Team females compared to single females

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Thank you note

I would like to thank Prof. dr Willen J.M.I. Verbeke my supervisor who has given me the chance to realize a very constructive research thesis and who has given me motivation, guidance and support from the initial to the final level, enabled me to develop and finish this project. I thank him for challenging me to do this experiment.

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By Sofia Hamdi

Thesis abstract

Sixty-nine students enrolled in an Economics & Business Master specialization Marketing at the Erasmus University of Rotterdam in The Netherlands participated in an experiment organized by Prof. Dr. Willem J.M.I. Verbeke and a group of 7 master Marketing students in order to deepen the knowledge in Neuroscience. For this study a sample of 37 women is used. The results of the experiment are collected thanks to organized game. The game is composed from a sales management simulation game made by ISAM (Institute for sales& account Management), collect of saliva samples and fulfillment of survey. Saliva was collected in order to measure the level of Testosterone and Cortisol. The present study will compare two groups of women. The first group is women competing individually and the second group is women competing in duo.

The first hypothesis suggests that cortisol is high when women are competing individually. The result of this hypothesis is valid. The explanation can be that when women compete alone, they have more stress and they are afraid to confront the situation of their own, while women in duo are supported by their partner, so they feel less stressed because they are supported and have less responsibility. When women competing in duo lose they feel less affected than women competing alone.

The second hypothesis suggests looking if the performance (the final result; the ranking) has effect on Cortisol for women working individually and in duo. In concrete terms, the winner of the competition should have the lowest level of cortisol. People who come in second place should experience the intense agony of defeat as they realize through counterfactual thinking that they could have been the winners. Therefore, we expect them to experience the highest level of cortisol. The result of this hypothesis is not valid. Being alone or in duo and final ranking have no influence on cortisol and Testosterone however the expected hypothesis that the winner will have the lower level of cortisol and the second position the

highest level of cortisol exists in the pattern regarding individual women but it is not significant. One reason of that can be the small sample of 37 women which is not significant.

Theoretical and practical implications will be discussed.

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1. Introduction

In this study students are engaged in a competitive business game. Each team is competing against other teams that are equally motivated to achieve the highest contest and win the game. The contest has no pre-established outcome which means all teams have an equal chance of winning. During the game, teams receive feedback on their current status, such as information on their own performance. Moreover, teams also receive information about their relative performance as compared to the performance of the other teams (i.e. ranking). Ending first on this ranking is the most important successful criterion as all teams start with the same resources. The most important question is to understand how hormones will react during the entire course of the game.

One important thing to know is that an increase in a team's relative status implies a decrease in the relative status of the other teams (Heffetz & Frank, 2010). As such, status gained (or lost) during the competition might be associated with hormonal changes, especially in hypothalamic-pituitary-adrenal (HPA) axis which involving the production of cortisol and hypothalamic-pituitary-gonadal (HPG) axis involving the testosterone (Salvador, 2005). According to the dual-hormone hypothesis, testosterone and cortisol are reciprocally (antagonistically) related: testosterone inhibits (HPA) axis functioning, decreasing bodily responses of the autonomic nervous system (example: heart-rate or skin-conductance). In contrast, cortisol has inhibitory effects on the functioning of the (HPG) axis (Terburg, Morgan and van Honk, 2009; Viau, 2002; Burnstein, Maiorino and Cameron, 1995; Mehta and Josephs, 2010), resulting in high punishment sensitivity (Terburg, Morgan & van Honk, 2009).Cortisol hormone is produced in the adrenal cortex.

The hormone plays some vital roles in the human body by giving a regulation in the blood pressure and by controlling the level of blood sugar. It also plays a significant role in the functioning of the immune system and regulation of the inflammatory response of the body. Stress or anxiety is the most important factor that stimulates the release of cortisol. Release of this hormone can be termed as a

response of the body to physical and mental stress. A high level of cortisol can be attributed to prolonged stress. Both testosterone and cortisol have an effect on the brain operation and on the brain working particularly the dopamine system (Coates, Gurnell and Sarnyai, 2010).

Higher levels of testosterone has receptors in the nuclues accumbens thus increasing dopamine release which is also responsible for vigilance against possible status threats (Eisenegger, Haushofer & Ferh, 2011), reward proneness (Caldu and Dreher, 2007) causing them to undertake risk (Coates, Gurnell & Saryai, 2010), staying focused on the purpose of the contest i.e., winning (e.g., Salvador, 2005). Van Wingen et al. (2010) also show a reduced functional coupling between the amygdala and the orbitofrontal cortex after artificially raising the testosterone levels through a nasal dose of testosterone. All this hikes the drive to reach or maintain status.

Higher levels of cortisol rises extracellular dopamine levels and impairs declarative memory and the consequence can be a risk of aversive behavior during a contest. This makes results in lower competitive motivation as well as lower status and a negative or socially undesirable identity (Dickerson, Gruenewald & Kemeny 2009). Also, cortisol responses have been associated with increased social avoidance behavior and increased stress responses to a social stress test (Roelofs et al., 2009), possibly pointing to an elevated susceptibility or sensitivity for (social) status loss as a consequence of losing a contest (loss in prefrontal control).

In order to assist this study of literature, we tested the dual hormone hypothesis in a context involving individual women competing against women in duo in a business game (see Method section). Although we expect that women working individually will have a higher level of cortisol than women working in duo. Moreover, in the second hypothesis we will look if the performance (the final result; the ranking) has effect on Cortisol/ Testosterone for women working individually and in duos. The expected situation is that the winner will have the lowest Cortisol

level; the second will have the highest Cortisol level. . In this context four teams are competing; so there will be four positions in the final ranking: first, second, third and fourth.

Salvador (2005) found that competing with loss in a competition has a reciprocal effect on hormonal changes. In concrete terms, the winner of the competition should have high positive T/C change as a result. People who come in second place should experiment the intense pain of defeat because they will be so close of the first place and they could have been the winners (Medvec, Madey & Gilovich, 1995). Therefore, our expectation is that they will have the highest level of Cortisol. The same, when people come in last they might perceive themselves as “losers” which would affect their self-esteem (e.g., Salvador, 2005). In contrast, people who come in second last remain in the middle mode, feeling that their status is still acceptable (they could think “we are not the last”) while at the same time not experiencing the feeling of being the ‘first loser’ that second ranked might suffer from. This might lower their cortisol levels. The goal of this study will be to test and see if the results are consistent with these hypotheses.

1.1. Research Topic

The aim of the research is to bring increased attention to the female competition when working alone or in duo. An important measure will be taken into account which is the level of Cortisol and Testosterone. Thus the experiment will test for the first time whether individual women versus intergroup women competition. Individual women and women in duo provided saliva samples and were randomly assigned to participate to a sales management game.

1.2. Hypotheses formulation

The steroid hormone cortisol is released by the hypothalamic–pituitary–adrenal (HPA) axis in response to physical exertion (Mastorakos, Pavlatou, Diamanti-Kandarakis, & Chrousos, 2005) and psychological stress (Dickerson &

Kemeny, 2004). The first hypothesis is that when women are alone they have more stress and they are afraid to confront the situation on their own, which means that they will have more Cortisol than women competing in duo because they are supported and have less responsibility. This hypothesis will test that cortisol is high when women are competing individually. The second hypothesis suggests looking if the performance (the final result; the ranking) has effect on Cortisol for women working individually and in duos. In concrete terms, the winner of the competition should have the lowest level of cortisol. People who come in second place should experiment the intense pain of defeat as they realize through counterfactual thinking that they could have been the winners (Medvec, Madey and Gilovich, 1995). Therefore, we expect them to experience the highest level of cortisol. Theoretical and practical implications will be discussed. The goal of this study will be to test and see if the results are consistent with these hypotheses.

1.3. Research Relevance

The relevance of this study provides more understanding regarding the role of Testosterone/ Cortisol during individual/ group women competition (in duo). Across different studies, we know that testosterone levels regulate social dominance (a behavior intended to gain or maintain high status (Mazur and Booth, 1998) and that Cortisol can be the reponse to exertion (Mastorakos, Pavlatou, Diamanti-Kandarakis, & Chrousos, 2005) and stress (Dickerson & Kemeny, 2004). Till now, most research on Cortisol and behavior has been conducted in men, so it is very interesting to look at the results through women.

Research of this type is important to the general knowledge particularly to the companies having a high level of competition and looking for the best way to compose their team for a high productivity and efficiency. This research will contribute to a better contribution of the companies understanding with regards to:

- The improvement of the decision-making ability
- The composition of the teams

- The understanding of the influence of Testosterone/Cortisol on the female work

1.4. Literature review

Many studies have explored the gender differences during work and team competition (Radosveta Ivanova-Stenze, Courtesy & Idleness 2005).The searchers wanted to know if the gender plays a role in the context of team work. For two different incentive schemes, revenue sharing within a team and competition between teams, they varied the gender composition of the teams.

Hormone (testosterone, cortisol)–behavior relationships have been extensively studied among male competitors as mentioned before, and far less so among female competitors. Regarding studies about females few studies have been made about hormones behavior relationship. The first research (Testosterone, cortisol, and women's competition Helen S. Bateupa, Alan Boothb, Elizabeth A. Shirtcliff , Douglas A. Grangerc 2001) studied members of a nationally recognized college women's rugby team. Seventeen players between 18–22 years provided saliva samples 24 h before, 20 min prior to, and immediately after five league matches. Subjects self-reported aggressiveness, pregame mental state, postgame performance evaluation, and whether the opponent was more or less challenging than expected. The result of this study is that Testosterone and Cortisol increase in anticipation of the matches. Postgame levels of both hormones were significantly higher than pregame levels. The pregame rise in testosterone was associated with team bonding, aggressiveness, and being focused, but was unrelated to perceptions of the opponent's skill. Regarding the testosterone change during the game, it was unrelated to losing or winning. Game changes in cortisol were positively related to player evaluations of whether the opponent was more of a challenge than expected, and negatively related to losing. These results are compared with hormone–behavior patterns found among male competitors

and are interpreted within a recent theory of sex differences in response to challenges.

Another study regarding women completion(Women's intercollegiate volleyball and tennis: Effects of warm-up, competition, and practice on saliva levels of cortisol and testosterone David A. Edwards, Lauren S. Kurlanderand 2010) is in a first place about women athletes from a highly ranked varsity college volleyball team ,and in a second place about a highly ranked varsity college tennis team gave saliva samples before warm-up, at mid-warm-up (volleyball) or after warm-up (tennis), and immediately after intercollegiate competition. For volleyball and tennis, warm-up was associated with a elevation in saliva levels of testosterone which was carried over through the period of actual competition. Cortisol levels were relatively unchanged during warm-up, but typically rose during competition. Thus, as women prepare for athletic competition by warming up, testosterone levels rise in apparent anticipation of the coming contest and then remain high through the period of play. In volleyball and tennis, after-practice testosterone level was significantly higher than before-practice level, and practice session increases in testosterone (but not cortisol) were positively correlated with increases in testosterone during intercollegiate competition.

Finally a study comparing individual versus intergroup men and women (When are low testosterone levels advantageous? The moderating role of individual versus intergroup competition, Pranjal H. Mehta, Elisabeth V. Wuehrmann, Robert A. Josephs.) This study tested the hypothesis that testosterone's effect on competitive performance is depending on whether competition is among individuals (individual competition) or among teams (group competition).

Limitations of previous studies likely contribute to the inconsistent findings. First of all, most studies to date involved physical activity (sports competitions), which makes it difficult to tease apart the known physical effects of Testosterone and Cortisol on muscle mass. That is why new studies are needed to find out the relationship between T or C and performance in non-physical domains, such as cognitive competitions. Second most previous studies have been conducted in

naturalistic settings and that is why we find a difference in characteristics of the social environment.

- ***Steroid hormones***

  - **Testosterone and the hypothalamic–pituitary–gonadal axis**

Testosterone is produced by the testes for the males, by the ovaries for the female and by the adrenal cortex in both sexes. The sex steroids, as testosterone and oestrogen, are regulated by a series of glands acting in concert: the hypothalamic–gonadal (HPG) axis (see figure 1) and have among others role: reproductive function, spermatogenesis in males, menstrual cycle in or other forms of motivated behaviors in both genders (Reichlin 1998).

Gonadotrophin-releasing hormone (GnRH), synthesized by a small group of neurons in the hypothalamus, is transported axonally to the median eminence where it is released in a pulsatile manner into the hypothalamic–pituitary portal circulation (a network of blood vessels connecting the hypothalamus with the pituitary gland). GnRH then acts on the anterior pituitary gonadotrophs-cells responsible for the production of luteinizing hormone (LH) and follicle-stimulating hormone (FSH). When LH and FSH are released into the blood in response to GnRH stimulation, they travel to the gonads (the ovaries in females and the testes in males.) (John M. Coates, Mark Gurnell & Zoltan Sarnyai 2009).

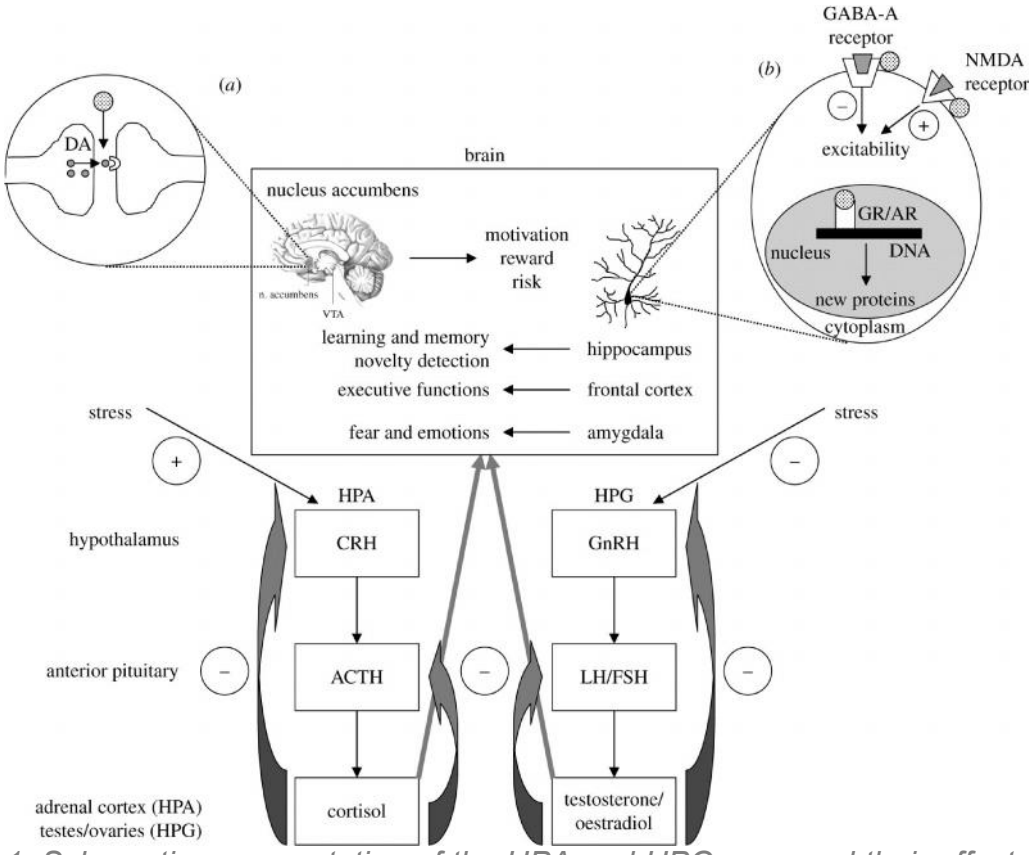


Figure 1: Schematic representation of the HPA and HPG axes and their effects on brain function. (a) Effects of steroid hormones on dopaminergic neurotransmisson in the nucleus accumbens; (b) genomic and non-genomic effects of steroids in the brain

- **Cortisol and the hypothalamic–pituitary–adrenal axis**

Cortisol, the main human glucocorticoid, is produced and regulated by the hypothalamic–pituitary–adrenal (HPA) axis (see figure 1). This axis has different functions as maintaining normal physiological homeostasis, regulating diverse processes, including metabolism, cardiovascular biology, and cognitive function. The system operates in a hierarchical manner similar to the HPG axis.

Role of cortisol is to help the body adapt to changing circumstances in both its internal and external environments. Biologically, cortisol facilitate the mobilization of resources to meet demand, including effects on intermediary metabolism, carbohydrate and protein metabolism, as well as acting as potent regulators of our endogenous ‘defense’ mechanisms, including the innate and adaptive immune

responses (Buckingham 1998). Owing to their highly lipophilic nature, they can enter the brain easily and exert widespread effects on emotions, cognition, and the behavioral response to stress (De Kloet 2000, John M. Coates, Mark Gurnell and Zoltan Sarnyai 2009).

- ***Female competition***

To our knowledge, only a few controlled studies have examined competition and hormone changes in women. One of them Mazur et al. (1997) obtained saliva samples from 28 men and 32 women before, during, and after competing with same-sex partners in a video game. The stud yfound that men's testosterone and cortisol followed the familiar pattern of a pregame rise but that there was no postgame difference in response to winning and losing. Women, on the other hand, experienced no change in testosterone and cortisol production, except for a downward trajectory most likely due to diurnal variation. Overall, women's cortisol level was higher than the men's, which may indicate that they experienced the event as more unfamiliar or challenging than did the men. While this was a carefully controlled study, women seldom play video games, compared to men, and may not have felt that the event challenged their status. The reason that male losers and winners did not differ from one another may also indicate that men did not find the video game sufficiently engaging to invest in the experience as a challenge to their status.

2. Method

2.1. Participants

Sixty-nine students (37 women) enrolled in an Economics & Business Master specialization marketing at the Erasmus University of Rotterdam in The Netherlands participated in the experiment in exchange for credit and an amount of money toward a research requirement. For this study a sample of 37 women is used. The average age is 23 years. The Medical Ethical Committee of the Erasmus MC approved the study. Participants prepared for the game by reading the game manual, which was given to them at the beginning of the experiment.

One week before the start of the game, the participants were reminded about the game. They were asked to maintain their usual daily rhythms in terms of sports and sleep. On the day of the game, they were asked to avoid from consuming alcohol, chocolate, tea or coffee. During the game, they could only drink water. All participants received general information about the study

2.2. Procedure

In total 37 women accepted to participate at the experiment. The game is composed from a sales management simulation game made by ISAM (Institute for sales& account Management), collect of saliva samples and fulfillment of survey.

2.3. Sales Management game

First, a short introduction is made about the Game. The Sales management game is made by ISAM.(Institute for sales& account Management). The Sales Force sales management game is a frequently used computer simulation game to assess sales managers during the course of an executive sales training program. During the game, the players represent the Sales Management Teams (SMT) of

fictional firms that operate in the same virtual world and market for specialty communications electronics. The four firms are direct competitors for market share and personnel. The firm with the most effective sales force, that is, the sales force with the highest cumulative earnings at the end of the game, is designated as the winner. In the game students started with a small sales force of 5 sales reps, and manage the sales force by making several types of decision:

- Organizing and staffing
- Training
- Compensation and expenses
- Account management supervision
- Time management
- Information

The contest is played in four rounds, each representing a year quarter. All firms start out with a sales force of five salespeople, each with identical sales performance. During the four quarters, the Sales management teams need to develop a sales strategy related to the hiring, remuneration, training, coaching, and firing of account managers. They make this by making decisions related to account management, compensation and expenses, business intelligence, organization and staffing, sales managers time management and training. Decisions are made under time pressure, since the time for each quarter decreases, from 60 minutes for the first quarter, to 45, 30, and 20 minutes for the second, third, and fourth quarter, respectively.

All of the firm's decisions are saved by the software and combined to determine the outcome of that quarter. After each round, the teams receive updates on the current status of all four companies. For instance, they find out which account managers have decided to leave their firm, or which account managers have accepted a work offer. Most importantly, the firms learn their ranking, which is based on their team's relative performance compared to the other three firms. The team that accumulates the most profit is the winner.

Students take decisions that have far-reaching and complex effect on their sales forces and its performance. The first decision concerns the organization and staffing. Each team started with the same level of reps. For this first decision they had to decide how many of the current sales reps they wanted to fire and which on they wanted to hire.

The students had to make two basic decisions regarding training and both had an impact on how effective their sales forces performance is. Other decision they had to make was about compensation and expense. One of sales manager's major and continuing tasks was that of developing a basic strategy for the reps to follow in conducting their sales activities and managing their accounts. Also they had to allocate the percentages of reps time for different points. Students also had the possibility to buy with the money of the company reports that provided them information about the sales department income statement, the sales reps performance and contribution report, the sales rep expense analysis and basic industry sales and earnings reports. After having made those decisions, no change was possible anymore. They received a mail when their decisions were processed. It took about 5 till 10 minutes. Each period, they could change every decision.

2.4. The Competition

The contest was played between 11.30 A.M. and 8.30 P.M. to minimize the effects of circadian fluctuations in Testosterone and Cortisol (Touitou & Haus, 2000). By arrival, students were randomly divided in teams. At the onset of the competition all teams were invited to a larger room where the aim and rules of the game were explained. All participants were instructed to read the manual during the game; they also received a table of content which facilitated the reading of the manual. During this session, participants were instructed not to eat or drink. Immediately after this introductory session, 30-minutes after entering, pre-contest saliva samples were collected (see figure 1).

After that, each team was placed in a separate room, equipped with one computer on which to play the game. In separate room, the researchers monitored the gameplay. At the end of each quarter, the teams sent their proposed strategy to the central computer that calculated the new simulation results. These results are combined into a quarter reports, which include information on the consequences of the decisions made, like sales revenue, company profits. Additionally, this report informed each team about the performance of the other teams, and hence about the current ranking of the team. These progress reports were handed to each team at the initial of each new round.

After the fourth round, all teams were invited to the instruction room where the final ranking was announced. Participants were asked to wait an additional 25 minutes during which they filled in the questionnaires and refrained from eating and drinking. Finally, the post-competition saliva sample was collected (see figure 1).

2.5. Collect of saliva samples

Saliva samples were taken using Sarstedt Cortisol Salivette devices, and the managing team exactly followed standard salivary hormone collection procedures (Schultheiss & Stanton, 2009; manual of the Sarstedt Salivette devices). Students chewed on a synthetic swab before the game start, during the game and finally 25 minutes after the game. The saliva samples were analyzed for Testosterone and Cortisol concentrations. The samples were stored at -20°C until analyzed. The free cortisol levels in saliva were analyzed with a commercially available ELISA kit (Demeditec Diagnostics, Germany). Limit of detection is 0.276 nmol/l. The inter- and intra-assay coefficients of variation were lower than 10% and 7% respectively. At different stages of the games participants were not allowed to eat or drink. They had to be very aware that this experiment is a huge influence on their final grade. So they had to make sure that they actively and seriously took part of the game!

Because there was a competition involved in this game, there was a cash reward for the winning team/ the winner. The name of the winners was announced on BB.

2.6. Survey

After they have completed this game, they were asked to fill in an evaluation form regarding the game that they played. This evaluation is obligatory for obtaining the final grade.

2.7. Requirements and rules during the game

During this game using of mobile phones and any others electronic devices was strictly prohibited otherwise students was penalized. There is no communication allowed during the game and after the game with other teams. These measures are to ensure the authenticity of the results.

2.8. Materials and Methods

All genotyping was performed blind to demographic and clinical data. Buccal swabs were obtained from each participant student. DNA concentrations were tooken using the Quant-iT DNA Assay kit (Invitrogen,Breda, The Netherlands). The average yield was 4g of genomic DNA/ buccal sample.

2.9. Statistical analyses

The SPSS statistical package was used for the whole calculation of independent and correlated T-tests. In all cases $p < .05$ was required for statistical significance.

3. Results

3.1. Hypothesis 1

Regarding the first hypothesis we can see in the data that the results concerning the cortisol are significant in phase B and C (during and after the game) but the results touching the Testosterone are not significant.

Tests of Between-Subjects Effects

Source	Dependent Variable	F	Sig.
Corrected Model	CortisolA	1.100	.301
	CortisolB	11.750	.002
	CortisolC	5.686	.023
	TestosteroneA	.032	.859
	TestosteroneB	.316	.578
	TestosteroneC	.202	.656
Intercept	CortisolA	50.279	.000
	CortisolB	87.868	.000
	CortisolC	60.485	.000
	TestosteroneA	92.115	.000
	TestosteroneB	86.962	.000
	TestosteroneC	123.412	.000
newcontext	CortisolA	1.100	.301
	CortisolB	11.750	.002
	CortisolC	5.686	.023
	TestosteroneA	.032	.859
	TestosteroneB	.316	.578
	TestosteroneC	.202	.656
Error	CortisolA		
	CortisolB		
	CortisolC		
	TestosteroneA		
	TestosteroneB		
	TestosteroneC		

Figure 2: Test of between subjects' effects; Cortisol during and after the game are significant. Testosterone during before, during and after the game is not significant.
New context means women competing alone+ women competing in duo.

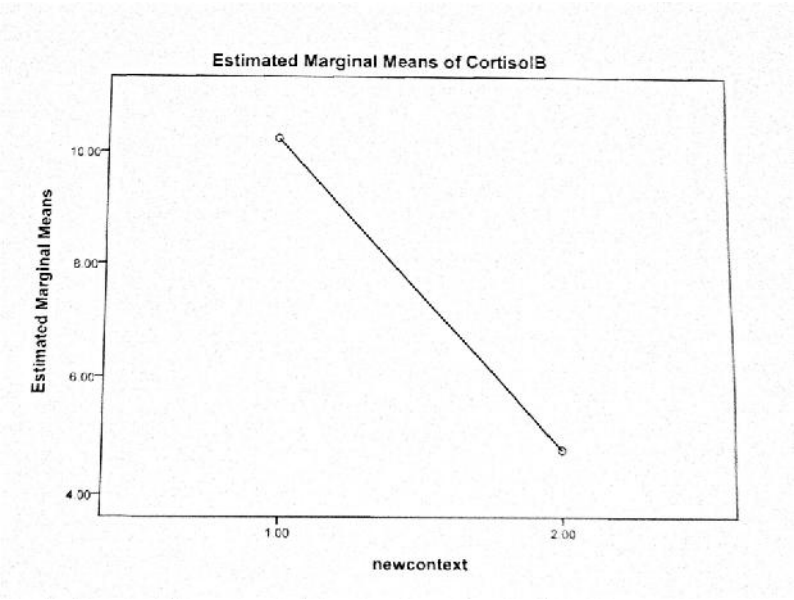


Figure 3: This Graph shows the level of cortisol in phase B (during the middle of the game).
New context means (1: women competing individually; 2: women competing in duos)

Now that we know that the results regarding Cortisol are significant in phase B and C, we can look at the graph above and see that women competing individually have a higher level of cortisol than women competing in duo during phase B. There is a big difference between the two groups. During the middle of the game we can see that the difference in Cortisol is very large between women alone and women in duos. Results are significant.

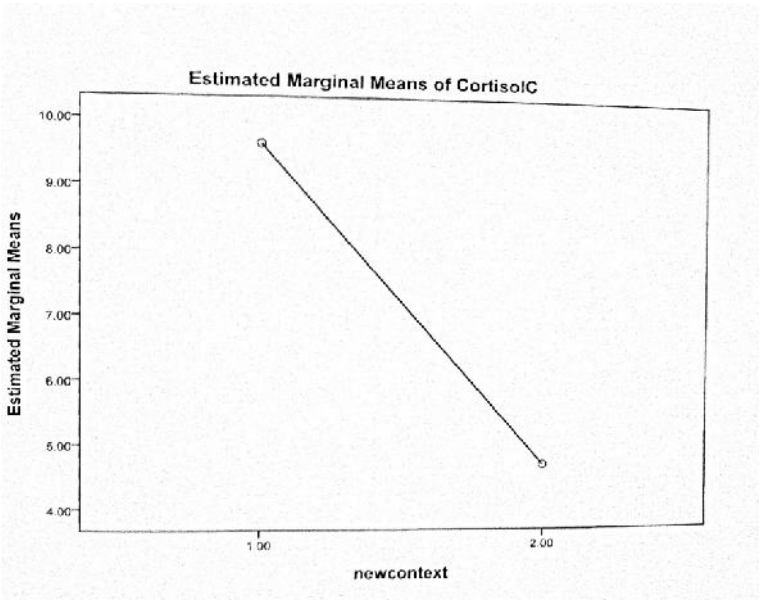


Figure 4: Graph showing the level of cortisol in phase C (after the game).
New context means (1: women competing individually; 2: women competing in duos)

The graph above shows us the level of cortisol in phase C (after the game). As we can see women competing individually have a higher level of cortisol than women competing in duo after the end of the game. There is a big difference between the two groups. Results are significant.

We can conclude that the first hypothesis is valid. The Level of Cortisol is high when women are competing alone. The explication can be that when women compete alone, they have more stress and they are afraid to confront the situation of their own, while women in duos are supported by their partner, so they feel less stressed because they are supported and have less responsibility. If women competing in duo lose they feel less affected than women competing alone.

3.2. Hypothesis 2

The second hypothesis tests if the performance (the final the ranking) has an effect on Cortisol/ Testosterone in phase C (after the game) for women working

individually and in duos. The expected situation is that the winner will have the lowest Cortisol level; the second person in the ranking will have the highest Cortisol level because. Theoretical and practical implications will be discussed.

Tests of Between-Subjects Effects

Source	Dependent Variable	F	Sig.
Corrected Model	CortisolC	1.072	.405
	TestosteroneC	.843	.561
Intercept	CortisolC	54.865	.000
	TestosteroneC	114.137	.000
newcontext	CortisolC	6.550	.016
	TestosteroneC	.453	.506
FinalRanking	CortisolC	.234	.872
	TestosteroneC	.041	.989
newcontext * FinalRanking	CortisolC	.487	.694
	TestosteroneC	1.734	.181
Error	CortisolC		
	TestosteroneC		
Total	CortisolC		
	TestosteroneC		
Corrected Total	CortisolC		
	TestosteroneC		

Figure 5: Test of between subjects' effects; Cortisol after the game is significant. Testosterone during after the game is not significant. New context and final ranking have no influence on cortisol and Testosterone. The results are not significant.

In the table above we can the result after making Test of between subjects' effects. The result of Cortisol after the game is significant with sig 0.16. The result of Testosterone is not significant with sig 0.506. Now if we look at the new context which means when women are competing alone or in duo and compare this

measure to the final ranking, we can conclude that the new context and final ranking have no influence on cortisol phase C with sig 0.694 and Testosterone sig 0.181.

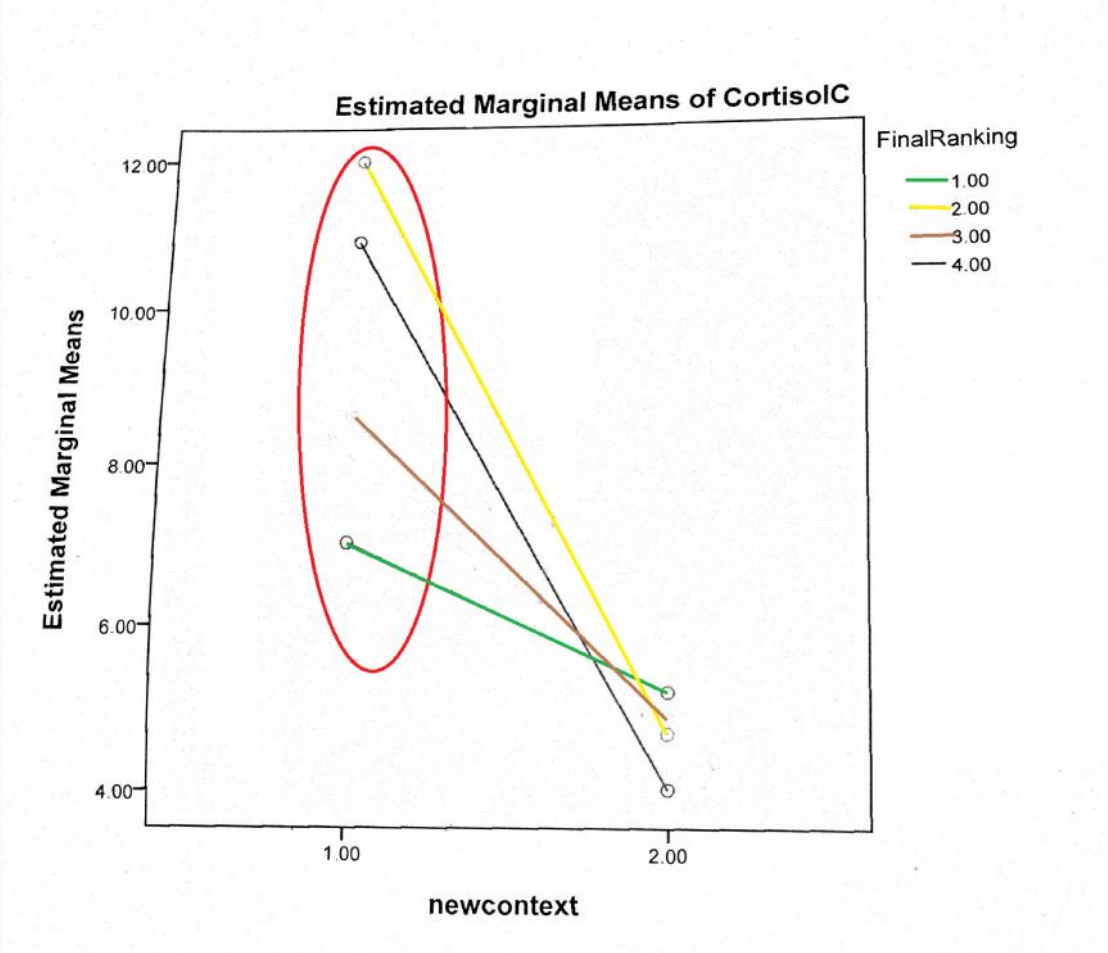


Figure 6: Graph showing the estimated Marginal Means of Cortisol in phase C (after the game).

New context means (1: women competing individually; 2: women competing in duos)

As we have already showed the new context and final ranking have no influence on cortisol phase C sig 0.694 and Testosterone sig 0.181 but the expected hypothesis that the winner will have the lower level of cortisol and the second position the highest level of cortisol exists in the pattern but it is not significant. One reason of that can be the small sample of 37 women which is not significant.

4. Discussion and limitations

This study shows that women competing individually score higher in Cortisol than women competing in duo. In addition the second hypothesis suggests verifying if the performance (the final result; the ranking) has effect on Cortisol for women working individually and in duos. In concrete terms, the winner of the competition should have the lowest level of cortisol. People who come in second place should experience the intense agony of defeat as they realize through counterfactual thinking that they could have been the winners (Medvec, Madey & Gilovich, 1995). Therefore, we expect them to experience the highest level of cortisol. The result of this hypothesis is not valid. Being alone or in duo and final ranking have no influence on cortisol and Testosterone however the expected hypothesis that the winner will have the lower level of cortisol and the second position the highest level of cortisol exists in the pattern for women competing individually but it is not significant. One reason of that can be the small sample of 37 women which is not significant.

Given that our focus on a competitive business game, future research could use bigger sample which will give results more reliable and significant. There is a high probability that the second hypothesis can be significant if the sample was bigger. Remember that this game is an unreal game which means that participants play with bigger amounts of money without incurring major consequences. The environment and the game don't reflect a real work situation which means that there is a probability that the Cortisol and Testosterone can react differently in a real work situation where stress and competition are taken more seriously. We invite researchers to study theses suppositions.

More evidence is needed to evaluate whether our findings can be generalized, for example by increasing the sample size, or by taking into account other factors as the origin of the participants or the age. Moreover this experiment didn't take into account if the participant were currently using oral contraceptives or injected, implanted or patch-delivered hormone contraceptive. It is possible that hormones

of women using contraceptive means are different from women not using contraceptive means. Furthermore the data was not completely full. Indeed some data are missing because some participants did not respond to the entire questionnaire. Future experiment could take into account this remarks.

5. Conclusion

This paper reports on an experiment designed to study the difference in competition between individual women versus women in duo. The first hypothesis was that women competing alone have a higher level of cortisol than women competing in duo. The results of the experiment suggest that this hypothesis is valid. The explication can be that when women compete alone, they have more stress and they are afraid to confront the situation of their own, while women in duos are supported by their partner, so they feel less stressed because they are supported and have less responsibility. If women competing in duo lose they feel less affected than women competing alone. The second hypothesis was to look if the performance (the final result; the ranking) has effect on Cortisol/ Testosterone for women working individually and in duos. The expected situation was that the winner will have the lowest Cortisol level; the second will have the highest Cortisol level. The results of the experiment showed that the final ranking has no effect on Cortisol/ Testosterone for women working alone or in duo. However the expected hypothesis that the winner will have the lower level of cortisol and the second position the highest level of cortisol exists in the pattern but it is not significant. One reason of that can be the small sample of 37 women which is not significant.

More evidence is needed to evaluate whether our findings can be generalized, for example by increasing the sample size, or by taking into account other factors as the origin of the participants. Moreover this experiment didn't take into account if the participant were currently using oral contraceptives or injected, implanted or patch-delivered hormone contraceptive. Future experiment could take into account this remarks. This experiment should thus be seen as a first step towards a better understanding of women working individually or in intergroup.

Bibliography

- Mehta PH & Josephs RA (2010). Testosterone and cortisol jointly regulate dominance: Evidence for a dual-hormone hypothesis. Hormones and Behavior, 58, 898–906

- Mehta PH & Beer JS (2010). Neural mechanisms of the testosterone-aggression relation: The role of orbitofrontal cortex. Journal of Cognitive Neuroscience, 22, 2357–2368.

- Roberti, Jonantan W (2004)," A review of behavioral and biological correlates of sensation seeking" Journal of research in persobality. 38,256-279

- Salvador, Alicia (2005), "coping with competitive situations in humans," Neuroscience and behavioral reviews, 29,195-205

- Mehta PH, Wuerrhman E, & Josephs RA (2009). When are low testosterone levels advantageous?: The moderating role of individual versus intergroup competition. Hormones and Behavior, 56, 158-162.

- The gender differences during work and team competition (Radosveta Ivanova-Stenze, Courtesy and Idleness 2005)

- Mehta PH, Jones AC, & Josephs RA (2008). The social endocrinology of dominance: Basal testosterone predicts cortisol changes and behavior following victory and defeat. Journal of Personality and Social Psychology, 94, 1078–1093.

- Testosterone, cortisol, and women's competition Helen S. Bateupa, Alan Boothb, Elizabeth A. Shirtcliff , Douglas A. Grangerc 2001

- Mehta PH & Josephs RA (2006). Testosterone change after losing predicts the decision to compete again. Hormones and Behavior, 50, 684-692.

- Edwards DA (2006). Competition and testosterone. Hormones and Behavior, 50, 681-683.

- Josephs RA, Sellers JG, Newman ML, & Mehta PH (2006). The mismatch effect: When testosterone and status are at odds. Journal of Personality and Social Psychology, 90, 999-1013.

- Women's intercollegiate volleyball and tennis: Effects of warm-up, competition, and practice on saliva levels of cortisol and testosterone David A. Edwards, Lauren S. Kurlanderand 2010

- Terburg, Davis, Barak Morgen and Jack van Honk (2009), “The testosterone cortisol ratio: A hormonal marker for proneness for social aggression” International journal of law and psychiatry, 32,216-223.

- Bernhardt, P., Dabbs, J., Fielden, J., & Lutter, C. (1989). Testosterone changes during vicarious experiences of winning and losing among fans at sporting events. Physiology & Behavior, 65, 59–62.

- H.S. Bateup et al. / Evolution and Human Behavior 23 (2002) 181–192 191

- Booth, A., Shelly, G., Mazur, A., Tharp, G., & Kittok, R. (1989). Testosterone, and winning and losing in human competition. Hormones and Behavior, 23, 556–571.

- Dabbs, J., & Dabbs, M. (2000). Heros, rogues, and lovers: testosterone and behavior. New York: McGraw-Hill.

- Daltzman, R., & Zuckerman, M. (1980). Disinhibitory sensation seeking, personality and gonadal hormones. Personality and Individual Differences, 1, 103–110.

- Elias, M. (1981). Serum cortisol, testosterone, and testosterone-binding globulin responses to competitive fighting in human males. Aggressive Behavior, 7, 215–224.

- Filaire, E., Masso, F., Sagnol, M., Lac, G., & Ferrand, S. (2001). Anxiety, hormonal responses and coping during judo competition. Aggressive Behavior, 27, 55–63.

- Graubard, B. I., & Korn, E. L. (1994). Regression analysis with cluster data. Statistics and Medicine, 13, 509–522.

- Herrmann, W., McDonald, R., & Bozak, M. (1976). A psycho experimental model for the investigation of hormones as psychotropic agents. In: T. Itil, G. Laudahn, & W. Herrmann (Eds.), The psychotropic effects of hormones (pp. 79–120). New York: Spectrum.

- Klaiber, L., Broverman, D., Vogel, W., Abraham, G., & Cone, F. (1971). Effects of infused testosterone on mental performances and serum LH. Journal of Clinical Endocrinology and Metabolism, 32, 341–349.

- Mazur, A. (1998). Aging and testosterone. Science, 279, 305–306.

- Mazur, A., & Lamb, T. (1980). Testosterone status, and mood in human males. Hormones and Behavior, 14, 236–246.

- Mazur, A., Susman, E., & Edelbrock, S. (1997). Sex differences in testosterone response to a video game contest. Evolution and Human Behavior, 18, 317–326.

- Nelson, R. (2000). An introduction to behavioral endocrinology. Sunderland, MA: Sinauer Associates. Parker, L. N. (1991). Adrenarche. Endocrinology and Metabolism Clinics of North America, 20, 71–83.

- Salvadore, A., Simon, V., Suay, F., & Llorens, L. (1987). Testosterone and cortisol responses to competitive fighting in human males. Aggressive Behavior, 13, 9–13.

- Schwartz, E., Granger, D. A., Susman, E. J., Gunnar, M., & Laird, B. (1998). Assessing salivary cortisol in studies of child development. Child Development, 69, 1503–1513.

- Stata Corp. (1999). Stata Statistical Software: Release 6.0. College Station, TX: Stata Corporation.

- Taylor, S., Klein, L., Lewis, B., Gruenewald, T., Gurung, R., & Updegaff, J. (2000). Biobehavioral responses to stress in females: tend-and-befriend, not fight-or-flight. Psychological Review, 107, 411–429.

- Roberti, J.W., 2004. A review of behavioral and biological correlates of sensation seeking. Journal of Research in Personality 38, 256–279.

- Roelofs, K., van Peer, J., Berretty, E., de Jong, P., Spinhoven, P., Elzinga, B.M., 2005. Hypothalamus-pituitary-adrenal Axis Hyperresponsiveness Is Associated with Increased Social Avoidance Behavior in Social Phobia. Biological Psychiatry 65 (4), 336-343.

Appendix

Figure 7. Description of the contest and the sampling of hormones

Green arrow: feedback moment on performance during previous round

Between-Subjects Factors

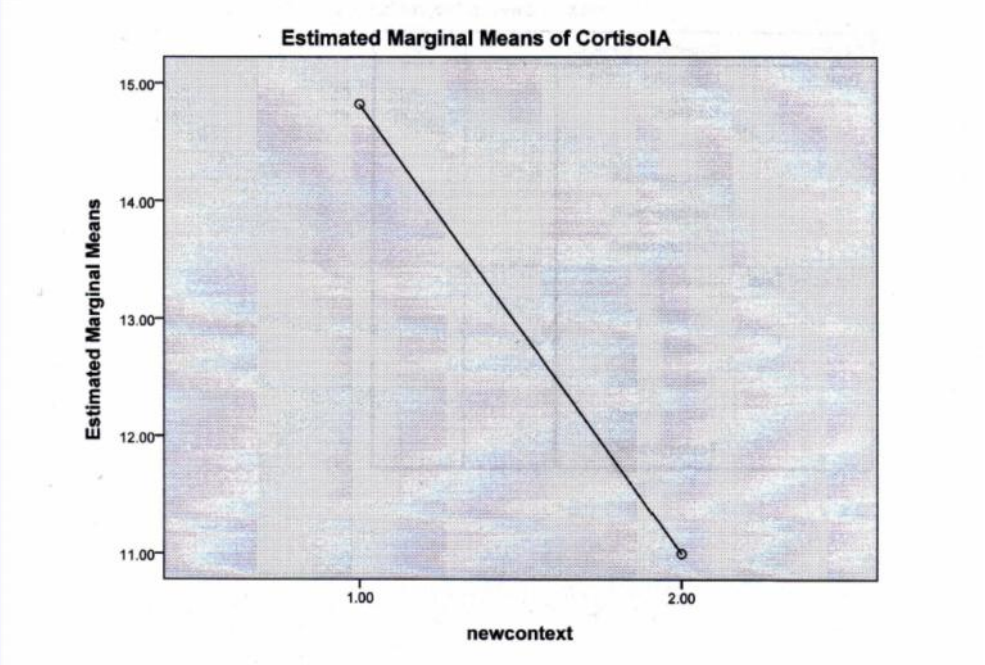
		N
newcontext	1.00	16
	2.00	21

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.801	20.159[a]	6.000	30.000	.000
	Wilks' Lambda	.199	20.159[a]	6.000	30.000	.000
	Hotelling's Trace	4.032	20.159[a]	6.000	30.000	.000
	Roy's Largest Root	4.032	20.159[a]	6.000	30.000	.000
newcontext	Pillai's Trace	.397	3.298[a]	6.000	30.000	.013
	Wilks' Lambda	.603	3.298[a]	6.000	30.000	.013
	Hotelling's Trace	.660	3.298[a]	6.000	30.000	.013
	Roy's Largest Root	.660	3.298[a]	6.000	30.000	.013

a. Exact statistic

b. Design: Intercept + newcontext


Estimated Marginal Means of CortisolA
Estimated Marginal Means
15.00
14.00
13.00
12.00
11.00
1.00
2.00
newcontext