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Escudero, Juan Pablo Sánchez; Zapata, Johny Villada
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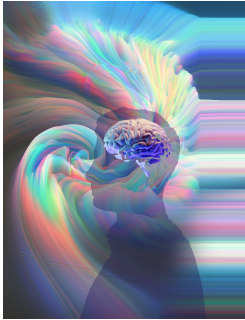
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*Corresponding author:

Fraidy-Alonso Alzate-Pamplona.

Email: fraidymanager@gmail.com

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Economic Decisions, Attractiveness, and Intrasexual Competition during Menstrual Cycle in the Ultimatum Game

Decisiones económicas, atractivo y competencia intrasexual durante el ciclo menstrual en el juego del ultimátum

Fraidy-Alonso Alzate-Pamplona^{1,*}, Óscar Galindo-Caballero², Juan Pablo Sánchez Escudero³, Johny Villada Zapata⁴.

¹Facultad de Ciencias de la Salud, Fundación Universitaria María Cano. Medellín, Colombia.

²Programa de Psicología, Facultad de Ciencias Sociales y Humanas, Universidad Manuela Beltrán. Bogotá, Colombia.

³Facultad Nacional de Salud Pública, Universidad de Antioquia. Medellín, Colombia.

⁴Departamento de Psicología, Facultad de Ciencias Sociales y Humanas, Universidad de Antioquia. Medellín, Colombia.

Abstract.

Introduction: it seems that, in the phase of greatest fertility, women's intrasexual competition (toward attractive women who live nearby) increases due to access to resources, status, and biologically desirable partners. **Objective:** to compare the economic decisions (ED) during the ovulatory (OP) and luteal (LP) phases of the menstrual cycle (MC) with exposure to two stimuli: a photograph of a more attractive woman and a photograph of a less attractive woman, through the ultimatum game (UG). **Methodology:** the research followed a cross-sectional design between subjects to see group differences by contrasting hypotheses. The sampling was probabilistic, with a sample of 100 heterosexual women, students at a public university with an age range of 18 to 24 years, with regular MC, who did not use hormonal contraceptive methods and did not have any endocrine condition. The inverse counting method with confirmation was applied to identify CM phases; and the UG to evaluate the DE. **Results:** the phases of the MC had no effect on the ED; the women behaved similarly in their decisions, regardless of the phase of the cycle they were in or the type of stimulus to which they were exposed. **Conclusion:** OP and LP do not affect the ED of women when they are exposed to an attractive stimulus. The discussion is made considering the evolutionary theory of the ovulatory shift hypothesis.

Resumen.

Introducción: parece ser que, en su fase de mayor fertilidad, la competencia intrasexual de la mujer (con mujeres atractivas y que viven cerca) aumenta por el acceso a recursos, estatus y parejas biológicamente deseables. **Objetivo:** comparar las decisiones económicas (DE) en las fases ovulatoria (FO) y lútea (FL) del ciclo menstrual (CM) con exposición a dos estímulos: fotografía de una mujer de mayor atractivo y fotografía de una mujer de menor atractivo, a través del juego del ultimátum (UG). **Metodología:** la investigación tuvo un diseño *cross-sectional* entre sujetos para ver diferencia de grupos mediante contraste de hipótesis. El muestreo fue probabilístico, con una muestra de 100 mujeres heterosexuales, estudiantes de una universidad pública con un rango de edad de 18 a 24 años, con CM regulares, que no usaran métodos anticonceptivos hormonales y no tuvieran ninguna afección endocrina. **Resultados:** las fases del CM no tuvieron efectos sobre las DE; las mujeres se comportaron de forma similar en sus decisiones, sin importar la fase del ciclo en la que se encontraban o el tipo de estímulo al que fueron expuestas. **Conclusión:** las FO y FL no afectan las DE de las mujeres cuando son expuestas a un estímulo atractivo. La discusión se hace a la luz de la teoría evolutiva de la hipótesis del cambio ovulatorio.

Keywords.

Menstrual Cycle; Ovulatory Phase; Luteal Phase; Estrogens; Progesterone; Intrasexual Competition; Attractiveness; Economic Decisions; Ultimatum Game.

Palabras Clave.

Ciclo menstrual; Fase ovulatoria; Fase lútea; Estrógenos; Progesterona; Competencia intrasexual; Atractivo; Decisiones económicas; Juego del ultimátum.

1. Introduction

The menstrual cycle (MC) lasts approximately 28 days and can be divided into three phases: menstrual, from days 1 to 4; follicular, from 5 to 14; and luteal (LP), from 15 to 28 (Mihm et al., 2011; Saad & Stenstrom, 2012). Fertility is relatively highest around days 9 to 15 of the cycle and relatively lowest around days 1 to 8 and 16 to 28 (Wilcox et al., 2000). In theory, conception is most likely to occur during a 6-day fertile window of the follicular phase, which generally spans days 10 to 15 of a 28-day cycle (Wilcox et al., 2001). During the MC there is a fluctuation of the basal levels of estrogens and progesterone: the former begin to rise in the follicular phase and reach their highest level with ovulation, to decrease afterwards; while the second shows low levels in the follicular phase, it increases in LP and reaches its peak in the middle of this cycle, when estrogen levels are lower (Buffet et al., 1998).

The female sex hormones —estrogen and progesterone— play a central role in reproduction, thus guaranteeing the permanence of the species. In the ovulatory phase (OP), when estrogen levels are highest, fertility and the probability of becoming pregnant increase (Wilcox et al., 2000, 2001), sexual desire (Regan, 1996) and sexual encounters increase (Wilcox et al., 2004), and women prefer partners with an optimal genetic profile for offspring (Gangestad & Thornhill, 2008), whose characteristics have been supported by robust effect sizes (Gildersleeve et al., 2014). In this sense, Gangestad and Thornhill (2008) propose the ovulatory shift hypothesis, which states that sexual selection may have developed evolved psychological mechanisms in women, related to the stage with the highest probability of conception. Specifically, in the window of greatest fertility, the preference for sexual partners with biological markers that exhibit an optimal genetic profile for the offspring would increase, which would facilitate greater genetic variability and, therefore, a greater probability of obtaining “good genes” (Gangestad & Thornhill, 2008).

Although female sex hormones play an important role in reproduction, they also trigger other behaviors such as intrasexual competition (IC), apparently to gain access to partners with better biological characteristics. Previous studies have reported that there is a relationship between OP and IC (Durante et al., 2008, 2011; Griskevicius et al., 2007; Nikiforidis et al., 2017; Sundie et al., 2011), and intrasexual competence increases when potential rivals are attractive and close (Durante et al., 2008, 2011) or are in the window of greatest fertility (Lobmaier et al., 2016). It seems that high estradiol levels produce subtle beauty enhancements in women’s face shape (Catena et al., 2019), making them more desirable to men (Buss & Schmitt, 2019), but increasing rivalry with their counterparts. IC, in OP, forces women to see themselves as more beautiful, leading them to have a

greater preference for sexy clothing and accessories (Durante et al., 2008, 2011; Haselton et al., 2007), to wear red clothing to increase their attractiveness (Beall & Tracy, 2013), to pay more attention to ornamental products that enhance their beauty (Zhuang & Wang, 2014), to prefer relatively expensive luxury products when compared to other women, and to have a greater preference for the variety of products (Durante et al., 2014). Makeup has also been part of IC; its use increases in the window of greatest fertility to improve physical appearance to attract a partner (Guéguen, 2012), be noticed by the opposite sex, display status (Varela et al., 2015), and flaunt more beauty and attractiveness than other potential rivals (Mafra et al., 2020). A recent review by Galindo-Caballero et al. (n.d.) confirmed, through p-curve analysis, that there is indeed an effect of hormones on consumption preferences in the phase of greatest fertility, which makes it possible to show reliable evidence on this type of behavior.

Research focused on women’s sexual hormones through the ultimatum game (UG) have found some results that begin to shed light on the effects they can have on economic decisions (ED) and IC. The UG describes a negotiation situation between two people: player 1 proposes the division of a sum of money and player 2 decides to accept it or reject it. If the person accepts it, each one keeps the part proposed by player 1; if he or she rejects it, neither receives anything (Güth et al., 1982). Studies that found effects of hormones on UG reported that women in the greatest fertility phase offered fewer resources and rejected more offers from other women (Lucas et al., 2007), and made fewer offers to attractive women (Lucas & Koff, 2013) or demanded more money to accept an offer (Eisenbruch & Roney, 2016), but this did not happen if they were in a different phase of the cycle. Other studies found no effect of sex hormones on economic behavior (Zethraeus et al., 2009); oestradiol did not influence the rejection of unfair proposals in any of the phases (Probst et al., 2018) or these did not influence economic behavior, unless it interacted with other measured variables (Rodríguez Ruiz, 2019).

Accordingly, there are mixed results, with some studies suggesting a higher IC in the window of higher fertility than in the window of lower fertility (Eisenbruch & Roney, 2016; Fisher, 2004; Lucas et al., 2007; Lucas & Koff, 2013). In the UG, for example, the women who were in the OP rejected more unfair offers from other women (Eisenbruch & Roney, 2016; Lucas et al., 2007). It seems that the behavior of women in the window of greatest fertility is changed more by the presence of other women than by the presence of potential partners (Durante et al., 2011), and they often compete selectively with attractive women, or those who live nearby, if they pose immediate threats to reproductive resources (Durante et al., 2011, 2014; Lucas & Koff, 2013).

Given this context, we agree with Stanton (2017) in saying that published studies on sex hormones and ED are scarce, and the works that document the hormonal variations throughout the phases of the menstrual cycle (MC), the ED, and the IC reviewed through the UG are even more so.

Bearing in mind that IC rises in the phase of greatest fertility, and even more so when women are attractive and live close to each other, the research raised the following question: do the MC phases influence ED, and especially when there is exposure to a more attractive woman than to a less attractive woman? The objective to answer it was to compare the economic decisions in the OP and FP of the MC with exposure to two stimuli—photograph of a more attractive woman and photograph of a less attractive woman—through the UG. To meet this goal, and considering the above assumptions, two hypotheses were proposed:

- H_1 : women in the ovulatory phase reject more economic proposals when the offers are made by a more attractive woman than by a less attractive one.
- H_2 : women in the luteal phase reject fewer economic proposals regardless of whether the offers are made by a more or a less attractive woman.

The results of this research aim to add evidence to reach clearer conclusions and consensus, and to calculate the size of the effect that the sex hormones of women have on ED and IC.

2. Method

The research was carried out following the empirical-analytical approach, with a non-experimental comparative design. A cross-sectional study between subjects was used, in which the difference between the scores of the groups was compared by contrasting the statistical hypotheses, according to the nature and level of measurement of the variables of interest.

2.1 Sampling and Criteria for Selection

Through the Gpower 3.1 software, the sample size necessary to test the statistical hypotheses was estimated a priori with a statistical power of at least 80%, assuming a significance level of 0.05. This way, the necessary sample size for H_1 and H_2 was calculated to contrast the differences between two related samples and find an effect size of 0.5 with an allocation ratio between the groups of 1:1, considering both compliance with the assumptions of normality and homoscedasticity of the scores (i.e., T test for related samples) and their noncompliance (i.e., Wilcoxon rank test). It was found that 53 participants per group would be necessary to test the hypotheses if the assumptions of normality and equality of variances were not met. On the other hand, 27 subjects would be necessary to test the hypotheses if the assumptions of normality and homoscedasticity were met.

For the selection of the participants, a probabilistic sampling was used, applied to a total population of 11042 students (women). Thus, 100 undergraduate and graduate students from the University of Antioquia, located in the city of Medellín (Colombia), aged between 18 and 24 years, and with regular menstrual cycles (cycle length between 25 and 35 days) were selected. Heterosexual women were selected to compare the results with previous studies, as well as students from a public university, due to the large size of the population and the geographical diversity of the department of Antioquia and Colombia. The age range, for its part, was determined to have women of legal age and reduce the range (an age higher than the one chosen introduces variables such as purchasing power due to employment status, for example); regular menstrual cycles were taken as indicators of normal expression of sex hormones and to make more precise estimates of ovulatory and luteal cycle dates.

Pregnant or lactating women, hysterectomized women, who used hormonal contraceptive methods, who had polycystic ovarian syndrome, irregular MC (less than 25 days or greater than 35 days), and who reported endocrine disorders were ruled out. The previous criteria cause the expression of sex hormones to vary or alter their normality. Women with neurological, psychiatric, endocrine, or sensory impairment were also excluded from the sample.

2.2 Variables and Instruments

For the sociodemographic characterization of the participants, information was collected regarding their age, socioeconomic level (measured through the stratum), partner relationship, income, and person responsible for personal costs, through an ad-hoc survey that included items from the Holt and Laury instrument (2002), adapted to the Colombian context.

For the classification of the participants according to the phase of the MC in which they were when participating (i.e., OP and LP), the survey used by Durante et al. (2014) was adapted. Based on this instrument, the inverse counting method (backwards) was applied with confirmation to determine the date on which the experiment would be applied. The counting method is one of the most used and recommended when it is not possible to measure hormone levels directly (Gangestad et al., 2016; Gangestad & Thornhill, 1998; Saad & Stenstrom, 2012).

For the evaluation of cooperation, the UG by Güth et al. (1982), the most widely used experiment to study cooperation and negotiation (Güth & Kocher, 2014), was used. Furthermore, it is the most transparent, simple, and direct way to study how human beings negotiate and to see the role of psychology and emotions in real life negotiations (Van Damme et al., 2014). The UG was applied using the UltiGamePc software by Hevia-Orozco et al. (2014).

2.3 Proceeding

Access to the sample was made by open call through email lists, with the support of the communication units of the University of Antioquia. The call described the inclusion and exclusion criteria. 218 students (women) responded to the call; all of them were given detailed information on the investigation and were interviewed. 118 of them did not continue for the following reasons: 62 did not meet the inclusion requirements, 45 did not apply to the next stages of the study, and 11 stated that they were not interested. The informed consent was given and explained to the 100 who continued in the study, and, after clarifying doubts, their signature was obtained as a sign of acceptance.

To define the experimental dates, the typical cycle length of each participant was calculated from the responses to the questionnaire by Durante et al. (2014): penultimate, last, and following date of the MC (the latter was confirmed by the participants for the respective calculation). From there, two groups were randomly formed: one with high fertility ($n = 50$), corresponding to OP, and another with low fertility ($n = 50$), corresponding to FP. Our study chose days 13 and 14 as the ones of greatest fertility, due to the occurrence or proximity to ovulation, and days 16 to 28 as the ones of low fertility. Once the calculations were made, the participants were notified of the date, time, and place for the application of the experiment (UG). As preparation, they were asked to sleep an average of 7 hours and arrive fasting at the laboratory at 6:00 a.m.

The experiment was applied between 6:00 and 8:00 a.m., to control diurnal changes in hormone levels. Then, the participants were placed in a properly lit room, without distractors and in front of a computer. The UG application lasted an average of 15 minutes. From the beginning of the investigation, the participants were informed that the game was real and with real economic stimuli, that is, they would be playing with another person and the money they won would be given to them at the end of the session.

For the game, two photographs of women were used (one more attractive than the other one), which were projected in the UltiGamePc software (Hevia-Orozco et al., 2014). For the selection of the photographs, a procedure like that of Durante et al. (2011, 2014) and Lucas and Koff (2013) was followed. The two photographs were selected by an external sample as follows: initially, the research group chose a total of 6 photographs of women from the city of Medellín between the ages of 18 and 24, used in the application of the instrument with the appropriate permission. Then, the photographs were presented to thirty students who were unaware of the research and were rated on a nine-point scale, where 1 meant “least attractive” and 9 “most attractive”. The instruction was as follows: “Please order the following photos from the most attractive to the least attractive

and assign them a value from 1 to 9, where 1 is unattractive and 9 is very attractive”. Once the analysis of the means was done, the two photographs used in the game were selected: the most attractive and the least attractive. It is important to note that when trying to define attractiveness it is common to resort to the characteristics of symmetry and average (Grammer & Thornhill, 1994; Rhodes, 2006); however, preferences vary with time and culture. For this reason, some researchers have achieved a measure of reliability through a consensus method. Specifically, subjects rate a photograph or an individual on a scale of attractiveness, and those ratings are then averaged to produce an overall evaluation. Such methods have produced a high degree of agreement, even among people of different gender, race, age, socioeconomic status, and cultural background (Patzner, 1985; Rhode, 2010).

As described above, the UG consists of two roles: proposer and responder. However, the first one was already programmed in UltiGamePc (Hevia-Orozco et al., 2014), that is, the software already had a preset number of proposals to be made (20 proposals), which were divided and duly randomized into fair and unfair proposals. The fair proposal rate was 25%; the unfair one, 75% (this information was unknown to the participant). To carry out the game, the participant (responder) was told that she was going to play online with another student from the University of Antioquia, who was in an adjoining room, and that, although they would not see each other directly, she could see her picture when she started the game. For its proper implementation, the instructions were presented and then a brief test exercise was carried out to verify that the instructions were understood. All the tests were applied successfully.

The participant had to play the same game twice (with the supposedly attractive girl and with the less attractive one). To avoid bias in the results, the software had the proposals randomized, and the stimuli were presented in the same way: on one occasion, the participants could start playing with the supposedly attractive girl and then with the less attractive one, or vice versa. Once the application of the instrument was completed, the participants were asked if at any time they suspected that the offers were not real. It was highlighted that all the participants believed that the bets were real and that they were playing with real people. Finally, they were given the total amount of money they earned, and a letter was signed ending their participation and agreement with the investigation.

2.4 Ethical Considerations and Informed Consent

The research was of minimal risk and adhered to the Scientific, Technical and Administrative Standards for Health Research [Normas Científicas, Técnicas y Administrativas para la Investigación en Salud] (Ministerio de Salud, 1993), the Universal Declaration on Bioethics

and Human Rights (Unesco, 2005), to the Declaration of Helsinki (World Medical Association, 2013), to the Guidelines of Deontology and Bioethics of the practice of Psychology in Colombia [Lineamientos de la Deontología y Bioética del ejercicio de la Psicología en Colombia] (Colegio Colombiano de Psicólogos, 2009), to the Ethical Principles of Psychologists and Code of Conduct (American Psychological Association, 2003), and laws 23 of 1982 and 599 of 2000 on copyright (Congreso de Colombia, 1982, 2000). The research project and the informed consent were reviewed and approved by the Bioethics Committee of the Faculty of Medicine of the University of Antioquia [Comité de Bioética de la Facultad de Medicina de la Universidad de Antioquia] (Act 022 of November 9th, 2017).

2.5 Data Analysis

The collected data was stored in Microsoft Excel[®] (XLSX format) spreadsheets for further processing in RStudio 1.4.1717. Outliers were replaced according to Tukey's criteria, that is, by the value corresponding to 1.5 deviations above or below quartiles 3 and 1, respectively. To select the statistical tests to be used, compliance with the assumption of normal distribution was analyzed using the Kolmogorov-Smirnov-Lilliefors test and the assumption of homoscedasticity with the Levene test. For all statistical tests, a p -value $< .05$ was assumed as evidence of statistical significance.

In a complementary way, the sociodemographic characteristics between the groups were compared by contrasting hypotheses in accordance with the nature and level of measurement of the variables, in search of potential confounding variables.

3. Results

The research had the participation of 100 students, with an average age of 21.3 years ($+1.81$). 50 participants were in OP and 50 in LP at the time of presenting the task. Table 1 presents the sociodemographic description of the groups. No statistically significant evidence of differences in the median ages was found, nor in the proportions of socioeconomic stratum, couple relationship or level of personal income. In the comparisons, the Mann-Whitney U test was used for scale variables (i.e., age), Fisher's exact test for qualitative variables with less than five data in one of the categories (i.e., stratum) and the Pearson's chi-square test for the remaining qualitative variables (i.e., partner relationship and personal income level).

To contrast the hypotheses, the percentage of rejection in each of the phases and conditions for the participants was compared. Table 2 presents a summary of the performance in each group, as well as the result of the Kolmogorov-Smirnov-Lilliefors test of normality. Statistically significant evidence was found to affirm that the

proportion of rejection of the OP participants, in the condition of photographing a more attractive woman, did not come from a normally distributed population. For the other conditions in the same group and in the participants in LP, no statistically significant evidence of breach of the normality assumption was found (see Table 2).

3.1 Hypothesis Test

- H_1 : women in the ovulatory phase reject more economic proposals when the offers are made by a more attractive woman than by a less attractive one.

To contrast the research hypothesis, the average percentage of rejection in the OP participants was compared according to the type of stimulus to which they were exposed. Since the performance of the same participants was compared at two different points in time, a test for related samples was used. The Wilcoxon signed-rank test was used, since statistically significant evidence of noncompliance with the normality assumption was found in the responses to the photograph condition of a less attractive woman.

According to the results, no statistically significant evidence of differences in the proportion of rejection of the OP participants was found, whether they were exposed to a photograph of a more attractive woman or a photograph of a less attractive woman during the task ($W = 407.000$; $p = .404$).

- H_2 : women in the luteal phase reject fewer economic proposals regardless of whether the offers are made by a more or a less attractive woman.

The difference in the proportion of rejections was estimated in both the photo condition of a more attractive and less attractive woman in the LP participants. According to the results of the Levene test, statistically significant evidence was found to affirm that the variances of the variables were equal ($F(1) = 1.36$; $p = .25$). Therefore, the T test for related samples was used. No statistically significant evidence was found to affirm that there are differences in the mean rejection rate between the groups ($t(98) = -.10$; $p = .46$).

4. Discussion

Our results showed that there are no statistically significant differences between the EDs of women who were in the OP or LP when they were exposed to a photograph of a more attractive woman or one of a less attractive woman, that is, they behaved similarly in their ED regardless of the phase of the cycle and the type of stimulus to which they were exposed. In the results, no sociodemographic confounding variables were found that could be a factor to be considered in the investigation.

The study of women's sex hormones and their effect on ED is recent (Stanton, 2017) and with mixed results in the UG. The studies that indicate those effects (Eisen-

Table 1

Sociodemographic by MC phase

	OP (<i>n</i> = 50)	LP (<i>n</i> = 50)	Differences Between Groups
Age			
Mean (ED)	21.5 (1.73)	21.2 (1.90)	$W = 7.24; p = .328$
Median [min,max]	22.0 [18.0, 24.0]	21.0 [18.0, 24.0]	
Social stratification			
Low	46 (92.0%)	41 (82.0%)	$p = .258$
Middle	2 (4.0%)	7 (14.0%)	
Upper	2 (4.0%)	2 (4.0%)	
Relationship			
Without	20 (40.0%)	27 (54.0%)	$\chi^2(2) = 1.97; p = .161$
With	30 (60.0%)	23 (46.0%)	
Personal income level			
1 Colombian minimum wage	45 (90.0%)	38 (76.0%)	$\chi^2(2) = 3.47; p = .062$
1-3 Colombian minimum wage	5 (10.0%)	12 (24.0%)	

Table 2

UG performance

		OP (<i>n</i> = 50)	LP (<i>n</i> = 50)
Rejection Ratio	Most attractive photography		
	Mean (ED)	.54 (.2)	.54 (.2)
	Median [min,max]	.55 [.2, .9]	.55 [.2, .9]
	KSL (<i>p</i> -value)	$D = .08$ ($p = .63$)	$D = .10$ ($p = .19$)
	Least attractive photography		
	Mean (ED)	.53 (.2)	.55 (.2)
	Median [min,max]	.55 [.0, .8]	.58 [.0, .9]
	KSL (<i>p</i> -value)	$D = .13$ ($p = .03$)	$D = .11$ ($p = .15$)

bruch & Roney, 2016; Lucas et al., 2007; Lucas & Koff, 2013) have interpreted this behavior as follows: in negotiation situations, and when the probability of conception is greater, women offer less to attractive women, while there is less motivation to cooperate and more willingness to punish. Other studies do not report effects (Probst et al., 2018; Rodríguez Ruiz, 2019; Zethraeus et al., 2009), to which our research is added by not finding, as has been said, differences in the ED of women in none of its phases, regardless of the stimulus to which they were exposed in the UG.

In other social experiments (trust game, public good, dictator, auctions, lotteries), the effect of sex hormones on ED also had mixed results. In the LP, women were more generous (Buser, 2012) and took fewer risks (Derntl et al., 2014); while in OP, they presented less risk aversion (Lazzaro et al., 2016; Pearson & Schipper, 2013) and loss (Durante et al., 2020; Lazzaro et al., 2016), they reduced their impulsivity (Kaighobadi & Stevens, 2013), offered less money to women (Durante et al., 2014; Necka et al., 2016), there were no effects on bidding (Chen et al., 2013; Schipper, 2015), there was risk aversion without regardless of the phase of the cycle (Alzate-Pamplona, 2020), and the participants competed selectively with other women, paying more attention to fertility markers (Necka et al., 2016).

The mixed results may be due to the technique used to determine the MC. There is uncertainty with studies that did not make direct measurements of hormones (Buser, 2012; Eisenbruch & Roney, 2016; Lucas et al., 2007; Lucas & Koff, 2013) compared to those that did (Probst et al., 2018; Zethraeus et al., 2009). Investigations that did not make direct measurements found effects on SD, while those that did it, could not found them. Our research is consistent with the results of the latter. Direct measurement of hormones allows precise identification of cycle phases and provides more peace of mind about the effects that are reported. Recently, Galindo-Caballero et al. (n.d.) carried out a p-curve analysis to estimate the relationship of the MC phases on the ED and found no evidence in favor that would allow confirming its effects.

Allen et al. (2016) recommend using precise methods to determine the phases of the MC. Thus, sonography would be the most recommended, but the most expensive. This is followed by the measurement of hormones in blood and saliva —high precision—, the measurement of basal temperature or LH in urine —medium precision— and self-reports of the onset of menstruation —low precision— (Allen et al., 2016; see also the validity estimates of the methods, the sample size and types of design recommended in Gangestad et al., 2016). Al-

though the methodology used is very important, Galindo-Caballero et al. (n.d.) found that there are few studies that applied the recommendations of Gangestad et al (2016) to review the effects of hormones on ED.

One of the proposed theories to explain the effects of female sex hormones on ED is the *ovulatory shift hypothesis*. This proposes that sexual selection may have developed evolved psychological mechanisms in women in the window of greatest fertility, in such a way that preference for sexual partners with an optimal genetic profile for offspring increased (Gangestad & Thornhill, 2008). This preference would lead women to be more competitive in OP (Lobmaier et al., 2016) for reproductive resources, especially with attractive women or those who live nearby (Durante et al., 2011, 2014; Lucas & Koff, 2013). Previous studies have reported that there is a relationship between the phase of greatest fertility and IC (Durante et al., 2008, 2011; Griskevicius et al., 2007; Nikiforidis et al., 2017; Sundie et al., 2011). For Nikiforidis et al. (2017), the effect of fertility on consumption and financial decision-making would arise from the desire to surpass other women in status and resources, and to access desirable partners of the opposite sex. In summary, and consistent with the ovulatory shift hypothesis, preferences for partners with better characteristics lead to IC, thereby modulating behaviors in women's decisions to access good partners and surpass other women in appearance and means. Despite this, in our study the behavior of the participants was similar, regardless of their cycle. It may have happened that the stimulus of attractiveness did not represent any threat to women who were in the fertile phase; or that a photographic stimulus could reduce the threat in the negotiation compared to offers made in person; or that the most attractive stimulus did not induce competition because they were not in the most fertile phase (this condition was not controlled when choosing the photographs). High estradiol levels produce subtle beauty enhancements in the shape of a woman's face (Catena et al., 2019) and that subtlety is noticeable by another woman in her fertile cycle (Lobmaier et al., 2016).

Finally, an issue that calls for revision is that of dual hormone (Mehta & Prasad, 2015). Testosterone and cortisol are present in the MC phases: the first, for example, increases in OP and is related to risk taking (Cook & Crewther, 2019). A positive association has been found between testosterone and risk taking when cortisol levels are low (Mehta et al., 2015); and in UG it was found that by increasing testosterone and decreasing cortisol, the gains are strong, but if both hormones increase in parallel, the gains are weak (Mehta et al., 2015). Another study found that when testosterone or estrogen levels are high and cortisol is low, women exhibit lower risk (Barel et al., 2017). Testosterone and estradiol have also been reported to have a positive correlation with risk taking, but estradiol had no signifi-

cant effect (Kurath & Mata, 2018). It has further been suggested that testosterone predicts status-seeking behavior and aggressive behavior, especially when cortisol levels are elevated (Probst et al., 2018). The previous studies invite us to continue reviewing the effects that the dual hormone hypothesis could have, where it seems that the effect of testosterone would be mediated by cortisol levels (Knight et al., 2020). For Hardy (2019), cortisol affects all nucleated cells in the body and can therefore have profound effects on any number of behavioral parameters.

4.1 Limitations and Recommendations

Although our sample had sufficient statistical power to contrast differences between two related samples, it is advisable to have larger samples; and although the counting method is valid to determine the phases of the cycle, it is advisable to make a direct measurement of the hormones to avoid biases and have more precision. See the recommendations of Gangestad et al. (2016) on the validity estimates of the different methods for establishing fertility, the sample size, and types of design (between and within subjects); the suggestions of Allen et al. (2016) to improve the accuracy and identification of the CM phases; and the recommendations of Casto and Prasad (2017) on the hormonal study of women and competition.

5. Conclusions

Our results revealed that the MC phases —OP and LP (high fertility vs. low fertility)— had no statistically significant effect on women's ED, and that their ED behavior was not affected by a stimulus (photographs of a woman of greater or less attractiveness). In this sense, the main contribution of our research is concrete: as has been said, women behave in a similar way in their ED regardless of the phase of the cycle in which they find themselves, that is, they accept and reject offers, cooperate or they compete in a similar way without the attractiveness of their conspecific having any effect on it.

We are aware of the limitations of our study regarding the direct measurement of hormones. Although the counting method is one of the most used and recommended when hormone levels cannot be measured directly, precision is necessary. Even though our results were similar to other studies that made direct measurements of hormones, there are also works that tested hormones and their results differed from ours, which leads us to conclude that this is a recent topic, which requires more evidence to reach a consensus and clearer conclusions.

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