



# The impact of the menstrual cycle and hormonal contraceptives on competitiveness

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## ABSTRACT

We examine whether competitiveness in women is influenced by biological factors. Female participants in a laboratory experiment solve a simple arithmetics task first under a piece rate and then under a competitive tournament scheme. Participants can then choose which compensation scheme to apply in a third round. We find that the likelihood of selecting into the competitive environment varies strongly and significantly over the menstrual cycle and with the intake of hormonal contraceptives. The observed patterns are consistent with a negative impact of the sex hormone progesterone on competitiveness. We show that the effect of the menstrual cycle and hormonal contraceptives on competitiveness is due neither to an impact on performance, nor to an impact on risk aversion or overconfidence.

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## 1. Introduction

Selection procedures for high paying jobs, promotions, and wage increases are often based on tournament-like competition which is believed to select the highest performers for the task at hand. A growing literature, however, demonstrates that there are individual differences in competitiveness that determine selection in and out of tournaments independently from performance. Some individuals simply seem to dislike being in competitive situations. The strongest evidence comes from the experimental literature on gender and competitiveness which finds that women tend to dislike competition while men actively seek it. The aim of this paper is to determine whether the menstrual cycle and intake of hormonal contraceptives have an impact on the competitiveness of women. As both lead to predictable hormonal fluctuations, such an impact would be an indication that individual differences in competitiveness are at least partially caused by biological factors.

Most experimental studies on competitiveness have subjects perform a simple task whereby the compensation scheme is varied between a non-competitive piece rate and a competitive tournament scheme. Niederle and Vesterlund (2007) find that, when given a choice, 73% of men but only 35% of women opt to compete. Gneezy et al. (2003) moreover find that men significantly increase effort when the compensation scheme for a task becomes more competitive while women show no reaction.<sup>1</sup> There is evidence that nurture can explain at least part of these gender differences. Gneezy et al. (2009) conduct the same compensation choice experiment with subjects from a patriarchal society (the Maasai of Tanzania) and subjects from a matrilineal society (the Khasi of India). While the Maasai exhibit the same gender gap in competitiveness found in Western societies, the roles are reversed in the Khasi sessions, though the authors explicitly mention the

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<sup>1</sup> See Croson and Gneezy (2009) for a review of gender differences in lab and field experiments covering the areas of risk aversion, competitiveness, and social preferences.

possibility that nature, as well as nurture, may play a role in this reversal. Further evidence comes from [Cardenas et al. \(forthcoming\)](#) who find that gender differences in competitiveness vary across countries and may be correlated with gender stereotypes.

How much of a role nature plays in determining attitudes towards competition is still largely an open question. In a rare study on the impact of hormones, [Apicella et al. \(2011\)](#) find no effect of testosterone on tournament entry in men. But in other areas of economic behaviour, testosterone has been associated with lower offers and more rejections in the ultimatum game ([Burnham, 2007](#); [Zak et al., 2009](#)), increased financial risk taking ([Apicella et al., 2008](#)), and the likelihood for MBA students to seek out a career in finance ([Sapienza et al., 2009](#)). Also, the hormone oxytocin increases giving in the trust game ([Kosfeld et al., 2005](#)) and the ultimatum game ([Zak et al., 2007](#)).<sup>2</sup> [Zethraeus et al. \(2009\)](#), on the other hand, find no impact of testosterone and oestrogen levels in a range of games measuring altruism, trust, fairness, and risk aversion.

The impact of the menstrual cycle on economic decision making has so far only been analysed in the context of sealed bid first-price auctions. [Chen et al. \(2009\)](#) find that bidding fluctuates over the menstrual cycle for users of hormonal contraceptives only. In a replication, [Pearson and Schipper \(2009\)](#) also find significant, but partially contradictory, fluctuations. Since the first version of this paper has been released, one other study concerned with the impact of the menstrual cycle on competitiveness has appeared ([Wozniak et al., 2010](#)). We will provide a more detailed discussion of these studies and a comparison of results in Section 5.

We hypothesise that competitiveness is related to fluctuations in female sex hormones and that it consequently fluctuates over the menstrual cycle and with contraceptive intake. Moreover, we expect competitiveness to fall when sex hormone levels are high and to rise when they are low. Such a finding would indicate that innate differences can explain a significant part of the gender gap in competitiveness. If the divergence between the competitive behaviour of men and women is due solely to nurture, on the other hand, we would expect to observe no effects.

Our results strongly confirm our hypotheses. Making use of the diverging patterns of oestrogen and progesterone secretion over the menstrual cycle, we also find that the fluctuations in competitiveness are most strongly correlated with fluctuations in progesterone levels. We consider three possible indirect pathways for the effect of the menstrual cycle and contraceptives on competitiveness: via an impact on risk aversion, via an impact on maths performance, and via an impact on overconfidence. None of these hold up to the data.

The next section describes which variables we use to capture the relevant features of the menstrual cycle and of hormonal contraceptives. Section 3 provides further details about the experimental design, and Section 4 describes the sample. Section 5 presents the main results and Section 6 reports the findings regarding possible pathways. Section 7 concludes.

## 2. Measurement of menstrual cycle phases and hormonal contraceptives

The medical literature commonly divides the menstrual cycle into five phases across which the levels of female sex hormones fluctuate according to a predictable pattern (see e.g. [Richardson, 1992](#)).<sup>3</sup> These phases and the fluctuations of oestrogen and progesterone assuming a regular 28-day menstrual cycle are illustrated in [Fig. 1](#). Women using hormonal contraceptives are subject to a different 28-day cycle wherein a 21-day intake period, which is characterised by constant daily doses of an artificial oestrogen and an artificial progestin,<sup>4</sup> is followed by a 7-day break. Oestrogen excretion by the body is markedly reduced in women taking hormonal contraceptives and progesterone excretion ceases almost completely ([Rivera et al., 1999](#)). This leads to a regular pattern whereby hormone levels are high during the 21-day intake period and low during the 7-day pill break.

We elicit the expected beginning of the next menstruation and use this to allocate subjects experiencing a natural cycle to one of the five cycle phases. Cycle length varies across individuals whereby the follicular phase is the most variable while the length of the ovulatory, luteal, and premenstrual phases is relatively fixed ([Hampson and Young, 2008](#)). Allocation between phase 2 and the subsequent phases should therefore be less affected by varying cycle lengths. Moreover, we ask subjects whether they are currently experiencing menstrual bleeding and use this to allocate subjects between phases 1 and 2. We also construct two continuous variables representing the expected oestrogen and progesterone levels given the day of the cycle a subject is currently in.<sup>5</sup> As the pill break coincides with the menstrual period for hormonal contraceptive takers, we define as pill break subjects those who are 20 or more days away from their next menstruation. This means that subjects are counted as high-hormone from the day after they take the first pill of a new package and as on the break from the day after they take the last.

For our analyses using the whole pooled sample, we divide subjects into high-oestrogen and low-oestrogen, as well as high-progesterone and low-progesterone individuals. The high oestrogen phase corresponds to cycle phases two and four while the high progesterone phase coincides with the fourth phase. For subjects taking hormonal contraceptives, the high-oestrogen and high-progesterone phases are congruent and coincide with the pill-intake phase.

<sup>2</sup> [Fehr \(2009\)](#) reviews further evidence of biological and other factors influencing trusting behaviour.

<sup>3</sup> Levels of testosterone are virtually constant over the cycle.

<sup>4</sup> A progestin is a synthetic hormone that has effects similar to progesterone.

<sup>5</sup> The average daily plasma hormone levels over the menstrual cycle are obtained from [Chabbert Buffet et al. \(1998\)](#) and are illustrated in [Fig. 1](#). We did not take any direct hormone measurements.

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