first introduced in the United States in the early 1960s and was a combination pill made up of synthetic estrogen and progestin (Dugdale & Masi, 1970). Finally, American women were able to separate sexuality and childbearing. Today, women have even more options regarding the type of OCs, the combination pill is still available along with progestin only as well as personalizing the dosage of the OC. Approximately 82% of women between the ages of 15 and 44 years in the United States have been on an oral contraceptive in their lifetime (Mosher & Jones, 2010). The pill has become an effective method to control pregnancies and aid with symptoms of various menstrual and hormonal issues. It is one of the most important inventions humans have created and has allowed women to have control over their reproductive function, expanding opportunities for women.

Since the introduction of the pill in 1960, its effects on cognition and memory have remained largely unexplored. Over 100 million worldwide use hormonal contraceptives, yet there still exists a large gap in contemporary literature - no doubt a result of androcentric lenses within empirical research. The long-term impact of OC use on human psychology has been vastly understudied and has only recently become a focus for mainstream scholars. Considering its incredibly wide usage, more research is needed surrounding the consequences of contraceptives and their effects on the human brain. In particular, OCs can have significant mood-related adverse effects on women including depression and premenstrual dysphoria. Oftentimes women report emotional side effects when using OCs, such as anxiety, irritability, and mood swings (Mosher & Jones, 2010). Previous women’s health research looking at the intersection of emotion and memory has found that those on OC display higher rates of altered memories for emotional stories compared to neutral ones. Hormonal contraception is shown to suppress levels of estrogen and progesterone, so sex/stress hormone interactions shown to affect both emotional memory and the amygdala were affected (Nielsen et al., 2011).

Ovulation & Hormones

The ovulatory cycle lasts on average about 28 days and is split into the follicular phase and the luteal phase. In the follicular phase, also known as the “energetic” phase, the egg is fertilized. The luteal phase shows an increase in progesterone, causing the body to be sleepier and hungrier (Desai, 2022). The combination pill, which is a hormonal contraceptive that contains estrogen and progestin, is the most commonly used method of hormonal contraception. Progesterone is the hormone that prevents pregnancy, and the estrogen component controls menstrual bleeding. The main mechanism of action is the prevention of ovulation since they inhibit follicular development and prevent ovulation. The negative feedback mechanism works to decrease the pulse frequency of the gonadotropin-releasing hormone (GnRH), which in turn reduces the secretion of both, follicle-stimulating hormone (FSH), and luteinizing hormone (LH), blocking ovulation (Cooper, 2022). Inhibition of GnRH, in turn, suppresses endogenous levels of estrogen and progesterone, disrupting sex/stress hormone interactions, cognitive performance, and memory (Nielsen et al., 2011).

Estrogen and progesterone are hormones that are essential for sexual and reproductive development in women and help regulate a woman's menstrual cycle. In an interview hosted by Netflix, Dr. Emily Jacobs from the University of California, Santa Barbara discussed that through increased estrogen levels, the brain subsequently had an increase in global efficiency, formed a richer understanding of the sensory environment, created new synaptic connections, and increased the brain's ability to release natural painkillers in the body (Desai, 2022). This research is important because understanding how hormones shape the brain is imperative for women's health and can demonstrate how hormones have the potential to influence cognition.

Hormonal Contraceptives, Memory, & the Brain

Recent studies have shown that OC users may have a wide range of perception of emotional valence (the level of pleasantness for a stimuli) and emotional memory performance (Spalek et al., 2019). In Spalek's study consisting of 2169 healthy young females, hormonal contraceptive users rated positive, negative, and neutral images higher for the reported level of arousal and more extremely on valence compared to non-users. Additionally, those on OC outperformed non-users in terms of memory recall accuracy of emotional pictures. Other studies have had similar findings with OC users having better memory recall of words describing negative personality characteristics compared to non-users (Hamstra, 2015). Studies using the California Verbal Learning Test have found evidence suggesting that OCs may improve verbal memory (Gogos et al., 2014). Suppression of endogenous ovarian hormones has shown to lead to declines in verbal memory (Kramer et al., 1988), and an add-back estrogen has been known to reverse these deficits (Sherwin & Tulandi, 1996). These specific findings regarding estrogen's effect on verbal memory suggests that in adulthood, estrogen serves to activate neural pathways. When looking at animal models, estrogen has been found to promote the formation of dendritic spines and synapses and enhance long term potentiation in the hippocampal CA1 region (Sherwin, 1998).

Ease of Memory Recall

In particular, autobiographical memory refers to the recollections of specific, personal events and previous research has shown that emotion is an important cue for recalling an event (Tulving, 1983). Recalling these memories seems to rely on different patterns of neural activation. For instance, the hippocampus supports the retrieval of autobiographical memories with contextual detail, and the ability to remember spatial and temporal details about life experiences. (Maguire et al., 2000). Autobiographical memory can serve many functions in everyday life, such as problem solving, personality development, and guiding future behavior (Pillemer, 2003). With regards to the interaction between emotion and autobiographical memory, two major findings have become prevalent in the literature. First, the emotional content of an experience at encoding, such as personal involvement, or affect, was able to influence the way in which the event was remembered. Second, for autobiographical retrieval, the emotion felt during the recall can influence the information recalled (Holland & Kesinger, 2011).

When thinking about the past, not all memories come to mind with equal ease or with the same level of detail. When an event is recalled, people tend to remember moments where they felt emotional, and these are the occasions that are remembered more vividly (Buchanan, 2007). Additionally, the

emotional significance of an event -including the arousal of the event and the consequentiality of the event - determines how likely the details of the event are retained. Events with high personal relevance are more salient, thus are more likely to be remembered than events with less personal relevance (Rogers, 1997). It has been found that emotionally based events are recalled easier and with more detail than events without any emotional significance. This finding is likely due to the increased activation in the amygdala when recalling emotional memories, which is associated with the encoding and retrieval of threatening and emotional stimuli (Phelps & LeDoux, 2005). For instance, remembering a stressful chemistry midterm would likely be easier than remembering what one had for breakfast a week ago. Understanding the memory negativity bias is crucial in order to develop methods to mitigate any detrimental effects the exposure to stressful events may have.

Research relating OCs to memory mainly focuses on working memory, recognition memory, and verbal memory (Gogos et al., 2014; Hamstra, 2015). The amount of research looking at the influence of OCs on autobiographical memory in particular is limited, so it is imperative to explore whether OCs potentially hinder the ability to recall details of personally experienced events. Additionally, measuring ease of recall of autobiographical memories in those taking OC's compared to NC women can be a step toward understanding how complex processes such as attention and decision-making are affected.

Ease of recall has been established in the literature as the speed, accuracy, and intensity of the memory search. One of the most widely shared assumptions in decision making as well as in social judgment research holds that people estimate the frequency of an event, or the likelihood of its occurrence, "by the ease with which instances or associations come to mind" (Tversky & Kahneman, 1973). The implications of recalled content may be qualified by the ease of difficulty with which the content can be brought to mind. If people cannot interpret the recency of a behavior, they may attribute the higher than expected recall difficulty to the quality of their memory or to the memorability of the event (the event was not vivid). Ease of recall is important to study because if one is quick, and is able to recall the event vividly, then they are more likely to be accurate in their memory, which can in turn lead to better decision making and other executive functioning.

Present Study

The main aim of the present study is to investigate how oral hormonal birth control may affect the ease of recall for an emotional autobiographical memory. Measuring the ease of recall while considering OC and NC conditions can shed light on how sex hormones may affect these memory related cognitive processes, and in turn help future researchers explore these effects in other important areas of executive functioning like decision making or attention.

Hypotheses

When looking at the ease of recall for those on and off birth control, regardless of emotional condition, it is predicted that OC women will have an easier time generating a recalled autobiographical event compared to those on NC. Regardless of birth control status, those who recall a negative event will rate the generation as easier to come up with compared to the neutral event. This is predicted because negative emotions can trigger increased activity in the part of the brain that is linked to memories (Phelps & LeDoux, 2005). This can result in the brain preserving emotionally charged memories in

greater detail than neutral ones. When combining all of these aspects of event emotion condition and birth control status, those who are using OC and are recalling a stressful personal event will have the highest rating of ease compared to any other recall emotion condition or group (NC women). This is predicted because those on OC are more sensitive to emotional experiences and are able to remember emotional memories in greater details than neutral ones. Those rating the highest level of difficulty when recalling an event will be reported by the NC group when having to remember a neutral event.

Methods

Design

A 2 (Event Recall: Negative and Neutral) x 2 (Birth Control Status: OC or NC) mixed model design was implemented to minimize individual differences. While the within-subjects aspect of this design is the event recall condition (every participant recalled a negative and neutral event), the between-subjects portion of the study has to do with the birth control status (participants were either part of the OC group or NC group).

Participants

Participants were recruited through the University of California, Santa Barbara (UCSB) SONA system with a total participant pool of $n=96$. Participants were required to be between 18-25 years of age ($M = 19.3$, $SD = 1.16$), and could be of any gender identity, race, and ethnicity. Subjects were comprised of psychology undergraduate students at UCSB through the 2021-22 academic year and were primarily White or Hispanic (36% White, 27.8% Hispanic, 19.6% Asian, 10.3% Multiple Ethnicities, 3.1% Middle Eastern, 2.1% Black, and 1.0% Hawaiian) (*Appendix F*). Participants' sex at birth was required to be female, and additionally they were not allowed to be on any sex hormone treatments (such as those used to transition to a new sex identification), be pregnant, have endometriosis, menorrhagia, polycystic ovarian syndrome, an eating disorder or any other related menstrual disorders that could potentially abnormally impact the level of regulating sex hormones. Participants must have been on an oral hormonal contraceptive for at least the last 3 months or must have been naturally cycling (not on an oral hormonal contraceptive) (*Appendix A*). This is because it can take two to three months for the body to adjust to the hormones in a new birth control pill and be effective in controlling symptoms such as acne and abnormal bleeding. Additional exclusion criteria included anyone who has suffered from a recent traumatic brain injury or was diagnosed with a neurodevelopmental disorder such as Attention Deficit Disorder (ADD) or Autism Spectrum Disorder (ASD) in order to control for other factors that may impact memory recall. Subjects must have been fluent in English in order to understand the research procedures. There were no minors, prisoners, mentally disabled, or institutionalized persons recruited for this research. In total there were 50 naturally cycling participants and 46 participants on oral birth control for at least 3 months.

Measures and Materials

Positive and Negative Affect Schedule (PANAS)

Participants were asked to fill out the Positive and Negative Affect Schedule (PANAS) Questionnaire, which followed a 5-point Likert scale where 1 = “very slightly or not at all” and 5 = “extremely. This questionnaire uses 20 questions to examine a participant’s current emotional state, including both positive and negative affect. The final scores were derived by finding the sum of the 10 items related to either positive or negative affect. Positive affect refers to positive emotions such as joy, contentment, or cheerfulness. Negative affect refers to negative emotions such as fear, sadness, and anger. The PANAS Questionnaire was administered as a baseline before and after asking the participants to recall a negative and/or neutral emotional autobiographical memory. The PANAS has been widely used as a self-reported measure of affect in both the community and clinical contexts (Merz et al., 2013).

Ease of Recall

Participants were asked to fill out an Ease of Recall Likert scale from 1-6, assessing how easy it was to recall the event where 1= “very difficult” and 6= “very easy.”

Demographics

Between the recall of the negative and neutral event, participants were asked a series of questions regarding demographics, including age, gender, sex at birth, race/ethnicity, year of college, and sexual orientation. This not only allowed a better understanding of the participant’s demographics, but also served as a short break between the recall events. This break could potentially serve to bring the participants back to a baseline state before recalling the next event.

Procedure

This study took place at UCSB in the Psychology East basement room 0814C from January, 2022 to April, 2022. The study was conducted at a computer where subjects responded via keyboard button presses. Data was collected through the web-based software Qualtrics, which automatically anonymizes participants’ data. Data was only accessible to researchers within the lab. Once the participants entered the testing room, the researcher explained the study to the subject in detail highlighting the purpose, procedures, risks, safeguards, and benefits associated with the study. Then, all participants, regardless of recruitment from SONA or otherwise were presented with the Qualtrics task on the computer they were randomly assigned within the lab.

The first part of the study was six eligibility questions. If the participants did not meet eligibility criteria, they were immediately disqualified from the study without credit or payment and their responses were discarded. If the participants met eligibility, they were shown a consent form to review and were able to continue on with the study.

The eligible participants who are on oral hormonal contraceptives were then given a birth control questionnaire. The birth control questionnaire inquired participants about their brand, dosage, type of oral contraceptive, as well as their reasoning behind why they chose to go on birth control (*Appendix B*). The naturally cycling participants were given a Women’s Health Questionnaire inquiring about their

menstrual flow, and associated symptoms they experienced due to their periods (*Appendix C*). Next, participants were given the PANAS as a baseline to measure their current mood/emotion state. Following the PANAS, the participants are asked to recall a negative or neutral memory. Given the nature of the mixed model design, both groups were asked to recall a negative and neutral event in a randomized order. For the negative event, participants were asked to recall a specific time where they felt extremely stressed during finals week last quarter (Fall, 2021). For the neutral event, they were asked to describe a specific meal they had during finals week last quarter (Fall, 2021). After each recall, they were asked to rate how easy they felt it was to recall the event, then they were given another PANAS questionnaire to assess their current mood. After PANAS #2, the participants were given a demographic questionnaire, another PANAS #3 was given. After the recall of the next event, they were given the ease of recall scale, and PANAS #4 respectively. At the conclusion of the study, the subject received compensation of \$5 or 1 unit based on the agreed upon amount specified prior to testing. Overall, this study approximately took 30 minutes to complete.

Results

PANAS

Participants completed a PANAS at baseline before recalling any event, after the first randomized recall, and after the final recall. This was to ensure that the participants were emotionally aroused by the negative recall, and not aroused by the neutral recall. A Welch's independent sample t-test was used to compare OC women to NC women and it was found that there was no significant difference in the negative PANAS scores at baseline [$t(94)=0.07, p=0.931$] for the recall of the negative or neutral event. The negative PANAS #1 was compared to PANAS #2, PANAS #2 to PANAS #3, and PANAS #3 to PANAS #4, for both the neutral and negative conditions, for those on OC and NC, and no significant differences were found for any combinations ($p>0.05$) (*Table D1*). The OC and NC groups were also compared in terms of positive PANAS scores, and there were also no significant differences found between baseline and recall for the negative or the neutral events (*Table D2*).

Ease of Recall

The participants completed two randomized recalls during the study, one which was a negative recall and one that was a neutral recall. After the recall event, the ease of recall rating was measured with a scale that went from 1-6, 1 being very difficult, and 6 being very easy.

Regardless of the recall emotion condition, those on OCs ($M=4.29$) did not significantly differ from those NC ($M=3.94$) with their ease of recall ratings [$t(186)=1.72, p=0.087$] (*Figure E7*). For those on OC, there was no significant difference between the ease of recall ratings for the negative and neutral conditions (*Figure E8*). However, there was a significant difference for those who were NC under these circumstances [$t(93)=-2.42, p=0.018$], indicating that participants that were NC found it easier to recall negative events ($M=4.32$) compared to neutral events ($M=3.67$) (*Figure E9*). When comparing the ease of recall rating for the negative event recall between those on OC and those who are NC, there were no significant differences found. The same was found for the neutral event recall as well.

The recall event conditions (negative versus neutral events) were analyzed without the consideration of birth control status, and the independent samples t-test found a significant difference between the two events [$t(188) = 2.6, p = 0.011$], indicating that it was easier to recall the negative event ($M = 4.41$) than the neutral event ($M = 3.90$) (Figure E6).

To investigate whether the current mood state correlates with the ease of recall rating, a Pearson correlation was run between the ease of recall for each recall event emotion (the negative and neutral events) and for both PANAS affect types (negative and positive). No significant correlations were found between any two variable combinations, thus indicating a weak association between the ease of recall rating and present mood.

Discussion

The present study investigated whether oral hormonal contraceptives influence the ease of recall of an emotional autobiographical memory. When looking at the ease of recall for those on and off birth control, regardless of emotional condition, it was hypothesized that OC women would have an easier time generating a recalled autobiographical event compared to those on NC. Results indicated that there was no significant difference between the two recall conditions, and women on OC did indeed have an easier time compared to those on NC. In fact, when comparing the means of both groups, those on OC ($M=4.29$) had an easier time recalling events than the NC group ($M=3.94$), ($p=0.087$) indicating that the difference is not yet significant but is going in that direction.

The present study also hypothesized that regardless of birth control status, those who recalled a negative event were able to rate the generation as easier to come up with compared to the neutral event. The results of this study were in line with this hypothesis, since a significant difference was found between the negative and neutral event, regardless of OC status [$t(188) = 2.6, p = 0.011$]. This indicated that it was easier to recall the negative event ($M = 4.41$) than the neutral event ($M = 3.90$) regardless of OC status. It was interesting because the NC group found it easier to recall stressful events ($M = 4.32$) rather than neutral events ($M=3.67$), [$t(93) = -2.42, p=0.018$], but no significant difference was seen in the OC group.

Previous literature is in line with these findings, since it is well known that stressful events are more accurately remembered and with more information than mundane events, which can have important implications for the memory of traumatic events (Kalbe et al., 2020; Buchanan, 2007; Paradis et al., 2004; Hamann, 2004). According to a study by Kensinger (2021), negative emotions such as fear can increase activity in the medial temporal lobe. This can result in the brain preserving emotionally charged memories in greater detail than neutral ones, as well as the ones with positive associations. This finding is important because it can allow researchers to better understand the underlying cognitive and neural mechanisms directly impacted by emotion. Given that emotional events are more likely to be remembered than neutral events, this research can guide future behavior and decision-making in avoiding aversive events and repeating pleasant events.

The present study hypothesized that those on OC and tasked with recalling a stressful personal event would have the highest rating of ease of recall compared to any other combination. Although not significant, this study does show that those on OC on average have the highest rating ($M= 4.50$) of ease when recalling a stressful event compared to NC ($M=4.32$). Lastly, the present study hypothesized that the most difficult recall would be reported by the NC group when recalling a neutral event ($M= 3.67$), which through completion turned out to be true, but was determined to only significantly differ when compared to the NC group in the negative condition ($M= 4.32$), and not either of the OC group cases (negative: $M= 4.50$; neutral: $M= 4.11$). There was no significant difference between the ease of recall of the OC group compared to the other groups, so no conclusions can be drawn about the differences between OC and NC groups in terms of ease of recall for autobiographical memories. Although no significant differences were found between the OC and NC groups, when only examining the autobiographical recall conditions, a significant difference was found between the negative ($M= 4.41$) and neutral ($M= 3.90$) recall events, indicating that it is found to be easier to recall stressful, negative events than neutral events.

No significant differences were found for the negative or positive PANAS scores when comparing the baseline to the after-recall rating which suggests that the participants may have not been negatively or positively aroused by the recall of their autobiographical events. For those on OC who completed the negative recall condition first, the baseline positive PANAS ($M= 27.73$) was compared to the second positive PANAS ($M= 23.65$) and there was not a significant difference. However, this decrease of positive affect scores from baseline to the secondary PANAS rating should be noted because it may indicate a potential negative trend, [$t(44)=1.89, p = 0.064$].

Limitations

One major limitation in the present study is that the data was collected throughout the Winter and Spring quarters. The question pertained to negative and neutral events that occurred in Fall Quarter of 2021, so a possible confound is that those that did the study in Spring quarter might have forgotten events that happened two quarters ago compared to those that did the study during Winter quarter. Research suggests that recent behaviors are easier to recall (Higgins, 1989). This may have given Spring quarter participants a more challenging experience of recalling events compared to those in Winter quarter. Furthermore, the arousal of the event may have been influenced if the details of the event were not retained. This may have been one explanation as to why there was no baseline to negative PANAS difference for the NC or OC groups. A solution to this limitation is only administering the task for the first three weeks of the quarter following Finals Week, to ensure that the participants will remember how stressed they felt during that point in their life.

Future Directions

Future analyses to investigate what may impact the ease of recall for an emotional autobiographical event for this study will include: (1) comparing time frames in a woman's menstrual cycle, (2) investigating the impact of brand/dosage of OC, and (3) investigating the impact of the duration the participant had been on the particular OC. These analyses would shed light on the effect of different birth control brands and the varying effects hormones have on the ease of recall for autobiographical

memories. This is important because future scientists can make modifications to the birth control pill, depending on the levels of estrogen and progesterone in different time points of the cycle to enhance cognition.

One suggestion for future iterations of this study would be to collect different physiological data and biospecimen. For example, saliva samples as well as blood from the participants would be used to study their cortisol, estradiol, and progesterone levels at baseline and after the recall of the autobiographical emotional events. Physiological measures such as heart rate, breathing rate, and sweat response (galvanic skin response) would also help to determine the level of stress participants feel when reflecting on their life experiences. Perhaps participants have a difficult time reflecting on their emotions, so, the ability to analyze whether there was an increase in the stress response during the negative condition could give evidence towards the task actually inducing stress. These investigations can provide insight into the ways our emotions and oral contraceptives can influence the ease of recall for our personal past.

Lastly, there are many individual differences that may have played a role in the ease of recall for an autobiographical event. For example, general lifestyle factors like diet, exercise, and other aspects that influence a person's quality of life may be affecting the individual's sex hormone production and impact on their cognition. Other individual differences could include whether the participant completed their final online or in person due to the COVID-19 pandemic. Future iterations of the study should control or enquire about these individual differences to note whether they have a significant effect on the person's ease of autobiographical recall. Other forms of birth control such as IUD, Nexplanon, the ring, patch, shot, etc, should also be considered in the future when looking into how sex hormones may impact memories for autobiographical emotional events because one option may optimize cognition over another.

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Appendices

Appendix A: Eligibility Questionnaire

STUDY TITLE: Birth Control and Autobiographical Memory Study

Eligibility Questions

The following six questions will determine your eligibility for the study. If you meet the eligibility criteria, then you will proceed to the consent form and study. If not, then you will not participate in the study, and your answers to the eligibility questions will be discarded. If ineligible for the study, you will not receive SONA credit or compensation for the eligibility questions.

1. Have you sustained any brain injuries?
 - Yes (if they select this option they are deemed ineligible for the current study)
 - No

2. Have you ever been diagnosed with a neurodevelopmental disorder such as Attention Deficit Disorder or Autism Spectrum Disorder?
 - Yes (if they select this option they are deemed ineligible for the current study)
 - No

3. Are you currently on any form of hormonal contraceptive?
 - No

- Yes, I am on an oral contraceptive/birth control pill
 - Yes, I am on another form of contraceptive other than the pill (if they select this option they are deemed ineligible for the current study)
4. Are you pregnant, undergoing feminizing hormone therapy (such as gender transition), have endometriosis, menorrhagia, polycystic ovarian syndrome, an eating disorder or any other related menstrual disorders?
- Yes (if they select this option they are deemed ineligible for the current study)
 - No

If they answer “No” to questions 1 - 4:

5. Have you been on any type of hormonal contraceptive in the past 3 months?
- Yes
 - No
 - Unsure (if they select this option they are deemed ineligible for the current study)

If they answer “Yes, I am on an oral contraceptive/birth control pill” to question 3 & “No” to question 1, 2, & 4:

6. Have you been on this same type of hormonal contraceptive for at least 3 months?
- No, I have been on this hormonal contraceptive for less than 3 months (if they select this option they are deemed ineligible for the current study)
 - Yes, I have been on this hormonal contraceptive for 3 months or more

Appendix B: Oral Contraceptive Questionnaire

Menstrual Flow Questionnaire

Hormonal contraceptive pathway:

If they answer “Yes” to question 6:

7. How long have you been on this same type of hormonal contraceptive in months? (Please give your best guess)

8. Have you ever “skipped/delayed” your period on the combined oral hormonal contraceptive pill?

9. Is your oral contraceptive a combined (estrogen and progestin) or progestin-only pill?

- Combined pill (estrogen and progestin)
- Progestin-only pill (minipill)
- Unsure

(All selected options remain eligible to continue, this is just to collect further data)

10. What type of oral contraceptive are you on? Please specify the brand and dosage if possible.

11. Why did you choose to go on birth control?

12. There are many reasons people may choose to use hormonal contraceptives. Please rank the following benefits in the order of importance to you.

- To prevent pregnancy
- Irregular periods
- Painful periods

- Heavy menstrual bleeding
- Acne

Appendix C: Menstrual Flow Questionnaire

13. How old were you when you got your first period?

14. Are you currently menstruating?

- Yes
- No

15. When was the first date of your last menstrual period? If you are currently menstruating, please state the date your last menstrual cycle started. (Please look at a calendar if you need)

16. On a scale of 1 to 10, how confident are you that you gave an accurate estimate of the first date of your last menstrual period?

(Slider function from 1-10 displayed here for them to toggle)

17. When was the last date of your last menstrual period? If you are currently menstruating, please state the date your last menstrual cycle ended. (Please look at a calendar if you need)

18. On a scale of 1 to 10, how confident are you that you gave an accurate estimate of the first date of your last menstrual period?

(Slider function from 1-10 displayed here for them to toggle)

19. How long does your menstrual period typically last in days?

20. How would you describe your overall typical menstrual flow?

- Heavy
- Regular
- Light

If “Heavy” or “Light” to 20, then

21. Has your menstrual flow ever been “Regular”

- Yes
- No, they have never been regular

If “Yes” to 21, then

22. Please describe when your menstrual flow was “Regular”. Were you on birth control? For how long was your menstrual flow “Regular”? Why do you think your menstrual flow was “Regular” then and irregular now?

23. How many pads/tampons do you use in one day during your typical menstrual cycle?

24. Are you bleeding in between periods (spotting)?

- Yes
- No

If yes to 24, then

25. For how many days do you bleed in between periods?

26. Please select any of the following for menstrual symptoms you experience:

- Premenstrual syndrome (PMS)
- Premenstrual syndrome (PMS)
- Tender breasts
- Bloating/fluid retention
- Muscle aches
- Joint pain
- Headaches
- Acne
- Abdominal cramps
- Diarrhea or constipation
- Lower back pain
- Trouble sleeping
- Low energy, fatigue

27. Have you experienced any of the following because of your menstruation?

- Miss work or school

- Not be able to participate in activities that you usually enjoy
- Struggle to carry out your usual daily activities
- Accomplish less than you would like to
- Have difficulty in your relationships with your family or friends
- Have severe pain
- Feel very blue (depressed or hopeless)
- Feel higher anxiety than you normally would
- Lack energy or feel very fatigued
- Not exercise when you normally do
- Choose not to go out when you normally would

Appendix D: PANAS Tables

Table D1. Means and Standard Deviations of Negative PANAS Scores

First BC/Condition Type	Baseline PANAS <i>M (SD)</i>	PANAS #2	Second BC/Condition Type	PANAS #3	PANAS #4
OC - Negative	16.31(5.83)	16.81(6.31)	OC - Neutral	14.70(5.93)	15.48(7.10)
OC - Neutral	15.39(4.79)	14.41(4.50)	OC - Negative	13.63(4.04)	15.17(5.73)
NC - Negative	14.64(5.06)	15.46(7.65)	NC - Neutral	14.31(7.50)	13.11(5.33)
NC - Neutral	16.96(7.43)	15.0(6.55)	NC - Negative	15.04(7.15)	17.80(8.50)

Table D2. Means and Standard Deviations of Positive PANAS Scores

BC/Condition Type	Baseline PANAS <i>M (SD)</i>	PANAS #2	Second BC/Condition Type	PANAS #3	PANAS #4
OC - Negative	27.74(7.17)	23.65(7.48)	OC - Neutral	22.30(8.28)	21.0(7.80)
OC - Neutral	27.60(6.72)	24.91(6.72)	OC - Negative	23.43(8.00)	22.17(7.05)
NC - Negative	26.38(6.40)	25.36(7.91)	NC - Neutral	24.17(8.00)	23.36(7.51)
NC - Neutral	28.25(7.90)	26.52(9.41)	NC - Negative	25.75(10.0)	22.96(10.60)

Appendix E: Ease of Recall Tables and Graphs

Table E1. Means for Ease of Recall for Neutral and Negative Condition Regardless of BC status.

Neutral Condition	Negative Condition
3.90	4.41

Table E2. Means for Ease of Recall for OC and NC Regardless of Condition

OC	NC
4.29	3.94

Table E3. Means for Ease of Recall for Neutral and Negative Condition for OC users

Neutral Condition OC	Negative Condition OC
4.11	4.50

Table E4. Means for Ease of Recall for Neutral and Negative Condition for NC women

Neutral Condition NC	Negative Condition NC
3.67	4.32

Table E5. Ease of Recall for Neutral and Negative Condition for NC and OC users.

	Neutral Condition	Negative Condition
Naturally Cycling	3.67	4.32
Oral Contraceptive	4.11	4.50

Figure E6. Means for Ease of Recall for Neutral and Negative Condition Regardless of Birth Control Status

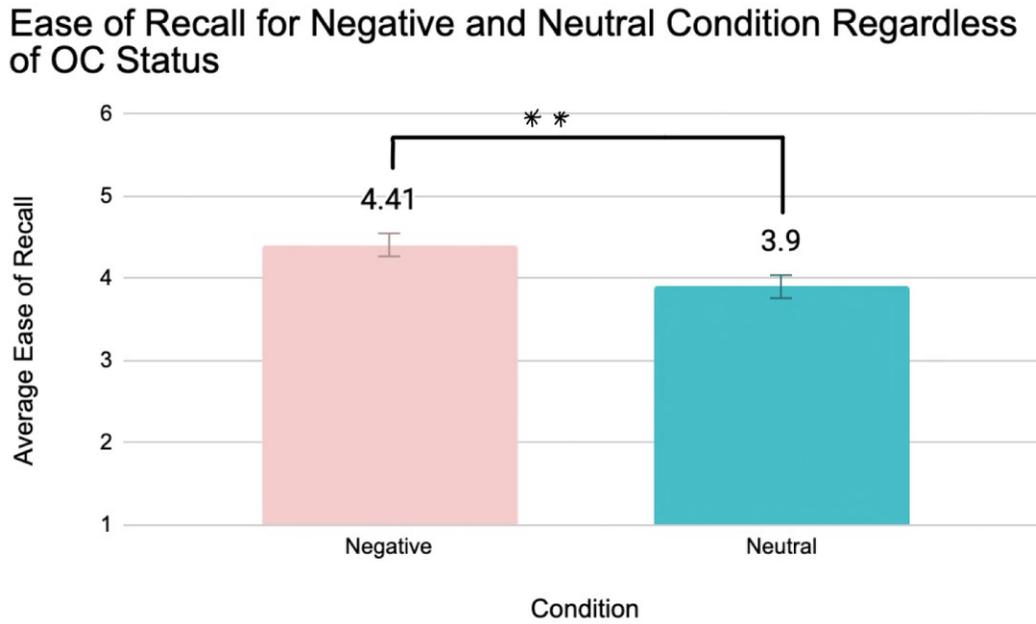


Figure E7. Means for Ease of Recall for OC and NC Regardless of Condition

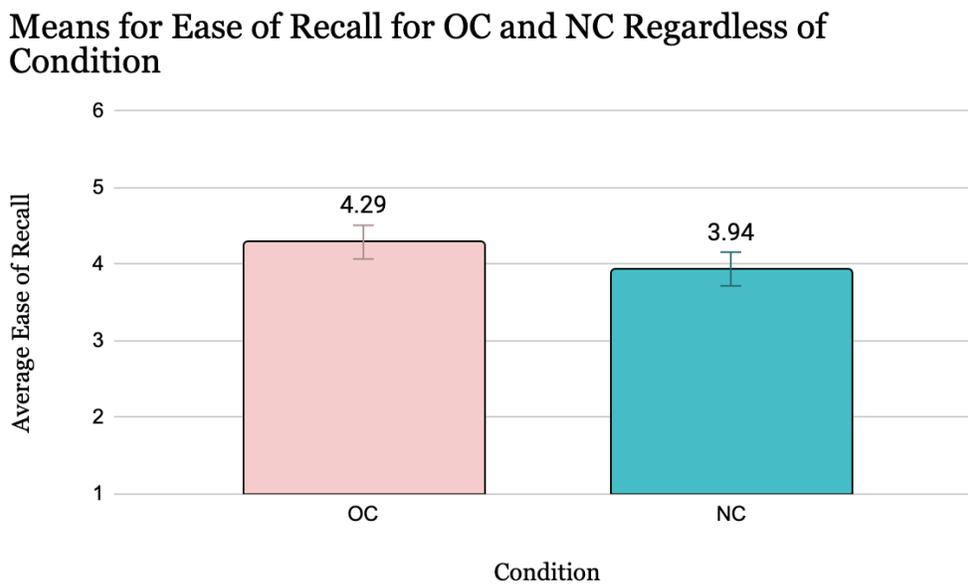


Figure E8. Means for Ease of Recall for Neutral and Negative Condition for OC users

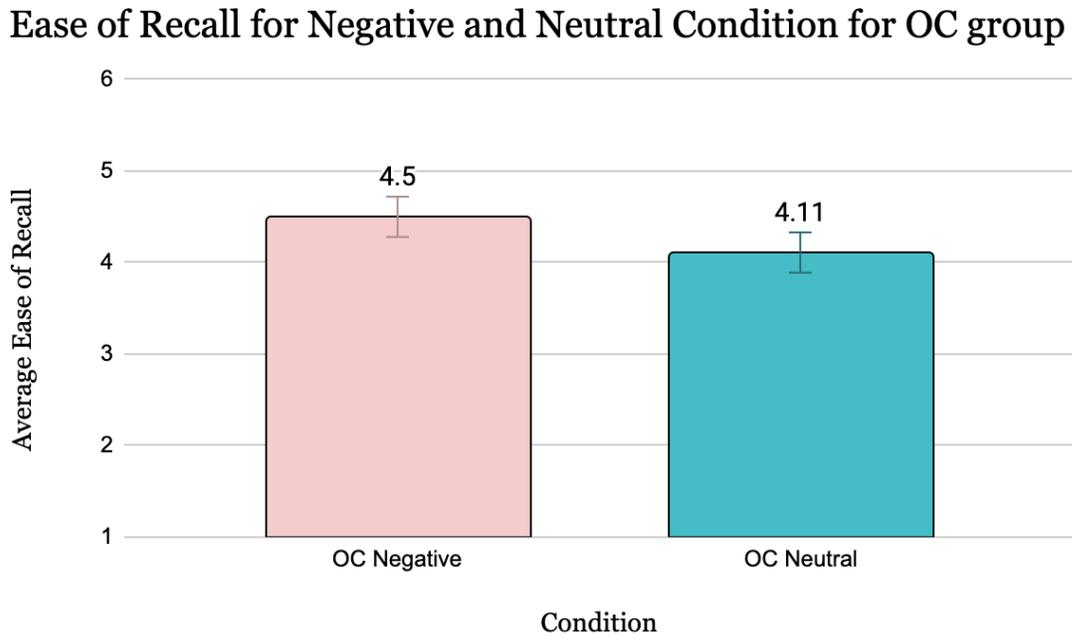
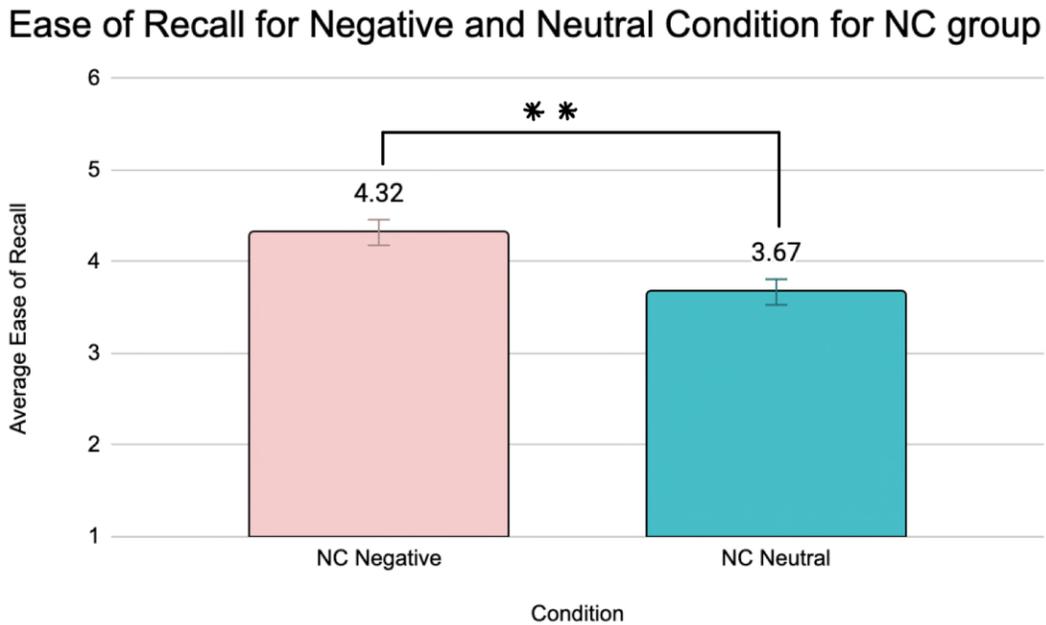


Figure E9. Means for Ease of Recall for Neutral and Negative Condition for NC group



Appendix F: Demographics

Figure F1. Race and Ethnicity of Participants

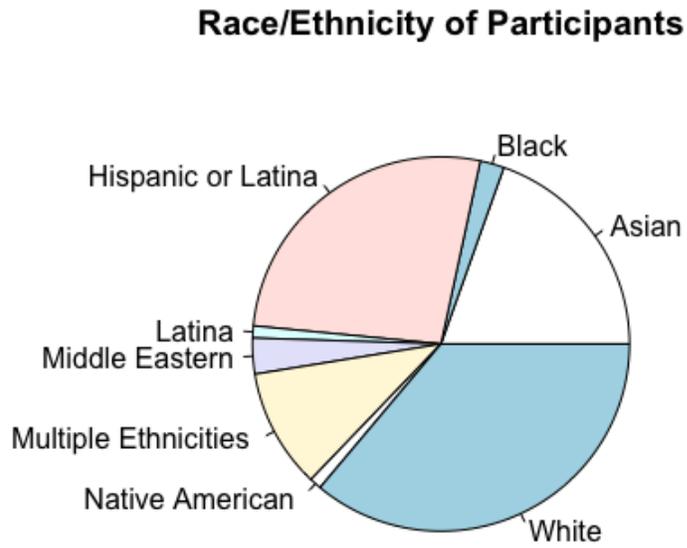


Figure F2. Participant Age and Sex at Birth

