Choices About Competition: Differences by gender and hormonal fluctuations, and the role of relative performance feedback.

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Differences by gender and hormonal fluctuations, and the role of relative performance feedback.

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Abstract

Economic experiments have shown that when given the choice between piece rate and winner-take-all tournament style compensation, women are more reluctant than men to choose tournaments. These gender difference experiments have all relied on a similar framework where subjects were not informed of their relative abilities as compared to other potential competitors. I replicate these previous findings and then show that giving feedback about past relative performance moves high ability females towards more competitive compensation schemes, moves low ability men towards less competitive compensation schemes such as piece rate and group pay, and removes the gender difference in compensation choices. I then examine between and within-subjects differences in choices for females, across the menstrual cycle. I find that, before receiving relative performance feedback, women in the low-hormone phase of their cycle are less likely to enter tournaments than women in the high-hormone phase. Men are more likely to choose tournaments than females at either stage. There are no significant selection differences between any of these groups after they receive relative performance feedback.

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1 Introduction

Labor markets include a variety of different forms of compensation or competitive environments. Firms may pay workers a flat rate, or instead they may incentivize workers using a piece rate or through an economic contest, such as a rank-order tournament (Lazear and Rosen 1981). These different forms of compensation and contests are used in a variety of different markets with the motive being to increase effort, output or performance or to sort high and low ability workers whose types are unobservable.

Ability is not the only factor to influence this sorting. Females are significantly less likely to choose a competitive tournament when given the choice between a tournament or a piece rate form of compensation, even with no performance differences (Niederle and Vesterlund 2007). It has been suggested that both risk aversion and preference differences for competition are partly responsible for these differences between the sexes, but the role that relative performance feedback may have on these gender differences has not been explored. In this paper, I attempt to answer whether differences in competitive environment selection are affected by fully informing agents about their relative performance compared to other agents they may compete against.

To examine effects of relative performance feedback, I use an economic experiment with two specific treatments to analyze the selection of competitive environments. In the uninformed treatment, with no relative performance feedback, subjects receive information only about their absolute performance from a previous treatment in a real effort task. They do not receive any information about how well any other participants performed. This uninformed treatment is followed by an informed treatment, where subjects receive information about the previous performance of all potential competitors along with their own performance. In both treatments, subjects make choices across the same set of competitive environments; thus, any differences in self selection between treatments may be attributed to the role that relative performance feedback has in these decisions. I find that relative performance feedback removes any systematic gender differences in the selection of competitive environments.

The possible biological mechanisms behind these behavioral differences between the sexes have only begun to be explored in economics.[1] Previous studies have concluded that females and males have differences in preferences and behaviors for competitive environments (Niederle and Vesterlund 2007), risk (Grossman and Eckel 2003), and investment behavior (Barber and Odean 2001, Charness and Gneezy 2007). A possible biological basis for these differences comes in the form of the hormonal differences between females and males. Females' hormones, specifically steroid hormones, fluctuate a great deal and in a predictable manner across the menstrual cycle.

[1] For a review combining findings in economics and psychology see Matsushita, Baldo, Martin and Da Silva (2007).

The economic impacts of hormonal effects caused by the menstrual cycle are potentially significant, but have only been studied in a few domains. For example, Ichino and Moretti (2009) found that female worker absenteeism may be partly a function of menstrual cycles. In this study, by scheduling females to participate in two sessions, during both a low and high-hormone phase, I test whether hormonal differences in females are related to competitive environment selection. I find that females participating during the low-hormone phase are less likely to enter competitive environments than females in a non-low-hormone phase of the menstrual cycle in the treatment with no relative performance feedback. But as with the gender differences, these selection differences are removed with relative performance feedback.

In the following section, I review the previous literature concerning competitive environments and gender differences. I also review the literature and provide rationale for why hormonal fluctuations may play a relevant role in competitive environment selection for females. In section 3, I explain the experiment design and the subsequent sections follow with results, a discussion, and ending with concluding remarks.

2 Previous Literature

In examining the previous literature, I separate the two main areas of study: competition and gender differences, and the effects of hormones on behavior. The first section focuses on previous literature concerning competitive environments and gender differences. This section is then followed by the literature on the effects of hormones in economic decision making.

2.1 Competition and Gender Differences

The corporate ladder can be considered a tournament where a number of individuals compete for promotion based on the results of individual performance. Females make up a small portion of top-level executive positions. Bertrand and Hallock (2001) found that in 1997 the fraction of females in top level management positions was 3% and only 15% of firms had at least one female in a top level executive position. This underrepresentation of females in executive positions may be partially explained by the roles that females have in the traditional family with the raising of children affecting their career choices and human capital investments (Polachek 1981). Part of this underrepresentation may be caused by a preference by females to receive piece rate compensation. Jirjahn and Stephan (2004) find that the attractiveness of piece rate schemes for females is likely caused by less wage discrimination in such a setting when performance can easily be measured. It could be for this reason that firms with a higher proportion of females are more likely to offer piece rate compensation (Brown 1990).

The disproportionate number of females in high ranking executive positions may also be a result of preference differences for competitive environments, or lower performance gains for females from participating in tournament settings when compared to males. A few other possible explanations exist for gender differences in competitive environment selection. Tournament settings are more risky than piece rate settings, so the difference in self selection may stem from gender differences in risk aversion. Another possibility is that females and males evaluate expected values differently when the distributions of outcomes or potential competitors are ambiguous.

Niederle and Vesterlund (2007) found, when given a choice between a piece rate or a winner-take-all tournament compensation scheme, that females overwhelmingly choose the piece rate while males choose the tournament. They infer that this gender difference in selection is driven by men being overconfident and by differences in preferences for competition between females and males. They find that the gender differences for competition still remain even when they control for confidence and risk aversion. Datta Gupta, Poulsen and Villeval (2005) get similar results in an experiment examining the effects of gender composition in tournaments. In another experiment, Dohmen and Falk (2007) find that females are less likely to choose variable pay schemes such as tournaments and piece rates when given the alternative choice of a fixed rate for their time. All these experiments used a similar protocol where subjects were given their absolute performance, but were never informed of their relative standing within the group. These economic experiments have been interpreted as meaning that gender differences in self selection are derived from a preference difference where females seem to have a greater distaste for competition than males. One should note that socialization may contribute to gender differences in the selection of competitive environments as Gneezy et al. (2009) find that in a matrilineal society women are more likely to compete than men.

One reason for these choice differences could be from a performance difference between females and males. Gneezy, Niederle, and Rustichini (2003) find that females see lower performance gains from participating in competitive environments. In observing children's performance in running races, Gneezy and Rustichini (2004) also find that competition increases performance of boys, but not girls. In an experimental setting, Gneezy, Niederle, and Rustichini (2003) find that for a mixed-gender competitive environment, males have significant performance increases when an environment is made more competitive and females do not. However, when females compete only against other females, their performance increases as the environment becomes more competitive. Gupta, Poulsen and Villeval (2005) find that females are more competitive when given the opportunity to choose the gender of a potential competitor. Specifically, females are more likely to choose to enter a tournament if they first choose to be paired against another female before making the competitive environment decision. These results suggest that performance in competitive environments is different for males and females and that the gender composition of groups may play a role in performance gains from competition, as well as in the selection of competitive environments. Both performance differences and gender composition effects may help explain the underrepresentation of females in the corporate business world.

In another study, Niederle, Seagal and Vesterlund (2009) replicate previous findings of gender differences for competitive environment selection, and then examine the role of confidence and an affirmative action type of policy on these selection differences. They find that while affirmative action policies change the composition of the applicant pool, the overall number of high-performing participants is not substantially affected. Thus, due to high-performing women coming in at the cost of high-performing men, the performance costs of selecting women over men by affirmative action policies may be offset by these selection behaviors by high ability individuals. These results suggest that affirmative action policies may remove gender differences in the selection of competitive environments, and may not be costly, so long as there are no ability differences between males and females.

Systematic differences between genders in risk aversion may also contribute to differences in participation in competitive environments. Some studies find that females are more risk averse than males though results are inconsistent in laboratory settings (Grossman and Eckel 2003). These gender differences are not entirely robust because subjects from non-western cultures, and children, appear to not exhibit differences in risk preferences between the sexes (Charness and Gneezy 2007, Harbaugh et al. 2002). Risk aversion is a significant factor when making a decision to enter a competitive environment; however, the competition studies mentioned above control for risk aversion effects and gender differences still remain.

Another factor that may contribute to gender differences in tournament selection may be ambiguity aversion. In the experiments that found gender differences in competitive environment selection, individuals had little information about the performance distribution that they must consider in calculating the probability of winning the tournament. But ambiguity aversion differences have not been found to occur systematically between the genders. Moore and Eckel (2003) find that females are more ambiguity averse for specific contexts and domains. On the other hand, Borghans et al. (2009) find that males are initially more ambiguity averse than females, but as ambiguity increases, males and females behave similarly.

Previous studies have found gender differences in the selection of competitive environments. The possibility exists that these gender differences in competitive environment selection are driven by biological factors. In the following section, I explore why hormones may also play a pivotal role in these decisions.

2.2 Hormones: Why might they matter?

A biological basis for differences in preferences and behaviors between the sexes may be due to hormonal differences between men and women. In addition to differences in hormone levels, females experience large and fairly predictable steroid hormonal fluctuations across the menstrual cycle. Steroid hormones have been found to matter for behaviors and economic outcomes in other contexts. Testosterone levels of financial traders in the morning can predict profitability through the rest of the day. Also, cortisol levels in these same traders were found to rise with increased volatility in their market returns (Coates and Herbert 2008). Testosterone levels are correlated with behaviors in economic experiments such as offers and acceptances in ultimatum games (Burnham 2007). Oxytocin has been shown to encourage generosity levels and trust in individuals (Kosfeld et al. 2005, Zak et al. 2005). Furthermore, through intranasal administration of oxytocin combined with fMRI scans, it was found that oxytocin reduces activation in specific areas of the brain related to fear processing and information feedback response (Baumgartner et al. 2008). Estradiol can increase power motivation–a preference for having an impact or dominance over individuals–in females suggesting that it may affect competitive appetites for females (Stanton and Schultheiss 2007).

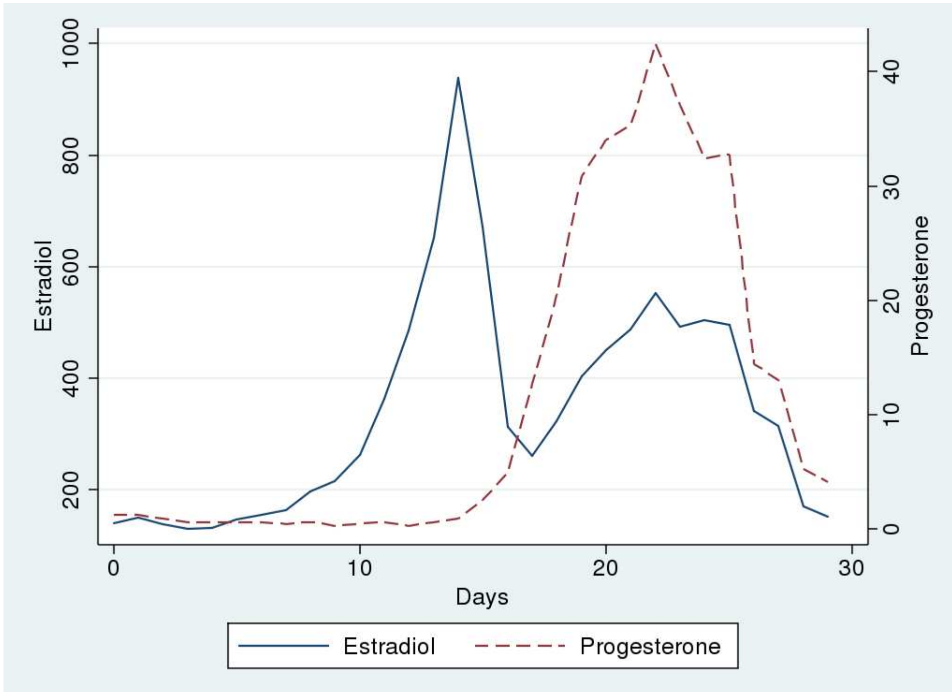
Premenopausal females not using hormonal contraceptives experience significant fluctuations in hormones. Estrogen, progesterone, follicle-stimulating hormone (FSH), and luteinizing hormone (LH) all have a consistent pattern for normal cycling females. Estrogen and progesterone have received most of the attention in studies examining neuroendocrinological, psychological and behavioral effects. As shown in Figure 1, both estrogen and progesterone remain low during the early part of the menstrual cycle. This first week of the cycle is when normal cycling females menstruate and can be considered a low-hormone phase. Estrogen rises quickly and spikes just prior to ovulation. This rise is referred to as the follicular spike as it occurs during the follicular phase, which is just prior to ovulation. After ovulation (approximately day 14 in the graph), progesterone levels spike in the latter half of the female menstrual cycle, which is called the luteal phase. During the luteal phase, females who ovulate experience heightened levels in both estrogen and progesterone. This second spike in both hormones may be referred to as the luteal spike or high-hormone phase (Stricker et al. 2006, Speroff and Fritz 2005).

Hormonal contraceptives cause major changes in the hormonal fluctuations that occur across the natural menstrual cycle. Females using a hormonal contraceptive experience suppression of endogenous hormone production when in the active phase of their contraceptive regimen (Speroff and Fritz 2005). Both progesterone and estrogen levels remain fairly constant as the body receives a dose of these hormones exogenously (Aden et al. 1998). During the placebo or non-active phase of the contraceptive regimen there are no exogenous hormones being provided to the body; this exogenous lowering of both progesterone and estrogen leads to *withdrawal bleeding* caused by the withdrawal of exogenous hormones (Speroff and Fritz 2005). Interestingly, there is no biological or medical necessity to induce this withdrawal bleeding (Anderson and Hait 2003). This is made apparent in the following quote from one of the leading textbooks on clinical gynecologic endocrinology.

> *Monthly bleeding, periodic bleeding, or no bleeding–this is an individual woman's choice (Speroff and Fritz 2005, 908).*

It is believed that keeping withdrawal bleeding as part of the hormonal contraceptive regimen was a mar-

Figure 1: Hormonal Fluctuations in Normal Cycling Females



Estradiol measured in pmol/L and Progesterone in nmol/L.
These are median values from Stricker et al. (2006)

keting ploy to make the birth control pill seem more socially acceptable (Coutinho and Segal 1999). Thus, females could entirely avoid hormonal fluctuations by sustained contraceptive use. Indeed, some forms of contraception do ensure that this occurs (Anderson and Hait 2003). If the decrease in hormones affects females in an costly manner then one could expect that there is some demand to prolong contraceptive use among the female population.

Neuroendocrinology has demonstrated the existence of hormonal effects on brain activity. Results show that major depression may be linked to reduced density of hydroxytryptamine (5-HT), also know as serotonin, binding sites (Malison et al. 1998). By injecting estradiol in rats, Fink et al. (1996) find that estrogen stimulates an increase in the density of 5-HT binding sites in certain areas of the brain. Injections of estradiol significantly increase the density of binding sites in the anterior cingulate cortex (24%), anterior frontal cortex (41%) and the nucleus accumbens (12%). These areas of the brain have been variously linked with mood, memory, and the anticipation and receipt of monetary rewards (Fink et al. 1996, McEwen 2002, Bethea et al. 2002, Platt and Huettel 2008). Progesterone has been shown to inhibit neurotransmission, and as a result it may decrease anxiety and increase sedation (Vliet 2001). Other research suggests that progesterone may decrease the degradation of 5-HT (Bethea et al. 2002).

Hormonal fluctuations occur across the female menstrual cycle and contribute to premenstrual syndrome effects, which may have significant economic consequences. Ichino and Moretti (2009) use detailed employee attendance data from a large Italian bank and find that absences for females below the age of 45 tend to occur according to a 28 day cycle. These 28-day cycle absences explain about one-third of the gender gap in employment absences at the firm. The female menstrual cycle is approximately 28 days and they focus on females below the age of 45, who are more likely to be premenopausal. Ichino and Moretti's result provides support for hormonal fluctuations of the menstrual cycle having significant economic effects.

Using economic experiments, Chen et al. (2005) explore hormonal differences as determinants of economic behaviors. They focus on behavioral differences between males and females in first-price auctions. They find that males and females behave differently only when females are in a phase of the menstrual cycle that provides heightened levels of estrogen. In contrast, Pearson and Schipper (2009) find that women bid higher than men only during the menstrual and premenstrual phases of the cycle when estrogen levels are lower.

Not all economic studies have found support for hormonal effects being significant in economic decision making. Zethraeus et al. (2009) examine 200 post-menopausal women in a double-blind study. Participants were given either estradiol (2 mg), testosterone (40 mg) or a placebo daily for a four week period. Then they participated in an economic experiment session that included a variety of different tasks looking at risk aversion, altruism, reciprocal fairness, trust and trustworthiness. No significant differences were found when comparing the behaviors between the three different treatment groups of females.

In the following section, I explain the experimental design used to examine both the effects of relative information and hormones on competitive environment selection.

3 Experiment Design

Previous experimental studies have concluded that preference differences for competition may be driving differences in selection for competitive environments by males and females. I use an experiment design to test whether preference differences are the main source of these gender differences. Use of a partial information treatment and a full information treatment creates an opportunity to observe the role that relative information may play in the selection of competitive environments.

Furthermore, no economic research has been done to examine the possible effects of hormonal fluctuations across the menstrual cycle and competitive environment selection. Therefore, the experiment design includes specific recruiting and scheduling to attempt to have subjects participate in two sessions; for females these sessions were to occur during both a low and high hormonal phase of the menstrual cycle. I also include females taking hormonal contraceptives since females may alter hormonal fluctuations by taking a hormonal contraceptive. For females using hormonal contraception, during the placebo phase of the hormonal contraception regimen, their hormone levels are the same as normal cycling females in the low-hormone phase of their cycle. This design allows for the comparison of behaviors between females in the low phase to those not in the low phase, while also comparing the behavior of male participants.

In this study, most subjects participated in two separate competitive task sessions. One session involved a word task and the other session involved a math task. There were multiple reasons to try to have subjects participate in two sessions. The first reason was to examine whether females select competitive environments differently conditional on being in a high or low phase during their menstrual cycle. The second reason behind the two sessions and two separate types of tasks was to observe whether gender differences for competitive environments exist regardless of the type of task. Two sessions of participation also provided the opportunity to observe the stability of gender differences for similar competitive environments.

In experiment sessions, participants performed math and word based tasks requiring the exertion of real effort in five different treatments. In the first treatment, participants performed the task under a piece rate compensation scheme, which was non-competitive, since it was entirely dependent on the individual's performance in the task. In the second treatment, participants performed the task under a tournament scheme, they were randomly assigned to a winner-take-all tournament with a size of 2, 4 or 6 total competitors. This second treatment provided participants with experience in a randomly chosen competitive environment in which their pay depended on their own performance as well as the performance of others. In the third treatment, participants performed the task under a group-pay treatment. This treatment randomly paired participants with another participant and their total group production was split evenly between the two group members. This third treatment could be considered the least competitive since free-riding was a possibility for participants. They could be paid more than the non-competitive piece rate scheme so long as their partner's output was greater than their own.

These first three treatments were designed to provide participants with some experience in all of the possible compensation schemes. In the final two treatments, they were able to choose between the piece rate, group pay, or any of the tournament compensation schemes. In each of the first three treatments, participants were given only their absolute performance, they were not informed of how productive other participants in the session had been, or if they won or lost a tournament. In the fourth treatment participants could choose between all of the possible compensation schemes. These choices consisted of group pay, individual piece rate, or a winner-take-all tournament consisting of 2, 4, or 6 total competitors. In the fourth treatment, subjects were not informed of their relative performance compared to others in the session.

In the fifth treatment, participants were first informed of how all individuals in the session performed in the first treatment. They then chose between all the possible compensation schemes for their performance in the fifth treatment. The fifth treatment is used to examine whether gender differences that were previously found in similar competition experiments (Niederle and Vesterlund 2007, Gupta, Poulsen and Villeval 2005) were a result of preference differences, risk aversion, overconfidence or different approaches to information processing between genders. Providing complete relative performance information allowed participants to update their beliefs accurately. If gender differences remain in this treatment then such results provide support for the conclusions from previous experiments that observed gender differences in selection for competitive environments are a result of preference differences for competitive environments and risk.

3.1 Tasks

Two different types of tasks were used for this study, a math-based task and a word-based task. The math-based task was similar to the one used by Niederle and Vesterlund (2007). In this task, participants are asked to add four randomized two-digit numbers and complete as many of these summations as possible in a period of four minutes. Equations are presented to participants on a computer screen and they simply type in the answer and press the *Enter* key or click a *Submit* button on the screen. After each submission participants are promptly shown the next equation to solve. On the screen, the equations look similar to the following:

$$12 + 57 + 48 + 52 = \tag{3.1}$$

In the experiment, a sheet of paper and a pencil were provided to all participants to use for this task, but no other form of assistance was provided.

The word-based task was similar to one used by Günther et al. (2008). In this task, participants are shown a letter on a computer screen and have four minutes to form as many unique words as possible that begin with that specific letter. The letter remains on the screen for the entire four minutes and participants enter in their word submissions in a text box below the letter. The attempted word formations are then listed below the text box to help subjects minimize duplicate answers as duplicate answers are counted as being incorrect. Common place names (cities, countries) are acceptable, but proper names are counted as incorrect. Plural and tense changes to root words are counted as separate and correct answers so long as these words still begin with the appropriate letter. In the experiment, participants were informed of the rules in advance of beginning the task. All participants were informed that everybody in the same session and same treatment received the same letter; thus, providing them with a task of equivalent difficulty for each treatment.

A select group of letters was used for this study to limit the variation of difficulty between treatments and sessions. The word list used for grading words is a common English word list used by open source word processors.[2] The letters chosen for the study had between 2.7% to 3.8% of all words in the word list beginning with these letters. The letters used are listed below with the percentage of words beginning with the letter in parentheses:

E	(3.8%)	F	(3.3%)	G	(3.0%)	H	(3.7%)
I	(3.6%)	L	(2.7%)	N	(3.5%)	O	(3.5%)

3.2 Compensation schemes

For the piece rate compensation, the payoff an individual receives is equal to the piece rate multiplied by the production of the individual for that particular treatment. To mitigate differences in the payoffs between math and verbal based sessions, the payouts were slightly different for word tasks compared to math tasks. Payoffs for both the math and verbal tasks were calculated in a similar manner though the base rate, in the form of the piece rate (w) was different for word formation tasks ($w_w = \$0.25$) and math addition tasks ($w_m = \$0.50$).

Suppose W_i is the total payoff from a treatment for individual i and y_i is the output of the individual and y_{-i} is the output of the other individual of interest that may have affect the payoff for individual i. In a binary group pay situation, individual $-i$ is the group member that is paired with individual i. For group pay, the payoff for individual i and symmetrically for individual $-i$ is:

$$W_i = \frac{w_k \left(y_i + y_{-i}\right)}{2} \tag{3.2}$$

In a tournament situation, if an individual has the best performance in his tournament then he receives the piece rate multiplied by the size of the tournament, multiplied by his individual performance. If an individual does not have the best performance in his tournament then he receives nothing. In the event of a tie, in terms of best performance, the individual receives a fraction of the tournament winnings based on the number of individuals he tied with. One should note that individuals were not informed about whether they won or lost a tournament until all five treatments were complete.

Individuals were informed that they could be randomly grouped with individuals that did not necessarily choose the same compensation option. This design creates a greater incentive for high ability individuals to choose a more competitive environment as there is a positive probability that they may compete against lower ability individuals. As well, this design creates an incentive for low ability individuals to choose group pay as there is a positive probability that they may be matched with a high ability individual; thus, increasing their expected payoffs.

[2]Spell Checking Oriented Word Lists (SCOWL), Revision 6, August 10, 2004 by Kevin Atkinson.

4 Results

Experiment sessions took place in a computer lab at a large public university. Potential participants completed a screening survey online and were then scheduled for the first of two sessions. One of the two sessions involved a math-based task and the other session involved a word-based task.

Table 1: Summary statistics of session attendees

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Age	20.5	2.81	18	33	344
Years PS	2.19	1.48	0	6	343
GPA	3.28	0.47	2	4.22	343
Live Independently	0.82	0.38	0	1	345
Word task	0.48	0.5	0	1	345
Session Size	14.54	4.15	7	21	345
Second session	0.37	0.48	0	1	345
Female	0.5	0.5	0	1	345
Low Phase	0.14	0.34	0	1	345
Psych meds	0.08	0.28	0	1	343

The majority of participants were university students; the summary statistics for this standard student sample are in Table 1. The average size of the 26 experiment sessions was 14.5 participants with a standard deviation of 4.15. The word task was used in 12 of the sessions while the math task was used in 14 sessions. Of the 345 individual subject sessions, 165 involved the use of the word task and 180 used the math task.[3] Approximately half the sample consists of females (172) and 37% (126) of the sample consists of individuals that attended a second session. Based on self reported data, 47 of the individual participants were females in the low-hormone phase of their menstrual cycle.

Table 2: Mean values of individual and session characteristics by gender.

Sex	Age	Years PS	GPA	Indep.	Psych	Word	Size	Sess. 2
Male	20.69	2.14	3.24	0.84	0.10	0.47	13.79	0.37
Female	20.32	2.24	3.32	0.81	0.07	0.48	15.30	0.36
Total	20.50	2.19	3.28	0.82	0.08	0.48	14.54	0.37

Table 2 shows that the males and females who participated were not noticeably different from each other. The one exception was that the average female participated in a session that was approximately larger by 1.5 individuals. In sessions, the female to male ratio ranged from 0.3 to 2.3. On average the female to male ratio per session was 1.01. Thus, all sessions had some degree of gender mix and on average this gender mix was approximately 1 to 1.

[3]One individual (female) was removed from the data due to a lack of understanding of the stimuli.

Sessions took place three to four times a week and were held in the morning. Sessions took slightly less than an hour, including approximately 10 minutes at the beginning of the session that were used for participants to wait together in a foyer. The reason for this initial wait period was to allow participants to see that sessions included both males and females. Once participants entered the lab, partitions were used so that participants could not see each other's computer screens or facial responses from the feedback received. Competition and group membership were also anonymous because subjects were unable to know with whom they were paired or with whom they were competing against.

Table 3: Payouts by Task Type

Type	**mean**	**sd**	**min**	**max**	**N**
Math	7.38	11.31	0	84	180
Word	15.01	18.90	0	111	165
Total	11.03	15.86	0	111	345

The summary statistics for payouts for task performance are shown in Table 3. These payouts were based on one randomly chosen treatment and do not include the participation fee given to all participants.[4] The word task paid substantially more than the math task. This difference was mainly due to the word task being substantially easier than the math task, despite the different wage used.

Participants who attended two sessions were subsequently asked to perform a risk aversion task similar to that used in Holt and Laury (2002). The risk aversion tasks were performed a few days after the second session to try to avoid endogeneity with the competition task performance. A total of 112 participants (56 male and 56 females) participated in the risk aversion task. The average payout for the risk aversion task was \$6.57. Thus, an individual who participated in two sessions and the risk aversion task received an average payout of \$38.95 for approximately 2 hours of time.

4.1 Task Performance

Each individual (in both word and math task sessions) participated in five different treatments of tasks. All participants in the session started the tasks at the same time as everyone else and had four minutes to complete the task. For the first three treatments, the compensation schemes were as follows:

Treatment 1: Piece rate (\$0.50 per sum and \$0.25 per word).

Treatment 2: Random sized tournament of 2, 4, or 6 individuals (the winner earned the piece rate multiplied by the size of tourney).

[4] The participation fee was \$5 or \$10 depending on the individual.

Treatment 3: Group pay: an individual was paired with a randomly chosen partner and the total production of the 2 individuals was split evenly and multiplied by the piece rate.

Table 4: Performance Across Treatments and Gender

Math	T1	T2	T3	T4	T5	Word	T1	T2	T3	T4	T5
Male	10.9	12.1	12.3	12.7	12.8	Male	38.2	39.4	43.0	45.3	47.0
Female	9.9	11.4	11.8	12.3	12.1	Female	41.0	41.1	45.0	48.4	47.3
Both	10.4	11.8	12.0	12.5	12.5	Both	39.6	40.3	44.0	46.9	47.1

Table 4 provides mean performance for each treatment for both math and word of tasks. According to the mean values, some learning seems to occur in both the math and the word tasks. This learning appears to be limited to the first three treatments. Table 4 also provides mean performance levels for both males and females for math and word tasks across the five treatments. The gender difference for performance in the math task is only significant in Treatment 1 at the 10% level.[5] In the word task the differences in performance are not statistically significant for any of the treatments. Thus, there are no noticeable performance differences between males and females after the first treatment.[6]

As in other experiments that used similar tasks, there are no significant performance differences between males and females. This lack of difference suggests that both males and females should select into competitive environments in a a similar fashion, but I find that this is not necessarily the case. These selection differences are discussed in the following section.

4.2 Gender Differences in Compensation Choice

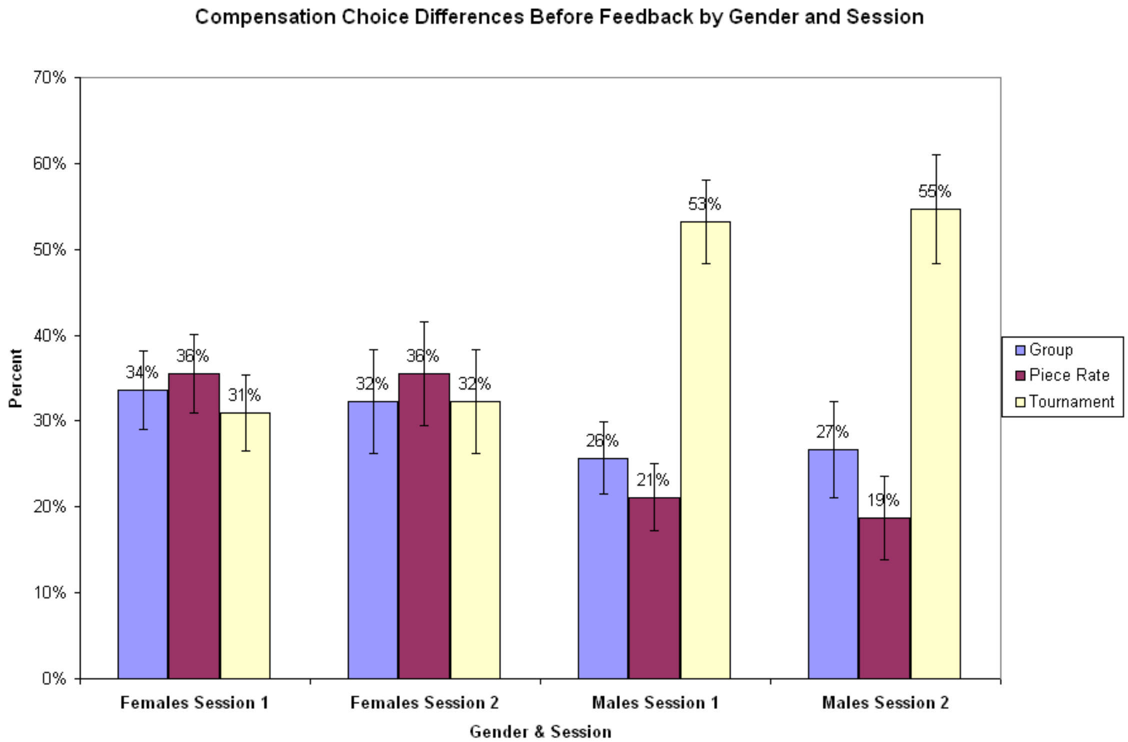
Previous experiments have found that females are less likely than males to enter tournament environments when given the option between a tournament and piece rate. To test whether these prior results can be replicated with this protocol, I first focus on choices made in Treatment 4. In this treatment, as in most previous studies, individuals were not given information about their relative performance against possible competitors from previous treatments.

Most individuals participated in two sessions. Figure 2 shows the histograms of the choices made by males and females in first and second sessions for Treatment 4. Both males and females behaved in a consistent manner in both sessions. The gender differences are large when no relative performance information was provided as over 53% of males in both sessions chose to compete in tournaments while only approximately only 30% of females select tournaments.

[5]1-tailed t-test

[6]The analysis of the performance effects that occur from learning and different competitive settings are explored in Appendix IA.

Figure 2: Compensation Choice Differences Without Relative Performance Information by Gender and Session

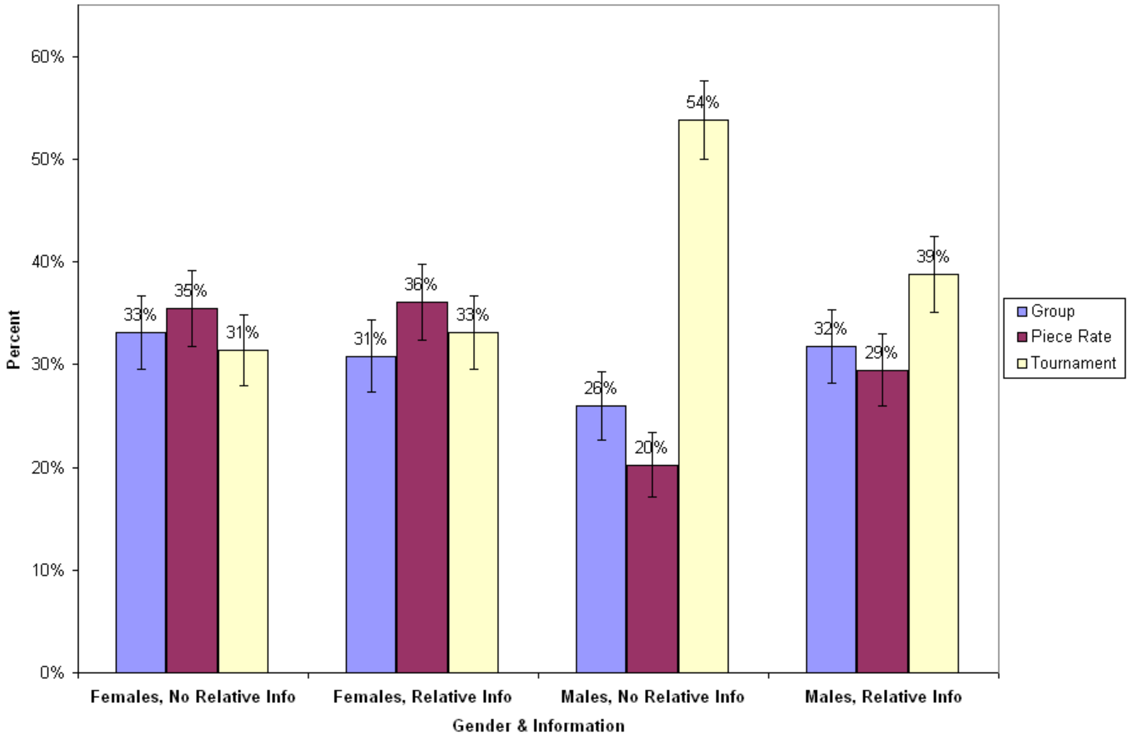


Error bars show standard errors.

Figure 3 shows the effect of relative performance feedback on competitive environment choices, which are aggregated by gender. In Treatment 4, subjects received no relative performance information; in Treatment 5, subjects received relative performance feedback prior to making their choices. Females tend to have an almost uniform distribution across choices as the proportions selecting group pay, piece rate, tournament are not significantly different from each other in both treatments. Females tend to select the piece rate more than the tournament or group pay, but this difference is not statistically significant. Females, when compared to males, systematically choose not to enter tournaments without relative performance information. Instead, females select both group pay and piece rate significantly more than males in Treatment 4. Thus, this treatment of no relative information replicates earlier findings while having an additional possible choice in the form of group pay.

The right side of Figure 3 shows that males select competitive environments quite differently when they have relative performance information about potential competitors. There is a significant increase in the proportion of males choosing the piece rate (5% level) and group pay (10% level), and a significant decrease in the proportion of males choosing the tournament (5% level). After receiving the relative performance

Figure 3: Selection Differences by Gender and Information Treatment (Treatments 4 and 5)



Error bars show standard errors.

information, the proportions of males and females have no statistically significant differences between them at the 5% level.[7] Relative performance information seems to remove any gender differences in competitive environment selections.

While there are no significant differences in performance between males and females, other factors such as age and GPA may play important roles in the output of individuals. If performance is affected by such factors, then individuals' choices to enter different competitive environments may also be affected by them. Therefore, it is important to test whether these gender differences in selection for Treatment 4 remain after controlling for these other potentially relevant factors.

Table 5 shows the results from ordered probit estimations from Treatment 4. Columns 1 to 3 use CompScale as the dependent variable where group pay is equal to -1, piece rate is equal to 0, and a selection of a tournament of any size is categorized as 1. As long as this ordinal ranking holds in terms of a dimension of competitiveness then this categorical variable can be properly used in an ordered probit estimation. Columns 4 to 6 additionally assume that the tournament size variable (TS) is ordered. The dependent variable is

[7] At a 10% significance level there is a difference in the piece rate selection between males and females.

tournament size where a size of zero is considered group pay, a size of 1 is considered the piece rate and sizes 2, 4, and 6 are the respective sizes of the tournament.

Table 5: Ordered Probit Estimates: Choices for No Relative Information Treatment

VARIABLES	(1) Pooled CompScale	(2) RE CompScale	(3) RE Risk CompScale	(4) Pooled TS	(5) RE TS	(6) RE Risk TS
Female	-0.36	-0.40	-0.49	-0.33	-0.37	-0.49
	(0.13)	(0.15)	(0.19)	(0.12)	(0.14)	(0.18)
	(***)	(***)	(**)	(***)	(***)	(***)
Confidence(T1)	0.86	0.98	0.99	0.80	0.87	0.85
	(0.25)	(0.29)	(0.34)	(0.21)	(0.23)	(0.26)
	(***)	(***)	(***)	(***)	(***)	(***)
Improve (T2)	0.61	0.72	0.73	0.61	0.68	0.80
	(0.20)	(0.23)	(0.32)	(0.18)	(0.20)	(0.29)
	(***)	(***)	(**)	(***)	(***)	(***)
%-tile Rank (T1)	1.05	1.08	0.85	1.05	1.05	0.87
	(0.23)	(0.26)	(0.32)	(0.21)	(0.23)	(0.30)
	(***)	(***)	(***)	(***)	(***)	(***)
Risk Controls	No	No	Yes	No	No	Yes
Characteristic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	343	343	224	343	343	224
ll	-336.6	-335.6	-212.3	-491.1	-490.3	-317.3
chi2	66.91	61.00	48.81	79.34	69.37	54.62
r2_p	0.0904			0.0747		

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5 shows that the results of Niederle and Vesterlund (2007) are replicated in the treatment without relative performance feedback: females choose to not enter competitive environments as frequently as males, even when controlling for individual confidence (Confidence(T1)) and relative rank of performance within the session (%-tile Rank(T1)) from the first treatment. This is shown by the negative significant coefficient for the female dummy variable (Female) in columns 1 through 6. Confidence is measured by the predicted performance an individual has at the end of Treatment 1 (prior to finding out their actual performance) divided by the individual's prediction of the average performance of all session participants. To control for performance, I use the relative rank from Treatment 1.[8] Both confidence and the percentile rank from treatment one are positively correlated with the selection of more competitive environments. Improvement in task performance between the first and second task (Improve(T2)) also has a significant positive effect on choosing a more competitive environment in Treatment 4.

[8] In regressions, performance from the math task (word task) explains over 67% (57%) of the variation in the percentile rank in the math task (word task). The difference between the math and word task is likely attributed to the random assignment of letters for tasks.

Table 5 shows that females are less likely to enter into competitive environments even when controlling for confidence, performance, improvement and some individual specific characteristics such as the number of years of college education, usage of psychological medication, GPA and age. The results are similar when using a random effects ordered probit as shown in columns 2 and 5. The possibility exists that gender differences in the self selection of competitive environments are in part attributed to risk aversion. Columns 3 and 6 include measures of risk aversion for individuals that participated in a task similar to the one used by Holt and Laury (2003). I find that risk aversion is not significantly correlated with competitive environment choice.

4.3 Do Gender Differences in Compensation Choice Exist When Individuals are Given Relative Performance Information?

With no information concerning the quality of potential competitors, females choose to enter less competitive environments than males, irrespective of confidence, performance, improvement or risk aversion. These gender differences do not seem to be related to risk or overconfidence suggesting that these differences are related to preference differences for competition. If a preference difference for competitive environments exists then providing information about the quality of possible competitors might reduce mistakes in selections of environments that are too competitive or not competitive enough, but this information should not reduce the gender differences in choices. If females dislike competitive environments more than males then there should still be a negative gender effect for females once both males and females are informed of the quality of possible competitors in Treatment 5.

In Treatment 5, before choosing the competitive environment, individuals are shown a list of the performance of all the participants in the session from Treatment 1. This information provides a signal of the quality of competitors that participants may compete against if they choose to enter a tournament setting. Or, alternatively, a signal of the quality of person they may be paired with if they choose group pay.

Table 6 shows the results from two different types of ordered probit estimations for Treatment 5 where individuals receive relative performance information prior to making choices about compensation. The table shows that females do not make significantly different choices than males for a number of different specifications. Columns 1 and 2 provide estimates using CompScale as the dependent variable, where there are only three dimensions, group pay, piece rate, and tournament. Using this dependent variable, I find there are no differences between males and females in the selection of competitive environments. The selection of competitive environments is mainly dependent on the relative performance information provided prior to making the decision and an individual's improvement from Treatment 1 to Treatment 2. Risk aversion control variables are not significantly related to whether an individual chooses a tournament, piece rate, or group pay compensation scheme. Though, the sample of individuals that participated in the risk aversion task, whether due to risk aversion controls or sample differences, seem to not be affected by improvement between tasks to the same degree (as magnitude and significance are both lower) as the rest of the sample. The one variable that consistently matters for individuals in this treatment is their percentile rank in Treatment 1.

Table 6: Ordered Probit Estimates: Choices for Relative Information Treatment

VARIABLES	(1) Pooled CompScale	(2) RE CompScale	(3) RE Risk CompScale	(4) Pooled TS	(5) RE TS	(6) RE Risk TS
Female	0.00	-0.02	0.13	-0.03	-0.07	0.07
	(0.13)	(0.18)	(0.21)	(0.12)	(0.17)	(0.21)
	()	()	()	()	()	()
Confidence (T1)	0.34	0.44	0.65	0.49	0.63	0.81
	(0.24)	(0.30)	(0.35)	(0.22)	(0.27)	(0.31)
	()	()	(*)	(**)	(**)	(***)
Improve (T2)	0.81	1.01	0.65	0.82	0.99	0.83
	(0.20)	(0.26)	(0.32)	(0.18)	(0.23)	(0.31)
	(***)	(***)	(**)	(***)	(***)	(***)
%-tile Rank (T1)	2.17	2.59	2.31	2.16	2.50	2.30
	(0.25)	(0.34)	(0.37)	(0.23)	(0.30)	(0.35)
	(***)	(***)	(***)	(***)	(***)	(***)
Risk Controls	No	No	Yes	No	No	Yes
Characteristic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	343	343	224	343	343	224
ll	-320.6	-316.7	-194.5	-448.6	-443.8	-285.9
chi2	110.9	98.51	79.67	127.1	111.1	85.19
r2_p	0.147			0.124		

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In columns 4 to 6 of Table 6, the ordinal dependent variable used is tournament size (TS) where the non-tournament choices are designated a 0 for group pay and 1 for piece rate. These ordered probit results are similar to the ones using competitive scale with the exception of confidence. Higher confidence in one's ability leads to that individual choosing a more competitive setting. This effect of confidence suggests that, conditional on an individual choosing a tournament, the more confident the individual, the more likely that he will enter a more difficult tournament. This confidence measure is recorded from Treatment 1; thus, previous confidence still affects choices after an individual is informed of his performance in that treatment, even when controlling for actual performance. Risk aversion seems to not have a significant impact on these types of decisions.[9] The relevant factors in making decisions with relative performance feedback from a previous treatment are relative ranking, and improvement between treatments. Confidence in ability from a previous treatment affects the size of tournament an individual may enter, but not whether that individual chooses a tournament versus the piece rate or group pay.

[9]Risk aversion measures were significant only for high ability individuals' choices for Treatment 5.

There are no significant differences between females' and males' selections of competitive environments in Treatment 5 when individuals were fully informed of their relative performance compared to potential competitors. The lack of differences between males and females in this treatment raises questions about the existence and sources of gender differences for competitive environments. This effect of information suggests that, relative to males, females may be less likely to compete when they lack knowledge about the quality of the competition. In the section below, I consider the costs of the selection differences between men and women when they lack information about the quality of competitors and whether there are gender differences according to ability levels.

4.3.1 The Cost of Gender Differences in Compensation Choice: The value of information.

To compare the costs of gender differences for competitive environments, I approach the problem as having each individual maximize expected value. This approach does not take into account risk aversion, but focuses on the dollar costs of suboptimal choices. In the case where there is no relative performance information, if females are making compensation choices by avoiding tournaments for promotion then these selections may be costly. The results have shown that with poor relative performance information, females select not to enter tournaments, while males overwhelmingly select to enter tournaments. Both types of selections may be suboptimal as males may select competitive environments too much and females may be selecting tournaments too little.

In this experiment, high ability individuals and low ability individuals make choices about the form of compensation they will receive. To maximize the returns from effort, a high ability individual should choose a more competitive environment while a low ability individual should choose a less competitive environment. An individual should choose a more competitive environment the higher that individual's relative ability is compared to the group of possible competitors. This choice should occur because a higher ability individual is more likely to win a tournament. Furthermore, in this experiment there is an even greater incentive for choosing a tournament for high ability individuals because individuals that choose to compete in a tournament may be randomly chosen to compete against individuals of lower ability who did not choose to enter the tournament. Thus, this framework is structured towards having higher ability individuals choose a more competitive tournament and lower ability individuals to choose a piece rate or group pay form of compensation.

Table 7 shows the average expected value losses for suboptimal selections by males and females in Treatment 4.[10] Each row represents an actual decision that was made by individuals, while each column represents the optimal decision that should have been made. For example, the first row and column section (Grp Loss, Grp) cell shows the average loss for individuals that selected the group pay and should have selected group

[10]The method used to calculate expected values is provided in A Appendix.

pay. In this case, the optimal choice was group pay and the average loss from optimally choosing group pay is zero. In contrast, under column 6 (for the 6 person sized tournament), the average expected value loss was 19.82 for males whose optimal choice would have been to choose a tournament of six, but who chose group pay instead.

Table 7: Treatment 4 Selection Loss

Males Treatment 4 Selection Loss						
	Optimal Choice					
Chosen	Grp	1	2	4	6	Avg Loss
Grp Loss	0	0.89	2.45	5.90	19.82	1.74
1 Loss	0.96	0	1.51	7.69	11.71	2.71
2 Loss	5.84	2.65	0	0.40	37.93	11.75
4 Loss	7.28	5.27	1.58	0	15.49	8.05
6 Loss	6.63	7.51	5.74	0.53	0	3.37
Avg Loss	2.42	2.97	2.31	3.29	12.60	4.91
Females Treatment 4 Selection Loss						
	Optimal Choice					
Chosen	Grp	1	2	4	6	Avg Loss
Grp Loss	0	0.48	2.16	5.00	42.61	5.18
1 Loss	0.95	0	1.48	9.52	39.28	9.98
2 Loss	4.57	2.26	0	1.81	.	3.19
4 Loss	9.27	6.51	3.91	0	7.31	5.51
6 Loss	7.08	9.04	6.97	.	0	5.43
Avg Loss	1.58	2.28	2.91	6.80	27.27	6.78

In Treatment 4, the average expected value loss of selection mistakes was 4.91 for males and 6.78 for females.[11] These loss differences are mostly driven by high ability females and to a lesser extent by low ability males. It becomes apparent from examining column 6 for males and females, that high ability females (those who should select a tournament size of 6) are making the costly choice of selecting group pay or piece rate. Females lose 27.30 in expected value compared to 12.60 for males. In contrast, low ability males make more costly decisions than low ability females as the females that should select group pay lose 1.58 while the low ability males lose 2.42 on average. I find that both high ability females and males are not entering competitive environments enough. But these high ability females overwhelming select the noncompetitive environments of piece rate and group pay, which are very costly decisions. In contrast, too many low ability males are entering competitive environments.

Table 8 shows that the relative performance feedback decreases the average expected value losses for both males and females. In Treatment 5, there are no longer significant differences in terms of expected value losses between males (3.95) and females (4.80) from suboptimal choices. The decreases in expected value losses are greatest for high ability females; their average expected value loss improved to 18.70 in

[11] This difference is significant at a 10% level using a 1-tailed test.

Table 8: Treatment 5 Selection Loss

Males Treatment 5 Selection Loss						
	Optimal Choice					
Chosen	Grp	1	2	4	6	Avg Loss
Grp Loss	0	0.49	2.27	7.52	7.53	0.84
1 Loss	1.28	0	1.63	6.02	21.29	4.54
2 Loss	6.39	2.16	0	.	32.88	8.61
4 Loss	5.76	5.52	2.93	0	10.20	7.59
6 Loss	5.16	9.59	6.64	0.77	0	2.55
Avg Loss	1.39	1.49	2.02	4.79	10.98	3.95

Females Treatment 5 Selection Loss						
	Optimal Choice					
Chosen	Grp	1	2	4	6	Avg Loss
Grp Loss	0	0.46	1.80	4.65	.	0.46
1 Loss	0.85	0	1.74	8.18	32.34	7.77
2 Loss	4.24	2.65	0	5.57	18.51	6.99
4 Loss	7.32	6.35	3.39	0	11.39	6.27
6 Loss	.	6.68	4.22	3.33	0	2.64
Avg Loss	0.88	1.88	2.21	5.93	18.70	4.80

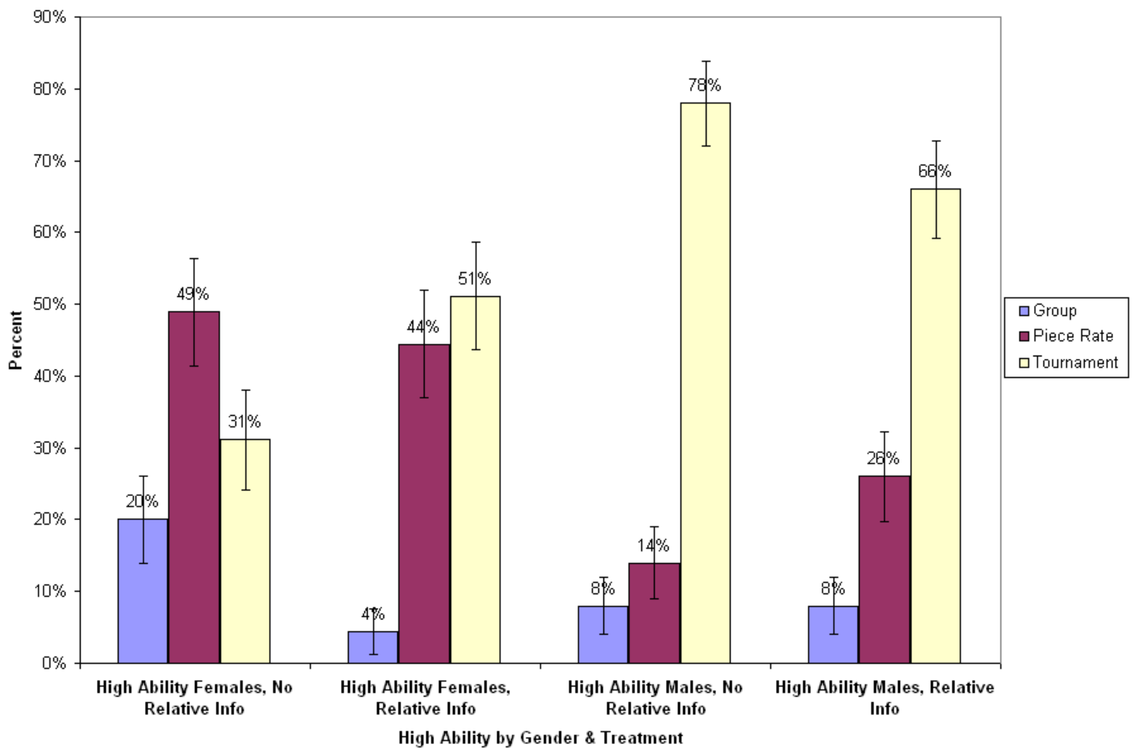
Treatment 5 from 27.27 in Treatment 4. High ability males also made more value maximizing decisions as the average expected value loss for males that should have selected a tournament size of six improved to 10.98 in Treatment 5 from 12.60 in Treatment 4. Thus, high ability females are still not entering competitive environments enough, but they are making better value maximizing decisions when they receive relative performance information by entering more competitive environments.

Low ability females and males tend to behave similarly after receiving the relative performance information as more of them optimally select group pay. The low ability females in the Treatment 4 lose (1.58) significantly less expected value than males (2.42).[12] Once these low ability individuals receive relative performance information, they make decisions that increase expected value, but a gender difference in terms of costs still remains as the expected value losses are 0.88 for low ability females and 1.39 for low ability males.[13] Therefore, the costs of suboptimal selections by both genders improve substantially with relative performance information.

Figure 4 provides the distributions of choices made by both high ability females and high ability males. High ability is defined as an individual that should enter a four person tournament and low ability is defined as someone who's performance is below the median performance level of their respective session. Figure 4 shows that the relative performance information leads to an increase in the proportion of high ability females entering tournaments. Over 50% of high ability females enter tournaments as compared to 31% without information. With information, fewer high ability males enter tournaments (12% less), but this change in

[12] 1-tailed p=0.063
[13] 1-tailed p=0.097

Figure 4: Information Effects for Decisions by High Ability Types



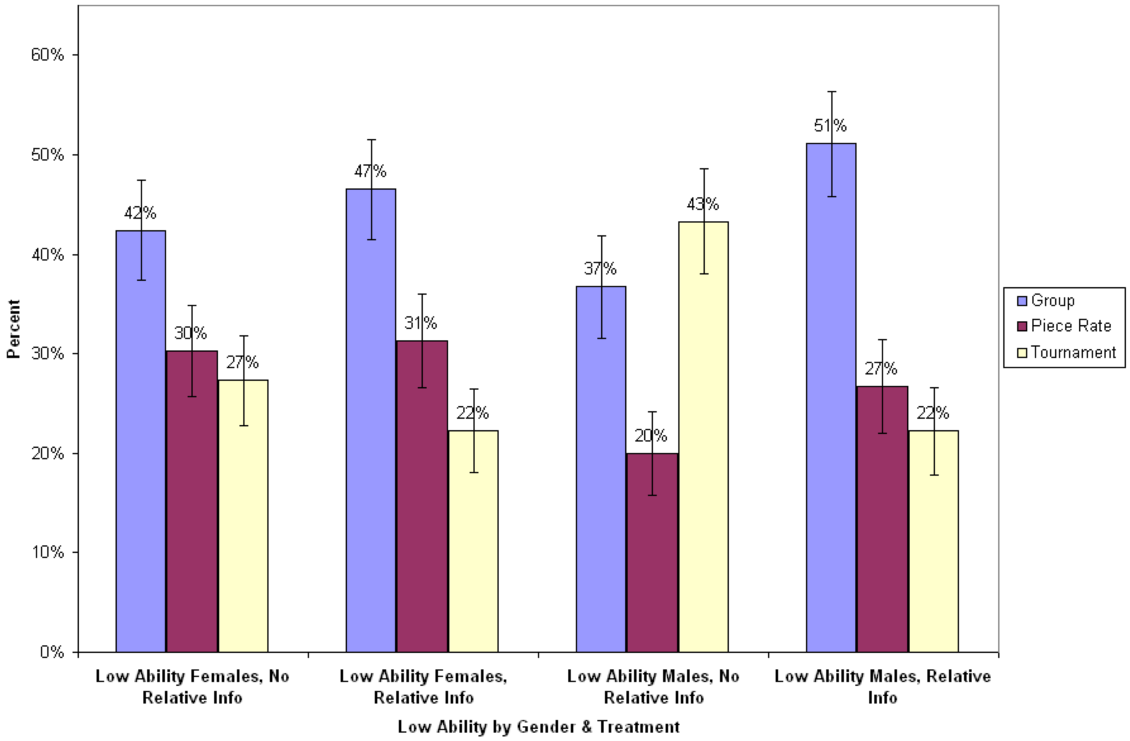
Error bars show standard errors.

tournament selection is not statistically significant (at 5% level). Relative performance information leads to more high ability females entering tournaments.

Figure 5 shows that low ability males enter into more competitive environments than females when they have no relative performance information. Once these low ability males can make decisions using the relative performance information, the proportion in tournaments drops from 43% to 22%. The information leads to 51% of these low ability males to select group pay, a significant increase from the 37% observed without the relative performance information. In considering low ability individuals, relative performance information mostly leads to more low ability males moving out of tournaments and towards the group pay form of compensation while low ability females exhibit little change.

High ability females select more competitive environments when given relative performance feedback. Fewer high ability males select the tournament with information, but on average the expected value loss is lower for high ability males once they receive relative performance information. Females could still choose more competitive environments, but the information has at least moved most high ability females away from selecting group pay. Low ability males also exhibit large changes in behavior after receiving the relative per-

Figure 5: Information Effects for Decisions by Low Ability Types



Error bars show standard errors.

formance information as many of them switch away from choosing tournaments towards the optimal choice of group pay. Thus, the relative performance information leads to more efficient sorting by both males and females.

Without relative performance information, males and females select competitive environments differently, but there are other possible biological reasons for differences in choices within the female population. The following section will examine whether the hormone phases of the menstrual cycle for women are correlated with competitive environment choices. If there is a systematic relationship between phases, then this may provide a further explanation for the drastic gender differences shown by females choices in the treatment without relative performance information in this experiment.

4.4 Hormonal Effects for Competitive Environments

Normal cycling women experience large changes in hormones across the menstrual cycle, and hormonal contraceptives alter the form of these fluctuations for females. Both groups of females experience a low hormone phase, this is during menses for normal cycling females and during the placebo phase (or non-use) for females using a hormonal contraceptive. I exploit this change in hormones in both groups of females to test whether hormonal fluctuations are related to competitive environment choices.

Females using hormonal contraceptives experience more predictable hormonal fluctuations than females who do not use hormonal contraceptives. Normal cycling females, those not using hormonal contraceptives, tend to experience more noise in the timing of their menstrual cycle period. Females using a hormonal contraceptive do not ovulate and during the off-week (or placebo phase) experience withdrawal bleeding caused by low-hormone levels. Thus, the low-hormone phase for both hormonal contraceptive users and normal cycling females occurs during the week of their menstrual period or withdrawal bleeding.

To identify where each participating female was in her menstrual cycle, screening and experiment session exit surveys were used. The screening survey was used to schedule all female participants during both a low-hormone phase and high-hormone phase. The high-hormone phase corresponds to the mid-luteal peak for normal cycling females (Figure 1) or three days into contraceptive use for female using a hormonal contraceptive. These phases were verified in the experiment exit survey that was filled out by each participant as experiment payoffs were prepared. Accurate scheduling of females according to their menstrual cycles was an important aspect of the study. Thus, it was important to know the variability of participants' menstrual cycles, forms of contraception used and start days of hormonal contraceptive regimens.

Table 9: Menstrual Cycle Regularity

Regularity of Period	Percent	Count
Identical	14.3%	55
Within 1-2 days	42.3%	163
Within 3-7 days	34.3%	132
Very Irregular (7+)	9.1%	35
Total		385
Missed Period in Last 3 Months	Percent	Count
Yes	14.7%	57
No	85.3%	330
Total		387

Numbers may not add up due to item non-response in screening survey.

Table 9 provides a summary of the answers given by potential female participants in the screening survey concerning the regularity of their menstrual periods. Some females experience a large degree of variability in their menstrual cycles. Of the females who completed the screening survey, almost 15% missed a menstrual period during the previous 3 months. Consequently, scheduling around predicted phases would not be accurate enough to identify hormonal phases. For this reason, an exit survey was also used at the end of each experiment session to help with identification of hormonal phases.[14]

[14]Missed periods are a problem for identification purposes in normal cycling females as they imply that a female may not have ovulated during that month, and thus did not experience a mid-luteal peak in hormones. Furthermore, without a recent

Table 10: Female Birth Control Use

Form of Birth Control	Percent	Count
Abstinence	11.3%	44
Pill	48.7%	189
Condoms	35.3%	137
Depo-provera	0.8%	3
IUD*	2.3%	9
Patch	0.0%	0
Timing	1.8%	7
Tubal Ligation	0.3%	1
Vaginal Ring	5.9%	23
Vasectomy	0.3%	1
Other	2.1%	8
None	19.3%	75
Total		497

Multiple responses were allowed.

*Intrauterine device

As mentioned in Section 2.2, hormonal contraceptives provide women with a choice about whether to menstruate. Many females already use a hormonal contraceptive to keep a regular and predictable menstrual period.[15] To understand how widespread hormonal contraceptive use is, at least among college students, consider the data in Table 10 obtained from females in the screening survey concerning the forms of birth control used. Over 54% of females use some form of hormonal contraceptive. Thus, over half the potential female participants could avoid the low-hormone phase by not taking an off-week or placebo week as part of their hormonal contraceptive regimen.

To help identify hormonal phases for females using a hormonal contraceptive, the start day for hormonal contraceptive use was asked of all potential female participants. Table 11 shows that females who completed the screening survey overwhelmingly favor a Sunday start day for their hormonal contraceptive regimen. This allows for easier predictability of low and high phases for these females as hormonal fluctuations are exogenously determined by hormonal contraceptive use.

Figure 6 shows the distribution of choices of females across the three possible competitive environments of group pay, piece rate and tournaments for Treatment 4, where participants had no relative performance information prior to making their choices. The histogram includes all females that were able to attend two sessions and could be identified as being in a low or non-low-hormone phase. Many of these females were scheduled for both a predicted low and contrasting high hormonal phase.[16] The figure suggests that low phase females are more likely to choose group pay and less likely to choose tournaments in comparison to

menstrual period, it is difficult to determine the phase in the hormonal cycle.

[15]With hormonal contraception, the bleeding females experience is withdrawal bleeding and not a menstrual period.

[16]Due to the error in predicting the low phase some females were in a non-low phase for both word and math tasks.

Table 11: Hormonal Contraceptive Start Day

Start day	Percent	Count
Sunday	51.7%	106
Monday	11.2%	23
Tuesday	8.3%	17
Wednesday	9.3%	19
Thursday	8.8%	18
Friday	7.3%	15
Saturday	3.4%	7
Total		205

females in a non-low-hormone phase when they have not received any relative performance feedback.

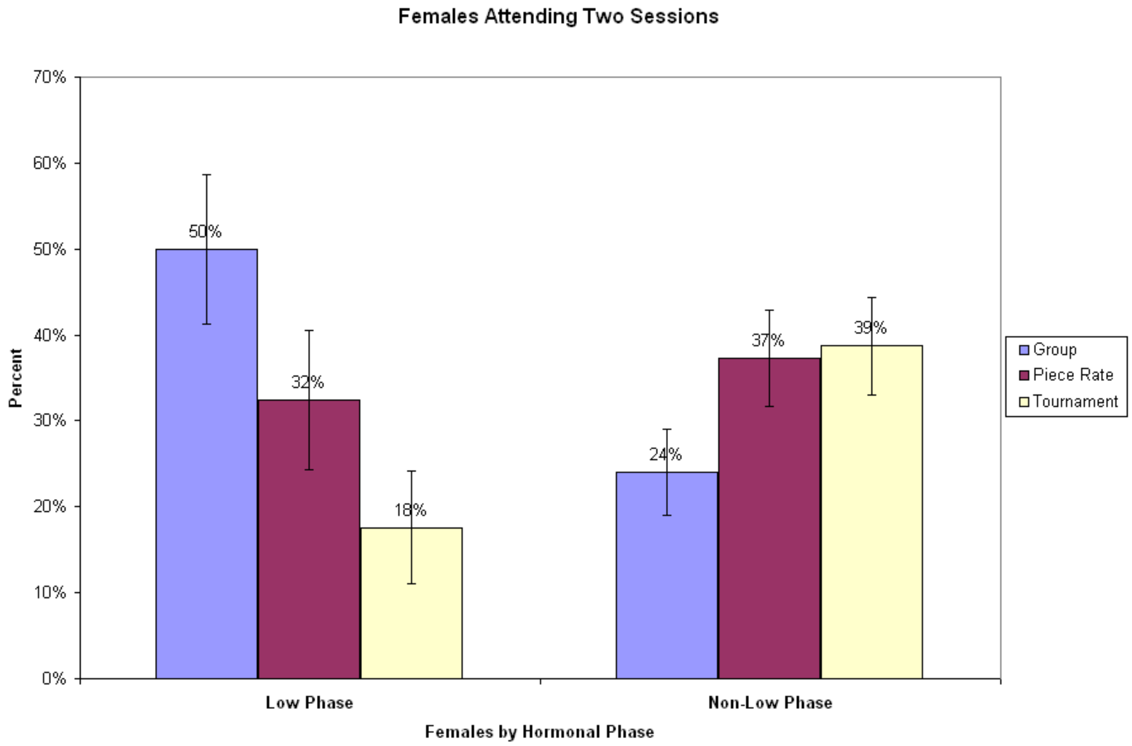
4.4.1 Are There Choice Differences Between Word and Math Tasks Across Hormonal Phases for Females?

These differences in competitive environment choices between females in the low-hormone phase and females in the non-low-hormone phase may be related to decreased expected performance across the menstrual cycle or from different preferences for competition in the math and word task. I find that, for the most part, there are no significant performance differences between females in the low phase and those that are not in the low phase.[17] Females in a specific hormonal phase may also experience greater aversion to certain types of tasks; therefore, I examine whether females in the low-hormone phase are more likely to choose group pay and less likely to choose a tournament for both math and word tasks.

Figure 7 provides histograms of females' choices by hormonal phase and task type. The general pattern of low phase females is the same for females that participate in word and math tasks during the low phase. Low phase females are more likely to choose group pay and less likely to choose tournaments in both math and word tasks. Non-low phase females, exhibit slightly different choices between math and word tasks as they overwhelmingly select tournament in the math task, while in the word task, tournament is still selected more than group pay, but piece rate is selected the most. Non-low phase females consistently select group pay the least in both math and word tasks, which is a direct contrast to females in the low-hormone phase. Subjects alternated the type of task used in sessions; females that participated in a math or word task during the low phase would then participate in the other type of when not in the low phase, and vice-versa. The differences in selections between hormonal phases suggest that these phases may be correlated with behavioral differences for females.

[17] Possible performance differences across hormonal phases are investigated in Appendix A.1.

Figure 6: Compensation Choice & Hormonal Phase for Females



Error bars show standard errors.

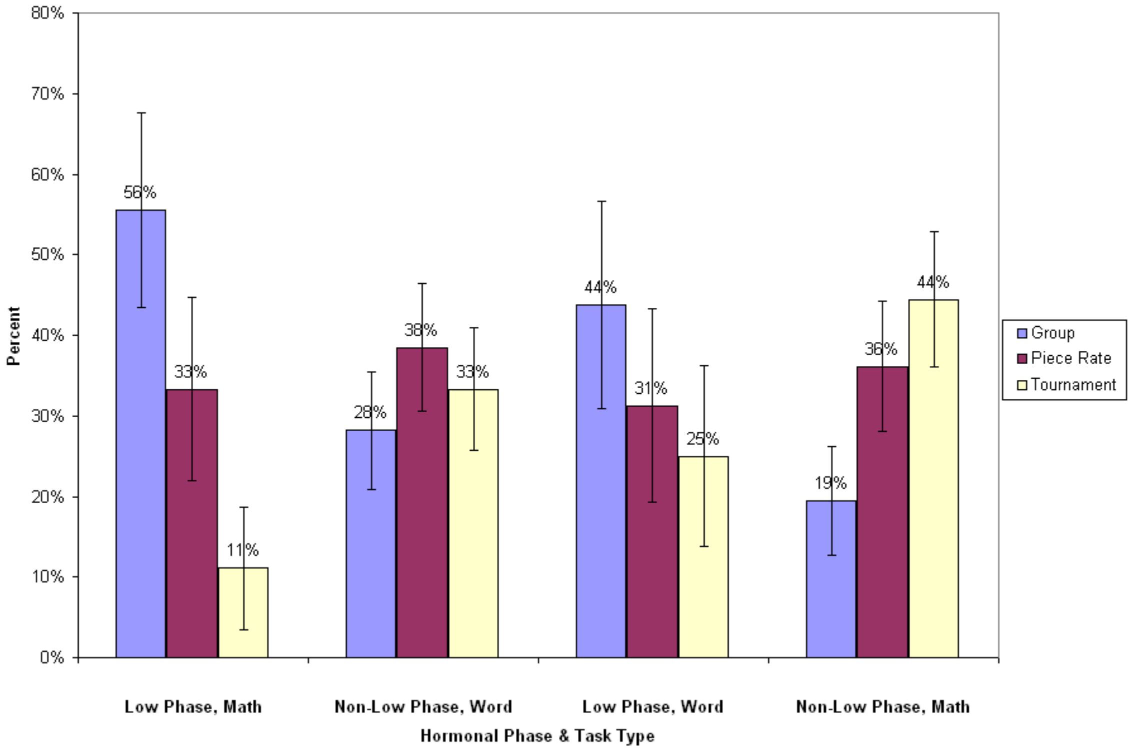
4.4.2 Do Low Phase Females Make Different Compensation Choices When Controlling for Performance and Confidence?

Table 12 provides the results from ordered probit models for Treatment 4 choices using the CompScale variable, which is an ordered categorical variable consisting of the following categories: group pay, piece rate, and tournament.[18] I find that females in the low phase choose to enter less competitive environments than females in a non-low phase. Without relative performance information, much of the difference between genders seems to be driven by low phase females, who shy away from the competitive environments of tournaments and choose the least competitive setting possible in the form of group pay.

Table 13 provides the results from ordered probit estimations for Treatment 5, where subjects were provided with relative performance information from Treatment 1 prior to making their competitive environment selections. The first column provides pooled cross-sectional results including all subjects, the second to fourth columns provide estimates from using a random effects ordered probit. The second column includes all males and females, the third column consists of a female only sample and the fourth column

[18]Estimations using the tournament size ordered categorical variable that takes into account further dimensions of competitiveness were not robust as significance for the low phase fluctuates depending on the specification. Too few low phase females chose tournaments to allow for disaggregation by tournament size.

Figure 7: Compensation Choice by Hormonal Phase and Task Type for Females that Attended Both a Math and Word Session.



Error bars show standard errors.

takes into account only males and females for which risk aversion measures were available. The results in Table 13 show that when participants are informed of their relative performance compared to other potential competitors then there is little difference in selection between genders or across the menstrual cycle. Once all participants are informed of the quality of possible competitors then differences between genders and across the menstrual cycle become insignificant.

There is a cost associated with high ability individuals not entering competitive settings and with low ability individuals not choosing less competitive settings. Low-hormone phase females make more costly decisions compared to non-low phase females and males when using expected value loss calculations. The expected value loss compares the expected value of optimal competitive environment selection with the actual selection expected value.[19] The average expected value losses for males, low phase and non-low phase females in Treatment 4 are shown in Table 14. Treatment 4 is used because in Treatment 5 selection differences are insignificant. In Treatment 4, low phase females sacrifice the greatest amount of expected value, \$8.50 per decision. The expected value losses for males and non-low phase females are respectively \$4.91 and \$6.52. The value difference between low and non-low phase females is not statistically significant and

[19]These expected values are calculated in the same way as discussed in the previous section.

Table 12: Ordered Probit: Hormone Effects (CompScale) for No Relative Information (Treatment 4)

	(1)	(2)	(3)	(4)
Sample	All	All	Females Only	Risk
VARIABLES	Pooled	RE	RE	RE
Female	-0.26	-0.29		-0.26
	(0.14)	(0.16)		(0.21)
	(*)	(*)		()
Low Phase	-0.44	-0.46	-0.53	-0.76
	(0.21)	(0.22)	(0.26)	(0.27)
	(**)	(**)	(**)	(***)
Confidence (T1)	0.81	0.91	1.08	0.90
	(0.26)	(0.30)	(0.54)	(0.35)
	(***)	(***)	(**)	(**)
Improve (T2)	0.60	0.69	0.79	0.72
	(0.20)	(0.23)	(0.38)	(0.32)
	(***)	(***)	(**)	(**)
%-tile Rank (T1)	0.97	0.99	0.52	0.72
	(0.23)	(0.26)	(0.43)	(0.32)
	(***)	(***)	()	(**)
Risk Controls	No	No	No	Yes
Characteristic Controls	Yes	Yes	Yes	Yes
Observations	328	328	155	211
ll	-322.3	-321.7	-156.0	-197.4
chi2	64.32	58.60	19.76	51.31
r2_p	0.0907			

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The total number of of low phase females that can be used for data analysis is 45.

the difference between males and non-low-phase females is not statistically significant either. But low phase females make more costly choices than males (5% significance).

These results imply that hormones may matter in the selection of competitive environments, but only if the strength of the competition or the probability of winning is relatively unknown. If there is little information, then females in the low-hormone phase make more costly decisions than males and non-low phase females. But there are no significant differences in expected value losses between genders or between different hormonal phases for females if good relative performance information is available.[20]

4.4.3 Systematic Absenteeism, Cancellations and Tardiness

This study was structured to have a large number of low-hormone phase females to compare with the rest of the sample. Due to the noisiness of the menstrual cycle, it is difficult to predict the low hormonal phase for females. Using the screening survey, female subjects were scheduled for their sessions according to their predicted cycle day. This was calculated using self reported data about the start of subjects' previous menstrual periods. Whenever possible these data were combined with self reported data concerning females'

[20]These insignificant differences are not shown here.

Table 13: Ordered Probit: Hormone Effects (CompScale) for Relative Information (Treatment 5)

	(1)	(2)	(3)	(4)
Sample	All	All	Females Only	Risk
VARIABLES	Pooled	RE	RE	RE
Female	-0.07	-0.13		0.10
	(0.15)	(0.20)		(0.24)
	()	()		()
Low Phase	0.03	0.13	0.12	-0.12
	(0.21)	(0.25)	(0.27)	(0.29)
	()	()	()	()
Confidence (T1)	0.23	0.32	0.21	0.54
	(0.25)	(0.31)	(0.53)	(0.36)
	()	()	()	()
Improve (T2)	0.76	0.92	1.06	0.49
	(0.20)	(0.26)	(0.40)	(0.33)
	(***)	(***)	(***)	()
%-tile Rank (T1)	2.18	2.61	2.63	2.33
	(0.25)	(0.35)	(0.55)	(0.38)
	(***)	(***)	(***)	(***)
Risk Controls	No	No	No	Yes
Characteristic Controls	Yes	Yes	Yes	Yes
Observations	328	328	155	211
ll	-307.8	-303.9	-143.3	-183.4
chi2	104.7	93.82	45.89	75.79
r2_p	0.145			

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 14: Expected Value Loss in Treatment 4

	Mean	Std. Error
Male	4.91	0.72
	Female	
Non-Low	6.52	1.30
Low	8.50	2.57

hormonal contraceptive regimens. Once the cycle day could be predicted, then a set of possible session days were provided to potential participants and they chose and confirmed these days with a research assistant. For individuals to be scheduled, they had to confirm that they would attend a specific session.

Absenteeism, cancellations and tardiness are frequent in experiments. In this study, because of the screening survey and experiment exit surveys, something can be learned about the individuals who do not show up for their scheduled session or cancel at the last moment or are tardy. Ichino and Moretti (2009) found that female worker absenteeism was highly correlated with the female menstrual cycle at a regular job. Due to systematically greater incidences of absences and cancellations in predicted low phase females in this experimental setting, I find results that support their findings.

Table 15: Session Attendance After Confirmation

Gender		
	Proportion	N
Male	0.79	217
Female	0.68	243
Total	0.73	460
Females by Predicted Phase		
	Proportion	N
Not Low	0.72	141
Low	0.62	102
Total	0.68	246

Table 15 shows that females are significantly less likely to show up as scheduled when compared to males. The table shows the proportion of participants that attended the experiment sessions as scheduled, meaning they were present and punctual. 79% of the males showed up as scheduled. Based on predicted phases, only 62% of low phase females low phase females attended as scheduled while non-low phase females attended 72% of the time. These differences between attendance rates of low phase and non-low phase females were significant (5% level). Furthermore, non-low phase females were significantly (10% level) less likely to attend compared to males. Thus, there is both a gender difference in attendance as well as a difference in attendance related to the phase of the female menstrual cycle.[21]

These attendance results suggest there may be a systematic bias in the hormonal phase of females who show up to experiment sessions. Additionally, if females who do not show up to sessions in this study are the ones who have worse symptoms during the low phase, or are more likely to behave differently, then a selection bias may add a downward bias to the hormonal effects found in this study. Since this study was partly focused on hormonal fluctuations, attempts were made to incentivize more low phase females to attend once this bias was found to exist. Part way through the study, due to low attendance from scheduled predicted low phase females, the participation payment of $5 was raised to $10 for low phase females to induce greater attendance of these females.[22] Even with this increase in participation payments for low phase females, a significant and systematic difference exists between individuals who attended sessions as scheduled and confirmed.

5 Discussion

In this study, I show that gender differences in compensation choices that have been found in other studies are robust to a variety of protocol changes, including different tasks, and variations in the degree of competitiveness of the available choices. This consistency is further shown by the similar choices made by

[21] Attendance rates suggest that 62 low phase females should be identified in the experiment, but due to error in predicting the female menstrual cycle only 45 session participants can be classified in the low phase.

[22] These females were not informed as to the reason they were receiving a higher participation payment.

individuals who participated in a second iteration of the experiment. I also find that females' choices vary across the menstrual cycle: in a low-hormone phase, females are less likely to enter tournaments than during a non-low phase. However, once relative performance information is provided to subjects, all these differences for competitive environment selections become smaller and statistically insignificant.

Previous studies have shown that the gender differences in compensation choices persist even after controlling for confidence and have concluded that an underlying gender difference in the taste for competition must drive the result. But if the choice differences originate from a difference in preferences for competitive environments then the selection differences should remain even after relative performance feedback is provided. Another possible explanation would be a gender difference in risk aversion. However, I control for risk aversion and beliefs about relative ability. With these controls, a gender difference still remains in the uninformed treatment, but is removed once subjects receive relative performance feedback. These results suggest that a lack of knowledge about the distribution of the quality of potential competitors causes males and females to make very different choices. Kagel and Roth (1995) define ambiguity as *"known to be missing information."* Thus, an explanation that would be consistent with these results is that males and females make compensation decisions differently when the level of ambiguity is high; once ambiguity is removed they behave similarilly.

I have also shown that hormonal fluctuations affect female entry into competitive environments when there is no relative performance information. This result can be particularly valuable for females to consider for important decisions such as choosing graduate programs or career choices. Females can adapt behaviors or make choices to mitigate or remove the effects of these hormonal fluctuations. Females are able to control these fluctuations by changing their hormonal contraceptive regimen such that they would not experience a low-hormone phase. Females may also refrain from making competitive environment choices during the low-hormone phase. Such behaviors would only have value if there is poor information about the quality of individuals that are part of the competitor pool.

Affirmative action policies are often used to encourage more females to participate in competitive environments in the workplace and in educational institutions. These policies typically involve increasing efforts to recruit females or changing the acceptance or promotion process to favor females. The results from this study suggest that providing better information to applicants and labor force participants about their relative abilities may also reduce the gender differences. Many work and educational environments where affirmative action policies are implemented involve a great deal of ambiguity concerning relative abilities of individuals in the employee or student pool. If feedback eliminates the gender differences in compensation choices then it may be possible to change gender specific participation rates in competitive environments without necessarily altering the structure of the recruitment, acceptance or promotion process.

6 Concluding Remarks

This study has called into question whether a basic female distaste for competition is driving selection differences. Instead, these results suggest that males and females may process information differently, and make decisions differently, when ambiguity exists. These selection differences in the absence of information are heightened for females in the low-hormone phase of their cycle. Thus, gender differences for competition are not just dependent on the informational environment, but also on the hormonal cycle of females.

Although this study has shed some light on the possible causes of gender differences with respect to choices for competitive environments, there is still a long way to go before these differences between males and females are thoroughly understood. Relative performance information, or the lack there of, seems to play a vital role in these selection differences. One cannot say that the choice differences between females and males are caused by hormonal differences, but due to the correlations of choices with low and high hormone phases, this study does suggest that hormones may play a role in compensation choices for females. To accurately identify whether hormones are a determining factor for these choice differences, further study will require the measurement of hormone levels within subjects.

References

Aden, U., Jung-Hoffmann, C. and Kuhl, H.: 1998, A randomized cross-over study on various hormonal parameters of two triphasic oral contraceptives, *Contraception* **58**(2), 75–81.

Anderson, F. and Hait, H.: 2003, A multicenter, randomized study of an extended cycle oral contraceptive, *Contraception* **68**(2), 89–96.

Barber, B. and Odean, T.: 2001, Boys Will be Boys: Gender, Overconfidence, and Common Stock Investment, *The Quarterly Journal of Economics* **116**(1), 261–292.

Baumgartner, T., Heinrichs, M., Vonlanthen, A., Fischbacher, U. and Fehr, E.: 2008, Oxytocin shapes the neural circuitry of trust and trust adaptation in humans, *Neuron* **58**(4), 639–650.

Bertrand, M. and Hallock, K.: 2001, The gender gap in top corporate jobs, *Industrial and Labor Relations Review* pp. 3–21.

Bethea, C., Lu, N., Gundlah, C. and Streicher, J.: 2002, Diverse Actions of Ovarian Steroids in the Serotonin Neural System, *Frontiers in Neuroendocrinology* **23**(1), 41–100.

Borghans, L., Golsteyn, B., Heckman, J. and Meijers, H.: 2009, Gender Differences in Risk Aversion and Ambiguity Aversion, *Journal of the European Economic Association* **7**(2-3), 649–658.

Brown, C.: 1990, Firms' choice of method of pay, *Industrial and Labor Relations Review* pp. 165–182.

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

Charness, G. and Gneezy, U.: 2007, Strong evidence for gender differences in investment, *SSRN* .

Chen, Y., Katuscak, P. and Ozdenoren, E.: 2005, Why Can't a Woman Bid More Like a Man?, *Working Paper, Ann Arbor* **1001**, 48109–1220.

Coates, J. and Herbert, J.: 2008, Endogenous steroids and financial risk taking on a London trading floor, *Proceedings of the National Academy of Sciences* **105**(16), 6167.

Coutinho, E. and Segal, S.: 1999, *Is menstruation obsolete?*, Oxford University Press, USA.

Dohmen, T. and Falk, A.: 2007, Performance pay and multi-dimensional sorting: productivity, preferences and gender, *Institute for the Study of Labor (IZA); CESifo (Center for Economic Studies and Ifo Institute for Economic Research)* .

Fink, G., Sumner, B., Rosie, R., Grace, O. and Quinn, J.: 1996, Estrogen control of central neurotransmission: effect on mood, mental state, and memory., *Cell Mol Neurobiol* **16**(3), 325–44.

Gneezy, U., Leonard, K. and List, J.: 2009, Gender Differences in Competition: Evidence From a Matrilineal and a Patriarchal Society, *Econometrica* **77**(5), 1637–1664.

Gneezy, U., Niederle, M. and Rustichini, A.: 2003, Performance in Competitive Environments: Gender Differences, *Quarterly Journal of Economics* **118**(3), 1049–1074.

Gneezy, U. and Rustichini, A.: 2004, Gender and Competition at a Young Age, *American Economic Review* **94**(2), 377–381.

Grossman, P. and Eckel, C.: 2003, Men, women and risk aversion: Experimental evidence, *Unpublished manuscript* .

Gunther, C., Ekinci, N., Schwieren, C. and Strobel, M.: 2008, Women can't jump?–An experiment on competitive attitudes and stereotype threat, *Technical report*, Mimeo.

Gupta, N., Poulsen, A. and Villeval, M.: 2005, Do (wo) men prefer (non-) competitive jobs, *Technical report*, GATE Working Paper.

Harbaugh, W., Krause, K. and Vesturlund, L.: 2002, Risk Attitudes of Children and Adults: Choices Over Small and Large Probability Gains and Losses, *Experimental Economics* **5**, 53–84.

Holt, C. and Laury, S.: 2002, Risk Aversion and Incentive Effects, *American Economic Review* **92**(5), 1644–1655.

Ichino, A. and Moretti, E.: 2009, Biological Gender Differences, Absenteeism and the Earnings Gap, *American Economic Journal: Applied Economics* **1**(1), 183–218.

Jirjahn, U. and Stephan, G.: 2004, Gender, piece rates and wages: evidence from matched employer-employee data, *Cambridge Journal of Economics* **28**(5), 683–704.

Kagel, J. and Roth, A.: 1995, *The Handbook of Experimental Economics*, Princeton University Press Princeton, NJ.

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

Lazear, E. and Rosen, S.: 1981, Rank-order tournaments as optimum labor contracts, *The Journal of Political Economy* **89**(5), 841.

Malison, R., Price, L., Berman, R., van Dyck, C., Pelton, G., Carpenter, L., Sanacora, G., Owens, M., Nemeroff, C., Rajeevan, N. et al.: 1998, Reduced brain serotonin transporter availability in major depression as measured by [123I]-2β-carbomethoxy-3β-(4-iodophenyl) tropane and single photon emission computed tomography, *Biological Psychiatry* **44**(11), 1090–1098.

Matsushita, R., Baldo, D., Martin, B. and Da Silva, S.: 2007, The biological basis of expected utility anomalies.

McEwen, B.: 2002, Estrogen Actions Throughout the Brain, *Recent Progress in Hormone Research* **57**(1), 357–384.

Moore, E. and Eckel, C.: 2003, Measuring Ambiguity Aversion. Virginia Tech.

Niederle, M., Segal, C. and Vesterlund, L.: 2009, How costly is diversity? Affirmative action in light of gender differences in competitiveness, *NBER Working Paper* .

Niederle, M. and Vesterlund, L.: 2007, Do women shy away from competition? do men compete too much?, *Quarterly Journal of Economics* **122**(3), 1067–1101.

Pearson, M. and Schipper, B.: 2009, Menstrual cycle and competitive bidding, *MPRA Paper* .

Platt, M. and Huettel, S.: 2008, Risky business: the neuroeconomics of decision making under uncertainty., *Nat Neurosci* **11**(4), 398–403.

Polachek, S.: 1981, Occupational self-selection: A human capital approach to sex differences in occupational structure, *The Review of Economics and Statistics* pp. 60–69.

Speroff, L. and Fritz, M.: 2005, *Clinical Gynecologic Endocrinology and Infertility*, Lippincott, Williams & Wilkins.

Stanton, S. and Schultheiss, O.: 2007, Basal and dynamic relationships between implicit power motivation and estradiol in women, *Hormones and Behavior* **52**(5), 571–580.

Stricker, R., Eberhart, R., Chevailler, M., Quinn, F., 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* **44**(7), 883.

Vliet, E.: 2001, *Screaming to be heard: hormone connections women suspect and doctors still ignore*, M. Evans and Co., New York, NY.

Zak, P., Kurzban, R. and Matzner, W.: 2005, Oxytocin is associated with human trustworthiness, *Hormones and Behavior* **48**(5), 522–527.

Zethraeus, N., Kocoska-Maras, L., Ellingsen, T., von Schoultz, B., Hirschberg, A. 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.

A Appendix I: Performance

The main focus of this paper is on the compensation choices that individuals made in the experiment; however, these choices may have been affected by performance differences. This section focuses on task performance for the different treatments. To consider how individuals are affected by the different incentives of each type of compensation, I focus on the performance of individuals in the first three treatments. In these first three treatments, individuals had no choice over the type of compensation they received for their efforts; thus, the performance effects from different compensation environments are exogenously determined.

According to the theory of piece rates and tournaments, one would expect greater effort for a higher piece rate. Similarly, an individual of higher ability and higher probability of winning should increase effort in a tournament. As the tournament gets larger and more competitive, one would expect that individuals would increase effort or set their effort levels to zero. Before considering the effects of tournament size on effort, I first focus on possible order effects and gender differences between treatments.

The regressions in Table 16 are used to consider gender differences in performance, learning effects and the incentive effects of increasing tournament size. The performance in the word task, but not the math task, is highly correlated with the GPA of participants. Regression estimates for both word and math show an order effect suggesting that subjects are learning in the first three treatments. Regression 1 in Table 16 shows that the tournament size has a statistically significant positive effect on individual performance in the math task. Increasing the competitiveness of a compensation environment from the piece rate to a tournament size of 6 should increase performance of an individual by 0.65 problems in a four-minute task. This is an increase of 5.7% for the average individual. In columns 2, 4, and 5, categorical variables are used to investigate whether tournament size is actually leading to the increase or whether just competing against someone in a tournament of any size leads to performance increases.

In the second column in Table 16, categorical variables were used for each of the possible competitive environments, for group pay and for tournaments. To test whether the tournament size matters a separate dummy variable, Tourney (ts>1) was used to identify if an individual had to compete against someone else. This categorization created a separate baseline for tournaments consisting of six individuals. Once controlling for tournament competition it was found that the size of the tournament does not matter and that group pay performance is not significantly different from the piece rate environment in the math task. There is also a positive effect for age as the average effect of a year of life leads to an increase in performance in the math task of 0.5 problems, though this may be offset by further post-secondary schooling. It is worth noting that overall the competitive environment and individual characteristics explain very little of the variation in performance for the math task in terms of goodness of fit measures such as R^2.

Table 16: RE Performance Regression of No Choice Treatments

VARIABLES	(1) Math	(2) Math	(3) Word	(4) Word	(5) Low Math
Task Order	0.88	0.82	3.49	3.50	1.10
	(0.09)	(0.09)	(0.39)	(0.38)	(0.11)
	(***)	(***)	(***)	(***)	(***)
Tourney Size	0.13		0.04		
	(0.04)		(0.15)		
	(***)		()		
Tourney(ts>1)		0.63		-0.16	1.18
		(0.27)		(1.02)	(0.31)
		(**)		()	(***)
Tourney Size=2		-0.07		2.08	-0.24
		(0.38)		(1.49)	(0.42)
		()		()	()
Tourney Size=4		-0.21		0.22	-0.73
		(0.37)		(1.40)	(0.45)
		()		()	()
Female	-0.45	-0.46	2.31	2.29	0.44
	(0.59)	(0.59)	(1.87)	(1.88)	(0.39)
	()	()	()	()	()
Years PS	-0.50	-0.50	0.16	0.15	0.17
	(0.29)	(0.30)	(0.87)	(0.87)	(0.23)
	(*)	(*)	()	()	()
Age	0.40	0.40	0.33	0.34	-0.07
	(0.15)	(0.15)	(0.49)	(0.49)	(0.14)
	(***)	(***)	()	()	()
GPA	-0.26	-0.26	6.60	6.57	0.32
	(0.63)	(0.64)	(1.94)	(1.95)	(0.41)
	()	()	(***)	(***)	()
Constant	3.22	3.39	4.11	0.00	6.43
	(3.42)	(3.43)	(11.57)	(0.00)	(2.58)
	()	()	()	()	(**)
Letter Controls	No	No	Yes	Yes	No
Observations	534	534	492	492	303
Number of id	178	178	164	164	101
R-sq	0.0745	0.0721	0.367	0.368	0.196
chi2	102.5	104.5	565.4	570.9	136.0

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The results from the word task (Regressions 3 and 4) in Table 16 suggest that neither the tournament nor tournament size increase performance. There is a significant amount of learning that occurs with each treatment. GPA has a significant positive effect in terms of performance. This likely occurs because an individual's vocabulary expands with age and individuals with a higher GPA probably have richer vocabularies than individuals with lower GPAs. More of the variation in performance can be explained in regressions using the word task than the math task; this mainly stems from the inclusion of control variables for the random letters used for each task.

The math task results suggest that being in a tournament does increase performance, but the size of the tournament is irrelevant. One might expect that only high ability individuals would increase performance from the incentive effects from being in a tournament, but I find the opposite. In splitting the sample for high and low ability individuals, according to their performance in the first task and whether they are above or below the median, I find that the low ability individuals increase performance in response to being in a tournament (significant at 1%) in the math task. I find no significant effects from tournament size for high ability individuals in the math task.[23]

The competitiveness of the environment has a significant impact on performance only in math tasks and once an individual is participating in a tournament, then the number of competitors does not lead to further performance benefits. Competitive environments (tournament size) had no influence on the performance of individuals in the word task. Thus, depending on the type of task, competition between individuals may increase performance. Therefore, due to mixed results, one cannot conclude that tournament size increases performance or effort of agents.

Overall, I find that a more competitive work environment may not lead to performance increases as the incentive effects of competitiveness are not robust across different types of tasks. Another important result shown by these regressions is that there are no significant performance differences between males and females. In terms of performance effects, some learning occurs across the different treatments and only low ability individuals tend to increase performance when they are put in a tournament of any size– it is enough to be competing against someone.

A.1 Performance differences according to hormonal phase.

To examine performance differences across the menstrual cycle, I consider the word and math tasks separately and estimate effects using linear specifications similar to the ones used to examine exogenous performance effects of tournaments (Appendix A). Table 17 provides the random effects OLS estimates for a number

[23]The estimation results for high ability individuals are not shown here, but none of the competitive environment variables were significant in these estimations.

of factors that may explain performance differences in both word and math tasks for all treatments where the participants could not choose their competitive environments. The estimations for math tasks are in columns 1 to 3 and the estimations for word tasks are in columns 4 to 6.

There seems to be no correlation with the low-hormone phase and performance in the word task (columns 4 to 6) for females. The Low Phase coefficient is insignificant for all the different samples in the word task. Focusing on performance in the math task (columns 1 to 3), there seems to be no effect from the low phase in the sample of both females and males (column 1), and only females (column 2). There seems to be some effect for low phase females when including controls for risk aversion for the portion of the particpants for which such measures were available. On average, performance in the math task decreases by about 2.2 correct answers for low phase females when controlling for risk aversion, which is a 20% decrease for the average female. Though the low phase effect is only significant at the 10% level when taking into account individuals for which measures of risk aversion can be used as controls, it still suggests that anticipated performance differences may play some role in differences in selection exhibited by females in the low phase. Therefore, if performance or confidence differences are driving selection differences, then controlling for performance and confidence in a discrete choice model should help isolate the effect of the low phase on selection choices.

Table 17: Hormonal Effects for Performance (t<4)

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All	Female	Female	All	Female	Female
Task	Math	Math	Math	Word	Word	Word
VARIABLES	RE	RE	RE Risk	RE	RE	RE Risk
Task Order	0.87	0.94	1.01	3.46	3.92	3.09
	(0.09)	(0.13)	(0.18)	(0.39)	(0.57)	(0.70)
	(***)	(***)	(***)	(***)	(***)	(***)
Tourney Size	0.14	0.12	0.09	0.05	-0.03	-0.20
	(0.04)	(0.06)	(0.08)	(0.16)	(0.23)	(0.29)
	(***)	(**)	()	()	()	()
Low Phase	-1.07	-1.09	-2.21	2.22	2.09	4.57
	(0.98)	(0.71)	(0.89)	(3.00)	(2.98)	(3.58)
	()	()	(**)	()	()	()
Female	-0.32			1.72		
	(0.67)			(2.11)		
	()			()		
Years PS	-0.41	-0.70	-1.19	0.31	-0.87	-3.41
	(0.30)	(0.40)	(0.52)	(0.87)	(1.39)	(2.10)
	()	(*)	(**)	()	()	()
Age	0.38	0.55	0.89	0.31	1.48	3.52
	(0.15)	(0.23)	(0.27)	(0.49)	(0.90)	(1.22)
	(**)	(**)	(***)	()	()	(***)
GPA	-0.12	-0.43	-0.46	5.73	7.56	6.22
	(0.65)	(0.78)	(1.03)	(2.00)	(3.19)	(4.13)
	()	()	()	(***)	(**)	()
Psych meds	-1.48	-0.88	-1.17	3.37	4.80	3.56
	(1.10)	(1.19)	(1.65)	(3.23)	(4.95)	(6.78)
	()	()	()	()	()	()
Constant	3.26	0.78	-3.87	6.92	-18.13	-43.30
	(3.47)	(4.18)	(5.28)	(11.70)	(19.47)	(26.05)
	()	()	()	()	()	(*)
Letter Controls	No	No	No	Yes	Yes	Yes
Risk Controls	No	No	Yes	No	No	Yes
Observations	510	237	147	471	225	147
Number of id	170	79	49	157	75	49
R-sq w	0.206	0.242	0.248	0.624	0.647	0.665
R-sq b	0.0740	0.147	0.365	0.291	0.340	0.430
R-sq o	0.0909	0.168	0.339	0.369	0.410	0.496
chi2	100.5	62.28	54.45	563.4	289.1	209.3
df_m	9	8	10	16	15	17

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

B Appendix II: Expected value from competitive choice

To maximize expected value from choosing to compete in a tournament, or to accept the piece rate, or to select the group pay scheme, an individual cares about his probability of winning a tournament and his expected output. Expected values are based on the performance from Treatment 1 and the improvement of the individual from repeating the task and being in a tournament in Treatment 2.[24] Assume an exogenous probability of winning a two person tournament in the form the percentile rank from Treatment 1 for the individual. If the individual is the best in the session then he receives a probability of winning a tournament of 0.99 and if he is the worst performing individual in the group his probability of winning is set to 0.01. Let this rank be equal to p. An individual's probability of winning an n person sized tournament is then p^{n-1}. Let b be the base piece rate and y be the expected output of the individual, then the expected value of an n person tournament is:

$$EV_n = p^{n-1}\, y\, b\, n \tag{B.1}$$

This expected value form includes the piece rate which is the equivalent of a tournament size of 1. For group pay selection, assume that an individual accurately predicts the mean performance of the group. If an individual expects his output to be lower than the group average and if his probability is less than $\frac{1}{2}$ then he should choose the group pay compensation scheme. Otherwise the rank ordering for the different sized tournaments in terms of expected values is as follows:

$$\left\{\begin{array}{ll} EV_6 \geq EV_4 & \text{if } y > \bar{y} \text{ and } p \geq \sqrt{\frac{2}{3}} \\ EV_4 \geq EV_6 & \text{if } y > \bar{y} \text{ and } p \leq \sqrt{\frac{2}{3}} \\ EV_2 \geq EV_4 & \text{if } y > \bar{y} \text{ and } p \leq \sqrt{\frac{1}{2}} \\ EV_1 \geq EV_2 & \text{if } y > \bar{y} \text{ and } p \leq \frac{1}{2} \\ EV_{Grp} \geq EV_n & \text{if } y \leq \bar{y},\ \forall\, n \in \{1, 2, 4, 6\} \end{array}\right\} \tag{B.2}$$

[24] For simplicity, the incentive effects of effort from entering a tournament are ignored in calculating these expected values.