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Maastricht University

Lina Lozano, Arno Riedl,
Christina Rott

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GSBE

Maastricht University School of Business and Economics
Graduate School of Business and Economics

P.O Box 616
NL- 6200 MD Maastricht
The Netherlands

The Impact of the Menstrual Cycle on Bargaining Behavior[†]

Lina Lozano, Arno Riedl, and Christina Rott[*]

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Abstract

We investigate experimentally how the menstrual cycle affects bargaining behavior and bargaining outcomes of women. Female participants negotiate in an unstructured bilateral bargaining game with asymmetric information about the allocation of a surplus ('pie size'). We find that the menstrual cycle affects bargaining behavior and that the effects depend on players' information. Players who are informed about the pie size are less compromising during ovulation and receive higher payoffs conditional on reaching an agreement. Uninformed players achieve higher final payoffs during ovulation, which is mainly driven by higher agreement rates. Our study provides first evidence that biological factors affect bargaining.

Keywords: bargaining, asymmetric information, menstrual cycle, biological factors
JEL codes: C78, C91, D87, J16

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[*]Lozano: Center for Behavioral Institutional Design, New York University Abu Dhabi (email: lina.lozano@nyu.edu); Riedl: CESifo, IZA, Netspar & Maastricht University (email: a.riedl@maastrichtuniversity.nl); Rott: Vrije Universiteit Amsterdam & Tinbergen Institute (c.e.rott@vu.nl) We would like to thank Andrzej Baranski, Thomas Buser, Diogo Geraldes, Nagore Iriberri, Christiane Schwieren, David Wozniak, and colleagues both at Maastricht and NYUAD for their helpful comments. We are also grateful for feedback of attendees of Gender Economics and The Workplace 2018, M-BEES Maastricht 2018, ESA North-America 2018, Neuroeconomics Talks Maastricht 2018, BEEC 2018 Bogota, BEET 2022 Heidelberg, KVS New Paper Sessions 2022, EEA-ESEM 2023, ESA World Meeting 2023, and IMEBESS 2023 as well as the audiences in seminars at the Universities of Heidelberg, Regensburg, Würzburg, and Zurich. Lozano gratefully recognizes financial support by Tamkeen under the NYU Abu Dhabi Research Institute Award CG005.

1 Introduction

Bargaining is an ubiquitous activity in the economy and it is undisputed that it greatly affects individuals' outcomes in many domains. For example, at the workplace, a disadvantageous bargaining position can have significant consequences on negotiators' life outcomes, because it may affect promotions and salaries. In fact, it has been shown that not negotiating the first job offer leads to a $500,000 income loss throughout women's careers in comparison to their male counterparts (Babcock and Laschever, 2009). Thus, understanding the determinants of bargaining behavior and outcomes is of utmost importance.

It is well known theoretically that attitudes toward risk should play a role in bargaining and there is empirical evidence that this is indeed the case (see, e.g. Murnighan et al., 1988; Shalev, 2002; Embrey et al., 2021). Regarding external factors influencing bargaining behavior and bargaining outcomes, there is empirical evidence that fairness views are important (Gächter and Riedl, 2005; Chen and Tang, 2009; Karagözoğlu and Riedl, 2015; Embrey et al., 2021), and a recent overview (Baranski and Morton, 2022) documents that age (Güth et al., 2007) and identity, in terms of race, gender, and ideological distance, (Laroze et al., 2020) play a role.[1]

Little attention has been paid to the potential impact of biological characteristics of negotiators on bargaining, despite the fact of accumulating evidence that an individual's biological state impacts factors that are considered to be important in bargaining. For instance, for women it has been shown that the menstrual cycle—via the female sex hormones estradiol and progesterone—influences women's risk preferences and loss aversion (Buser, 2012b; Lazzaro et al., 2016), social preferences (Buser, 2012a), and competitiveness (Buser, 2012b; Wozniak et al., 2014).[2] In this study, we investigate experimentally the role of biological factors on bargaining by exploiting the natural hormonal variation of women during the menstrual cycle.

Understanding the relationship between the menstrual cycle and bargaining behavior is important because the obtained results give insights as to whether biological characteristics can directly affect negotiation behavior. Additionally, the obtained results can be used to raise women's awareness of variations in bargaining behavior over the menstrual cycle which influence their bargaining behavior and thereby may help them to achieve better bargaining outcomes.

In our laboratory experiment, we design and implement a negotiation environment with a bilateral unstructured bargaining scheme characterized by asymmetric information about the negotiable surplus (Camerer et al., 2019). We use an asymmetric information set-up because it mirrors many types of economically relevant situations, such as salary negotiations. Moreover, in bargaining settings with asymmetric information, equal splits are less focal than in symmetric settings, providing a richer context for studying bargaining behavior.

In the bargaining game, two female negotiators bargain over the allocation of an amount of money (i.e., the pie size). The distribution of the pie size is common knowledge, but only one bargaining partner—the *informed* player—knows the actual pie size, whereas the other bargaining party —the *uninformed* player—does not have this information. To investigate the effect of the menstrual cycle on bargaining,

[1] For dictator games it has been found that cognitive ability affects offers made to beneficiaries. There is also evidence that external factors affect gender differences in bargaining (for reviews, see e.g., Mazei et al., 2015; Hernandez-Arenaz and Iriberri, 2019; Lozano et al., 2023).

[2] Recent evidence by Ranehill et al. (2018) shows no relation between artificial and natural female sex hormones (in the form of hormonal contraceptives and menstrual cycle phases) and economic preferences (such as competitiveness, altruism, and risk preferences).

participants have to track their menstrual cycle for three months, before coming to the laboratory. This information allows us to obtain an accurate measurement of the cycle length at the individual level and of the menstrual phase each woman is in, at the moment of the bargaining experiment. We also measure risk and social preferences and control for them in the analysis.

We hypothesize that during the ovulation phase women's bargaining behavior is less compromising (i.e., more demanding opening offers, smaller concessions) compared to the other phases. We base this conjecture on the evidence mentioned above that suggests that women are most competitive, less risk averse, and more profit maximizing during ovulation. We expect this difference in bargaining behavior to be particularly pronounced when comparing the ovulation phase with the premenstrual phase because sex hormone levels change most drastically between these two phases. We also expect variations in bargaining outcomes across the menstrual cycle and look at payoffs conditional on reaching an agreement, deal rates (i.e., agreements), and final payoffs inclusive disagreements.[3] We expect that during the ovulation phase women can achieve higher conditional payoffs but will experience lower deal rates than in the other three menstrual phases.

We find partial support for our hypotheses. Unanticipated, we also find that the effect of the menstrual cycle on bargaining differs between informed and uninformed players. Informed players are less willing to compromise during the ovulation phase in comparison to the other menstrual phases. However, for uninformed players this is not the case. Informed players achieve higher conditional payoffs during ovulation but there is no effect on deal rates and final payoffs. Interestingly, uninformed players' final payoffs are highest during the ovulation phase, which is mostly driven by higher deal rates during this phase, in contrast to our hypothesis. In the discussion section, we conjecture that an interaction between the hormonal state and social status may contribute to this result. Taken together our study shows that biological factors can affect bargaining behavior and outcomes of women and that this effect may depend on the information players have.

The rest of the paper is organized as follows. Section 2 provides a brief overview of the related literature. Section 3 describes the experimental design and how we estimated the menstrual cycle phases of our participants. Sections 4 and 5 present the hypotheses and results, respectively. Finally, we discuss the findings and conclude in Section 6.

2 Related literature

In this overview, we focus on evidence relating the menstrual cycle to competitive behavior, risk aversion, and social preferences because these aspects matter in a bargaining environment.

Several studies analyze variations in competitive behavior over the menstrual cycle. Buser (2012b) uses self-reported menstrual cycle data and shows that women are less competitive during the premenstrual phase or during the 21-days intake period for hormonal contraceptive takers (which are circumstances when the levels of the hormone progesterone are high). Relatedly, Chen et al. (2013) and Pearson and Schipper (2013) observe that women make lower bids during the premenstrual phase in sealed-bid first-price auctions. Wozniak et al. (2014) compare women's competitive choices in a phase with low lev-

[3] As suggested by Hernandez-Arenaz and Iriberri (2023), the differentiation between payoffs conditional and unconditional on a deal is important: being less willing to compromise can result in lower deal rates, but higher payoffs if a deal is reached.

els of both hormones (menstruation for naturally cycling women; intake break for contraceptive takers) with those in a high-hormone phase (mid-premenstrual phase for naturally cycling women; intake period for contraceptive takers). Their findings suggest that women's willingness to select into a competitive environment is higher when progesterone levels are high.[4] In a recent study, Ranehill et al. (2018) employ a clinical randomized placebo-controlled method to study the causal effect of hormonal contraceptives on risk preferences, social preferences, and preferences for competitiveness. Their results suggest that there is no effect of hormonal contraceptives—that is, artificial female sex hormones—on competitiveness.

Regarding risk attitudes, Buser (2012b), Ranehill et al. (2018), and Schipper (2015) find no variation across the menstrual cycle, whereas Lazzaro et al. (2016) observe a reduction in risk aversion during the ovulation phase compared to the premenstrual phase, but not compared to the other phases.[5] Bröder and Hohmann (2003) and Chavanne and Gallup Jr (1998) also observe a decrease in risk aversion during the ovulation phase. Importantly, the latter two studies do not look at risk attitudes in general, but at behavior that increases the risk of falling victim to rape. For social behavior, Buser (2012a) find lower levels of trust during and before menstruation and higher levels of altruism when the levels of progesterone are high (i.e., the premenstrual phase). Ranehill et al. (2018) do not find significant differences in altruistic behavior across the menstrual cycle in the placebo group.

Despite a number of methodological differences between the discussed studies, most of them support the idea that the ovulation phase and the premenstrual phase of naturally cycling women stand out: overall, women seem to be more competitive, less risk averse, and less prosocial during the ovulation phase, especially when compared to the premenstrual phase. This is consistent with the fact that these two menstrual phases entail the most extreme differences in levels of estradiol and progesterone (Wozniak et al., 2014; Buser, 2012b; Lazzaro et al., 2016).

3 Study design and procedures

The study consisted of two stages, a menstrual cycle tracking stage and a laboratory session with bargaining and measurement of several attitudes of participants. In the following, we first describe the tracking and estimation of the menstrual cycle, followed by a detailed description of the bargaining stage and the other tasks in the laboratory session.

3.1 Tracking of the menstrual cycle and estimation of the cycle phase

The menstrual cycle is mainly characterized by the level and fluctuation of two sex hormones: estradiol (an endogenous oestrogen) and progesterone (Stricker et al., 2006). For non-contraceptive takers, these hormones fluctuate in a roughly predictable pattern during an average cycle length of 28 days (Haag et al., 2016). Figure 1 displays the four phases of the natural menstrual cycle—menstrual, postmenstrual (or follicular), ovulation, and premenstrual (or luteal)—and accompanying prototypical hormone levels. At the individual level, both the cycle length and the (fluctuations of) hormone levels vary substantially

[4] This is inconsistent with the results of Buser (2012b). However, it should be noted that it is difficult to compare the studies by Buser (2012b) and Wozniak et al. (2014) because the competitive tasks and the gender composition of the samples differ. Buser (2012b) uses an all female sample, as we do, whereas Wozniak et al. (2014) studies a mixed-gender sample. If hormonal effects interact with gender composition is an open question.

[5] Lazzaro et al. (2016) also report that women are less loss averse during the ovulation phase.

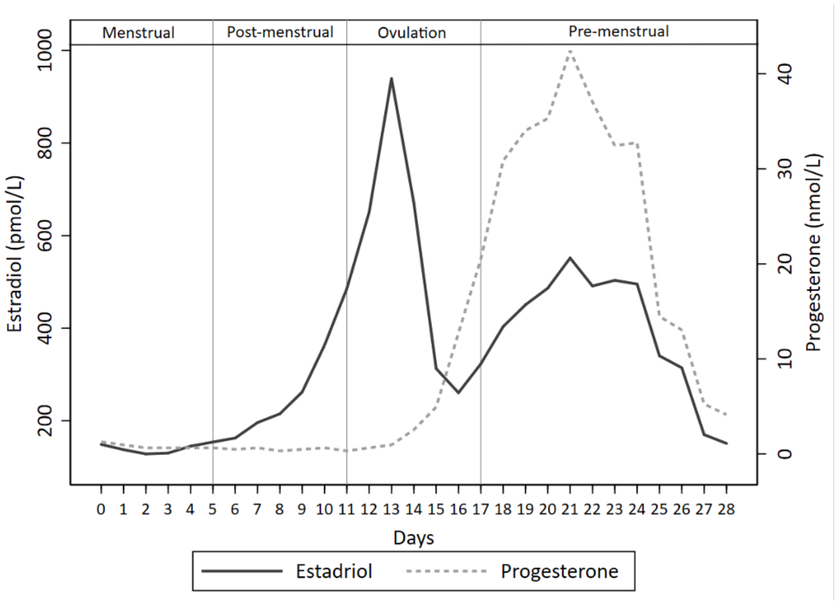


Figure 1. Menstrual phases and hormone levels over the natural menstrual cycle.

Note: The figure shows the menstrual cycle division as suggested in the gynecological literature, Haag et al. (2016). The left vertical axis depicts the level of estradiol and the right vertical axis the level of progesterone.

across women. Therefore, in order to know the phase a non-contraceptive taker is in, it is important to track and estimate the menstrual cycle at the individual level.

We have data of both, non-contraceptive and contraceptive takers. However, we only use the observations of non-contraceptive takers in the analysis reported in the main text. The reason is twofold. First, for exploring the effect of biological factors on bargaining naturally cycling women appear more suitable. Second, using both groups may lead to confounds due to uncontrolled differences between these two groups.[6,7]

Participants were recruited three months before the lab session took place and asked to track their menstrual cycle during the entire period between recruitment and lab session. Following Buser (2012b) and Lazzaro et al. (2016), we use the participants' reported start date of their last menstruation before the lab session and their individual average cycle length over the reported three months to estimate the first day of their subsequent menstruation. Since the duration of the ovulation and the premenstrual phases is known to be relatively constant, we can calculate the dates of each of the four menstrual phases (menstrual, postmenstrual, ovulation, and premenstrual) backward. The three-month tracking period provides us with reliable individual estimates of the cycle length and the menstrual phase each participant is in at the moment of the lab session. For our participants, the mean cycle length is 30 days (standard deviation: 4.33 days) and varies between 21 and 46 days.[8]

[6] Contraceptive takers have very different hormone levels during the 28-day cycle than non-contraceptive takers and hormone levels vary considerably across different kinds of contraceptives (Lovett et al., 2017). Contraceptives also affect other biological aspects. For instance, conditional on a correct intake of the hormonal contraceptive and no disrupting factors, contraceptive takers are not fertile during the naturally occurring ovulation phase.

[7] We provide an analysis for contraceptive takers in Appendix B.6. We recruited also contraceptive takers for the study for the following three reasons. First, it reduces selection issues due to specific recruitment texts and helps us to verify whether the dropout rate during the tracking phase differs between non-contraceptive takers and contraceptive takers. Second, it helps us to mitigate statistical power issues by allowing us to analyze non-contraceptive takers when matched with contraceptive takers. Third, while it is not the focus of this paper it also allows us to discuss differences in behavior between contraceptive and non-contraceptive takers.

[8] Appendix A.1 contains the instructions participants received for tracking their menstrual cycles and describes how the menstrual phases are estimated at the individual level.

The estimated menstrual cycle phases are based on self-reported data and, thus, are prone to measurement error.[9] We account for this in the following ways. First, we ask participants to track their menstrual cycle for a period of three months. The medical literature suggests that this time interval is sufficient to control for individual variations in the menstrual cycle length (Lazzaro et al., 2016). Second, after the three-month tracking period, participants are asked in a questionnaire at the end of the lab session when their last menstruation started. We compare this last menstruation information with the estimation of the menstrual phase obtained from the tracking period.

3.2 Laboratory sessions with bargaining

Each lab session is divided into four parts: In Part 1, participants interact in unstructured bargaining, in Part 2 and Part 3, they perform risk and social preference elicitation tasks, respectively, and in Part 4, they complete a questionnaire. Participants know that the lab session consists of several parts and they receive instructions for each part only at the beginning of the respective part (see Appendix B.7 for the experiment instructions).

Part 1 – Bargaining. In this part, participants interact in an adapted version of the continuous-time bargaining game with one-sided private information introduced by Camerer et al. (2019). Two participants (called *players* for convenience) bargain over the allocation of an amount of money, which we refer to as the *pie size*. It is publicly known that the possible pie sizes are €4.00, €8.00, €12.00, €16.00, €20.00, and €24.00, and that the computer picks each pie size with equal probability. During bargaining, only one of the two players—the *informed player*—in a pair knows the actual pie size. The other player—the *uninformed player*—only knows the distribution of the potential pie sizes. Both players know that only the informed player is informed about the actual pie size.

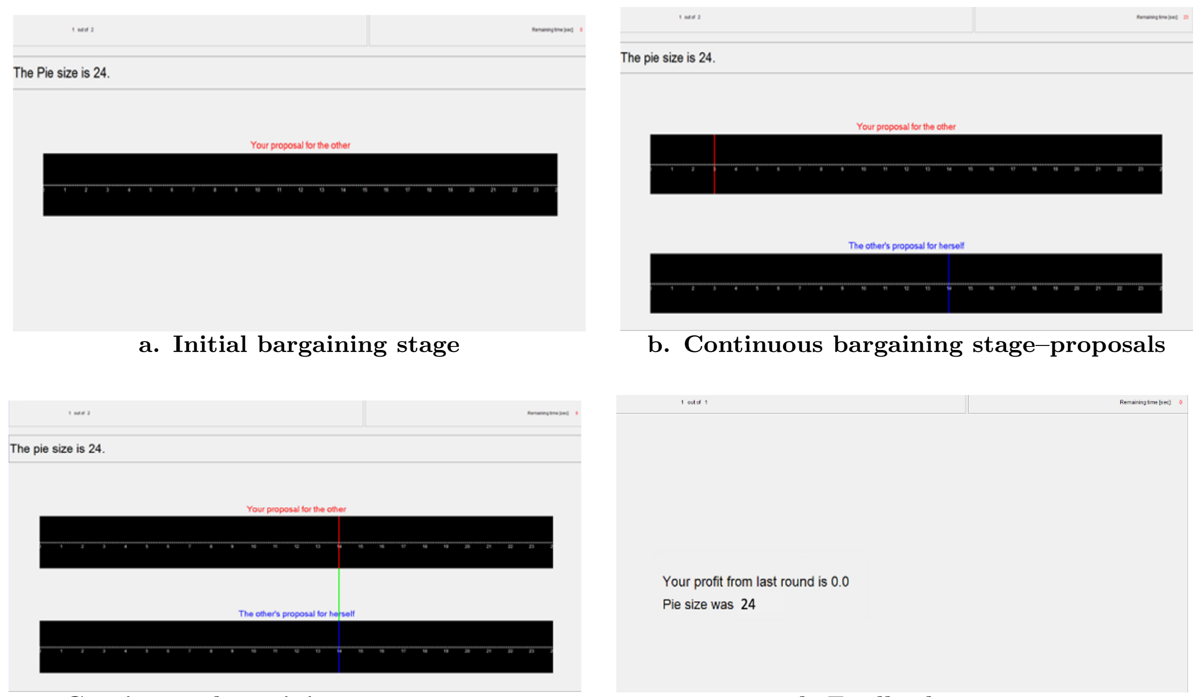
At the beginning of the experiment, players are randomly assigned the role of either informed player or uninformed player and keep it for the whole of Part 1. The randomly paired players negotiate over the uninformed player's absolute €-share of the pie. We refer to the informed player's bargaining proposals as *offers* (to the uninformed player) and to the uninformed player's bargaining proposals as *demands* (for themselves). Players can place offers and demands, respectively, on a slider interface as the ones displayed in Figure 2. The bargaining positions can take any value between €0.00 and €24.00 in multiples of €0.20.

Participants bargain repeatedly for ten rounds. In each round, players are newly paired using a random stranger protocol within matching groups, composed of three informed players and three uninformed players, respectively.[10] There are 28 independent matching groups in total. In each round, bargaining consists of an initial bargaining stage, a continuous bargaining stage, and a feedback stage, which we describe in detail below.

***Initial bargaining stage*:** In this stage, both players simultaneously and independently place their initial offer and demand, respectively. They do this at their own pace without time restriction (see

[9] Alternatively, the menstrual phases could have been estimated by measuring hormone levels through saliva or blood samples. This method might be more accurate (Creinin et al., 2004) but it is also more intrusive and effortful. It requires a number of measurements over a certain period of time because natural hormone levels vary greatly across women. For instance, the same measurement of progesterone at a specific point in time may represent a high level for one woman but a regular level for another one. Because of our between-subject design, we would have needed too many measurements and, therefore, decided against this method.

[10] Participants are randomly matched with a new participant from their matching group in each round. The probability to interact with the same participant twice is positive but small and participants do not receive feedback on this matter.



a. Initial bargaining stage

b. Continuous bargaining stage–proposals

c. Continuous bargaining stage–agreement

d. Feedback stage

Figure 2. Bargaining interface (informed player)

Notes. Screenshot extracts of informed players of (a) Initial bargaining stage: each player in a pair simultaneously and independently chooses their initial offer and demand, respectively; the pie size appears in the top left corner of the screen of informed players only. (b) Continuous bargaining stage–proposals: players have 30 seconds to place offers and demands. (c) Continuous bargaining stage–agreement: when offer and demand match, a green vertical line appears; a deal is made if both bargaining positions remain in the same place for 2 seconds. (d) Feedback stage: at the end of each round, both players are informed about their own payoff and the pie size in that round. Uninformed players screens looked identical except that no information on the pie size was displayed.

Figure 2a).[11] Bargaining moves to the next stage only after both players have submitted their initial proposal. Then, each player's initial bargaining position is revealed to both players by displaying players' sliders vertically stacked on the screen (see Figure 2b).

***Continuous bargaining stage*:** After the players' initial positions are revealed, they have 30 seconds to bargain and reach a deal. Offers and demands can be made at any time within this time frame. Players see their own and the bargaining partner's currently valid offer (demand) on the screen. A deal is reached when offer and demand coincide and do not change for two seconds (see Figure 2c). In that case bargaining ends. If a deal is reached, the uninformed player's payoff is equal to the agreed share and the informed player's payoff is equal to the pie size minus the agreed share for the uninformed player. In case the agreed share for the uninformed player exceeds the pie size, the informed player's payoff is negative. Negative payoffs are subtracted from other earnings in the experiment. If no deal is reached after 30 seconds of bargaining, both players get nothing.

***Feedback stage*:** After a deal or no agreement after 30 seconds, both players are informed of their own payoff and the actual pie size (see Figure 2d).

Part 2 & 3 – Risk and social preference elicitation. In part 2, participants' risk preferences are measured by eliciting certainty equivalents for lotteries (see, e.g., Bruhin et al., 2010; Cettolin et al., 2017). Participants make choices in ten multiple price lists (MPL), each consisting of one lottery and

[11] The initial cursor location on the slider (i.e., before the first click) is randomized at the individual level.

ten different sure amounts (for details see Table A.1 in Appendix A.2). The switching point between the lottery and sure amounts defines the certainty equivalent in each MPL, which we use to estimate participants' risk preferences. For the estimation, we assume a CRRA power utility function for money $U(x) = x^{1-\alpha}$, where $0 < \alpha < 1$ indicates risk aversion, $\alpha = 0$ risk neutrality and $\alpha < 0$ risk seeking (Holt and Laury, 2002; Andersen et al., 2008; Wakker, 2008; Dohmen et al., 2011).

In part 3, we elicit social preferences with the method developed by Kerschbamer (2015). In this task, participants make choices between the allocation of payoffs to themselves and to a randomly matched 'passive' participant. Participants have to choose between an equal allocation for themselves and the passive participant and an allocation with advantageous inequality and disadvantageous inequality, respectively. Based on these choices, we create an index that measures the degree of benevolent (or malevolent) behavior. Participants are both in the role of active decision maker and passive participant. To exclude (anticipated) reciprocity, a passive participant is never the active participant towards their own active decision maker. Participants were informed about that. A more detailed description of the elicitation of risk preferences and social preferences is provided in Appendix A.2.

Part 4 – Questionnaire. In this part, participants fill in a questionnaire, which includes socio-demographic questions on gender, age, nationality, and educational background. Additionally, they provide information about their current menstrual cycle to verify the data obtained from their prior menstrual cycle tracking. As in Buser (2012b), participants are asked to indicate the date when the last menstruation started, their average cycle length, the average length of menstruation, whether they are experiencing menstrual bleeding at the moment of the laboratory session, how regular their cycle is, and whether they use a hormonal contraceptive method, and if so which one. We also ask hypothetical questions about their risk attitudes in different contexts (Dohmen et al., 2011).

3.3 Experimental procedures

The computerized bargaining experiment (using z-Tree, Fischbacher, 2007) consisted of nine experimental sessions and was conducted at the Behavioral and Experimental Economics Laboratory (BEElab) at Maastricht University. The data were collected in two waves (January-May 2016 and January-May 2017), which includes the menstrual cycle tracking. Participants were recruited through the online recruitment system ORSEE (Greiner, 2015). All participants were either non-contraceptive takers or contraceptive takers using a method that did not suppress menstruation completely.[12] In total, 166 women participated in the lab sessions, of which 97 were non-contraceptive takers (with 45 uninformed players and 52 informed players) and 69 were contraceptive takers (with 38 uninformed players and 31 informed players).

We have a purely female sample and decided against a mixed-gender sample because women revealed highly sensitive and intimate information, and to create a safe and comfortable environment for the participating women. For that reason, also only the female co-authors of this study met the participants

[12] The only exclusion criteria was not experiencing a menstrual cycle at all, which can be due to contraceptive methods such as intra-uterine devices, pregnancy, or trans-sexuality. One participant was excluded because she did not complete the menstrual tracking phase, resulting in a sample of 97 non-contraceptive takers. Three non-contraceptive takers, in the role of uninformed players, had an irregular cycle, but we decided to keep them in our analysis. Two of those had a long menstrual cycle (average cycle longer than 40 days), and for one of them, the calendar report did not match the information provided in the questionnaire answered in the lab session. We used the calendar information for this participant to estimate her menstrual cycle phases.

in person and all tracked information and session data were recorded anonymously. Information about the bargaining partner was not revealed during the session but women could observe the gender composition before the start of the session. Another advantage of a pure female sample is that participants do not have to form beliefs about the gender (distribution) of the negotiation partner, which would create noise if it indeed affected bargaining behavior.[13]

The study was approved by the Ethical Review Committee of Psychology and Neuroscience (ERCPN) at Maastricht University. At the beginning of the menstrual cycle tracking phase, all participants signed informed consent and thereby agreed to track their cycle for three months and to provide this information. After the lab session, participants received in cash a €10 bonus for providing their menstrual cycle information, a €5 show-up fee for the lab session, and the payment for one randomly selected part with incentivized tasks of the lab experiment (Part 1, 2, or 3). The latter payment was determined as follows: if Part 1 was selected for payment, one of the ten bargaining rounds was randomly drawn to be relevant for payout; if Part 2 was selected, one of the 100 decisions made in the risk elicitation task was chosen with an equal probability to be paid out; if Part 3 was selected, one of the choices in the social preferences elicitation task was drawn randomly and the participant received the payment as an active decision maker in that choice plus the payoffs obtained as a passive player. The lab session lasted on average 45 minutes and the total average payment was €35.

3.4 Measures of bargaining process and outcomes

For the bargaining process, we analyze informed players' initial offers, uninformed players' initial demands, and both players' concessions during bargaining. Initial offers and demands capture an individual's bargaining attitudes before they are affected by the negotiation partner's behavior. To investigate the interactive nature of bargaining, we look at concessions during the simultaneous bargaining stage. Concessions are changes in offers and demands, respectively, that show a negotiator's willingness to give up part of their own stake to reach an agreement and make the bargaining partner better off. Ceteris paribus, concessions reveal a player's willingness to compromise, although we also allow for negative concessions. We measure concessions using the relative concession index developed by Gächter and Riedl (2005). A relative concession is given by the absolute concession—that is, the difference between standing offer (demand) and new offer (demand)—normalized to the bargaining area, which is the difference between the standing demand and standing offer. The relative concession index is then defined as the average of all relative concessions a player makes during bargaining.[14]

Bargaining outcomes are measures of negotiation success. We analyze negotiators' final payoffs, deal rates, and payoffs conditional on reaching an agreement. These measures capture two distinct motives that are important in bargaining: cooperating with the negotiation partner to reach an agreement and competing with the negotiation partner to maximize their own share of the pie. Deal rates are related to the cooperative component of bargaining, whereas conditional payoffs reflect the competitive bargaining component, and final payoffs relate to a combination of both motives.

[13] Baranski et al. (2023) and D'Exelle et al. (2023) show that different gender compositions change the negotiation dynamics. We leave the investigation of menstrual cycle effects in mixed gender samples for future research.

[14] Gächter and Riedl (2005) also introduce an absolute concession index that is not normalized to the bargaining area. We consider the relative index as more appropriate as the same absolute compromise is likely perceived larger when the bargaining area is small than when it is large.

4 Hypotheses

During ovulation—the fertile phase of the menstrual cycle—women experience a drastic increase in estradiol levels (cf. Figure 1), which has been associated with higher levels of risk-seeking, competitiveness, and profit-maximizing behavior (see, e.g, Buser, 2012b; Lazzaro et al., 2016). Translating these observations to our bargaining setting, we expect women to place higher initial demands and lower initial offers during the ovulation phase, in comparison to the other phases. In contrast, the premenstrual phase—which is characterized by high levels of progesterone and large changes in these levels—has been linked with economic behavior opposite to that observed during ovulation, that is, reduced risk-taking and less competitive behavior (Buser, 2012b,a; Lazzaro et al., 2016). Therefore, we expect the most pronounced difference in initial demands and offers between the ovulation and the premenstrual phase, and less so between ovulation and the other two menstrual phases (i.e., menstrual and postmenstrual).[15]

Regarding compromising behavior, in principle, the same factors are at work as for initial offers and demands. Thus, we would expect smaller compromises during the ovulation phase in comparison to the other phases. However, the expected smaller initial offers and larger initial demands during ovulation increase the initial bargaining area (i.e., the distance that needs to be bridged to come to a deal), which in turn may increase the (psychological) pressure to make compromises. In addition, concessions are also affected by the bargaining behavior of the matched player who might be in a different phase of the menstrual cycle. Therefore, we expect at best a small effect of the menstrual cycle on concession behavior.

Based on these considerations, we formulate our hypothesis on the impact of the menstrual cycle on the bargaining process.

Hypothesis 1 Bargaining process
(a) During ovulation, informed players' initial offers are lower and uninformed players' initial demands are higher than in the other phases. The difference is most pronounced in comparison to the premenstrual phase. (b) During ovulation, informed and uninformed players' concession behavior tends to be smaller relative to the other phases. The effect is most pronounced in comparison to the premenstrual phase.

As the ovulation phase is predicted to affect the bargaining process, we expect that also the bargaining outcomes, that is, payoffs and deal rates, differ from those in the other phases. As mentioned earlier, two distinct behavioral components are important in the negotiation process: a cooperative component—reflected by deal rates—and a competitive component—reflected by payoffs conditional on reaching a deal. For final payoffs, which include disagreements, predictions are ambiguous because both components are at work in opposite directions. Therefore, we formulate directed predictions for deal rates and conditional payoffs (i.e., payoffs conditional on having reached an agreement) only. In line with the expected effects on the bargaining process during the ovulation phase (i.e., a more competitive and less cooperative attitude), we expect lower deal rates and higher conditional payoffs, in comparison to the other phases. We formulate these expectations in our second hypothesis.

[15] From an evolutionary perspective, one may argue that women engage less in competitive behavior during their infertile phase and potential pregnancy (i.e., premenstrual phase) than in their fertile phase (i.e., ovulation phase), which is when women might compete for the fittest males for reproduction purposes (Lazzaro et al., 2016).

Hypothesis 2 Bargaining outcomes

During ovulation, informed and uninformed players' conditional payoffs are higher and deal rates are lower compared to the other phases. The differences are most pronounced in comparison to the premenstrual phase.

Note that concessions, payoffs and deal rates depend on the bargaining behavior of both, informed and uninformed, players. As players are likely in different phases of the menstrual cycle when bargaining, we expect that the differences in bargaining outcomes across cycle phases are less pronounced than the differences in initial offers and demands.

5 Results

The sample of non-contraceptive takers ($n = 97$; 52 informed and 45 uninformed players) is composed of 20 participants in the ovulation phase, 41 in the premenstrual, 17 in the menstrual, and 19 in the postmenstrual phase.[16,17] We analyze the bargaining process and outcomes with Ordinary Least Square (OLS) regressions and control for data dependency by clustering at the matching group level. To check the robustness of our results we also run regressions with bootstrapped cluster-robust standard errors with 1000 repetitions.[18] The main text and tables display p-values without correcting for multiple hypotheses testing.[19]

The remainder of this section is divided into three sub-sections: first, we contrast informed and uninformed players' general bargaining behavior. Second, we analyze if and how informed players' offers and uninformed players' demands as well as their respective concession rates are affected by their menstrual cycle (Hypothesis 1). Third, we investigate bargaining outcomes—payoffs and deal rates—across the menstrual cycle (Hypothesis 2).

5.1 Comparison of informed and uninformed players

To test whether bargaining behavior differs between informed and uninformed players, we compare their bargaining positions over the duration of the 30-second long interactive bargaining stage. Figure 3 displays the average bargaining positions over time for informed players (left panel) and uninformed players (right panel), aggregated across menstrual cycle phases and the 10 rounds. For convenience,

[16] As explained in Section 4, we focus on non-contraceptive takers. Observations from non-contraceptive takers from interactions with contraceptive takers are included in the analysis, which increases the number of independent observations (that is, clusters) and the power of our statistical tests. In Appendix B.1, we provide descriptive statistics separately for contraceptive and non-contraceptive takers. We report further results for contraceptive takers ($n = 69$; 31 informed players and 38 uninformed players; 42 participants in the intake and 27 in the break phase without any irregularities) in Appendix B.6.

[17] Our sample size is comparable to the sample sizes of other studies addressing the relationship between biological factors and economic behavior (Kosfeld et al., 2005; Burnham, 2007; Apicella et al., 2008; Eisenegger et al., 2010; Lazzaro et al., 2016; Buser, 2012b,a; Wozniak et al., 2014; Schipper, 2015).

[18] Cameron et al. (2008) recommend this procedure for cases with a relatively low number of clusters. All our main findings hold when using this procedure. There are only a few minor changes in non-hypothesized outcomes for uninformed players. We provide detailed information in Appendix B.4 where we present all outcomes and discuss the main differences compared to the main analysis.

[19] In our main analysis, we make 20 comparisons for five outcome variables (initial offers/demands, concession rates, deal rates, final payoffs, and conditional payoffs), two bargaining roles (informed players and uninformed players), and two menstrual phase comparisons (ovulation versus all other menstrual phases and ovulation versus premenstrual phase). Using a very conservative approach by correcting for all 20 comparisons with the Benjamini-Hochberg procedure (Benjamini and Hochberg, 1995), we get a false discovery rate of 0.125, suggesting that our findings are quite robust.

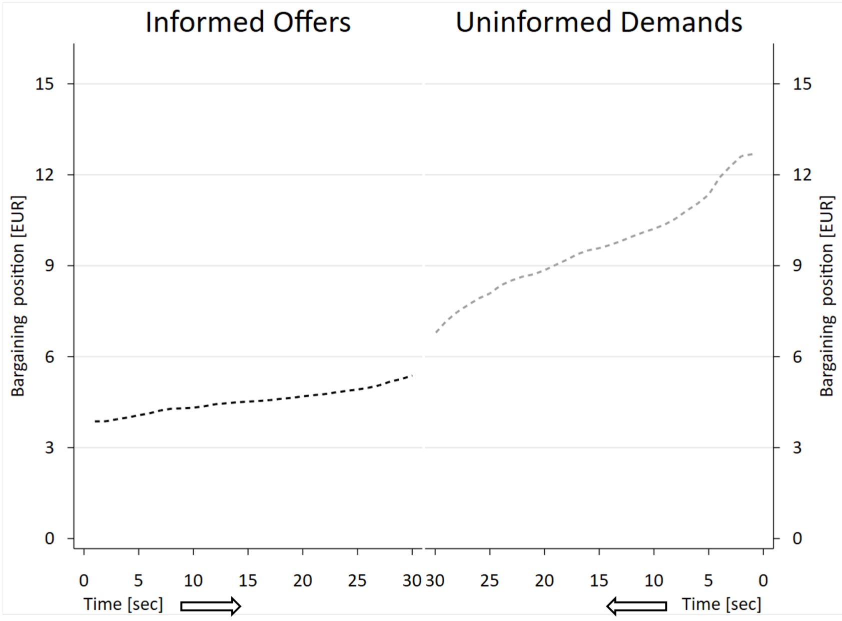


Figure 3. Bargaining position across time during the continuous bargaining stage.

the chronological order of informed players' offers is from left to right, whereas for uninformed players' demands time passes from right to left.[20]

The figure shows that informed players' offers start low (mean = €3.86, and sd = €2.85) and uninformed players' demands start high (mean = €12.72, and sd = €2.85). Over time, informed players' offers increase and uninformed players' demands decline, eventually coming close to each other towards the end of the continuous bargaining stage. This pattern is similar to the bargaining dynamics found in Camerer et al. (2019). An agreement is reached in 69% and 71% of the cases for informed players and uninformed players, respectively.[21]

The positive relationship between bargaining time and the informed player's bargaining position and the negative relationship between bargaining time and the uninformed player's bargaining position are both highly significant (Zellner's seemingly unrelated regression; $p < 0.001$ for both information types).[22] We also find a significant difference in the steepness of the slope for the bargaining position across time between informed and uninformed players (post-estimation Wald test of the absolute coefficients obtained from Zellner's seemingly unrelated regression, $p < 0.001$). This indicates that uninformed players concede significantly more than informed players during bargaining.

The difference in bargaining behavior between player types is also reflected in their payoffs. Including disagreements, informed players earn on average €2.40 more than uninformed players (final payoffs; Mann-Whitney U tests, $p < 0.001$). Among those who reach a deal, informed players earn €3.50 more than uninformed players (conditional payoffs; Mann-Whitney U tests, $p < 0.001$).[23]

[20] Figure B.1 in Appendix B.2 displays the mean bargaining positions per second in the continuous bargaining stage separately for each menstrual phase for informed and uninformed players.

[21] The agreement rates for informed and uninformed players slightly differ because of an asymmetry in the distribution of informed and uninformed players between contraceptive takers and non-contraceptive takers.

[22] The relationship between bargaining time and bargaining positions of informed and uninformed players might be correlated due to their interactions. Therefore, we use Zellner's seemingly unrelated regression that accounts for correlated error terms in both relationships. In this regression, we use the bargaining position as a dependent variable and the time in seconds as an explanatory variable for informed and uninformed players, separately. The resulting coefficient estimate for informed and uninformed players is 0.046 ($SE = 0.001$) and -0.177 ($SE = 0.006$), respectively.

[23] Table B.2 in Appendix B.2 reports the average final payoffs, deal rates, and conditional payoffs for informed and uninformed players, together with tests for differences between information types.

Taken together, we find that bargaining behavior and outcomes differ between informed and uninformed players, as expected from earlier research using a similar bargaining environment (Camerer et al., 2019). In the following, we analyze the effect of the menstrual cycle on the bargaining process and outcomes separately for each information type.

5.2 Bargaining process: Initial positions and concessions

Here we test Hypothesis 1 and analyze the bargaining process across the menstrual phases. First, we look at informed players' *Initial offers* and uninformed players' *Initial demands*, which they submit before observing the matched partner's bargaining position. As reported already in Figure 3, the average initial offers and demands differ substantially, implying that concessions are necessary to reach an agreement, which is the second variable we analyze. As described in Section 3.4, we use the *Relative concession rate* (Gächter and Riedl, 2005) to measure players' willingness to compromise. The higher this rate, the more willingness to concede a player reveals.

Informed players

Figure 4 displays the average initial offers of informed players for each menstrual cycle phase, aggregated over the 10 bargaining rounds. Initial offers show a large variation (€0.00 to €14.30) and are on average lowest during ovulation (average initial offers: ovulation, €2.94; menstruation, €3.52; Postmenstrual, €4.67; premenstrual: €4.10).

We use OLS regression analysis to test for statistical differences in bargaining behavior between the ovulation phase and the other menstrual phases. The estimates presented in Table 1 use data from all 10 bargaining rounds. In all models, we include two sets of controls. The first set, *Controls A*, comprises two bargaining covariates: *Pie size*, which is the €-amount over which a negotiation pair bargains in the respective round, and *Bargaining round*. The second set of controls, *Controls B*, includes the demographic variables *Age*, *Nationality*, and *Study background*, as well as the individual characteristics *Risk aversion* and *Social preferences*. The latter two are included because they have been shown to be factors that can affect bargaining (see, e.g., Embrey et al., 2021; Camerer et al., 2019, for risk preferences, and, e.g., Gächter and Riedl, 2005; Karagözoğlu and Riedl, 2015; Bolton and Karagözoğlu, 2016, for social preferences).[24]

In models 1 and 2 of Table 1, the dependent variable is the informed player's initial offer and the explanatory variable of interest is the dummy variable *Ovulation*, which takes the value one when the player is in the ovulation phase, and zero otherwise. In panel A, the reference category consists of all menstrual phases other than ovulation. In panel B, the dummy variables *Menstruation* and *Postmenstrual*, which take the value one when the individual is in the respective phase and zero otherwise, are additionally included in the regression and the reference category is now the premenstrual phase. To test for differences between the ovulation phase and the menstruation and postmenstrual phase, we run post-estimation F-tests, which are reported in the lower part of Table 1.

[24] Individual risk aversion is captured by the parameter estimated from the risk preferences elicitation task and social preferences measure the player's level of benevolence (higher values indicate higher levels of risk aversion and benevolence, respectively). Given the evidence on risk preferences and the menstrual cycle (Buser, 2012b,a; Lazzaro et al., 2016), we also explore whether risk preferences and social preferences change across the menstrual cycle for informed and uninformed players in Appendix B.5. Overall, we observe that women are more risk-averse during the premenstrual phase in comparison to the menstrual and postmenstrual phases. We do not observe variations in benevolence levels across the menstrual phases.

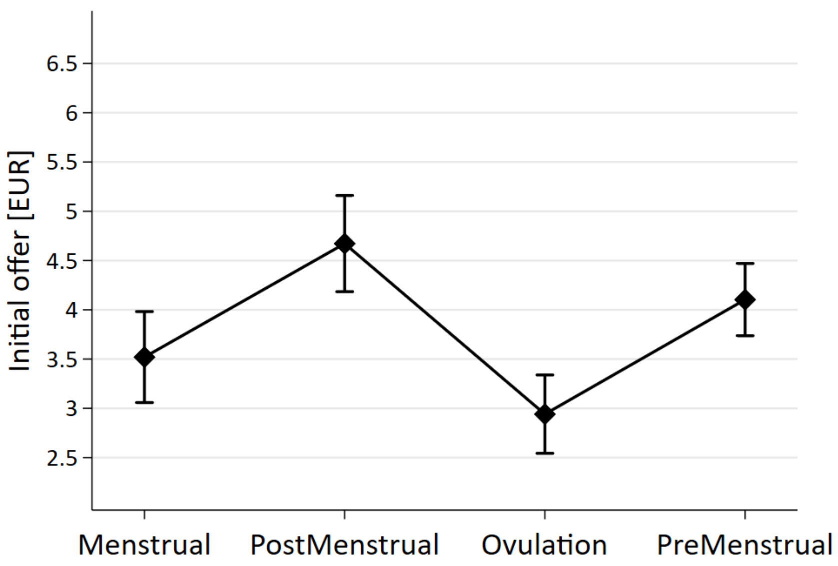


Figure 4. Initial offers of informed players.

Note: The figure shows the average offers and corresponding standard errors for each menstrual cycle phase. Standard errors are obtained from OLS regressions clustered on the matching group level and controlling for pie size and bargaining round.

Compared to other phases, initial offers are significantly lower in the ovulation phase, as hypothesized. Specifically, initial offers are €1.26 and €1.12, respectively, lower during ovulation compared to the rest of the menstrual cycle (panel A: model 1, $p = 0.042$; model 2, $p = 0.038$) and €1.25 and €1.18, respectively, lower than during the premenstrual phase (panel B: model 1, $p = 0.049$; model 2, $p = 0.020$). Initial offers are not significantly lower during ovulation than during menstruation (panel B: model 1, $p = 0.406$; model 2, $p = 0.694$), but (marginally) significantly lower than during the postmenstrual phase (panel B: model 1, $p = 0.042$; model 2, $p = 0.084$). There is no significant difference between the premenstrual phase, on one hand, and the menstrual and postmenstrual phases, respectively, on the other hand (panel B: model 1, $p = 0.432$ and $p = 0.505$, respectively; model 2, $p = 0.277$ and $p = 0.720$, respectively).[25]

Next, we test whether informed players' concession behavior differs across menstrual phases, using the relative concession rates, defined above. The average concession rate is lowest during the premenstrual (mean 0.153) and highest during the menstrual phase (mean: 0.184), with the other two phases in-between (means: ovulation 0.165, postmenstrual 0.175). Models 3 and 4 of Table 1 have the same specifications as models 1 and 2, respectively, except for the dependent variable. The analysis shows that there is no significant difference in the relative concession rates between the ovulation phase and the other menstrual phases pooled (panel A: model 3, $p = 0.978$; model 4, $p = 0.927$). Also for the pairwise comparisons, concession rates during ovulation are not significantly different from concession rates in the premenstrual phase (panel B: model 3, $p = 0.783$; model 4, $p = 0.910$), menstruation (panel B: model 3, $p = 0.684$; model 4, $p = 0.305$), or the postmenstrual phase (panel B: model 3, $p = 0.937$; model 4, $p = 0.983$). This null effect for ovulation may be due to opposite forces canceling each other out.

[25] Table B.3 in Appendix B.3 reports the coefficients for the variables included in Controls A and Controls B in Table 1. The results show that the pie size affects the initial offer positively. There is learning, as initial offers significantly decrease as the bargaining round increases. Thus, with more experience, informed players seem to become 'tougher' negotiators. Risk aversion affects initial offers negatively.

Table 1. Initial offers and relative concession rates for informed players.

	Initial offer		Concession rate	
	(1)	(2)	(3)	(4)
Panel A:				
Ovulation	-1.263**	-1.121**	-0.001	-0.005
	(0.591)	(0.514)	(0.048)	(0.055)
Constant	1.867***	0.585	0.098*	0.521
	(0.244)	(2.484)	(0.051)	(0.420)
Controls A	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes
Observations	520	520	520	520
Adjusted R^2	0.304	0.338	-0.004	-0.005
Panel B:				
Menstruation	-0.582	-0.865	0.031	0.053
	(0.730)	(0.779)	(0.039)	(0.049)
Postmenstrual	0.466	0.273	0.022	0.009
	(0.689)	(0.753)	(0.138)	(0.132)
Ovulation	-1.252**	-1.177**	0.011	0.006
	(0.608)	(0.474)	(0.039)	(0.049)
Constant	1.869***	-0.054	0.087*	0.535
	(0.346)	(2.745)	(0.043)	(0.465)
Controls A	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes
Observations	520	520	520	520
Adjusted R^2	0.313	0.350	-0.007	-0.009
Ovulation vs. Menstruation	-1.834	-2.042	-0.020	-0.047
[F-test p-value]	[0.406]	[0.694]	[0.684]	[0.305]
Ovulation vs Postmenstrual	-0.786	-0.904	-0.011	-0.003
[F-test p-value]	[0.042]	[0.084]	[0.937]	[0.983]

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). Post-estimation F-tests for ovulation versus the menstrual and postmenstrual phases with the effect sizes and the corresponding p-values [in brackets]. The dependent variable is initial offers in models 1 and 2 and relative concession rates in models 3 and 4. *Controls A* includes a set of bargaining covariates (pie size and bargaining round). *Controls B* includes a set of demographic covariates (age, nationality, and study background) and individual characteristics (risk preferences and social preferences). The reference category in Panel A is all menstrual phases except *Ovulation*, and in Panel B the premenstrual phase.

Specifically, the observed lower initial offers during ovulation increase the need for concessions to reach an agreement, which may offset the hypothesized direct negative effect on the willingness to compromise.[26] We summarize the findings for informed players with respect to Hypothesis 1 in the following result.

Result 1 Bargaining process – Informed players
(a) Informed players' initial offers are significantly lower during ovulation compared to the other menstrual phases pooled and compared to the premenstrual and postmenstrual phases. (b) There are no statistically significant differences in informed payers' relative concession rates across the menstrual cycle.

Thus, for informed players we find, as hypothesized, that their initial offers are most competitive during ovulation compared to all other phases pooled and compared to the premenstrual (and postmenstrual)

[26] Table B.3 in Appendix B.3 reports the coefficient estimates of the control variables. We do not find significant effects of the pie size (models 3 and 4 panels B, $p = 0.936$ and $p = 0.930$, respectively) or the bargaining round (models 3 and 4 panels B, $p = 0.354$ and $p = 0.356$, respectively) on the informed players' concession rates. Similarly, neither risk preferences nor social preferences significantly influence informed players' concession rates.

phase. In terms of effect size, we do not find that the effect is most pronounced in comparison to the premenstrual phase. The reason is that, unexpectedly, initial offers are least competitive during the postmenstrual phase. Regarding concession behavior, we do find that concessions are lowest during ovulation, but these differences do not reach statistical significance. In summary, for informed players part (a) of Hypothesis 1 is largely supported but part (b) is rejected.

Uninformed players

Figure 5 displays the average initial demands of uninformed players across the menstrual phases, aggregated over the 10 bargaining rounds. The figure indicates that demands tend to be lowest in the menstrual and ovulation phases and highest during the premenstrual phase. However, overall, there is little variation in demands across the menstrual cycle.

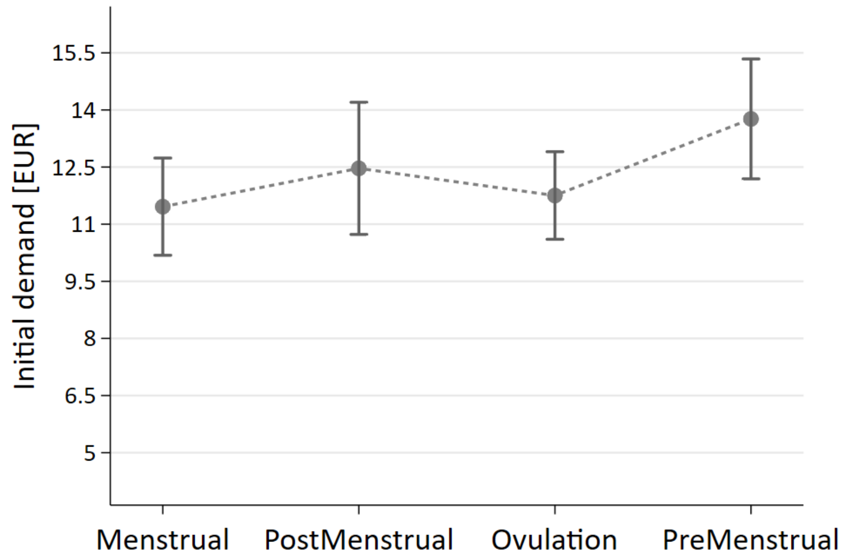


Figure 5. Initial demands of uninformed players.

Note: The figure shows the average demands and corresponding standard errors for each menstrual cycle phase. Standard errors are obtained from OLS regressions clustered on the matching group level and controlling for pie size and bargaining round.

The OLS regression analysis reported in Table 2 tests for uninformed players whether initial demands are higher and concessions smaller during the ovulation phase compared to the other phases, and especially, compared to the premenstrual phase (Hypothesis 1). Models 1 and 2 display the results for initial demands and models 3 and 4 for relative concession rates. In all specifications, we control for data dependency by clustering at the matching group level, and use the same sets of control variables as in the analysis for informed players.[27]

Consistent with the visual impression from Figure 5, the regression results confirm that for uninformed players neither initial demands nor concessions vary significantly across the menstrual cycle. We do not

[27]The number of observations for informed and uninformed players differ slightly because of a small asymmetry in the distribution of informed and uninformed players between contraceptive takers and non-contraceptive takers. In total, there are 166 participants (83 informed players and 83 uninformed players. Of these, 97 are non-contraceptive takers (with 52 informed players and 45 uninformed players) and 69 are contraceptive takers (with 31 informed players and 38 uninformed players). Since Tables 1 and 2 only display the results of non-contraceptive takers in the 10 bargaining rounds, there are 520 observations for informed players and 450 observations for uninformed players.

Table 2. Initial demands and relative concession rates for uninformed players.

	Initial demand		Concession rate	
	(1)	(2)	(3)	(4)
Panel A:				
Ovulation	-1.128	-1.541	0.058	0.059
	(1.407)	(1.464)	(0.062)	(0.081)
Constant	11.629***	8.941*	0.396***	0.634
	(0.786)	(4.893)	(0.105)	(0.518)
Controls A	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes
Observations	450	450	450	450
Adjusted R^2	0.018	0.134	-0.001	-0.006
Panel B:				
Menstruation	-2.310	-1.113	-0.072	-0.046
	(1.382)	(1.380)	(0.103)	(0.119)
Postmenstrual	-1.287	-0.491	0.038	0.054
	(1.577)	(1.550)	(0.057)	(0.048)
Ovulation	-1.968	-1.856	0.049	0.060
	(1.816)	(1.723)	(0.072)	(0.088)
Constant	12.459***	8.979*	0.402***	0.596
	(1.230)	(4.802)	(0.122)	(0.524)
Controls A	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes
Observations	450	450	450	450
Adjusted R^2	0.048	0.137	-0.003	-0.008
Ovulation vs Menstruation	-4.278	-2.969	0.121	0.106
[F-test p-value]	[0.769]	[0.609]	[0.239]	[0.871]
Ovulation vs Postmenstrual	-3.255	-2.347	0.011	0.006
[F-test p-value]	[0.650]	[0.378]	[0.399]	[0.937]

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). Post-estimation F-tests for ovulation versus the menstrual and postmenstrual phases with the effect sizes and the corresponding p-values [in brackets]. The dependent variable is initial demands in models 1 and 2 and relative concession rates in models 3 and 4. *Controls A* includes a set of bargaining covariates (pie size and bargaining round). *Controls B* includes a set of demographic covariates (age, nationality, and study background) and individual characteristics (risk preferences and social preferences). The reference category in Panel A is all menstrual phases except *Ovulation*, and in Panel B the premenstrual phase.

observe significant differences between initial demands made during the ovulation phase and all the other phases pooled (panel A: model 1, $p = 0.431$; model 2, $p = 0.303$). Also, the pairwise comparisons of the ovulation phase with the premenstrual (panel B: model 1, $p = 0.289$; model 2, $p = 0.292$), the menstrual (panel B: model 1, $p = 0.769$; model 2, $p = 0.609$), and the postmenstrual (panel B: model 1, $p = 0.650$; model 2, $p = 0.378$) phase do not show significant differences.[28]

The relative concession rates are highest during ovulation (mean 0.404) and lowest during menstruation (mean 0.283) and are in between these values during the premenstrual (mean 0.357) and the postmenstrual (mean 0.401) phase. For the relative concession rates, models 3 and 4 in Table 2 show that there are no statistically significant differences between ovulation and all other menstrual phases pooled

[28] Table B.4 in Appendix B.3 reports the coefficients for the control variables included in Table 2. The results show that the pie size does not significantly affect initial demands (panels A and B: model 2, $p = 0.674$ and $p = 0.642$, respectively). This is expected because uninformed players do not know the pie size while negotiating (they learn the respective pie size only at the end of each round). The initial demands of uninformed players increase significantly as the bargaining rounds proceed (panels A and B: model 2, $p = 0.002$). Thus, like informed players, uninformed players become 'tougher' negotiators with experience. For the other control variables, we only find that uninformed players who are more risk-averse tend to place higher initial demands (panel A: model 2, $p = 0.084$).

(panel A: model 3, $p = 0.360$; model 4, $p = 0.477$) and when comparing pairwise with the premenstrual (panel B: model 3, $p = 0.505$; model 4, $p = 0.501$), menstrual (panel B: model 3, $p = 0.490$; model 4, $p = 0.699$), and postmenstrual (panel B: model 3, $p = 0.515$; model 4, $p = 0.268$) phase, respectively.[29] We summarize the results for uninformed players with respect to Hypothesis 1 in our next result.

Result 2 BARGAINING PROCESS – UNINFORMED PLAYERS
For uninformed players, neither initial demands nor relative concession rates vary significantly across the menstrual cycle.

Thus, for uninformed players we do not find statistical support for Hypothesis 1.

5.3 Bargaining outcomes: Payoffs and deal rates

For bargaining outcomes, we focus on the variables *Conditional payoffs* (i.e., payoffs conditional on reaching an agreement)and *Deal rates* (i.e., the frequency of agreements) (Hypothesis 2). Specifically, we expect that during ovulation conditional payoffs are higher and deal rates are lower than in the other menstrual phases. We also report results on *Final payoffs* (i.e., payoffs including disagreements). For the latter we do not have a directed hypothesis, because the expected menstrual cycle effect during ovulation on deal rates and conditional payoffs work in opposite directions for final payoffs. In the analysis, *Final payoffs* and *Conditional payoffs* are continuous variables at the individual level and *Deal rates* (or *Deals*) is a dummy variable at the pair level that takes the value one if a negotiation pair reaches an agreement in the respective bargaining round and zero otherwise.

Figure 6 displays the average conditional payoffs (left panel) and final payoffs (right panel) of informed and uninformed players for each menstrual phase, aggregated over the 10 bargaining rounds. For both types of players, both types of payoffs are highest during the ovulation phase.[30] In the following, we analyze bargaining outcomes across the menstrual cycle phases again separately for informed players and uninformed players.

Informed players

The regression analysis reported in Table 3 tests for differences in payoffs and deal rates of informed players between the ovulation and the other three menstrual phases. Analogously to the analysis of the bargaining process, the reference category in panel A is all menstrual phases, except ovulation, and the reference category in panel B is the premenstrual phase. The dependent variable is *Conditional payoffs* in models 1 and 2, *Deal rates* in models 3 and 4, and *Final payoffs* in models 5 and 6. In all models, we use the same set of explanatory variables as in the regressions for the bargaining process (cf. Tables 1 and 2), except that we add the initial bargaining position of the negotiation partner as a control variable to the former set of *Controls A* (therefore, renamed to *Controls A'*). We do this, because in previous studies the

[29] The coefficient estimates of the control variables are reported in Table B.4 in Appendix B.3. We find that neither the pie size (panels A and B: model 4, $p = 0.547$ and $p = 0.473$, respectively) nor bargaining round (panels A and B: model 4, $p = 0.691$ and $p = 0.693$, respectively) significantly influence concession rates. Social preferences do affect concessions, in that higher benevolence levels increase concession rates (panels A and B: model 4, $p = 0.020$ and $p = 0.055$, respectively), whereas risk aversion levels do not affect concession rates (panels A and B: model 4, $p = 0.668$).

[30] Individual final payoffs vary between €-6,00 and €22,00 for informed players, and between €0,00 and €19.90 for uninformed players. In all menstrual phases, final payoffs and conditional payoffs are significantly higher for the informed player in comparison to the uninformed players (Mann-Whitney U tests, $p < 0.001$).

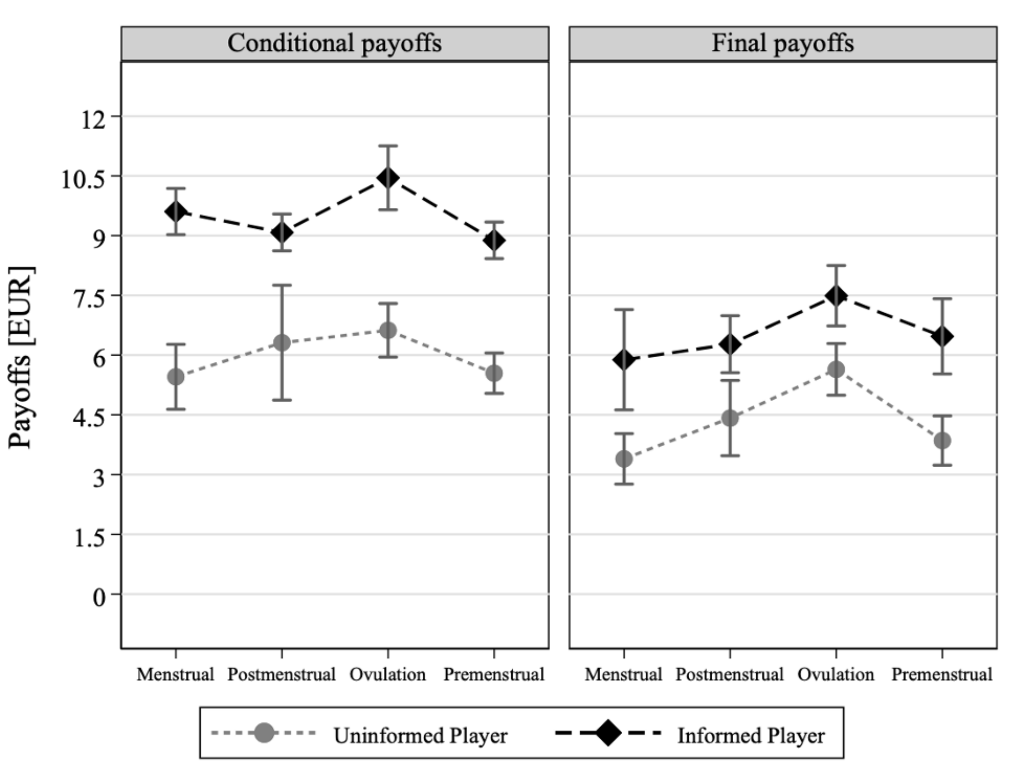


Figure 6. Conditional and final payoffs for informed and uninformed players.

Note: The figure shows *Conditional payoffs* and *Final payoffs* and their corresponding standard errors for each menstrual cycle phase. Standard errors are obtained from OLS regressions clustered on the matching group level and controlling for pie size and bargaining round.

partner's initial bargaining position has been shown to be an explanatory factor for bargaining outcomes (see, e.g., Gächter and Riedl, 2005; Karagözoğlu and Riedl, 2015; Camerer et al., 2019).[31]

We first present the results for conditional payoffs and deal rates for which we have a hypothesis, followed by the results for final payoffs. Models 1 and 2 indicate that during the ovulation phase these conditional payoffs are between €1.239 and €1.163 higher compared to the rest of the menstrual phases (panel A: model 1, $p = 0.062$; model 2, $p = 0.028$). Moreover, also in comparison to the other menstrual phases separately, conditional payoffs are higher during ovulation, albeit not always significantly so: premenstrual (panel B: model 1, $p = 0.100$; model 2, $p = 0.022$), menstruation (panel B: model 1, $p = 0.153$; model 2, $p = 0.261$), and postmenstrual (panel B: model 3, $p = 0.049$; model 4, $p = 0.068$).

Together, these results indicate that the decrease in compromising behavior, expressed mainly in lower initial offers, observed during the ovulation phase, translates into higher conditional payoffs for the informed players in that phase. It can be interpreted as reflecting a more competitive attitude in the negotiation process during ovulation.

In contrast to conditional payoffs, the effect of ovulation on deal rates is not significant, neither compared to all the other phases together nor separately: ovulation compared to the rest of menstrual phases (panel A: models 3 and 4, $p \geq 0.746$), ovulation compared to the other phases separately (panel B: models 3 and 4, $p \geq 0.229$).

[31] Camerer et al. (2019) suggest that the initial position of the partner in a bargaining pair influences strongly the final payoffs reflecting the interactive nature of the continuous bargaining stage. Moreover, Galinsky and Mussweiler (2001) show that lower initial offers of the bargaining partner seem to increase the chances of a deal, and this effect is stronger when the initial demand is smaller.

Table 3. Informed players' conditional payoffs, deal rates, and final payoffs.

	Conditional payoffs		Deal rates		Final payoffs	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Ovulation	1.239*	1.163**	0.015	-0.003	0.988	0.768
	(0.636)	(0.501)	(0.045)	(0.055)	(0.700)	(0.560)
Constant	-1.409**	-0.398	0.638***	0.532**	-1.441**	-0.568
	(0.585)	(1.860)	(0.087)	(0.198)	(0.665)	(1.230)
Controls A'	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes	No	Yes
Observations	364	364	520	520	520	520
Adjusted R^2	0.806	0.816	0.076	0.084	0.496	0.509
Panel B:						
Menstruation	0.013	0.358	-0.086	-0.075	-0.322	-0.045
	(0.478)	(0.536)	(0.061)	(0.049)	(0.561)	(0.411)
Postmenstrual	-0.563	-0.332	-0.042	-0.016	-0.479	-0.115
	(0.569)	(0.631)	(0.056)	(0.048)	(0.462)	(0.487)
Ovulation	1.087*	1.122**	-0.014	-0.019	0.792	0.728
	(0.638)	(0.461)	(0.052)	(0.060)	(0.728)	(0.548)
Constant	-1.257*	0.048	0.654***	0.511**	-1.288*	-0.472
	(0.663)	(1.958)	(0.086)	(0.195)	(0.717)	(1.354)
Controls A'	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes	No	Yes
Observations	364	364	520	520	520	520
Adjusted R^2	0.807	0.817	0.076	0.083	0.495	0.507
Ovulation vs Menstruation	1.074	0.764	0.072	0.056	1.114	0.837
[F-test p-value]	[0.153]	[0.261]	[0.229]	[0.388]	[0.162]	[0.245]
Ovulation vs Postmenstrual	1.65	1.454	0.028	-0.003	1.271	0.907
[F-test p-value]	[0.049]	[0.068]	[0.634]	[0.961]	[0.123]	[0.251]

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). Post-estimation F-tests for ovulation versus the menstrual and postmenstrual phases with the effect size and the corresponding p-values [in brackets]. The dependent variable is conditional payoffs in models 1 and 2, deal rates in models 3 and 4, and final payoffs in models 5 and 6. *Controls A'* include a set of bargaining covariates (pie size, bargaining round, and initial bargaining position of the negotiation partner). *Controls B* include a set of demographic covariates (age, nationality, and study background) and individual characteristics (risk preferences and social preferences). The reference group in Panel A (Panel B) is all menstrual phases except *Ovulation* (the premenstrual phase).

We summarize these observations related to Hypothesis 2 in the following result, which shows that, for informed players, the hypothesis is supported for conditional payoffs but not for deal rates.

Result 3 Conditional payoffs & deal rates – Informed players
(a) Informed players' conditional payoffs are significantly higher during ovulation than during the pooled other phases of the menstrual cycle, and, (marginally) also when compared to the premenstrual and postmenstrual phase, separately. (b) There is no evidence for differences in informed players' deal rates across the menstrual cycle.

Models 5 and 6 of Table 3 test the effect of ovulation on informed players' final payoffs. The results show that there is no significant effect: ovulation compared to the pooled other menstrual phases (panel A: models 5 and 6, $p \geq 0.170$), ovulation compared to the other phases separately (panel B: models 5 and 6, $p \geq 0.162$). The difference in effects of the ovulation phase between conditional and final payoffs cannot be attributed to a countervailing effect on deal rates because those barely vary across the menstrual cycle, but is likely due to the substantial increase of zero-payoffs from disagreements.[32,33]

Uninformed players

Table 4 reports regression analyses, comparing conditional payoffs (models 1 and 2), deal rates (models 3 and 4), and final payoffs (models 5 and 6), across the menstrual cycle phases of uninformed players. The explanatory variables and control variables are the same as those used for informed players.

For conditional payoffs, we do not observe differences during the ovulation phase when compared to the other three phases pooled (panel A: models 1 and 2, $p \geq 0.780$) or when compared to the other phases separately (panel B: models 1 and 2, $p \geq 0.515$). This is consistent with the bargaining process results for uninformed players, where we do not find differences in initial demands and concessions across their menstrual cycle.

However, deal rates are affected by the menstrual cycle phase players are in. Specifically, we observe significantly higher deal rates during ovulation compared to the other phases pooled (panel A: model 3, $p = 0.022$; model 4, $p = 0.034$) and compared to the other phases separately, except for the postmenstrual phase: premenstrual (panel B: model 3, $p = 0.045$; model 4, $p = 0.048$), menstruation (panel B: model 3, $p = 0.012$; model 4, $p = 0.031$), postmenstrual (panel B: model 3, $p = 0.178$; model 4, $p = 0.176$). Thus, uninformed players appear to manage to achieve more agreements during the ovulation phase.

We summarize these observations related to Hypothesis 2 in the following result, which shows that, for uninformed players, the hypothesis is not supported either for conditional payoffs or for deal rates.

Result 4 Conditional payoffs & deal rates – Uninformed players
(a) Uninformed players' conditional payoffs are not affected by the menstrual cycle. (b) Uninformed players' deal rates are higher during ovulation in comparison to the other cycle phases pooled, and also when compared to the premenstrual and menstruation phase, separately.

We hypothesized that deal rates will be lower during ovulation due to increased competitiveness during this phase, but we find the opposite. Further below we discuss a possible explanation for this unanticipated result.

Models 5 and 6 of Table 4 test for differences in final payoffs across the menstrual cycle. The results show that, during ovulation, final payoffs are higher when compared to the pooled rest of the cycle phases (panel A: model 5, $p = 0.020$; model 6, $p = 0.030$). Moreover, final payoffs during ovulation are also higher when compared separately with the premenstrual phase (panel B: model 5, $p = 0.030$; model 6, $p = 0.045$) and menstruation phase (panel B: model 5, $p = 0.005$; model 6, $p = 0.004$), but

[32] The shares of zero-payoffs in final payoffs within each cycle phase are not too different (menstruation: 38.75%, postmenstrual: 30.1%, ovulation: 29.17%, and premenstrual: 27.14%). Including a substantial number of zeros in two or more samples (proportionally) reduces the difference in means and increases the standard errors. Potentially leading to insignificant differences as is the case here.

[33] Table 3 in Appendix B.3 reports the coefficient estimates of the control variables. The impact of the pie size on all bargaining outcomes is significantly positive ($p < 0.001$, models 1–6) and the negotiation experience—captured by *Bargaining round*—affects deal rates and thereby final payoffs (marginally) significantly positively ($p < 0.05$, models 1–2 and $p < 0.1$ models 5–6, in panels A and B). Further, the initial demand of the matched uninformed player affects deal rates and thereby final payoffs significantly negatively ($p < 0.02$ and $p < 0.01$ models 1–2, and models 5–6, respectively, in both panels).

Table 4. Uninformed players' conditional payoffs, deal rates, and final payoffs.

	Conditional payoffs		Deal rates		Final payoffs	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Ovulation	0.090	0.038	0.153**	0.150**	1.093**	1.055**
	(0.318)	(0.274)	(0.063)	(0.067)	(0.439)	(0.458)
Constant	0.383**	0.632	0.442***	0.771***	-1.066***	0.527
	(0.183)	(1.232)	(0.060)	(0.189)	(0.265)	(1.391)
Controls A'	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes	No	Yes
Observations	319	319	450	450	450	450
Adjusted R^2	0.724	0.730	0.057	0.058	0.472	0.474
Panel B:						
Menstruation	-0.277	-0.233	-0.083	-0.077	-0.794*	-0.801**
	(0.453)	(0.554)	(0.070)	(0.081)	(0.403)	(0.364)
Postmenstrual	0.148	0.120	0.002	-0.001	0.297	0.218
	(0.398)	(0.404)	(0.071)	(0.072)	(0.366)	(0.335)
Ovulation	0.064	0.028	0.133**	0.135**	0.965**	0.945**
	(0.359)	(0.317)	(0.063)	(0.065)	(0.418)	(0.447)
Constant	0.404*	0.519	0.459***	0.756***	-0.969***	0.255
	(0.200)	(1.198)	(0.053)	(0.195)	(0.295)	(1.335)
Controls A'	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes	No	Yes
Observations	319	319	450	450	450	450
Adjusted R^2	0.724	0.729	0.058	0.057	0.478	0.479
Ovulation vs Menstruation	0.341	0.212	0.216	0.261	1.759	1.746
[F-test p-value]	[0.515]	[0.659]	[0.012]	[0.031]	[0.005]	[0.004]
Ovulation vs Postmenstrual	-0.084	0.136	0.131	0.092	0.668	0.727
[F-test p-value]	[0.815]	[0.771]	[0.178]	[0.176]	[0.224]	[0.515]

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). Post-estimation F-tests for ovulation versus the menstrual and postmenstrual phases with the effect size and the corresponding p-values [in brackets]. The dependent variable is conditional payoffs in models 1 and 2, deal rates in models 3 and 4, and final payoffs in models 5 and 6. *Controls A'* include a set of bargaining covariates (pie size, bargaining round, and initial bargaining position of the negotiation partner). *Controls B* include a set of demographic covariates (age, nationality, and study background) and individual characteristics (risk preferences and social preferences). The reference group in Panel A (Panel B) is all menstrual phases except *Ovulation* (the premenstrual phase).

not in comparison with the postmenstrual phase (panel B: model 5 and 6, $p \geq 0.224$). The main reason for the positive effect of ovulation on final payoffs is the high frequency of deal rates (72%) during this phase (for details, see Table B.2 in Appendix B.2).[34]

6 Discussion and conclusion

Our study shows that the menstrual cycle affects bargaining behavior of women and thereby contributes to the nascent but growing literature on the impact of biological factors on economic behavior (Kosfeld et al., 2005; Burnham, 2007; Apicella et al., 2008; Zethraeus et al., 2009; Eisenegger et al., 2010; Buser, 2012b,a; Wozniak et al., 2014; Nave et al., 2015; Schipper, 2015; Lazzaro et al., 2016; Ranehill et al.,

[34] Table B.6 in Appendix B.3 reports the coefficient estimates of the control variables. The pie size and the initial offer of the matched informed player strongly affect uninformed players' bargaining outcomes—both final and conditional payoffs (panels A and B: models 1–4, $p < 0.010$) and (marginally) also deal rates (panels A and B: models 5–6, $p < 0.100$). Although the pie size is not known to uninformed players', their bargaining outcomes appear to be affected by it through information transmitted during the interaction with the matched informed player. This can happen through informed players' initial offers, which impact uninformed players' payoffs positively (panels A and B: models 1–4, $p < 0.001$) together with learning to accrue higher payoffs over rounds as captured by the variable *Bargaining round* (panels A and B: models 1–4, $p < 0.05$).

2018). To our knowledge, this is the first study that investigates the effect of the menstrual cycle on bargaining in a controlled laboratory experiment. For this, we implement a variant of the unstructured bilateral bargaining game proposed by Camerer et al. (2019), with asymmetric information about the pie size, involving an informed and an uninformed player.

Based on evidence of how the menstrual cycle affects competitiveness and risk taking, we propose hypotheses for important aspects of the bargaining process (initial offers and demands and concessions) and bargaining outcomes (payoffs conditional on a deal and deal rates) and also explore final payoffs. In particular, we expected that, during the ovulation phase, players will be less compromising in their initial bargaining positions and during bargaining, and consequently will achieve higher payoffs conditional on a deal but lower deal rates, with an ambiguous effect on final payoffs.

The hypotheses are partially supported by the data and there are differences depending on the information a player has. Informed players are less compromising in their initial proposals during their ovulation phase but we do not find such an effect for uninformed players and concessions for either player type. During ovulation, informed players achieve higher payoffs conditional on a deal but deal rates are unaffected. Uninformed players' final payoffs are higher during ovulation, which is driven largely by higher deal rates during this phase, which runs counter to our expectations.

Next to these main results, we also observe that players learn, as they become tougher and better negotiators when gaining experience over bargaining rounds, which is in line with Camerer et al. (2019)'s findings. In later rounds, both player types initiate the negotiation with a less compromising bargaining position, informed players reach more deals, and both player types obtain higher (conditional) payoffs. Moreover, the pie size and the partner's initial bargaining position do predict bargaining behavior and outcomes.

Contrary to our hypotheses, during the ovulation phase, uninformed players display an increase in deal rates and consequently higher final payoffs. We offer a possible interpretation for these unanticipated results, related to social status. The hormone testosterone is thought to be implicated in social status (see, e.g., Dreher et al., 2016) and the medical literature has shown that the body transforms testosterone into estradiol (Ishikawa et al., 2006). As estradiol levels are higher during the ovulation phase, social status may be more important for women in this phase. Thus, during this phase, informed players—who know the pie size—may experience a higher status when getting a higher share, which is consistent with our evidence. On the other hand, for uninformed players—who do not know the pie size—social status may be increased by achieving more deals, which is what we observe. This is also consistent with evidence that higher testosterone levels induce proposers in the ultimatum game to make more generous offers because they care more about reaching a deal (Eisenegger et al., 2010). Admittedly this interpretation is post-hoc and speculative and future research should investigate it thoroughly.

Overall, our findings show that biological factors can affect bargaining behavior and outcomes, and women can obtain better negotiation outcomes during the ovulation phase. We see our research as a staring point and many important questions remain open. We list a few possible avenues of future research, which could exploit our research design. First, as mentioned already, increased social status concerns during the ovulation phase could be a possible explanation of the divergent results between informed and uninformed players. This is suggestive but the hypotheses need to be tested in a controlled environment. Second, to reduce potential noise in bargaining we focus on negotiations between women only. Arguably, in the field important negotiations can take place in mixed gender pairs, especially in labor relations. Thus, extending our research to a mixed gender setting is a natural next step. Third, in our setting naturally cycling women bargain with other naturally cycling women as well as contraceptive takers. We have too little statistical power to investigate potential interaction effects between contraceptive takers and non-contraceptive takers. These interactions could be explored more in depth. Fourth, we find that exogenous and endogenous factors such as the pie size, experience, and initial offers of the bargaining partner affect behavior. It may be interesting to explore if the menstrual cycle phases interact with these factors. Fifth, but not least, as this is the first study on bargaining and the menstrual cycle, the robustness of our results should be scrutinized in a replication study.

References

Andersen, S., Harrison, G. W., Lau, M. I., and Rutström, E. E. (2008). Eliciting risk and time preferences. *Econometrica*, 76(3):583–618.

Apicella, C. L., Dreber, A., Campbell, B., Gray, P. B., Hoffman, M., and Little, A. C. (2008). Testosterone and financial risk preferences. *Evolution and Human Behavior*, 29(6):384–390.

Babcock, L. and Laschever, S. (2009). *Women don't ask: Negotiation and the gender divide*. Princeton University Press.

Baranski, A., Geraldes, D., Kovaliukaite, A., and Tremewan, J. (2023). An experiment on gender representation in majoritarian bargaining. *Management Science*.

Baranski, A. and Morton, R. (2022). The determinants of multilateral bargaining: A comprehensive analysis of Baron and Ferejohn majoritarian bargaining experiments. *Experimental Economics*, 25(4):1079–1108.

Benjamini, Y. and Hochberg, Y. (1995). Controlling the false discovery rate: a practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society: Series B (Methodological)*, 57(1):289–300.

Bolton, G. E. and Karagözoğlu, E. (2016). On the influence of hard leverage in a soft leverage bargaining game: The importance of credible claims. *Games and Economic Behavior*, 99:164–179.

Bröder, A. and Hohmann, N. (2003). Variations in risk taking behavior over the menstrual cycle: An improved replication. *Evolution and Human Behavior*, 24(6):391–398.

Bruhin, A., Fehr-Duda, H., and Epper, T. (2010). Risk and rationality: Uncovering heterogeneity in probability distortion. *Econometrica*, 78(4):1375–1412.

Burnham, T. C. (2007). High-testosterone men reject low ultimatum game offers. *Proceedings of the Royal Society B: Biological Sciences*, 274(1623):2327–2330.

Buser, T. (2012a). Digit ratios, the menstrual cycle and social preferences. *Games and Economic Behavior*, 76(2):457–470.

Buser, T. (2012b). The impact of the menstrual cycle and hormonal contraceptives on competitiveness. *Journal of Economic Behavior & Organization*, 83(1):1–10.

Camerer, C. F., Nave, G., and Smith, A. (2019). Dynamic unstructured bargaining with private information: theory, experiment, and outcome prediction via machine learning. *Management Science*, 65(4):1867–1890.

Cameron, A. C., Gelbach, J. B., and Miller, D. L. (2008). Bootstrap-based improvements for inference with clustered errors. *The Review of Economics and Statistics*, 90(3):414–427.

Cettolin, E., Riedl, A., and Tran, G. (2017). Giving in the face of risk. *Journal of Risk and Uncertainty*, 55(2-3):95–118.

Chavanne, T. J. and Gallup Jr, G. G. (1998). Variation in risk taking behavior among female college students as a function of the menstrual cycle. *Evolution and Human Behavior*, 19(1):27–32.

Chen, K. and Tang, F.-F. (2009). Cultural differences between tibetans and ethnic han chinese in ultimatum bargaining experiments. *European Journal of Political Economy*, 25(1):78–84.

Chen, Y., Katuščák, P., and Ozdenoren, E. (2013). Why cant a woman bid more like a man? *Games and Economic Behavior*, 77(1):181–213.

Creinin, M. D., Keverline, S., and Meyn, L. A. (2004). How regular is regular? an analysis of menstrual cycle regularity. *Contraception*, 70(4):289–292.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., and Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association*, 9(3):522–550.

Dreher, J.-C., Dunne, S., Pazderska, A., Frodl, T., Nolan, J. J., and O'Doherty, J. P. (2016). Testosterone causes both prosocial and antisocial status-enhancing behaviors in human males. *Proceedings of the National Academy of Sciences*, 113(41):11633–11638.

D'Exelle, B., Gutekunst, C., and Riedl, A. (2023). The effect of gender and gender pairing on bargaining: Evidence from an artefactual field experiment. *Journal of Economic Behavior & Organization*, 205:237–269.

Eisenegger, C., Naef, M., Snozzi, R., Heinrichs, M., and Fehr, E. (2010). Prejudice and truth about the effect of testosterone on human bargaining behaviour. *Nature*, 463(7279):356–359.

Embrey, M., Hyndman, K. B., and Riedl, A. (2021). Bargaining with a residual claimant: An experimental study. *Games and Economic Behavior*, 126:335–354.

Fischbacher, U. (2007). z-tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics*, 10(2):171–178.

Gächter, S. and Riedl, A. (2005). Moral property rights in bargaining with infeasible claims. *Management Science*, 51(2):249–263.

Galinsky, A. D. and Mussweiler, T. (2001). First offers as anchors: the role of perspective-taking and negotiator focus. *Journal of Personality and Social Psychology*, 81(4):657.

Greiner, B. (2015). Subject pool recruitment procedures: organizing experiments with ORSEE. *Journal of the Economic Science Association*, 1(1):114–125.

Güth, W., Schmidt, C., and Sutter, M. (2007). Bargaining outside the lab–a newspaper experiment of a three-person ultimatum game. *The Economic Journal*, 117(518):449–469.

Haag, P., Hanhart, N., and Müller, M. (2016). Gynäkologie und urologie für studium und praxis: inkl. geburtshilfe, reproduktionsmedizin, sexualmedizin, andrologie u. venerologie; unter berücksichtigung des gegenstandskataloges und der mündlichen examina in den ärztlichen prüfungen. *Med. Verlag-und Informationsdienste.*

Hampson, E. and Young, E. A. (2008). Methodological issues in the study of hormone-behavior relations in humans: Understanding and monitoring the menstrual cycle. *Sex Differences in the Brain: From Genes to Behavior*, pages 63–78.

Hernandez-Arenaz, I. and Iriberri, N. (2019). A review of gender differences in negotiation. *Oxford Research Encyclopedia of Economics and Finance*.

Hernandez-Arenaz, I. and Iriberri, N. (2023). Gender differences in alternating-offer bargaining: An experimental study. *Experimental Economics*, pages 1–36.

Holt, C. A. and Laury, S. K. (2002). Risk aversion and incentive effects. *American Economic Review*, 92(5):1644–1655.

Ishikawa, T., Glidewell-Kenney, C., and Jameson, J. L. (2006). Aromatase-independent testosterone conversion into estrogenic steroids is inhibited by a 5α-reductase inhibitor. *The Journal of Steroid Biochemistry and Molecular Biology*, 98(2-3):133–138.

Karagözoğlu, E. and Riedl, A. (2015). Performance information, production uncertainty, and subjective entitlements in bargaining. *Management Science*, 61(11):2611–2626.

Kerschbamer, R. (2015). The geometry of distributional preferences and a non-parametric identification approach: The equality equivalence test. *European Economic Review*, 76:85–103.

Kosfeld, M., Heinrichs, M., Zak, P. J., Fischbacher, U., and Fehr, E. (2005). Oxytocin increases trust in humans. *Nature*, 435(7042):673–676.

Laroze, D., Hugh-Jones, D., and Leininger, A. (2020). The impact of group identity on coalition formation. *Research & Politics*, 7(4):2053168020967488.

Lazzaro, S. C., Rutledge, R. B., Burghart, D. R., and Glimcher, P. W. (2016). The impact of menstrual cycle phase on economic choice and rationality. *PLoS One*, 11(1):e0144080.

Lovett, J. L., Chima, M. A., Wexler, J. K., Arslanian, K. J., Friedman, A. B., Yousif, C. B., and Strassmann, B. I. (2017). Oral contraceptives cause evolutionarily novel increases in hormone exposurea risk factor for breast cancer. *Evolution, Medicine, and Public Health*, 2017(1):97–108.

Lozano, L., Ranehill, E., and Reuben, E. (2023). Gender and preferences in the labor market: Insights from experiments. In K. F. Zimmermann (ed.). *Handbook of Labor, Human Resources and Population Economics*, pages 1–34.

Mazei, J., Hüffmeier, J., Freund, P. A., Stuhlmacher, A. F., Bilke, L., and Hertel, G. (2015). A meta-analysis on gender differences in negotiation outcomes and their moderators. *Psychological Bulletin*, 141(1):85.

Murnighan, J. K., Roth, A. E., and Schoumaker, F. (1988). Risk aversion in bargaining: An experimental study. *Journal of Risk and Uncertainty*, 1(1):101–124.

Nave, G., Camerer, C., and McCullough, M. (2015). Does oxytocin increase trust in humans? a critical review of research. *Perspectives on Psychological Science*, 10(6):772–789.

Pearson, M. and Schipper, B. C. (2013). Menstrual cycle and competitive bidding. *Games and Economic Behavior*, 78:1–20.

Ranehill, E., Zethraeus, N., Blomberg, L., von Schoultz, B., Hirschberg, A. L., Johannesson, M., and Dreber, A. (2018). Hormonal contraceptives do not impact economic preferences: Evidence from a randomized trial. *Management Science*, 64(10):4515–4532.

Schipper, B. C. (2015). Sex hormones and competitive bidding. *Management Science*, 61(2):249–266.

Shalev, J. (2002). Loss aversion and bargaining. *Theory and Decision*, 52(3):201–232.

Stricker, R., Eberhart, R., Chevailler, M.-C., Quinn, F. A., Bischof, P., and Stricker, R. (2006). Establishment of detailed reference values for luteinizing hormone, follicle stimulating hormone, estradiol, and progesterone during different phases of the menstrual cycle on the abbott architect® analyzer. *Clinical Chemistry and Laboratory Medicine (CCLM)*, 44(7):883–887.

Wakker, P. P. (2008). Explaining the characteristics of the power (CRRA) utility family. *Health Economics*, 17(12):1329–1344.

Wozniak, D., Harbaugh, W. T., and Mayr, U. (2014). The menstrual cycle and performance feedback alter gender differences in competitive choices. *Journal of Labor Economics*, 32(1):161–198.

Zethraeus, N., Kocoska-Maras, L., Ellingsen, T., von Schoultz, B., Hirschberg, A. L., and Johannesson, M. (2009). A randomized trial of the effect of estrogen and testosterone on economic behavior. *Proceedings of the National Academy of Sciences*, 106(16):6535–6538.

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Appendix

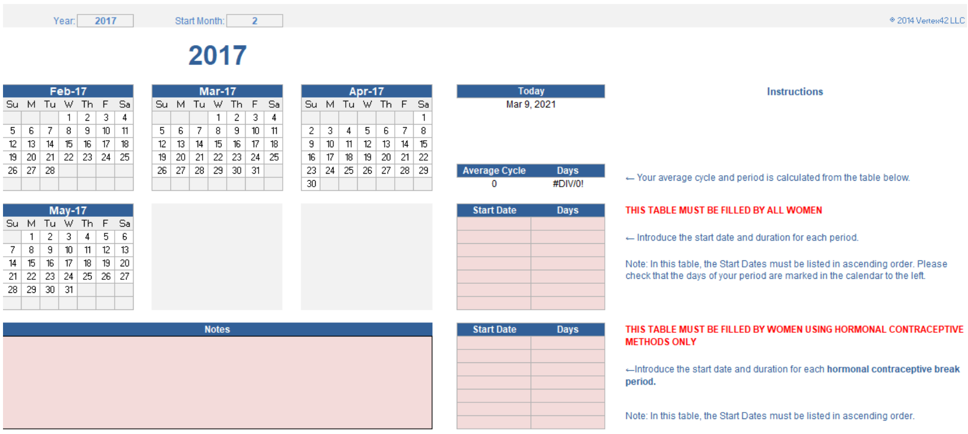
A Experimental design details

In this subsection, we provide detailed information of the menstrual tracking phase and additional details about the experiment tasks.

A.1 Tracking and estimation of the menstrual cycle phases

Three months before the lab sessions take place, participants attend an introductory meeting to learn about the duration of the whole experiment and also receive detailed instructions on how to track their menstrual cycle.[35] To track the menstrual cycle, participants had an electronic menstrual cycle calendar as the one displayed in Figure A.1. Within the electronic calendar interface, participants were required to input the starting day and the duration of their menstruation for a continuous three-month timeframe. Furthermore, women utilizing hormonal contraceptive methods provided details about their chosen method and, if applicable, the schedule for the pill intake period. Participants received reminders every two weeks to guarantee consistent calendar entries at least once per month.

Figure A.1. Electronic menstrual cycle calendar



About two weeks before the behavioral experimental sessions, participants handed in the menstrual cycle calendar to the researchers and were assigned to one of the scheduled experimental sessions. We pre-allocated participants to these sessions in order to achieve a balanced representation across distinct menstrual phases. Approximately two and a half months into the menstrual cycle tracking, we could reasonably predict the phase participants would be in during the behavioral experimental session. During the session itself, participants submitted their menstrual cycle calendars for the final time. Notably, each participant was assigned an individual ID to ensure anonymity throughout the entire study duration.[36]

[35]Participants remained unaware of the precise nature of the lab sessions; their only knowledge was that they would be required to attend a single behavioral experiment session following the three-month tracking period.

[36]Importantly, to ensure careful treatment of the menstrual cycle information, participants consistently interacted with the same female researcher throughout the experiment.

Estimation of menstrual cycle phases using the calendar information As illustrated in Figure 1, our methodology involved utilizing the individual average cycle duration, the mean individual menstruation length, as well as specific periods of 5 days for ovulation and 12 days for the premenstrual phase. With these parameters in mind, we proceeded to estimate the menstrual phases using the following four steps:

1. The menstrual phase is obtained by using the last day of their cycle reported in the calendar and their individual average menstruation duration.

2. The premenstrual phase is calculated by using the expected next menstruation date and an average duration of 12 days for this phase.

3. We calculated the ovulation phase by using the expected next menstruation date minus the premenstrual phase, and an average duration of 5 days for this phase.

4. Lastly, the postmenstrual phase is obtained by using the day after the menstrual phase and the date right before the ovulation phase.[37] Importantly, on the day of the behavioral experimental session we asked participants whether they were experiencing menstrual bleeding on that day, this helped us to allocate them correctly between the menstrual and postmenstrual phases.

For most participants, we used a "backward" estimation method of their menstrual phase. That is, if participants expected their next menstruation to start after the behavioral experimental session, we estimated their menstrual phases backward to ensure the session date occurred during one of the estimated phases. Contrary, if participants had their expected next menstruation date before the experiment session date, we estimate their menstrual phases forward (11 out of 97 participants required a forward estimation).

A.2 Risk and social preference elicitation tasks

In this Subsection, we describe in detail the risk and social preference elicitation tasks, which correspond to parts 2 and 3 in the experiment, respectively.

Part 2: Risk preferences. In part 2, participants' risk preferences are elicited following the experimental design in Cettolin et al. (2017). In ten different multiple price lists (MPL), participants decide between one of the ten lotteries displayed in Table A.1 and ten sure amounts.[38] Specifically, each MPL contains ten rows where in each row the sure amount decreases monotonically from the highest outcome in the lottery to the lowest outcome in the lottery in equally spaced steps. Also, the values chosen for the lotteries and certain amounts range around the pie sizes used in the bargaining stage (i,e., from 0 to 24). To ensure a unique switching point within a MPL, participants are allowed to switch only once between the lottery and the sure amount.

[37] We proceed in the second and third steps with the premenstrual and ovulation phases, and not postmenstrual, since the latter is known to be the phase with the most variation at individual level (Hampson and Young, 2008).

[38] See Appendix B.7 for an example of the decision screen that participants see during the experiment in Part 2.

Table A.1. Lotteries for risk preferences.

Lottery	$p1$	$x1$	$x2$
1	0.2	16	5
2	0.5	10	4
3	0.8	7	20
4	0.15	22	2
5	0.25	15	4
6	0.33	12	0
7	0.2	13	3
8	0.35	18	6
9	0.9	4	24
10	0.33	10	6

Note: $p1$ is the probability of winning €$x1$.

Using the switching points, we calculate the certainty equivalent of each MPL as the average between the smallest sure amount preferred to the lottery and the next smallest sure amount in the MPL. We estimate risk preferences with the certainty equivalents at the individual level assuming a CRRA power utility function for money $U(x) = x^{1-\alpha}$, where $0 < \alpha < 1$ indicates risk aversion, $\alpha = 0$ risk neutrality and $\alpha < 0$ risk lovingness (Holt and Laury, 2002; Andersen et al., 2008; Wakker, 2008; Dohmen et al., 2011). At the end of the experiment, one of the 10 MPLs is randomly chosen with equal chance, and one of the 10 rows within the selected MPL is chosen with equal probability to be paid out (if part 2 is selected for payment).

Part 3: Social preferences. In this part, participants' social preferences are elicited using the experimental task developed by Kerschbamer (2015). In the task, participants make incentivized individual binary choices between ten allocations that entail a payoff for the decision maker herself and a payoff for a randomly matched player—the passive player. As displayed by the two first columns and two last columns in Table A.2, there are two types of allocations: Right and Left. The Right options represent symmetric allocations, where both players receive the same amount (i.e., €2 for each player). The Left options represent asymmetric allocations, where both players receive different amounts. Specifically, for the Left allocations, there are two blocks of 5 allocations each: a disadvantageous inequality block and an advantageous inequality block. In the former block, the decision maker always gets a smaller amount than the passive player, whereas in the latter block, the opposite happens.

We use an index that measures the degree of benevolent (or malevolent) behavior given the choices participants make in the (dis)advantageous blocks. Specifically, we categorize a player to have a high degree of benevolence if, when confronted with the binary choices in the disadvantageous inequality block, she chooses most of the times the asymmetric allocation; and, when confronted with the binary choices in the advantageous inequality block, she chooses most of the times the symmetric allocation.[39]

Table A.2. Choices for social preferences.

Left		Right	
You get	Passive person gets	You get	Passive person gets
Disadvantageous inequality block			
€1.60	€2.60	€2.00	€2.00
€1.80	€2.60	€2.00	€2.00
€2.00	€2.60	€2.00	€2.00
€2.20	€2.60	€2.00	€2.00
€2.40	€2.60	€2.00	€2.00
Advantageous inequality block			
€1.60	€1.40	€2.00	€2.00
€1.80	€1.40	€2.00	€2.00
€2.00	€1.40	€2.00	€2.00
€2.20	€1.40	€2.00	€2.00
€2.40	€1.40	€2.00	€2.00

Note: this table was not displayed to the participants. There were presented each row in separate screens and in a random order.

Following the design of Kerschbamer (2015), we use a double role assignment protocol. That is, each participant gets two payoffs in this part, one obtained for the role of decision maker and the other one for the role of passive player. At the end of the experiment, the earnings from this part correspond to the payoff from one of the ten choices made as an active decision maker (randomly selected with equal probability) plus the payoff obtained as a passive player (if part 3 is selected for payment).[40]

B Descriptive statistics and robustness checks

B.1 Descriptive statistics

Table B.1 displays demographic statistics such as age, nationality, education, and role during the bargaining game for both non-contraceptive and contraceptive takers across their respective phases. Overall, we observe that women from different menstrual phases in our sample have similar characteristics. This ensures participants in our sample do not differ in any other dimension apart from being in a different menstrual phase. Lastly, the last two rows of Table B.1 show the distribution of participants across the two roles assigned during the bargaining task.

[39] The index is a counting variable of how many times a participant chooses the asymmetric allocation in the disadvantageous block and chooses the symmetric allocation in the advantageous block. This benevolence index ranges from zero to nine, where the closer to zero the less benevolent the participant is considered. Note that we do not use the measurement of distributional preferences suggested by Kerschbamer (2015) because the switching behavior of our participants doesn't allow for the rationalization of such choices. We observe more than one switching per block for some participants (7 and 12 participants in the disadvantageous and advantageous blocks, respectively). This inconsistent switching behavior makes it difficult to precisely estimate participants' distributional preferences for the entire sample.

[40] We ensured that the matched participant (either decision maker or passive player) remained anonymous and had not interacted with the player before in the experiment. Also, participants were aware that the decision maker they were matched with as a passive player was not the same passive player they were matched with as a decision maker.

Table B.1. Descriptive statistics.

	Non-contraceptive takers				Contraceptive takers	
	Menstrual (n=17)	Postmens. (n=19)	Ovulat. (n=20)	Premens. (n=41)	Intake (n=42)	Break (n=27)
Age (mean)	22.6±3.2	21.3±2.1	21.5±3.2	21.2±2.6	21.1±1.9	20.9±2.4
Nationality-no.						
Dutch/Germ/Belg.	14 (82%)	14 (74%)	12 (60%)	30 (73%)	38 (90%)	25 (93%)
Other	3 (18%)	5 (26%)	8 (40%)	11 (27%)	4 (10%)	2 (7%)
Studies-no.						
Econ. related	7 (41%)	11 (58%)	16 (80%)	32 (78%)	31 (74%)	20 (74%)
Other	10 (49%)	8 (42%)	4 (20%)	9 (22%)	11 (26%)	7 (26%)
Barg. Role-no.						
Informed	8 (47%)	11 (58%)	12 (60%)	21 (51%)	23 (55%)	19 (70%)
Uninformed	9 (53%)	8 (42%)	8 (40%)	20 (49%)	19 (45%)	8 (30%)

Note: plus-minus values are means ± SD. Percentages are calculated as the number of participants in the corresponding category over the total number of participants in the specific menstrual phase.

B.2 Additional analysis non-contraceptive takers

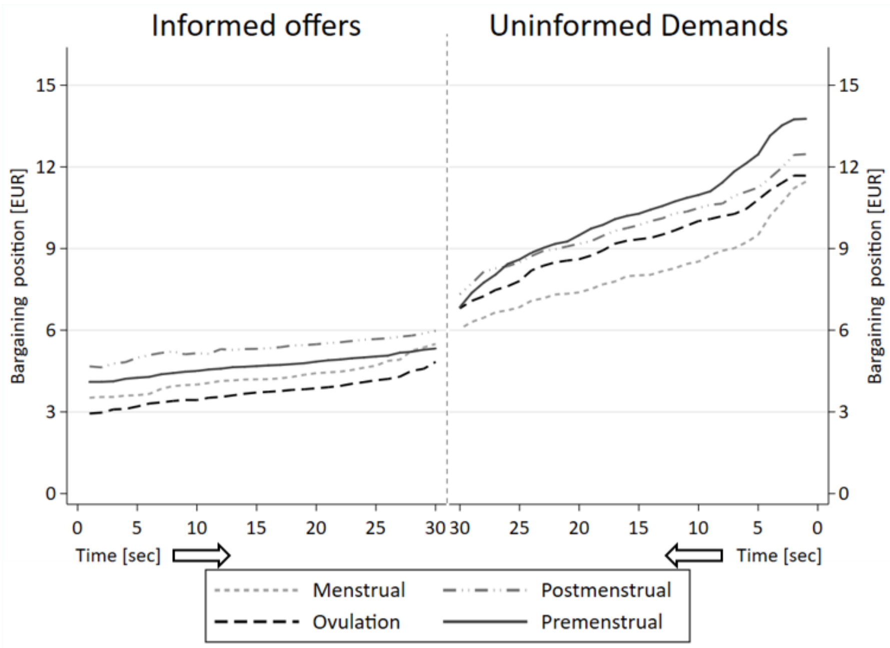


Figure B.1. Bargaining position across time during the simultaneous bargaining stage.

Table B.2. Informed and uninformed players' deal rates, payoffs conditional on a deal, and final payoffs.

	Conditional payoffs			Deal rates			Final payoffs		
	Inf.	Uninf.	Diff	Inf.	Uninf.	Diff	Inf.	Uninf.	Diff
Menstrual	9.606	5.455	4.150 [0.001]	0.612	0.622	.009 [0.009]	5.883	3.394	2.489 [0.001]
Postmenstrual	9.080	6.312	2.767 [0.001]	0.690	0.7	.690 [0.893]	6.273	4.418	1.854 [0.0172]
Ovulation	10.452	6.602	3.849 [0.001]	0.85	0.716	.133 [0.028]	7.490	5.612	1.878 [0.028]
Premenstrual	8.882	5.545	3.337 [0.001]	0.728	0.695	0.033 [0.454]	6.471	3.854	2.617 [0.001]
Total	9.392	5.889	3.502 [0.001]	0.7	0.708	.008 [0.762]	6.574	4.175	2.399 [0.001]

Note: Mean values of payoffs conditional on a deal, deal rates, and final payoffs for informed and uninformed players by the menstrual phases. The column labeled "Diff" displays the difference between informed and uninformed players' mean values and the corresponding p-value from a two-sample test with equal variance [in parentheses]. The sample size of informed and uninformed players in the menstrual phase is $n_{inf} = 80$ and $n_{uninf} = 90$, respectively. For postmenstrual, $n_{inf} = 110$ and $n_{uninf} = 80$, ovulation $n_{inf} = 120$ and $n_{uninf} = 80$, and premenstrual $n_{inf} = 210$ and $n_{uninf} = 200$.

B.3 Bargaining behavior and outcomes: Regressions including all covariates coefficients.

In this subsection, we perform the analysis done in Tables 1, 2, 3 and 4, but this time we display the coefficients for all demographic and the bargaining controls, as well as individuals' risk and social preferences. We use an Ordinary Least Square specification and cluster errors at the matching group level in the regression estimates presented in Tables B.3, B.4, B.5 and B.6. In all models, we control for a set of covariates for demographics (age, nationality, and educational background), a set of covariates for bargaining variables: *Pie size*, which is the total amount over which a negotiation pair bargains in the respective round, and *Bargaining round*. *Risk aversion* captures an individual's risk aversion coefficient estimated from the risk elicitation task and *Social preferences* measures the informed player's level of benevolence (higher values indicate higher levels of risk aversion and benevolence, respectively). In Tables B.3 (and B.4), the dependent variable is initial offers (demands) in models 1 and 2 and relative concession rates in models 3 and 4. In Tables B.5 and B.6, the dependent variable is final payoffs in models 1 and 2, conditional payoffs in models 3 and 4, and deals in models 5 and 6.

We expect both risk-averse and altruistic players to be more likely to compromise. That is, risk-averse informed players are expected to offer more to the bargaining partner, and risk-averse uninformed players demand less. Pro-social individuals are expected to choose more generous allocations, that is, higher offers of informed players and lower demands of uninformed players.

Table B.3. Initial offers and relative concession rates for informed players.

	Initial offer		Concession rate	
	(1)	(2)	(3)	(4)
Panel A:				
Ovulation	-1.263**	-1.121**	-0.001	-0.005
	(0.591)	(0.514)	(0.048)	(0.055)
Pie size	0.209***	0.206***	0.000	0.000
	(0.021)	(0.022)	(0.006)	(0.006)
Bargaining round	-0.119***	-0.119***	0.011	0.011
	(0.028)	(0.028)	(0.012)	(0.012)
Risk Aversion		-0.294**		-0.004
		(0.113)		(0.017)
Benevolence		0.201		0.001
		(0.130)		(0.021)
Age		-0.028		-0.020
		(0.095)		(0.017)
West European		0.880*		0.052
		(0.460)		(0.074)
EconBusiness		0.067		-0.036
		(0.573)		(0.097)
Constant	1.867***	0.585	0.098*	0.521
	(0.244)	(2.484)	(0.051)	(0.420)
Observations	520	520	520	520
Adjusted R^2	0.304	0.338	-0.004	-0.005
Panel B:				
Menstrual	-0.582	-0.865	0.031	0.053
	(0.730)	(0.779)	(0.039)	(0.049)
Postmenstrual	0.466	0.273	0.022	0.009
	(0.689)	(0.753)	(0.138)	(0.132)
Ovulation	-1.252**	-1.177**	0.011	0.006
	(0.608)	(0.474)	(0.039)	(0.049)
Pie size	0.208***	0.205***	0.000	0.001
	(0.022)	(0.022)	(0.006)	(0.006)
Bargaining round	-0.119***	-0.119***	0.011	0.011
	(0.028)	(0.028)	(0.012)	(0.012)
Age		-0.001		-0.021
		(0.102)		(0.018)
West European		0.915*		0.051
		(0.454)		(0.070)
EconBusiness		-0.019		-0.028
		(0.572)		(0.100)
Risk Aversion		-0.305**		-0.002
		(0.119)		(0.017)
Benevolence		0.234		-0.001
		(0.145)		(0.023)
Constant	1.869***	-0.054	0.087*	0.535
	(0.346)	(2.745)	(0.043)	(0.465)
Observations	520	520	520	520
Adjusted R^2	0.313	0.350	-0.007	-0.009

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). The reference group in Panel A (Panel B) is all menstrual phases except *Ovulation* (the premenstrual phase).

Table B.4. Initial demands and relative concession rates for uninformed players

	Initial demand		Concession rate	
	(1)	(2)	(3)	(4)
Panel A:				
Ovulation	-1.128	-1.541	0.058	0.059
	(1.407)	(1.464)	(0.062)	(0.081)
Pie size	0.010	0.011	-0.006	-0.005
	(0.029)	(0.027)	(0.005)	(0.004)
Bargaining round	0.210***	0.210***	0.006	0.006
	(0.060)	(0.060)	(0.019)	(0.019)
Risk Aversion		0.762*		0.002
		(0.423)		(0.013)
Benevolence		-0.606		0.016
		(0.563)		(0.034)
Age		0.179		-0.016
		(0.126)		(0.022)
West European		1.991*		-0.036
		(1.123)		(0.083)
EconBusiness		1.552		0.055
		(1.091)		(0.093)
Constant	11.629***	8.941*	0.396***	0.634
	(0.786)	(4.893)	(0.105)	(0.518)
Observations	450	450	450	450
Adjusted R^2	0.018	0.134	-0.001	-0.006
Panel B:				
Menstrual	-2.310	-1.113	-0.072	-0.046
	(1.382)	(1.380)	(0.103)	(0.119)
Postmenstrual	-1.287	-0.491	0.038	0.054
	(1.577)	(1.550)	(0.057)	(0.048)
Ovulation	-1.968	-1.856	0.049	0.060
	(1.816)	(1.723)	(0.072)	(0.088)
Pie size	0.011	0.012	-0.006	-0.005
	(0.027)	(0.026)	(0.005)	(0.004)
Bargaining round	0.210***	0.210***	0.006	0.006
	(0.060)	(0.060)	(0.019)	(0.019)
Risk Aversion		0.712*		0.001
		(0.416)		(0.013)
Benevolence		-0.546		0.019
		(0.537)		(0.032)
Age		0.180		-0.016
		(0.127)		(0.022)
West European		2.065*		-0.031
		(1.125)		(0.076)
EconBusiness		1.380		0.054
		(1.038)		(0.091)
Constant	12.459***	8.979*	0.402***	0.596
	(1.230)	(4.802)	(0.122)	(0.524)
Observations	450	450	450	450
Adjusted R^2	0.048	0.137	-0.003	-0.008

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). The reference group in Panel A (Panel B) is all menstrual phases except *Ovulation* (the premenstrual phase).

Table B.5. Informed players' final payoffs, payoffs conditional on a deal, and deal rates.

	Conditional payoffs		Deal rates		Final payoffs	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Ovulation	1.239*	1.163**	0.015	-0.003	0.988	0.768
	(0.636)	(0.501)	(0.045)	(0.055)	(0.700)	(0.560)
Initial Position Partner	-0.034	-0.022	-0.017***	-0.018***	-0.143**	-0.142**
	(0.054)	(0.054)	(0.005)	(0.005)	(0.055)	(0.055)
Risk Aversion		0.388***		0.028***		0.506***
		(0.104)		(0.010)		(0.101)
Benevolence		-0.293**		0.002		-0.084
		(0.128)		(0.012)		(0.104)
Age		0.033		0.007		0.030
		(0.076)		(0.007)		(0.038)
West European		-0.251		-0.097**		-1.288***
		(0.415)		(0.043)		(0.313)
EconBusiness		0.012		0.029		-0.183
		(0.371)		(0.055)		(0.330)
Constant	-1.409**	-0.398	0.638***	0.532**	-1.441**	-0.568
	(0.585)	(1.860)	(0.087)	(0.198)	(0.665)	(1.230)
Observations	364	364	520	520	520	520
Adjusted R^2	0.806	0.816	0.076	0.084	0.496	0.509
Panel B:						
Menstrual	0.013	0.358	-0.086	-0.075	-0.322	-0.045
	(0.478)	(0.536)	(0.061)	(0.049)	(0.561)	(0.411)
Postmenstrual	-0.563	-0.332	-0.042	-0.016	-0.479	-0.115
	(0.569)	(0.631)	(0.056)	(0.048)	(0.462)	(0.487)
Ovulation	1.087*	1.122**	-0.014	-0.019	0.792	0.728
	(0.638)	(0.461)	(0.052)	(0.060)	(0.728)	(0.548)
Initial Position Partner	-0.035	-0.027	-0.016***	-0.017***	-0.140**	-0.142**
	(0.058)	(0.055)	(0.005)	(0.005)	(0.057)	(0.056)
Risk Aversion		0.381***		0.025**		0.498***
		(0.107)		(0.010)		(0.109)
Benevolence		-0.311**		0.004		-0.085
		(0.134)		(0.011)		(0.108)
Age		0.020		0.008		0.028
		(0.077)		(0.007)		(0.039)
West European		-0.257		-0.095**		-1.291***
		(0.414)		(0.042)		(0.309)
EconBusiness		0.044		0.017		-0.202
		(0.418)		(0.054)		(0.325)
Constant	-1.257*	0.048	0.654***	0.511**	-1.288*	-0.472
	(0.663)	(1.958)	(0.086)	(0.195)	(0.717)	(1.354)
Observations	364	364	520	520	520	520
Adjusted R^2	0.807	0.817	0.076	0.083	0.495	0.507

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). The reference group in Panel A (Panel B) is all menstrual phases except *Ovulation* (the premenstrual phase).

Table B.6. Uninformed players' final payoffs, payoffs conditional on a deal, and deal rates.

	Conditional payoffs		Deal rates		Final payoffs	
	(3)	(4)	(5)	(6)	(1)	(2)
Panel A:						
Ovulation	0.090	0.038	0.153**	0.150**	1.093**	1.055**
	(0.318)	(0.274)	(0.063)	(0.067)	(0.439)	(0.458)
Pie size	0.136***	0.132***	0.007	0.007*	0.121***	0.119***
	(0.021)	(0.021)	(0.004)	(0.004)	(0.024)	(0.024)
Bargaining round	0.067**	0.070**	0.013	0.012	0.113**	0.112**
	(0.028)	(0.028)	(0.008)	(0.008)	(0.049)	(0.049)
Initial Position Partner	0.746***	0.731***	0.019**	0.018**	0.714***	0.702***
	(0.053)	(0.056)	(0.009)	(0.008)	(0.077)	(0.079)
Risk Aversion		-0.082		0.006		-0.014
		(0.115)		(0.009)		(0.069)
Benevolence		-0.261		0.001		-0.203
		(0.172)		(0.022)		(0.139)
Age		0.057		-0.010		0.009
		(0.036)		(0.010)		(0.051)
West European		0.251		-0.117*		-0.380
		(0.400)	(0.060)	(0.358)		
EconBusiness		-0.095				-0.394
		(0.249)		(0.328)		
Constant	0.383**	0.632	0.442***	0.771***	-1.066***	0.527
	(0.183)	(1.232)	(0.060)	(0.189)	(0.265)	(1.391)
Observations	319	319	450	450	450	450
Adjusted R^2	0.724	0.730	0.057	0.058	0.472	0.474
Panel B:						
Menstrual	-0.277	-0.233	-0.083	-0.077	-0.794*	-0.801**
	(0.453)	(0.554)	(0.070)	(0.081)	(0.403)	(0.364)
Postmenstrual	0.148	0.120	0.002	-0.001	0.297	0.218
	(0.398)	(0.404)	(0.071)	(0.072)	(0.366)	(0.335)
Ovulation	0.064	0.028	0.133**	0.135**	0.965**	0.945**
	(0.359)	(0.317)	(0.063)	(0.065)	(0.418)	(0.447)
Pie size	0.138***	0.134***	0.007*	0.008*	0.125***	0.123***
	(0.021)	(0.021)	(0.004)	(0.004)	(0.025)	(0.025)
Bargaining round	0.067**	0.070**	0.013	0.012	0.112**	0.111**
	(0.028)	(0.027)	(0.008)	(0.008)	(0.049)	(0.049)
Initial Position Partner	0.742***	0.728***	0.019**	0.018**	0.711***	0.698***
	(0.056)	(0.059)	(0.009)	(0.008)	(0.077)	(0.080)
Risk Aversion		-0.087		0.003		-0.037
		(0.117)		(0.010)		(0.080)
Benevolence		-0.247		0.006		-0.153
		(0.177)		(0.020)		(0.101)
Age		0.059		-0.010		0.013
		(0.037)		(0.010)		(0.052)
West European		0.281	(0.060)	(0.057)		-0.318
		(0.379)	(0.057)	(0.272)		
EconBusiness		-0.122		-0.053		-0.470
		(0.249)		(0.050)		
Constant	0.404*	0.519	0.459***	0.756***	-0.969***	0.255
	(0.200)	(1.198)	(0.053)	(0.195)	(0.295)	(1.335)
Observations	319	319	450	450	450	450
Adjusted R^2	0.724	0.729	0.058	0.057	0.478	0.479

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). The reference group in Panel A (Panel B) is all menstrual phases except *Ovulation* (the premenstrual phase).

B.4 Bargaining behavior and outcomes: Regressions bootstrapping cluster-robust standard errors

In this subsection, we conduct the entire analysis for both informed and uninformed players using bootstrapped cluster-robust standard errors with 1000 repetitions. Overall, the results remain unchanged for all the main outcomes. Only for uninformed players, there are some minor changes in the significance levels of certain findings: (i) Uninformed players' deal rates are initially higher during ovulation compared to all other phases and menstruation alone (significant at the 5% level). With bootstrapping, these two findings become significant at the 10% level (see Table B.10, column 6, Panel A and the post-test ovulation vs menstruation, respectively). (ii) Final payoffs are initially significantly lower during menstruation compared to the ovulation phase (at the 5% level). With bootstrapping, the significance level decreases to the 10% level (see Table B.10, column 2).

Table B.7. Initial offers and mean relative concession rates for informed players.

	Initial offer		Concession rate	
	(1)	(2)	(3)	(4)
Panel A:				
Ovulation	-1.263**	-1.121**	-0.001	-0.005
	(0.577)	(0.568)	(0.048)	(0.062)
Constant	1.867***	0.585	0.098*	0.521
	(0.236)	(2.848)	(0.050)	(0.493)
Controls A	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes
Observations	520	520	520	520
Adjusted R^2	0.304	0.338	-0.004	-0.005
Panel B:				
Menstrual	-0.582	-0.865	0.031	0.053
	(0.774)	(0.951)	(0.044)	(0.080)
Postmenstrual	0.466	0.273	0.022	0.009
	(0.675)	(0.834)	(0.142)	(0.145)
Ovulation	-1.252**	-1.177**	0.011	0.006
	(0.572)	(0.538)	(0.040)	(0.062)
Constant	1.869***	-0.054	0.087**	0.535
	(0.333)	(3.243)	(0.041)	(0.537)
Controls A	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes
Observations	520	520	520	520
Adjusted R^2	0.313	0.350	-0.007	-0.009
Ovulation vs. Menstruation	-0.670	-0.312	-0.020	-0.047
[F-test p-value]	[0.409]	[0.741]	[0.703]	[0.937]
Ovulation vs. Postmenstrual	-1.718	-1.450	-0.011	-0.003
[F-test p-value]	[0.035]	[0.703]	[0.937]	[0.869]

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with bootstrapped cluster-robust standard errors with 1000 repetitions (in parentheses). Post-estimation F-tests for ovulation versus the menstrual and postmenstrual phases with the effect sizes and the corresponding p-values [in brackets]. The dependent variable is initial offers in models 1 and 2 and relative concession rates in models 3 and 4. *Controls A* includes a set of bargaining covariates (pie size and bargaining round). *Controls B* includes a set of demographic covariates (age, nationality, and study background) and individual characteristics (risk preferences and social preferences). The reference category in Panel A is all menstrual phases except *Ovulation*, and in Panel B the premenstrual phase.

Table B.8. Initial demands and mean relative concession rates for uninformed players.

	Initial demand		Concession rate	
	(1)	(2)	(3)	(4)
Panel A:				
Ovulation	-1.128	-1.541	0.058	0.059
	(1.352)	(1.553)	(0.066)	(0.095)
Constant	11.629***	8.941	0.396***	0.634
	(0.781)	(6.000)	(0.102)	(0.542)
Controls A	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes
Observations	450	450	450	450
Adjusted R^2	0.018	0.134	-0.001	-0.006
Panel B:				
Menstrual	-2.310	-1.113	-0.072	-0.046
	(1.418)	(1.873)	(0.106)	(0.142)
Postmenstrual	-1.287	-0.491	0.038	0.054
	(1.630)	(1.960)	(0.059)	(0.064)
Ovulation	-1.968	-1.856	0.049	0.060
	(1.767)	(1.807)	(0.077)	(0.104)
Constant	12.459***	8.979	0.402***	0.596
	(1.248)	(6.869)	(0.120)	(0.573)
Controls A	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes
Observations	450	450	450	450
Adjusted R^2	0.048	0.137	-0.003	-0.008
Ovulation vs. Menstruation	0.342	-0.743	0.121	0.106
[F-test p-value]	[0.764]	[0.692]	[0.245]	[0.878]
Ovulation vs. Postmenstrual	-0.681	-1.365	0.011	0.006
[F-test p-value]	[0.655]	[0.466]	[0.245]	[0.878]

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with bootstrapped cluster-robust standard errors with 1000 repetitions (in parentheses). Post-estimation F-tests for ovulation versus the menstrual and postmenstrual phases with the effect sizes and the corresponding p-values [in brackets]. The dependent variable is initial demands in models 1 and 2 and relative concession rates in models 3 and 4. *Controls A* includes a set of bargaining covariates (pie size and bargaining round). *Controls B* includes a set of demographic covariates (age, nationality, and study background) and individual characteristics (risk preferences and social preferences). The reference category in Panel A is all menstrual phases except *Ovulation*, and in Panel B the premenstrual phase.

Table B.9. Informed players' final payoffs, payoffs conditional on a deal, and deal rates.

	Conditional payoffs		Deal rates		Final payoffs	
	(3)	(4)	(5)	(6)	(1)	(2)
Panel A:						
Ovulation	1.239*	1.163**	0.015	-0.003	0.988	0.768
	(0.635)	(0.578)	(0.046)	(0.063)	(0.691)	(0.637)
Initial Position Partner	-0.034	-0.022	-0.017***	-0.018***	-0.143***	-0.142***
	(0.052)	(0.052)	(0.005)	(0.005)	(0.053)	(0.054)
Constant	-1.409**	-0.398	0.638***	0.532**	-1.441**	-0.568
	(0.588)	(2.328)	(0.091)	(0.232)	(0.669)	(1.588)
Controls A'	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes	No	Yes
Observations	364	364	520	520	520	520
Adjusted R^2	0.806	0.816	0.076	0.084	0.496	0.509
Panel B:						
Menstrual	0.013	0.358	-0.086	-0.075	-0.322	-0.045
	(0.493)	(0.670)	(0.062)	(0.060)	(0.577)	(0.506)
Postmenstrual	-0.563	-0.332	-0.042	-0.016	-0.479	-0.115
	(0.564)	(0.697)	(0.057)	(0.054)	(0.456)	(0.524)
Ovulation	1.087*	1.122**	-0.014	-0.019	0.792	0.728
	(0.622)	(0.533)	(0.054)	(0.069)	(0.709)	(0.633)
Initial Position Partner	-0.035	-0.027	-0.016***	-0.017***	-0.140**	-0.142**
	(0.055)	(0.052)	(0.005)	(0.005)	(0.055)	(0.055)
Constant	-1.257*	0.048	0.654***	0.511**	-1.288*	-0.472
	(0.652)	(2.484)	(0.089)	(0.246)	(0.713)	(1.764)
Controls A'	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes	No	Yes
Observations	364	364	520	520	520	520
Adjusted R^2	0.807	0.817	0.076	0.083	0.495	0.507
Ovulation vs. Menstruation	1.074	0.764	0.072	0.056	1.114	0.773
[F-test p-value]	[0.151]	[0.360]	[0.239]	[0.466]	[0.163]	[0.323]
Ovulation vs. Postmenstrual	1.650	1.454	0.028	-0.003	1.271	0.843
[F-test p-value]	[0.042]	[0.092]	[0.633]	[0.966]	[0.112]	[0.293]

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with bootstrapped cluster-robust standard errors with 1000 repetitions (in parentheses). Post-estimation F-tests for ovulation versus the menstrual and postmenstrual phases with the effect size and the corresponding p-values [in parentheses]. The dependent variable is final payoffs in models 1 and 2, payoffs conditional on a deal in models 3 and 4, and deal rates in models 5 and 6. *Controls A'* include a set of bargaining covariates (pie size, bargaining round, and initial bargaining position of the negotiation partner). *Controls B* include a set of demographic covariates (age, nationality, and study background) and individual characteristics (risk preferences and social preferences). The reference group in Panel A (Panel B) is all menstrual phases except *Ovulation* (the premenstrual phase).

Table B.10. Uninformed players' final payoffs, payoffs conditional on a deal, and deal rates.

	Final payoffs		Conditional payoffs		Deal rates	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Ovulation	0.090	0.038	0.153**	0.150*	1.093**	1.055**
	(0.318)	(0.328)	(0.068)	(0.080)	(0.474)	(0.518)
Initial Position Partner	0.746***	0.731***	0.714***	0.702***	0.019**	0.018**
	(0.053)	(0.058)	(0.076)	(0.078)	(0.009)	(0.008)
Constant	0.383**	0.632	-1.066***	0.527	0.442***	0.771***
	(0.185)	(1.652)	(0.249)	(1.781)	(0.058)	(0.250)
Controls A'	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes	No	Yes
Observations	319	319	450	450	450	450
Adjusted R^2	0.724	0.730	0.057	0.058	0.472	0.474
Panel B:						
Menstrual	-0.277	-0.233	-0.794*	-0.801*	-0.083	-0.077
	(0.443)	(0.688)	(0.412)	(0.456)	(0.073)	(0.102)
Postmenstrual	0.148	0.120	0.297	0.218	0.002	-0.001
	(0.416)	(0.527)	(0.368)	(0.389)	(0.076)	(0.092)
Ovulation	0.064	0.028	0.133**	0.135*	0.965**	0.945*
	(0.364)	(0.391)	(0.067)	(0.076)	(0.461)	(0.521)
Initial Position Partner	0.742***	0.728***	0.711***	0.698***	0.019**	0.018**
	(0.057)	(0.061)	(0.076)	(0.080)	(0.009)	(0.009)
Constant	0.404*	0.519	-0.969***	0.255	0.459***	0.756***
	(0.208)	(1.916)	(0.272)	(1.780)	(0.052)	(0.268)
Controls A'	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes	No	Yes
Observations	319	319	450	450	450	450
Adjusted R^2	0.724	0.729	0.058	0.057	0.478	0.479
Ovulation vs. Menstruation	0.341	0.261	0.216	0.212	1.759	1.746
[F-test p-value]	[0.502]	[0.705]	[0.011]	[0.074]	[0.003]	[0.006]
Ovulation vs. Postmenstrual	-0.084	-0.092	0.131	0.136	0.668	0.727
[F-test p-value]	[0.824]	[0.837]	[0.201]	[0.259]	[0.229]	[0.243]

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with bootstrapped cluster-robust standard errors with 1000 repetitions (in parentheses). Post-estimation F-tests for ovulation versus the menstrual and postmenstrual phases with the effect size and the corresponding p-values [in parentheses]. The dependent variable is final payoffs in models 1 and 2, payoffs conditional on a deal in models 3 and 4, and deal rates in models 5 and 6. *Controls A'* include a set of bargaining covariates (pie size, bargaining round, and initial bargaining position of the negotiation partner). *Controls B* include a set of demographic covariates (age, nationality, and study background) and individual characteristics (risk preferences and social preferences). The reference group in Panel A (Panel B) is all menstrual phases except *Ovulation* (the premenstrual phase).

B.5 Risk and social preferences and the menstrual cycle phases

Table B.11 displays the findings of the regression analysis concerning the variation in risk and social preferences across the menstrual cycle for non-contraceptive users. The outcomes reveal that participants display reduced risk aversion during the menstrual and postmenstrual phases compared to the premenstrual phase. Previous research by (Lazzaro et al., 2016) suggested higher risk aversion during the premenstrual phase compared to the ovulation phase. However, the evidence appears mixed as some studies find no variation in risk aversion across menstrual phases (Buser, 2012b; Ranehill et al., 2018; Schipper, 2015). For social preferences, we do not observe significant variation in benevolence levels across menstrual phases, consistent with previous results in (Ranehill et al., 2018).

Table B.11. Risk and social preferences.

	Risk aversion		Benevolence	
	(1)	(2)	(3)	(4)
Menstrual		-0.712**		0.504
		(0.342)		(0.491)
Postmenstrual		-0.752*		0.0144
		(0.391)		(0.347)
Ovulation	0.144	-0.168	0.0812	0.176
	(0.377)	(0.410)	(0.263)	(0.318)
Constant	0.877	1.265	4.258**	4.305**
	(1.171)	(1.023)	(1.614)	(1.583)
Observations	970	970	970	970
R-squared	0.051	0.100	0.062	0.079

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). The dependent variable is risk aversion in models 1 and 2, and benevolence in models 3 and 4. All models include a set of demographic covariates (age, nationality, and study background). The reference group is the premenstrual phase.

B.6 Contraceptive takers

In this subsection, we analyze bargaining behavior and outcomes for contraceptive takers only. We compare the intake and break periods for the outcome variables used in the main analysis. Our findings reveal that there are no differences in bargaining behavior or outcomes for contraceptive takers between these two periods. Our findings suggest a null effect of contraceptive intake on bargaining behavior. This result is consistent with the recent findings from Ranehill et al. (2018), which suggest that hormonal changes induced by oral contraceptives do not affect economic behavior.

Table B.12. Initial offer and concession rates for informed players.

	Initial offer		Concession rate	
	(1)	(2)	(3)	(4)
Intake	-0.142	-0.176	-0.072	-0.080
	(0.586)	(0.582)	(0.054)	(0.054)
Constant	0.640	7.778*	0.130*	0.413
	(0.508)	(4.314)	(0.069)	(0.242)
Controls A	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes
Observations	310	310	310	310
Adjusted R^2	0.391	0.479	0.055	0.069

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). The dependent variable is initial offers in models 1 and 2 and relative concession rates in models 3 and 4. *Controls A* includes a set of bargaining covariates (pie size and bargaining round). *Controls B* includes a set of demographic covariates (age, nationality, and study background) and individual characteristics (risk preferences and social preferences). The reference category is the break period.

Table B.13. Initial demand and concession rates for uninformed players.

	Initial demand		Concession rate	
	(1)	(2)	(3)	(4)
Intake	0.130	-0.364	0.067	0.023
	(0.722)	(0.838)	(0.059)	(0.047)
Constant	13.243***	-0.169	0.364***	-0.027
	(0.726)	(6.256)	(0.072)	(0.273)
Controls A	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes
Observations	379	379	379	379
Adjusted R^2	0.004	0.131	0.014	0.053

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). The dependent variable is initial offers in models 1 and 2 and relative concession rates in models 3 and 4. *Controls A* includes a set of bargaining covariates (pie size and bargaining round). *Controls B* includes a set of demographic covariates (age, nationality, and study background) and individual characteristics (risk preferences and social preferences). The reference category is the break period.

Table B.14. Informed players' payoffs, deal rates, and final payoffs.

	Conditional Payoffs		Deals		Final Payoffs	
	(3)	(4)	(5)	(6)	(1)	(2)
Intake	0.042	0.037	0.233	0.590	0.244	0.595
	(0.039)	(0.042)	(0.597)	(0.600)	(0.391)	(0.467)
Constant	0.446***	0.458	-2.524***	-6.266*	-3.409***	-5.961***
	(0.084)	(0.452)	(0.529)	(3.512)	(0.601)	(2.106)
Controls A'	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes	No	Yes
Observations	310	310	226	226	310	310
Adjusted R^2	0.043	0.059	0.794	0.825	0.520	0.564

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). The dependent variable is initial offers in models 1 and 2 and relative concession rates in models 3 and 4. *Controls A* includes a set of bargaining covariates (pie size and bargaining round). *Controls B* includes a set of demographic covariates (age, nationality, and study background) and individual characteristics (risk preferences and social preferences). The reference category is the break period.

Table B.15. Uninformed players' payoffs, deal rates, and final payoffs.

	Conditional Payoffs		Deals		Final Payoffs	
	(3)	(4)	(5)	(6)	(1)	(2)
Intake	0.070	0.056	0.294	0.349	0.541	0.595**
	(0.051)	(0.043)	(0.306)	(0.215)	(0.371)	(0.252)
Constant	0.363***	0.670*	1.914***	-0.659	-0.549	-0.078
	(0.072)	(0.327)	(0.540)	(1.293)	(0.606)	(1.701)
Controls A'	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	Yes	No	Yes
Observations	379	379	270	270	379	379
Adjusted R^2	0.085	0.089	0.435	0.758	0.333	0.445

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ordinary Least Square regressions with standard errors clustered at the matching group level (in parentheses). The dependent variable is initial offers in models 1 and 2 and relative concession rates in models 3 and 4. *Controls A* includes a set of bargaining covariates (pie size and bargaining round). *Controls B* includes a set of demographic covariates (age, nationality, and study background) and individual characteristics (risk preferences and social preferences). The reference category is the break period.

B.7 Instructions

[Page 1]

GENERAL INSTRUCTIONS

Thank you for your participation in the experiment today. It is important for the research that you are not communicating with the other participants in any other way than detailed in the instructions. If you have a question, please raise your hand and one of the experimenters will come to your place to answer your question in private.

In the experiment you can earn money with the decisions you make. It is therefore in your interest that you carefully read the instructions. All your decisions are private and anonymous. That means that your decisions cannot be linked to your name and other participants will not be able to identify your decisions during or after the experiment.

Please keep your ID number until the end of the experiment. You will be asked to introduce your ID number on the screen at the end of the experiment.

The experiment today consists of three parts: PART A, PART B, and PART C. After the last part you will be asked to answer a short questionnaire. You will receive the instructions for each part at the beginning of the corresponding part. You can find the printed instructions for Part A on your desk. The instructions for Part B and Part C will appear on the screen once you reach the corresponding part.

You will receive €5.00 for the participation in the experiment and additionally €10.00 for having provided the printed calendar. The additional earnings you can make will depend on your own decisions, decisions of other participants and random events. This will be different in the different parts and will be described in detail in the beginning of the corresponding part. In PART A your earnings can be negative depending on your and other participants' decisions. In case of negative earnings they will be subtracted from your earnings in the other parts of this experiment. Note that you can always avoid negative earnings with your own decisions.

In summary, your total earnings from this experiment will be equal to: €5.00 show-up fee + €10.00 bonus + earnings from PART A + earnings from PART B + earnings from PART C. Your earnings will be paid to you privately in cash at the end of the session.

[Page 2]

PART A, Instructions

PART A will consist of 10 rounds of bargaining with different other participants.

In each round, two participants bargain on how to split an amount of money, which we call the "pie-size." This pie-size can be different in different rounds.

In each round, one participant in a bargaining pair will be informed about the pie-size. This participant will be called the "informed participant". The other participant in a bargaining round will not be informed of the pie-size. This participant will be called the "uninformed participant".

Who will be an informed who will be an uninformed participant will be decided randomly by the computer at the beginning of Part A. An informed participant will keep this role throughout all 10 rounds. Equivalently, an uninformed participant will also keep this role throughout all 10 rounds.

At the beginning of each round an informed and an uninformed participant will be randomly matched to bargain over the pie.

Importantly, in each round, bargaining takes place over the uninformed participant's share of the pie. In case of an agreement the uninformed participant earns that share and the informed participant earns the pie-size minus the share of the uninformed participant.

In each round the size of the pie will be €4.00, €8.00, €12.00, €16.00, €20.00 or €24.00. In each round each of these pie-sizes is equally likely to be chosen. The actual pie-size will appear on the top left corner of the informed participant's screen. The uninformed participant will not be informed of the pie-size.

Bargaining takes place via the computer screen. The two participants in a pair will negotiate by moving a cursor on a slider that represents values from €0.00 to €24.00 (in increments of €0.10). Importantly, for both participants the amounts on the slider represent the uninformed participant's share. On the computer screen this will be indicated by "Your proposal for the other" in case you are in the role of the informed participant and "Your proposal for yourself" in case you are in the role of the uninformed participant.

In the beginning of each round, both participants in a pair will have to select their initial offers. Initial offers will not be seen by the other participant until both participants have confirmed their initial offers (see Figure 1). At the beginning of a round the cursor will appear on the slider only after you have clicked on the slider. Bargaining will start only after both participants have confirmed their initial offers. Once both participants in a pair have confirmed their initial offers, a simultaneous bargaining stage will start. In this stage both participants in a pair will see both sliders (see Figure 2).

Figure B.2. Screen for the initial offer/demand of the informed (A) and uninformed (B) player

As soon as both sliders appear on the screen there are 30 seconds left for bargaining and reaching an agreement. Bargaining takes place by using the mouse to select proposals for the uninformed participant.

Clicking the mouse on different positions of the slider moves the cursor to these positions.

The remaining time for reaching and agreements is shown on the top right corner of the computer screen (see Figure 2).

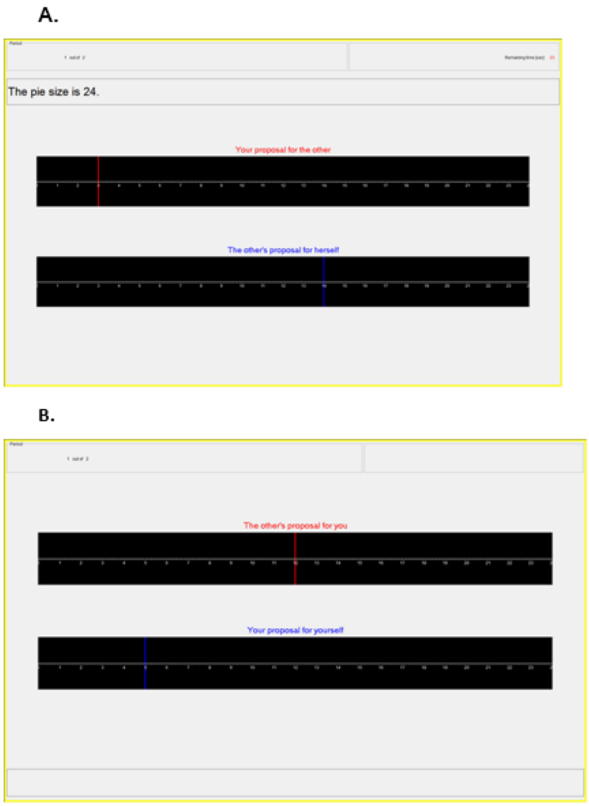


Figure B.3. Simultaneous bargaining screen for the informed (A) and uninformed (B) player. This screen will show for 30 seconds.

An agreement is reached when both cursors are in the same position for 2 seconds or if both sliders are at the same position when the time is over. When both cursors are in the same position on the slider, a green line connecting the two sliders will appear on the screen (see Figure 3).

Payment

If an agreement is reached, the informed participant's payment is equal to the pie-size minus the agreed share for the uninformed participant. If the agreed share to the uninformed participant exceeds the pie-size, the payment of the informed participant will be negative. Negative payments will be subtracted from the other earnings in the experiment.

If no agreement is reached after 30 seconds of bargaining, both participants get €0.00.

After each round, both participants will be informed about the pie-size and their own payment (see Figure 4).

PART A consists of 10 rounds of bargaining. **Importantly**, after each round participants will be rematched and it is unlikely that the same pair bargains in consecutive rounds.

Earnings in PART A

For your earnings in PART A, one of the 10 bargaining rounds will be randomly selected for being

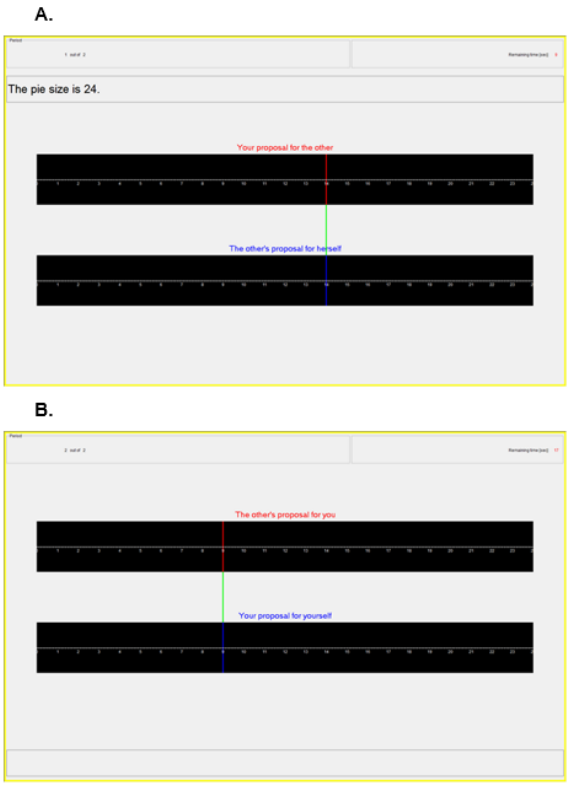


Figure B.4. Agreement screen for the informed (A) and uninformed (B) player.

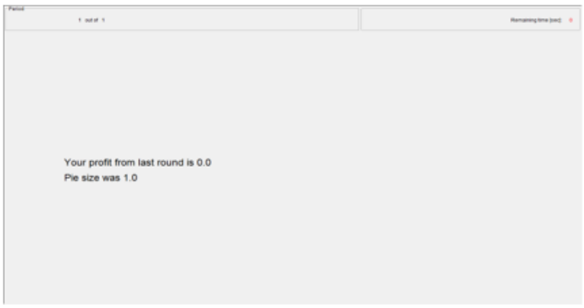


Figure B.5. Payment screen for each participant.

paid out. Each round is equally likely to be selected. Therefore you should view each round as the one that counts for your earnings in PART A.

PART B, Instructions

[Page 1]

You are now going to make a series of decisions. These decisions will not influence your earnings from the first part of the experiment, nor will the decisions you made in the first part of the experiment influence the earnings from this part. Furthermore, the decisions you are going to make will only influence your own earnings.

You will be confronted with 10 decision situations. All these decision situations are completely independent of each other. A choice you made in one decision situation does not affect any of the other following decision situations.

Each decision situation is displayed on the screen. Each decision situation consists of a lottery (Option A), where you can earn a higher amount with some probability and a lower amount with some other probability and 10 sure amounts (Option B) represented in 10 rows. You have to decide for every row whether you prefer Option A (the lottery) or option B (the sure amount). Option A is the same for every row in a given decision situation, while option B takes 10 different values, one for each row. Note that within a decision situation you can only switch once: if you switch more than once a warning message will appear on the screen and you will be asked to change your decisions. By clicking on NEXT you will see an example screen of a decision situation.

[Page 2]

This is a screen shot of a typical decision situation that you are going to face. You are not asked to make choices now! Please have a careful look. Thereafter click on NEXT to proceed.

[Page 3]

Determination of earnings

At the end of the experiment one of the 10 decision situations will be randomly selected with equal probability. Once the decision situation is selected, one of the 10 rows in this decision situation will be randomly selected with equal probability. The choice you will have made in this specific row will determine your earnings.

Consider, for instance, the screen shot that you just saw. Option A gives you a 20% chance to earn 8.- Euro and a 80% chance to earn nothing. Option B is always a sure amount that ranges from 8.- Euro in the first row, to 0.8 Euro in the 10th row. Suppose that the 8th row is randomly selected. If you would have selected option B, you would receive 2.40 Euro. If, instead, you would have selected option A, the outcome of the lottery determines your earnings. In that case the lottery would be played out by rolling a die. Depending on the outcome you would either earn 8,- Euro or 0,- Euro.

Please note that each decision situation has the same likelihood to be the one that is relevant for your earnings. Therefore, **you should view each decision independently and consider all your choices carefully**. At the end of the experiment, you will throw dice to determine which decision situation, which row in that decision situation, and possibly the lottery outcome will be paid out to you. You will throw dice under supervision of an experimenter.

If you like to, you can review the example screen once more by clicking on BACK. If you have any question please raise your hand. When you are ready, please press the BEGIN button below.

PART C, Instructions

[**ACTIVE ROLE**]

[**Page 1**]

This part of the experiment consists of another 10 decision situations. The decisions you make in this part will not influence your earnings from the first two parts of the experiment, nor will the decisions you made in the first two parts of the experiment influence the earnings from this part. The decisions you are going to make will influence your own earnings and the earnings of another person.

In each of the following 10 decision situations you are matched with another participant who remains anonymous to you and with whom you have not interacted before. We will refer to you as "active person" and to the other participant as "passive person." These use of terms will become clear below The passive person you are matched with is randomly determined by the computer.

In each decision situation you will have to choose between an " Alternative LEFT" and an "Alternative RIGHT". Each alternative has consequences for you and for the passive person you are matched with.

Example of a decision situation

In the example below you would have to choose between Alternative LEFT, in which you would get 2.00 Euro and the passive person would get 3.25 Euro, and Alternative RIGHT, in which you would get 2.50 Euro and the passive person would get 2.50 Euro. You make your decision by clicking on the LEFT or RIGHT button You are not asked to make choices now! Please have a careful look.

Alternative LEFT		**Your Choice**	**Alternative RIGHT**	
you get	passive person gets	select here	you get	passive person gets
2.00 **Euros**	***3.25*** **Euros**	LEFT ○ ○ RIGHT	***2.50*** **Euros**	***2.50*** **Euros**

Determination of earnings

Your earnings as active person in this part are determined as follows: At the end of the experiment, one of the 10 decision situations will be randomly chosen and the alternative chosen in this decision situation will be actually paid out. To determine the decision situation that is relevant for your earnings you will throw dice at the end of the experiment. If, for example, the randomly chosen decision task was the one shown above, and if in this task you had chosen Alternative RIGHT, then you as active person would receive 2.50 Euro, while the passive person you are matched with would receive 2.50 Euro. You will throw dice under supervision of an experimenter.

Recall that **you have not interacted before with the passive person you are matched with in this part**. Note also that each decision situation is equally likely to be relevant for your earnings and the earnings of the passive person. Therefore **you should view each decision situation as the one that count**s.

[PASSIVE ROLE]

[Page 1]

PART C, Instructions (continued)

You just made 10 choices as active person. The other participants also made choices in the same 10 decision situations. In addition to your earnings as active person, you will also earnings as passive person.

Your earnings as passive person in this part are determined as follows: In the exact same manner that the passive person you are matched with receives earnings from your decision, without having taken any action, you receive earnings from another participant without doing anything. That is you are the passive person of this other participant. This active person you are matched with as passive person is not the passive person you are matched with as active person. Moreover, you did not interact before with the active person you are matched with as passive person.

To determine the decision situation that counts for your earnings as passive person, the active person you are matched with will throw dice the same as you do as active person. In summary, your earnings from PART C are determined by your earnings from the randomly selected decision task as active person plus your earnings from the randomly selected decision task as passive person.