UNIVERSITY OF LJUBLJANA

SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

THE INFLUENCE OF HORMONES AND PERSONAL TRAITS ON THE PROPENSITY FOR RISK-TAKING

Ljubljana, September 2019 URŠA FERJANČIČ

AUTHORSHIP STATEMENT

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LIST OF ABBREVIATIONS

angl. - angleško
2D:4D – second to fourth digit ratio
Act – Activity
AggHost – Aggression Hostility
BART – Balloon Analogue Risk Task
BOLD signal – blood-oxygen-level-dependent signal
BS - Boredom Susceptibility
CAPM – Capital Asset Pricing Model

Dis - Disinhibition
DOSPERT – Domain-Specific Risk-Taking
EEG – electroencephalography
ES - Experience Seeking
ET – eye-tracking
fMRI – functional magnetic resonance imaging
fWHR – face width-to-height ratio
ImpSS – Impulsive Sensation-Seeking
N-Anx – Neuroticism Anxiety
PET – positron emission tomography
SEB – School of Economics and Business
SSS-V – Sensation-Seeking Scale Form V
Sy – Sociability
TAS - Thrill and Adventure Seeking
ZKPQ – Zuckerman-Kuhlman Personality Questionnaire
OLS – ordinary least squares

INTRODUCTION

The concept of risk is one of the most important ideas in economic and financial theories. It influences how market participants, namely consumers, companies and institutions make economic and financial decisions. When one makes rational financial decisions and compares values from different time periods, they consider the discount rate which includes some estimation of risk (Berk & DeMarzo, 2017). Many mathematical models have been developed to determine the discount rate, such as Capital Asset Pricing Model (CAPM) (Sharpe, 1964; Lintner, 1965) and its improved versions, such as Fama-French three-factor model (Fama & French, 1993), Carhart four-factor model (Carhart, 1997) and its alternatives (Gregory, Tharyan & Christidis, 2013), etc.

In general, traditional financial theories that have been built upon the assumption of rational individuals who make consistent choices based on relatively stable preferences through time to maximize their utility, are well constructed to make calculated financial decisions. However, they have been unable to explain disruptions in stock markets or market anomalies and have been questioned many times, especially during market breakdowns - one example is the recent financial crisis of 2007–2009 (and following years) (Kandasamy et al., 2014). Partly as a response to this, new fields of research have begun to emerge (i.e., neuroeconomics, originating from behavioral economics), attempting to understand a wider range of factors influencing the propensity for risk-taking (Peterson, 2010).

Several factors have been recognized to have influence on the propensity for risk-taking, such as current levels of hormones, especially testosterone and cortisol (Apicella et al., 2008; Cueva et al., 2015; Mehta & Prasad, 2015; Nofsinger, Patterson & Shank, 2018; Sapienza, Zingales & Maestripieri, 2009; Schipper, 2012; Stanton et al., 2011 and more), prenatal testosterone exposure measured as second to fourth digit ratio (hereinafter: 2D:4D) (Chicaiza-Beccera & Garcia-Molina, 2017; Coates, Gurnell & Rustichini, 2009; Dreber & Hoffman, 2007; Garbarino, Slonim & Sydnor, 2011), facial masculinity measured with face width-to-height ratio (hereinafter: fWHR) (Ahmed, Silhvonen & Vähämaa, 2019; Apicella et al., 2008; Dreber, Gerdes, Gränsmark & Little, 2013; Kamiya, Kim & Soohyun, 2018; Welker, Goetz & Carre, 2015), personal traits (Zuckerman, Kuhlman, Joireman, Teta & Kraft, 1993, Zuckerman & Kuhlman, 2000, Zuckerman, 2007, Zuckerman & Aluja, 2015), optimism and pessimism (Puri & Robinson, 2005; Barel, 2017; Dohmen, Quercia & Willrodt, 2018), mental disorders (Dolvin & Pyles, 2007), etc. Last but not least, demographic characteristic, such as age (Gibson, Michayluk & Van der Venter, 2013; Yao, Sharpe & Wang, 2011), education (Chang, DeVaney & Chiremba, 2004), gender (Eckel & Grossman, 2002; Eckel & Grossman, 2008), racial and ethnic background (Yao, Gutter & Hanna, 2005) have been found to have influence on the propensity for risk-taking as well.

The main purpose of my master's thesis is to gain new findings from the neuroeconomics field of research. Moreover, this research presents itself as a learning experiment for the faculty of School of Economics and Business, since this kind of experiment has been done

withour precedent. Furthermore, I expect my master's thesis to encourage other students, especially the ones who participated in the experiment, to be eager to explore new fields of research, e.g., neuroeconomics.

The main goal of my master's thesis is to investigate how current levels of hormones, specifically testosterone and cortisol, prenatal testosterone level, facial masculinity, personal traits, and demographic characteristics influence risk-taking behavior. The propensity for risk-taking was measured in five different manners, namely with a computerized game Balloon Analogue Risk Task (hereinafter: BART) (Lejuez et al., 2002), lottery games Eckel & Grossman Risk Task (Eckel & Grossman, 2002; Eckel & Grossman, 2008) and Holt-Laury Measure of Risk-Aversion (Holt & Laury, 2002), Domain-Specific Risk-Taking Scale (hereinafter: DOSPERT) (Blais & Weber, 2006b; Weber, Blais & Betz, 2002) and Sensation-Seeking Scale Form V (Zuckerman, 1994; Zuckerman, 2007). On the other hand, independent variables can be classified into three main groups: i) hormone levels measured directly with saliva samples (testosterone, cortisol) and indirectly with 2D:4D ratio (prenatal testosterone) and fWHR (pubertal testosterone), ii) demographic characteristics and life habits (e.g., gender, age, educational and ethnic background, smoking, alcohol consumption, optimism/pessimism) and iii) personal traits (e.g., neuroticism, anxiety, impulsive sensation-seeking).

The methodological approach was diverse since many distinctive research techniques were used. The theoretical part was investigated by conducting a literature review to evaluate what has yet been discovered. In the empirical part, saliva samples were obtained and analyzed by an external, certified laboratory. To calculate the 2D:4D ratio, participants' right hands were scanned faced down. 2D:4D ratio was measured and calculated with software developed especially for this purpose. Participants' portrait photos were taken and later analyzed with specific software to measure fWHR. Questionnaires were answered online using participants' computers or mobile phones. The experiment and all procedures were approved by the Committee on ethics and research at the School of Economics and Business of University of Ljubljana. Written consent was obtained from all subjects before having participated in the experiment.

Based on reviewed literature from neuroeconomics research, the following hypotheses were designed:

H1a: Higher concentrations of testosterone and lower concentrations of cortisol result in a higher propensity for risk-taking.

H1b: Lower concentrations of testosterone and higher concentrations of cortisol result in a lower propensity for risk-taking.

H2: A lower 2D:4D ratio results in a higher propensity for risk-taking.

H3: A higher fWHR results in a higher propensity for risk-taking.

H4: A higher propensity for impulsive sensation-seeking behavior results in a higher propensity for risk-taking.

H5: A higher propensity for neuroticism and anxiety results in a lower propensity for risk-taking.

H6: Demographic characteristics such as smoking and greater alcohol consumption result in a higher propensity for risk-taking.

H7: Optimism results in a higher propensity for risk-taking.

Master's thesis consists of three major parts, i.e., theoretical, experimental procedures and design, and empirical part. The theoretical section reviews the evolution of financial theory from traditional to behavioral economics and neuroeconomics. It explains the concept of risk, specifically financial risk, and describes various risk-taking measures. Furthermore, it presents key characteristics of hormones, particularly testosterone, cortisol and dual-hormone hypothesis. The theoretical section is concluded with a brief literature review of neuroeconomics research on hormones, 2D:4D ratio, fWHR, personal traits, and demographic characteristics. The experimental procedures and design section include a description of the research methods and samples. Research ethics is discussed, as well. The empirical analysis part consists of the methodology description, descriptive statistics, results, and discussion. The thesis is concluded with a summary of the main findings, its limitations, and implications for further research.

1 THEORETICAL BACKGROUND

This chapter provides a review on evolution from traditional to new financial theories, such as behavioral finance and neuroeconomics. Further on, the concept of risk and more specifically financial risk are discussed, as well as risk-taking measures. Following is a brief description of hormones, in more detail the testosterone, cortisol, and dual-hormone hypothesis, including a literature review on relations between the propensity for risk-taking and hormones.

1.1 From traditional to new financial theories

Traditional financial theories are based on assumptions of rational investors who consider all available information in the decision-making process. Therefore, investment markets are efficient, reflecting all available information in security prices. When making decisions, investors always pursue their self-interest (Suryawanshi & Jumle, 2016) and the optimal choice that has the highest possible expected utility. In traditional finance, investors are also considered to be risk-averse, therefore they must receive compensation for taking risks (Ackert, 2014). As mentioned earlier, according to traditional financial theories, investors are rational and they trade only on new information, not on intuition, emotions or any other psychological factor (Ricciardi, 2010). However, many people question these traditional

assumptions, since they appear to be frequently violated in real life and are unable to explain disruptions in stock markets or market anomalies. In this paradigm, behavioral finance started to evolve (Kapoor & Prosad, 2017).

1.1.1 Behavioral finance

Behavioral finance – a subfield of behavioral economics – relaxes the underlying assumption of rationality and explains how emotions and cognitive errors influence investors and decision-making processes (Kapoor & Prosad, 2017). In 1979, Kahneman and Tversky introduced the concept of prospect theory, which formed the backbone of behavioral finance and was presented as a critique of expected utility theory. Prospect theory describes how people choose between different options (or prospects) under uncertainty and how they estimate the perceived likelihood of each of these options, which is usually biased (Harley, 2016). Firstly, it postulates that people evaluate outcomes relative to some reference point. Secondly, they will rather take on risk than realize losses, and finally put too much weight on unlikely events (Berk & DeMarzo, 2017). All in all, behavioral finance incorporates insights from social sciences, namely psychology and sociology to demonstrate that our financial decisions are influenced by emotional, cultural, and social factors (Miendlarzewska, Kometer & Preuschoff, 2019). Unfortunately, these studies fail to explain the causes of such behavior, which is why neuroeconomics started to emerge (Peterson, 2010).

1.1.2 Neuroeconomics

This relatively new area of research aims to understand financial decision-making by combining insights from psychology and neuroscience with theories of finance. Nonetheless, neuroeconomics partially incorporates behavioral finance but adds two major goals. Firstly, understanding the biological (i.e., neural and physiological) mechanisms of behaviors of financial market participants, and secondly, providing a physiologically motivated, alternative explanation for the apparent failure of standard finance theories (Miendlarzewska, Kometer & Preuschoff, 2019).

Neuroscience serves as a neurological basis of emotional influences on financial decisions by understanding the functioning of the human brain (Sahi, 2012). The most widely used methods to measure brain activity are very diverse and complex, including functional magnetic resonance imaging (fMRI), electroencephalography (EEG), and positron emission tomography (PET). These methods are complemented by physiological signals, namely heart rate, skin conductance, eye movements, hormones, and genetic analysis, as well. Changes in the level of blood oxygen within the brain are measured with fMRI, which is a non-invasive method and has high spatial precision. Event or stimulus-related neuronal activity is then measured by contrasting the blood-oxygen-level-dependent signal (BOLD signal), which is used to indirectly infer the neuronal activity of the brain areas. Electroencephalography or shorter EEG uses electrodes placed on the scalp to noninvasively

record the electrical activity of the brain with high temporal precisions (milliseconds) (Miendlarzewska, Kometer & Preuschoff, 2019). Positron emission tomography (PET) scan is an imaging test that uses a radioactive drug (tracer) to reveal how an individual's tissues and organs are functioning (Mayo Clinic Staff, n.d.). Another important research tool is eye-tracking (ET), which can be simply described as a measurement of eye movement. In more detail, it detects eye position, gaze direction, sequence of eye movement and visual adaptation during cognitive processes of the human brain. Therefore, it is very useful in understanding choice behavior and perceptual decision-making (Popa et al., 2015). Furthermore, a few authors have also started to explore the impact of emotions on investment decision-making, which requires to go inside the investor's mind (Sahi, 2012).

Traditional financial literature considers rationality as a state of perfect knowledge and decision-making. Emotions were considered opposite to rational, therefore emotional people were not rational. However, several neuroeconomics studies on involved brain areas in the context of financial decision-making have shown that being emotional is associated with being rational (Sahi, 2012). To explain in more detail, our neural systems have evolved to quickly adapt to new environments, which is termed neuroplasticity. Humans have learned to promptly select actions associated with rewards (i.e., reward system) and to avoid actions associated with punishments (i.e., loss avoidance system). This mechanism is regulated by the dopaminergic system, which drives learning based on rewards (Miendlarzewska, Kometer & Preuschoff, 2019). Both loss avoidance and reward system lie in the forebrain, more specifically in the limbic system (Peterson, 2007), which is referred to as the emotional part of the brain (Sahi, 2012). Peterson (2010, p. 25) claims emotions direct risk behavior through "subtle emotional influences on judgment, thinking, and behavior". Interesting from my point of research is that loss avoidance system among others consists of the hypothalamus, as well, which is in charge of hormone-secreting (Peterson, 2010).

Neuroeconomics is still in its infancy. However, it has provided some valuable insights into how humans process financial information and how we use this information to make financial decisions. Like any other field of research, neuroeconomics, too, has its limitations. The most discussed shortcomings or challenges are the following. Firstly, the fact that neuroscience research has to be conducted in a laboratory setting under medical supervision. This means that participants' responses could be different from the ones in natural settings. Also, a certain amount of expertise and knowledge is required to conduct such tests and interpret the results, which may not be possible without a degree in the related fields (Sahi, 2012). Secondly, sample sizes and composition may not be appropriate. fMRI and other research techniques in neuroeconomics are relatively expensive, that is why many studies use samples of 20 or less. The subjects in these studies are usually students. It has been found there are observed differences in the biological substrates of decision-making over the lifespan. Therefore, results found on young samples may not be confirmed for older samples. What is more, most samples are drawn from university student bodies, which may not reflect the learning experience of "real world" decision-makers. Finally, findings from very specific studies may not represent noisy real-world decision-making (Peterson, 2010). Humans are

unreliable decision-makers since their judgments can be influenced by irrelevant factors, such as their current mood, the time since their last meal, and the weather. This chance variability of judgments is called noise (Kahneman, Rosenfield, Gandhi & Blasser, 2016). Neuro-economists are being criticized that they try to explain and model a human based on small pieces of data and anatomical findings, without taking a complex person, with all their conflicts, and contradictions (Peterson, 2010).

The main lesson from neuroeconomics for financial practitioners are various biological factors that can predict economic decision-making (Peterson, 2010). However, more research needs to be done in this field to better understand the functioning of the human brain and the connection between biological factors and economic decision-making (Sahi, 2012).

1.2 Risk

Risk-taking is central to human activity and is inescapable. People face various risks daily, e.g., when playing a sport, entering a personal relationship or choosing a career (Kandasamy et al., 2014). There is no ambiguous definition of risk. Wikipedia (n.d.) defines risk as "the possibility of losing something of value". Value can be physical, health, social status, emotional well-being, or financial wealth. Individuals can gain or lose value when taking risk, which can be foreseen or unforeseen (Wikipedia, n.d.). Wikipedia is cited because it is collectively written and edited, and therefore the perfect place to find acceptable wisdom. However, I will focus on financial risk, since I am exploring the influence of hormones and personal traits on the propensity for risk-taking.

In line with neuroeconomics research, several factors have been recognized to have influence on propensity for risk-taking, such as current levels of hormones, especially testosterone and cortisol (Apicella et al., 2008; Cueva et al., 2015; Mehta & Prasad, 2015; Nofsinger, Patterson & Shank, 2018; Sapienza, Zingales & Maestripieri, 2009; Schipper, 2012; Stanton et al., 2011 and more), prenatal testosterone exposure measured as 2D:4D ratio (Chicaiza-Beccera & Garcia-Molina, 2017; Coates, Gurnell & Rustichini, 2009; Dreber & Hoffman, 2007; Garbarino, Slonim & Sydnor, 2011), facial masculinity measured with fWHR (Ahmed, SIlhvonen & Vähäamaa, 2019; Apicella et al., 2008; Dreber, Gerdes, Gränsmark & Little, 2013; Kamiya, Kim & Soohyun, 2018; Welker, Goetz & Carre, 2015), personal traits (Zuckerman, 2007; Zuckerman & Aluja, 2015; Zuckerman, Kuhlman, Joireman, Teta & Kraft, 1993), optimism and pessimism (Puri & Robinson, 2005; Barel, 2017; Dohmen, Quercia & Willrodt, 2018), mental disorders (Dolvin & Pyles, 2007), etc. Last but not least, demographic characteristic, such as age (Gibson, Michayluk & Van der Venter, 2013; Yao, Sharpe & Wang, 2011), education (Grable, McGill & Britt, 2009; Chang, DeVaney & Chiremba, 2004), gender (Eckel & Grossman, 2002; Eckel & Grossman, 2008), racial and ethnic background (Yao, Gutter & Hanna, 2005) have been found to have influence on the propensity for risk-taking, as well.

1.2.1 Financial Risk

In financial and economic theories, risk is defined more mathematically as the variance of reward outcomes where the likelihood of each outcome is known (Miendlarzewska, Kometer & Preuschoff, 2019). There is no definite explanation for risk, therefore various authors define risk differently, for example as "the appraised likelihood of a negative outcome for behavior" (Zuckerman, 1994, p. 124), or as the choice between a less rewarding, but more certain option, and a less certain, but potentially more rewarding option (Apicella, Carré & Dreber, 2015), or as a level of discomfort that an individual is willing to accept while risking current wealth for future growth (Gibson, Michayluk & Van der Venter, 2013).

The concept of risk is often connected with uncertainty, although there is a conceptual distinction between decisions made under risk and decisions made under uncertainty. According to Knight (1921), risk refers to situations where the decision-maker knows with certainty the mathematical probabilities of possible outcomes of choice alternatives, while "uncertainty refers to situations where the likelihood of different outcomes cannot be expressed with any mathematical precision" (Weber & Johnson, 2009, p. 131).

When analyzing risk-seeking behavior, an individual can be positioned anywhere on the risk continuum from complete risk-averse to risk-seeking behavior. Risk-averse individuals give up monetary gain to avoid risk, while risk-seeking individuals pay money to experience risk (Herbet, 2018). Risk-neutral individuals are positioned in the middle of risk continuum, where they are indifferent to risk when making an investment decision (Kenton, 2018).

1.2.2 Risk-taking measures

The propensity for risk-taking can be measured in many different ways. Some methods, specifically the ones adopted in this research are presented further in the thesis. Literature about behavior discusses that risk-taking is often domain-specific. This means that - for example - Holt-Laury Risk Task, which measures the level of relative risk-aversion from gambling choices, will better predict risk-taking behavior in monetary gambling choices rather than in risky agricultural production decisions (Weber & Johnson, 2009). Weber and Johnson (2009, p. 137) state that "when measuring levels of risk-taking in other situations, it is very important to use a decision task that is as similar as possible to the situation for which behavior is being predicted". For example, it has been discovered that assessed risk-taking for monetary gambling decisions predicted real-world investment decisions far worse compared to assessed risk-taking for investment decisions, even though both were about monetary returns (Weber, Blais & Betz, 2002). Additionally, Holt-Laury Measure of Risk-Aversion has had very mixed results in predicting risk-taking in other domains (Weber & Johnson, 2009).

As mentioned, there are multiple determinants that influence decision-making in risky conditions. Doman-Specific Risk-Taking (DOSPERT) Scale, which was developed by Weber, Blais, and Betz (2002), allows researchers to asses risk in five commonly

encountered content domains (i.e., ethical, financial, health/safety, social, and recreational decisions) (Blais & Weber, 2006b).

Real-world propensity for risk-taking is also very dynamic, which involves sequential risk-taking with feedback, as well. Therefore, risk-taking in such dynamic contexts cannot be typically predicted by static assessment tools, such as one-shot lottery choices that are not resolved until the end of the task. If the nature of risk-taking is dynamic, then one should use dynamic assessment tools like Balloon Analogue Risk Task (BART) (Lejuez et al., 2002) or the diagnostically more sophisticated Columbia Card Task (CCT), which was developed by Figner, Mackinlay, Wilkening, and Weber (2009). Nonetheless, using dynamic or static risk assessment tools, one should carefully consider the real-world situation and try to adapt risk-taking measure to it as much as possible (Weber & Johnson, 2009).

The propensity for risk-taking is also associated with sensation-seeking behavior. The latter can be measured with Sensation-Seeking Scale, which was developed by Zuckerman (Zuckerman, 1994). The author describes sensation-seeking as "a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of such experience" (Zuckerman, 1994). Researchers report evidence linking sensation-seeking to a greater propensity for risk-taking in the health/safety and recreational domain (Weber & Johnson, 2009). Weber, Blais, and Betz (2002) report high positive correlations between sensation-seeking subscales and greater risk-taking in several content domains, such as thrill- and adventure-seeking subscale (TAS) and recreational risk-taking, the disinhibition subscale (Dis) and ethical risk-taking. Lejuez et al. (2002) find riskiness on Balloon Analogue Risk Task (BART) correlated with self-reported risky behavior, measures of impulsivity and sensation-seeking.

1.3 Hormones

In the same manner as neuroeconomics, endocrinological approaches may provide a potentially powerful framework, which will help to better understand human decision-making, especially behavioral anomalies involving economic risk (Apicella, Carré & Dreber, 2015). Hormones are biochemical substances that may affect distant cells of the body by traveling through the bloodstream and are chemically regulated by centers in the hypothalamus (Zuckerman, 1994).

Many hormones may have been able to influence financial decision-making. However, testosterone and cortisol stand out because of their biological functions. Testosterone plays an important role in reproduction, which welcomes aggression, competitiveness, and risk-taking behavior. All are essential elements of successful reproduction and financial dealing as well. On the other hand, cortisol is very important when coping with uncertain and risky situations. Also, it is a common feature or consequence of financial decisions, especially those made under various threats (Herbet, 2018).

In the following sections, I examine each hormone, i.e., testosterone and cortisol separately and operating together as the dual-hormone hypothesis proposes. In real-life conditions, both operate together in the same individual (Herbet, 2018), that is why I consider it necessary to analyze them in this manner.

1.3.1 Testosterone

Testosterone is a steroid hormone mainly produced by the Leydig cells of the testes in men and by the ovaries in women. It is known as a male sex hormone. Smaller amounts are produced by the adrenal cortex within the adrenal glands in both sexes. Much higher levels of testosterone are present in men compared to women (You and Your Hormones, 2018). The hormone has a circadian rhythm in both sexes (Mazur & Booth, 1998). Circadian rhythm means roughly 24 hours in the physiological processes of living beings including humans (Science Daily, n.d.). It has been shown that testosterone levels are the highest and most variable in the morning, while in the afternoon, it is more stable and lower (Mazur & Booth, 1998). Testosterone concentrations decrease steadily with age in industrialized populations (Apicella, Carré & Dreber, 2015).

Testosterone is an androgen that functions to biologically differentiate the sexes in utero and at puberty contributes to the development of secondary sexual characteristics (Ronay & Von Hippel, 2009). It has also anabolic effects, namely stimulating bone density and muscle mass (Schipper, 2015). Fetal development and puberty period are also considered to be the critical periods of testosterone exposure when testosterone can permanently influence an individual's behavior (Apicella, Carré & Dreber, 2015). Nonetheless, androgen exposure in the uterus and at puberty are usually not highly related to current circulating levels of testosterone in adulthood (Apicella et al., 2011).

Over the last twenty years, numerous studies have been trying to explain the relationship between circulating testosterone and social behavior in many species including humans. Testosterone has been associated with a great amount of behavior, especially in men, such as aggression (Archer, 2006; Carre & McCormick, 2008b), dominance (Mazur & Booth, 1998; Carre & McCormick, 2008b), sensation-seeking (Roberti, 2004), hostility (Hartgens & Kuipers, 2004), mate-seeking (Ronay, Mahler & Maestripieri, 2003), and some indications were also found in financial risk-taking (Apicella et al., 2008) - in all, behaviors that carry a component of risk (Mhlanga, 2012).

There have also been attempts to relate testosterone to risk-related decisions outside the lab. White, Thornhill and Hampson (2006) used a sample of 110 male MBA students and found that those with substantial experience in new venture creation, a risky business endeavor, have significantly higher baseline testosterone levels than others. Coates and Herbert (2008) studied testosterone and cortisol levels among 17 male traders on London trading floor. They found testosterone levels in the morning predict profitability during the day and that cortisol

rises with both variance of trader's trading results and the volatility of the market. Profitability is assumed to be a function of risk-taking (Coates & Herbert, 2008).

There are a few researchers who study the exogenous administration of testosterone. Nadler, Peiran, Johnson, Alexander, and Zak (2018) found that traders who received exogenous testosterone bid higher amounts for stock prices, which creates mispricing resulting in larger and longer-lasting bubbles. 140 male traders of an average age of 23 participated in this experiment (Nadler, Peiran, Johnson, Alexander & Zak, 2018). Cueva et al. (2015) also administered either cortisol (N=34) or testosterone (N=41) to young males before they played an asset-trading game. The authors report that both cortisol and testosterone shifted investment towards riskier assets. Cortisol affects risk preferences directly, while testosterone operates by inducing increased optimism about future price changes (Cueva et al., 2015).

1.3.1.1 Current testosterone levels and the propensity for risk-taking

There are several methods to measure the roles of hormones in financial decision-making. However, none of them is entirely satisfactory. The most direct method would be to give steroids, such as testosterone and cortisol, to those engaged in finance or the observed field of research and then measure the outcome. However, this is legally, practically and ethically impossible. Steroids can be administered to subjects under experimental or laboratory settings, where they play games designed to reproduce at least some of the real-life characteristics. Nonetheless, we should keep in mind that experimental conditions never reproduce real-life circumstances (Herbet, 2018). For measuring current testosterone exposure, a non-invasive method of collecting testosterone by saliva sampling is most commonly used (Campbell et al., 2010).

Existing literature reports about mixed findings on correlations between salivary testosterone levels and the propensity for risk-taking. However, the majority reports on positive correlations between salivary testosterone levels and the propensity for risk-taking (Apicella et al., 2008; Apicella, Dreber & Mollestrom, 2014; Nofsinger, Patterson & Shank, 2018; Sapienza, Zingales & Maestripieri, 2009; Stanton et al., 2011; Schipper, 2015). Nonetheless, some studies report there is no significant effect of salivary testosterone on the propensity for risk-taking (Zethraeus et al., 2009).

1.3.1.2 Prenatal testosterone exposure and the propensity for risk-taking

Any research related to prenatal or in-utero testosterone exposure is associated with several empirical challenges, as well. Firstly, the direct measurement of prenatal testosterone in pregnant women is invasive and has been restricted to small and potentially non-representative samples. Secondly, any manipulation during pregnancy is ethically precluded. Finally, exogenous prenatal testosterone manipulation would be impractical, because it would take several decades to conduct the treatment and then observe the effect on financial decision-making later in life (Cronqvist, Previtero, Siegel & White, 2015). The existing body

of research in the field of prenatal testosterone effects on finance has employed the 2D:4D ratio, which is the ratio between index and ring finger lengths (Campbell et al., 2010). This measure tends to be sexually dimorphic, specifically on average men having lower ratios. The correlation between 2D:4D ratio and prenatal testosterone exposure is supposedly negative. Therefore, a low 2D:4D ratio is an indication of high testosterone exposure (Apicella, Carré & Dreber, 2015).

Existing literature reports about mixed findings on correlations between prenatal testosterone exposure, measured as 2D:4D ratio and the propensity for risk-taking. The majority of reviewed articles report about negative correlation between 2D:4D ratio and risk-taking propensity, that is, a lower 2D:4D ratio results in higher propensity for risk-taking (Chicaiza-Beccera & Garcia-Molina, 2017; Coates, Gurnell & Rustichini, 2009; Dreber & Hoffman, 2007; Branas-Garza & Rustichini, 2011; Garbarino, Slonim & Sydnor, 2011; Stenstrom, Saad, Nepomuceno & Mendenhall, 2011). However, some studies report about nonsignificant relations between prenatal testosterone exposure and risk-taking behaviour (Apicella et al., 2008; Cueva et al., 2015; Drichoutis & Nayga, Jr., 2015; Sapienza, Zingales, & Maestripieri, 2009; Schipper, 2015).

1.3.1.3 Pubertal testosterone exposure and the propensity for risk-taking

In existing literature associated with testosterone exposure related to finance, facial masculinity is believed to reflect pubertal testosterone exposure (Campbell et al., 2010). Several authors have reported that more testosterone during pubertal stage makes the facial bone grow to be more masculine, which implies a higher facial width-to-height-ratio (fWHR) (Kamiya, Kim & Soohyun, 2018).

Since this is a very recent research question, little examinations have been done in this field. For example, Apicella et al. (2008) find that facial masculinity correlates positively with risk-taking propensity in an investment task. However, facial masculinity was measured with other sexual dimorphism measurements and not with fWHR. Lefevre, Lewis, Perrett, and Penke (2013) report about the positive correlation between testosterone levels and fWHR. Some studies also report that CEO's fWHR is positively associated with riskier corporate financial and investment policies (Ahmed, Silhvonen,& Vähämaa, 2019; Kamiya, Kim & Soohyun, 2018). However, Welker, Goetz, and Carre (2015) suggest that fWHR is not always an indicator of risk-taking behaviors, but only when individuals perceive themselves as being low in status.

As mentioned, examining associations between fWHR and the propensity for risk-taking give mixed results, although there is some evidence supporting a positive relation between fWHR and riskier behavior. However, more work needs to be done to draw more specific conclusions (Lefevre, Lewis, Perrett & Penke, 2013).

1.3.2 Cortisol

Another important hormone that influences decision-making is cortisol and it is produced by the adrenal cortex within the adrenal glands (Coates & Herbert, 2008). Cortisol is also a steroid, which increases in response to physical or psychological stress and is especially sensitive to novel, uncertain or threatening situations. Cortisol is usually referred to as the stress hormone since it is released in response to stress (Cueva et al., 2015) and it helps us to organize a preparatory stress response (Kandasamy et al., 2014). Its wide-ranging effects include suppressing the immune system, increasing blood sugar, aiding fat, protein, and carbohydrate metabolism, altering mood, memory, and behavioral response to threatening circumstances (Coates & Herbert, 2008; Schipper, 2015). Based on previous findings, it has been assumed cortisol will influence financial decision-making under stress and uncertainty.

Cortisol levels are less stable compared to testosterone, i.e., morning cortisol levels can be 4-5 times higher than those in the evening (Herbet, 2018). Cortisol follows a circadian cycle and it has been found that on average, it is at its lowest at 4:00 a.m. it peaks at 8:00 a.m. (Schipper, 2015). Nevertheless, we should keep in mind the amplitude is individually very variable. Also, compared to testosterone, cortisol levels vary less between sexes, although morning levels of cortisol are around 20% higher in females. Moreover, there might be significant sex differences in decision-making affected by cortisol. What is more, cortisol does not show these age-related surges as testosterone. Still, adverse events early in life may alter the way individuals respond to stress (Herbet, 2018).

As discussed above, in the same manner as testosterone, cortisol levels, too, can be measured using several different measures. The most direct method is giving cortisol to those engaged in the observed field of research and measuring the outcome. As it has been pointed out above, this is legally, practically and ethically impossible (Herbet, 2018). Therefore, a non-invasive method of collecting cortisol by saliva sampling is usually employed (Kandasamy et al., 2014).

When reviewing the literature on cortisol and the propensity for risk-taking, some empirical evidence can be found. For example, Schipper (2015) investigated associations between cortisol and risk-taking. The author finds a positive association between cortisol and risk-aversion in women but not in men. Nofsinger, Patterson, and Shank (2018) find cortisol level negatively related to excess risk-taking. Kluen, Agorastos, Wiedemann, and Schwabe (2017) suggest elevated cortisol levels boost risk-taking behavior in men but not in women. On the other hand, Kurath & Mata (2018) find no correlation between cortisol and risk-related constructs.

1.3.3 Dual-hormone hypothesis

Considering the actions of a single hormone, e.g., testosterone or cortisol, it might be an unnecessarily simplistic research approach and may hide important findings (Stanton, 2017). It has been shown that in terms of behavioral effects, cortisol might interact with testosterone

(Schipper, 2015). Traditional theories suggest that testosterone alone should directly increase behaviors like dominance and social status seeking behaviors (Mehta & Prasad, 2015).

That is why Mehta and Prasad (2010) introduced a dual-hormone hypothesis, which postulates that testosterone's role in status-relevant behavior should depend on concentrations of cortisol. More specifically, testosterone should interact with cortisol in such a manner that testosterone should be positively related to status-seeking behavior only when cortisol concentrations are low. On the other hand, when cortisol concentrations are high, testosterone should not have an impact on status-seeking behavior. What is more, it should be blocked or inhibited (Mehta & Prasad, 2015).

Mehta and Prasad (2015) showed a positive association between basal testosterone and risk-taking, but only for individuals with low basal cortisol. This finding did not hold for individuals with high basal cortisol (Mehta & Prasad, 2015). Nofsinger, Patterson, and Shank (2018) also found evidence to support dual-hormone hypothesis, while Dekkers et al. (2019) found only marginal support for dual-hormone hypothesis. The current body of research gives inconsistent results. However, we should keep in mind that research on the dual-hormone hypothesis is still in its early stages. Further research is needed or even further theoretical and conceptual refinement to draw more serious conclusions (Grebe et al., 2019).

1.4 Personal traits

Personal traits can be measured with many questionnaires, the Big Five Personality Traits Test and its alternative five model of personality, the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) being one of them. ZKPQ explains personality traits with five broad factors such as Neuroticism-Anxiety, Activity, Aggression-Hostility, Impulsive Sensation-Seeking, and Sociability. ZKPQ is based on the assumption that basic personality traits are those with a strong biological-evolutionary basis (Zuckerman, Kuhlman, Joireman, Teta & Kraft, 1993).

Previous studies have shown some personal traits influence the propensity for risk-taking. Zuckerman and Kuhlman (2002) have shown that Neuroticism-Anxiety and Activity showed little or no relationship to the composite of risk-taking score or any of the specific areas of risk-taking (i.e., drinking, smoking, drugs, sexual behavior, driving habits, and gambling). However, other scales (i.e., Impulsive Sensation-Seeking, Aggression-Hostility, and Sociability) were related to the general risk-taking factor (Zuckerman & Kuhlman, 2002). Furthermore, it has been found that risk propensity is strongly rooted in personality. More specifically, this means an individual's personality measured with The Big 5 should present high scores of Extraversion and Openness, and low scores of Neuroticism, Agreeableness, and Conscientiousness. At a subscale level, sensation-seeking appears to be a key important component of risk propensity (Nicholson, Soane, Fenton-O'Creevy & Williams, 2005).

Additionally, impulsivity has been shown to be positively correlated to BART (Lejuez et al., 2002).

1.5 Demographic characteristics

Demographic characteristic have also been found to have influence on the propensity for risk-taking, namely age (Gibson, Michayluk & Van der Venter, 2013; Yao, Sharpe & Wang, 2011), education (Chang, DeVaney & Chiremba, 2004), gender (Eckel & Grossman, 2002; Eckel & Grossman, 2008), racial and ethnic background (Yao, Gutter & Hanna, 2005). Furthermore, Roberti (2004) reports alcohol consumption is associated with Disinhibition (i.e., seeking novel experiences through the mind and the senses, as in music, art, travel, social nonconformity and association with like-minded individuals and groups) and Experience Seeking (i.e., desire to engage in disinhibited social behavior as facilitated by alcohol in parties and impulsive sexual activities) from SSS-V. It has also been found that smokers are more likely to take risks that concern their health but are taking no more risk in other DOSPERT domains compared to non-smokers (Hanoch, Johnson & Wilke, 2006).

2 EXPERIMENTAL PROCEDURES AND DESIGN

The following chapter provides an explanation of research tools used in this research, sample description, and research ethics.

2.1 Research tools

Various research tools have been used in this research, namely Demographic Questionnaire, DOSPERT Scale, Sensation-Seeking Scale Form V, Zuckerman-Kuhlman Personality Questionnaire, and BART, which were done online. On the other hand, Eckel & Grossman Risk Task, and Holt-Laury Risk task were played in the classroom. Portrait photographs for fWHR measurement, right hand scans for 2D:4D ratio measurement, and saliva samples were also obtained in the classroom, however, not in this exact order.

2.1.1 Demographic Questionnaire

Participants had to fill in a Demographic Questionnaire, which is available in Appendix 1. The questionnaire consists of 10 questions that helped me determine subjects' demographic background, namely gender, age, nationality, smoking habits, alcohol consumption, educational background, self-evaluation of the propensity for risk-taking and degree of optimism or pessimism. The answer to the last question provided information about subjects having had broken fingers on right hand, which was an indicator of eliminating those who had broken fingers from 2D:4D ratio measurements.

2.1.2 Saliva sample

The experiment was conducted on March 27, 2019. Participants provided two saliva samples at the beginning of the experiment, which was at approximately 9:20 a.m. and at the end of

the experiment at approximately 11:20 a.m. I used saliva samples to determine current levels of testosterone and cortisol. Saliva samples were collected by staff of Medicare PLUS Laboratory. Participants were asked to spit into a small polystyrene tube. They were also informed in advance about the saliva sample procedure. They were not allowed to eat, drink, smoke, chew, brush or floss their teeth, take medicine and get involved in physical activity at least 30 minutes before providing saliva samples. Participants were allowed to drink a glass of water before, but they had to wait at least 5 minutes before providing saliva samples. It was not recommended to provide a saliva sample in case of suffering from some kind of gum disease or infection, due to the possibility of contaminating saliva sample with blood. Detailed instructions for the saliva sample collection by Medicare PLUS Laboratory are provided in Appendix 2.

2.1.3 Balloon Analogue Risk Task

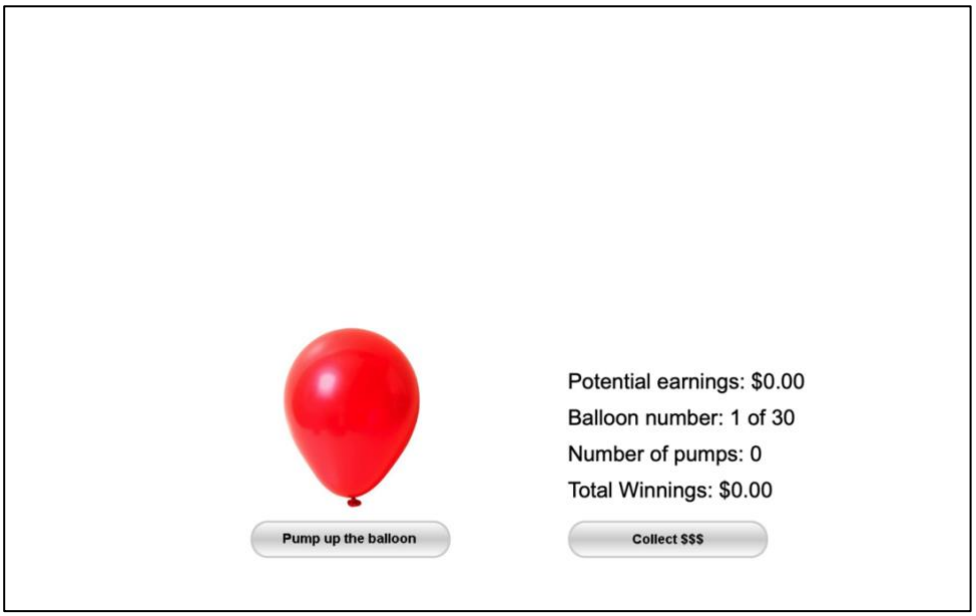
The Balloon Analogue Risk Task (hereinafter: BART) is a behavioral measure that is commonly used to assess the human propensity for risk-taking (MacLean, Pincus, Smyth, Geier & Wilson, 2018). Lejuez et al. (2002) developed BART, which is "a computerized, laboratory-based measure that involves actual risky behavior for which similar to real-world situations, riskiness is rewarded up until a point at which further riskiness results in poorer outcomes" (Lejuez et al., 2002, pp. 75–76).

Construct validity of the BART has been demonstrated through moderate associations with various real-world risk-taking behaviors, e.g., alcohol and drug use, cigarette smoking, gambling, theft, aggression, psychopathy, and unprotected sexual intercourse. Measures assessing sensation-seeking, disinhibition, and impulsivity were also significantly associated with risk-taking on BART (Hunt, Hopko, Bare, Lejuez & Robinson, 2005). However, further research is required to clarify and validate if risk preferences elicited through this measure extend to other domains, in particular, financial decision-making (Charness, Gneezy & Imas, 2013)

BART was performed on an online platform (Millisecond.com, n.d.) using participants' computers or mobile devices. Figure 1 below shows computer screen capture of BART. Participants could see a small red balloon, the "Pump up the balloon" button, the "Collect $$$" button, money earned on the last balloon labeled as "Potential earnings", trial number labeled as "Balloon number", number of pumps, and permanent money earned labeled as "Total winnings". Each click on the "Pump up the balloon" button inflates the balloon which increases in its size in all directions. With each pump, 5 cents are earned and displayed as "Potential earnings". When a balloon is pumped past its explosion point, it pops, and participants lose their potential earnings. Participants were given no specific information about the probability of a balloon explosion. They were told that a balloon can explode anytime from the first to the last pump (see instructions in Appendix 3) (Lejuez et al., 2002). The probability that a balloon would explode on the first pump was 1/128. If the balloon did not explode after the first pump, the probability that the balloon would explode was 1/127

on the second pump, 1/126 on the third pump, and so on up until the 128th pump. At this point, the probability of an explosion was 1/1 (i.e., 100%). According to this algorithm, the average breakpoint was 64 pumps (Hopko et al., 2006). The only way to save potential earnings before the balloon explodes is to click on the "Collect $$$" button. When clicking on it potential earnings are transferred to total winnings, which is the final score of the simulation. After each balloon explosion or money collection, a new balloon appears on the screen until a total of 30 balloons or trials are reached (Lejuez et al., 2002). Participants had to note their number of pumps and total winnings on a given sheet of paper (see Appendix 4). At the end of the experiment, three participants were randomly selected and they received gift coupons for a sports shop in the amount of their total winnings.

Figure 1: Computer screen capture for BART



Source: Millisecond.com (n.d.).

The risk level in BART is defined as the adjusted number of pumps across balloons. These adjusted values are defined as the average number of pumps excluding balloons that exploded (i.e., the average number of pumps on each balloon prior to money collection) (Lejuez et al., 2002). Instead of using an absolute average number of pumps, however, these adjusted values are preferable, since including balloon pumps from all trials (including those in which balloons exploded) would have resulted in the inclusion of trials in which the participants were forced to stop pumping because of the explosion (Hunt, Hopko, Bare, Lejuez & Robinson, 2005). Nevertheless, Hunt, Hopko, Bare, Lejuez, and Robinson (2005) suggest that other variables, such as total number of explosions and unadjusted average number of pumps produce similar findings.

During BART, participants are repeatedly given the option to continue or discontinue inflating a virtual balloon, which provides them the voluntarily choice to determine the risk level for each balloon. The larger the balloon participants inflated, the greater the risk level

participants are willing to take (Rao, Korczykowski, Pluta, Hoand & Detre, 2008). Therefore, BART offers us an appealing framework to study the willingness to engage in a risky choice that incorporates information from previous decisions (MacLean, Pincus, Smyth, Geier & Wilson, 2018).

2.1.4 DOSPERT Scale

Blais & Weber (2006b) have developed a psychometric Domain-Specific Risk-Taking (hereinafter: DOSPERT) Scale, which allows researchers and practitioners to measure the risk propensity dimensions in five commonly encountered content domains, i.e., ethical, financial (which can be further decomposed into gambling and investment), health/safety, social, and recreational decisions. DOSPERT Scale allows researchers to asses both conventional risk attitudes and perceived risk attitudes in five commonly encountered content domains. Conventional risk attitude is defined as the reported level of risk-taking, while perceived risk attitude is defined as the willingness to engage in a risky activity as a function of its perceived riskiness. There are two versions of the DOSPERT Scale, i.e., 40-items (Weber, Blais & Betz, 2002), and 30-items (Blais & Weber, 2006b) version. The shorter version was used in this research, since it applies to a broader range of ages, cultures, and educational levels (Blais & Weber, 2006b).

Sample items from DOSPERT Scale include the following statements: "Having an affair with a married man/woman" (Ethical), "Investing 10% of your annual income in a new business venture" (Financial), "Engaging in unprotected sex" (Health/Safety), "Disagreeing with an authority figure on a major issue" (Social), and "Taking a weekend sky-diving class" (Recreational). DOSPERT Scale contains three separate response scales, i.e., risk-taking scale, risk-perception scale, and expected benefits scale. The risk-taking scale evaluates behavioral intentions, that is, the likelihood with which respondents might engage in risky behaviors originating from five domains of life (i.e., ethical, financial, health/safety, social, and recreational risks) described in DOSPERT statements. Respondents use a 7-point rating scale ranging from 1 (Extremely Unlikely) to 7 (Extremely Likely). Risk perception scale evaluates respondents' gut-level assessment of how risky each situation or behavior is, using a 7-point rating scale ranging from 1 (Not at all Risky) to 7 (Extremely Risky). Respondents have to indicate how risky they perceive each situation. Finally, using a 7-point rating scale ranging from 1 (No benefits at all) to 7 (Great Benefits) for expected benefits scale, respondents have to indicate the benefits they would obtain from each situation (Blais & Weber, 2006b). See Appendix 5 for details.

2.1.5 Eckel & Grossman Risk Task

Eckel & Grossman Risk Task, developed by Eckel and Grossman (2002; 2008) is a decision task that was designed to measure risk attitudes using simple lottery choices. Firstly, subjects have to select the one gamble they would prefer to play among a total of six gambles. Secondly, they should throw the dice to determine their payoffs (Dave, Eckel, Johnson &

Rojas, 2010). The number of presented gambles can be varied, e.g., Dave et al. (2010) presented participants with six gambles, while Eckel and Grossman (2002; 2008) presented them with five gambles.

As shown in Table 1, each gamble has two possible outcomes (i.e., high or low payoff), each occurring with a 50% probability. The first Gamble is a sure payoff of 28€ with zero variance. Moving from Gamble 1 to Gamble 6, the expected return increases linearly with standard deviation. Gamble 6 involves only an increase in variance, with the same expected return as Gamble 5. Therefore, more risk-averse subjects would choose lower-risk and lower-return gambles. Especially extremely risk-averse subjects would choose Gamble 1, which gives a sure payoff with zero variance. A moderately risk-averse individual would choose an intermediate bet (Gamble 2-4). Risk-neutral subjects would choose Gamble 5, which has the highest rate of return. Only risk-seeking subjects would choose Gamble 6. The authors used constant relative risk-aversion (CRRA) to determine each Gamble interval (Dave, Eckel, Johnson & Rojas, 2010).

Table 1: Eckel & Grossman Risk Task

Choice (50/50 Gamble)	Low payoff	High payoff	Expected return	Standard deviation
Gamble 1	28	28	28	0
Gamble 2	24	36	30	6
Gamble 3	20	44	32	12
Gamble 4	16	52	34	18
Gamble 5	12	60	36	24
Gamble 6	2	70	36	34

Source: Dave, Eckel Johnson & Rojas (2010).

After subjects select their gamble choice, they have to roll a 6-sided die to determine which of the events occurred. If a 1, 2, or 3 was rolled, low payoff occurred. If a 4, 5, or 6 was rolled, high payoff occurred. See detailed instructions in Appendix 6 (Eckel & Grossman, 2002). Subjects were informed in advance this is only a hypothetical payoff. Eckel & Grossman Risk Task is relatively easy for individuals to understand. However, it cannot differentiate between different degrees of risk-seeking behavior (Charness, Gneezy & Imas, 2013).

2.1.6 Holt-Laury Measure of Risk-Aversion

Holt and Laury (2002) popularized the multiple price list (MPL) measure, using it to estimate risk parameters of the utility function. Holt-Laury Measure of Risk-Aversion has been used extensively in economic studies to measure risk-aversion (Charness, Gneezy & Imas, 2013). The idea behind this measure is that individuals have stable risk preferences when making decisions under risk (Ert & Haruvy, 2017).

Participants are typically presented with a list of ten decisions between paired gambles, as is shown in Table 2. Firstly, they have to choose between Option A and Option B for all ten decisions. Secondly, they throw a 10-sided dice. First time to determine one of the ten decisions to be used. After that, participants should check whether they chose Option A or Option B for the selected decision row and throw the 10-sided dice again, to determine the payoff (2.00€ or 1.60€ if Option A was chosen, or 3.85€ or 0.10€ if Option B was chosen). Participants were informed in advance this is only a hypothetical payoff. The payoffs of gambles in Option A and Option B remain constant, only probability associated with each payoff changes for each decision row (Holt & Laury, 2002). Notice that payoffs for Option A (2.00€ or 1.60€) are less variable than payoffs for Option B (3.85€ or 0.10€), that is why it is referred to Option A as the "safe" lottery and Option B as the "risky" lottery. Starting from the first decision row, most subjects will initially choose the safe lottery, and eventually switch to the riskier Option B when the chance of a higher-payoff outcome in each pair becomes large enough (Laury, 2006). Moving down the rows, the probability of a high payoff increases and by the last decision row, participants have to choose between 2.00€ and 3.85€ with certainty. Even the most risk-averse person should switch to Option B, which yields a sure payoff of 3.85€ (Holt & Laury, 2002). See Appendix 7 for detailed instructions.

Table 2: Holt-Laury Measure of Risk-Aversion

	Option A		Option B		Mark your decision (A or B)
1	1/10 of 2.00€	9/10 of 1.60€	1/10 of 3.85€	9/10 of 0.10€	
2	2/10 of 2.00€	8/10 of 1.60€	2/10 of 3.85€	8/10 of 0.10€	
3	3/10 of 2.00€	7/10 of 1.60€	3/10 of 3.85€	7/10 of 0.10€	
4	4/10 of 2.00€	6/10 of 1.60€	4/10 of 3.85€	6/10 of 0.10€	
5	5/10 of 2.00€	5/10 of 1.60€	5/10 of 3.85€	5/10 of 0.10€	
6	6/10 of 2.00€	4/10 of 1.60€	6/10 of 3.85€	4/10 of 0.10€	
7	7/10 of 2.00€	310 of 1.60€	7/10 of 3.85€	3/10 of 0.10€	
8	8/10 of 2.00€	2/10 of 1.60€	8/10 of 3.85€	2/10 of 0.10€	
9	9/10 of 2.00€	1/10 of 1.60€	9/10 of 3.85€	1/10 of 0.10€	
10	10/10 of 2.00€	0/10 of 1.60€	10/10 of 3.85€	0/10 of 0.10€	

Source: Holt & Laury (2002).

For all except the most risk-seeking persons, this implies a pattern where individuals start by choosing Option A for the first decision and switch to Option B at some point before the last decision row (Charness, Gneezy & Imas, 2013). The number of safe choices a person makes is therefore used to infer the degree of risk-aversion (Laury, 2006). For example, a risk-neutral person would choose Option A four times before switching to Option B (Holt & Laury, 2002). Participants are allowed to switch freely between Option A and B, not necessarily in order as they progress down the decision rows. Therefore, they can make inconsistent decisions, either by switching more than once or by switching in the other direction. Participants may do that for many reasons, not only confusion. Those observations are then removed from the analysis (Dave, Eckel, Johnson & Rojas, 2010).

In the same manner as Eckel & Grossman Risk Task (2002; 2008), Holt-Laury Measure of Risk-Aversion assumes constant relative risk-aversion assumption (CRRA) to determine

risk preference classification. Therefore, as is presented in Table 3, choosing Option A for the first four decisions and Option B for the rest (AAAA/BBBBBB) would be consistent with risk-neutrality, since we are evaluating the number of safe choices (i.e., Option A) individuals make (Holt & Laury, 2002).

Table 3: Risk-Aversion Classification Based on Lottery Choices

Number of safe choices	Risk preference classification
0-1	highly risk-loving
2	very risk-loving
3	risk-loving
4	risk-neutral
5	slightly risk-averse
6	risk-averse
7	very risk-averse
8	highly risk-averse
9-0	stay in bed

Source: Holt & Laury (2002).

One of the Holt-Laury Measure of Risk-Aversion's main disadvantages is the complexity of the method. While it depends on populations, there is a significant number of subjects that will highly likely fail to understand the procedure, which reduces its reliability and can potentially bias the results (Charness, Gneezy & Imas, 2013).

2.1.7 Sensation-Seeking Scale Form V (SSS-V)

The concept of sensation-seeking was developed by Zuckerman, based on the idea that there were consistent individual differences in optimal levels of stimulation and arousal, and that these differences could be measured with a questionnaire. Sensation-seeking was defined as "a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of such experience" (Zuckerman, 1994, p. 27). The most widely used is Sensation-Seeking Scale Form V (SSS-V), which consists of four interrelated sub-scales: Thrill and Adventure Seeking (TAS), Experience Seeking (ES), Boredom Susceptibility (BS), and Disinhibition (DIS). Since its development, the SSS-V has been very reliable and associated with a wide range of behaviors (Gray & Wilson, 2007). Many studies have linked sensation-seeking with risky behavior (Zuckerman, 2007).

Subscales or factors are described in terms of their content (Zuckerman & Aluja, 2015, pp. 356–357):

- Thrill and Adventure Seeking (TAS) factor measures desire to engage in extreme sports that provide unusual and intense experiences, e.g., skydiving, or more common sports that can provide intense sensations in their expressions through speed and extreme risk,

i.e., driving fast or skiing down extreme slopes. Most items are described in terms of the desired experience.

- Experience Seeking (ES) factor describes seeking novel experiences through the mind and the senses as in music, art, travel, social nonconformity, and association with like-minded individuals and groups.
- Disinhibition (Dis) describes a desire to engage in disinhibited social behavior as facilitated by alcohol in parties and impulsive sexual activities.
- Boredom Susceptibility (BS) expresses intolerance for routine work and boring people. There is an expressed need for change and unpredictability in stimulation.

The SSS-V consists of 40 forced-choice items, with 10 items relating to each of the sub-scales. For example, TAS includes items like "I often wish I could be a mountain climber", which is considered as high sensation-seeking behavior and "I can't understand people who risk their necks climbing mountains", which reflects low sensation-seeking behavior. ES includes items like "I dislike all body odors" (low sensation-seeking behavior) and "I like some of the earthy body smells (high sensation-seeking behavior). Dis includes items like "I like 'wild' uninhibited parties" (high sensation-seeking behavior) and "I prefer quiet parties with good conversations" (low sensation-seeking behavior). Lastly, BS includes statements like "There are some movies I enjoy seeing a second or even a third time" (low sensation-seeking behavior) and "I can't stand watching a movie that I've seen before" (high sensation-seeking behavior) (Zuckerman, 1994). See Appendix 8 for details. The difference between high and low sensation-seekers is in their willingness to take risks for desired sensations. High sensation-seekers value the sensations much more than low sensation-seekers. Therefore, risk-taking is sometimes necessary for enjoying some types of sensations and experiences. However, it is not the essential goal of sensation-seeking (Zuckerman, 1994).

2.1.8 Zuckerman-Kuhlman Personality Questionnaire

The Zuckerman-Kuhlman Personality Questionnaire (hereinafter: ZKPQ) was developed as the result of an attempt to define basic factors of personality or temperament and is considered to be the alternative five model of personality. The guiding assumption when designing the ZKPQ was that basic personality traits are those with a strong biological-evolutionary basis. ZKPQ consists of more subscales of which Sensation-Seeking has been shown to have many biological correlates (Zuckerman, 2002).

Numerous versions of ZKPQ were developed and I decided to use a cross-cultural shortened form of ZKPQ developed by Aluja et al. (2006). The short version (ZKPQ-50-cc) presents psychometric properties strongly similar to the original version in four countries and it distinguishes the following five personality factors: Impulsive Sensation-Seeking (ImpSS), Neuroticism-Anxiety (N-Anx), Aggression-Hostility (Agg-Host), Activity (Act), and Sociability (Sy). Each subscale includes 10 items and asks participants to score items as True or False (Aluja et al., 2006). See Appendix 9 for detailed information.

The five personality factors can be described in terms of their typical content (Zuckerman, Kuhlman, Joireman, Teta & Kraft, 1993, pp. 759–760):

- Activity (Act). About half of the items describe the need for activity and an inability to relax and do nothing when the opportunity presents itself. The other part portrays a preference for hard or challenging work, an active busy life, and a high energy level. For example, "I lead a busier life than most people".
- Aggression-Hostility (Agg-Host). The aggression items describe a readiness to express verbal aggression, while hostility items concern rude, thoughtless, or antisocial behavior, vengefulness, and spitefulness. For example, "When I get mad, I say ugly things".
- Impulsive Sensation-Seeking (ImpSS). The impulsivity items involve a lack of planning and the tendency to act impulsively without thinking, while sensation-seeking items describe experience seeking, or the willingness to take risks for the sake of excitement or novel experience. For example, "I often do things on impulse".
- Neuroticism-Anxiety (N-Anx) describes emotional upset, tension, worry, fearfulness, obsessive indecision, lack of self-confidence, and sensitivity to criticism. For example, "I frequently get emotionally upset".
- Sociability (Sy) includes the number of friends one has, and the amount spent with them, outgoingness at parties, and a preference for being with others as opposed to being alone or pursuing solitary activities. For example, "I spend as much time with my friends as I can".

2.1.9 2D:4D ratio

Finger length ratios, especially the second-to-fourth digit length ratio (2D:4D) has been linked to several physical and mental characteristics. The digit ratio usually refers to the ratio between index and ring finger. Fingers, labeled as digits, are numbered from one starting with the thumb to the little finger labeled number five. Therefore, the index finger is thus 2D and the ring finger is 4D. The 2D:4D ratio is considered to be a proxy of prenatal testosterone exposure, i.e., exposure to testosterone in the uterus (Sandnes, 2014), which shows sexual dimorphism. For example, a fetus with more exposure to testosterone is expected to have a lower digit ratio. Male ratios are typically shorter than those of females (Coates, Gurnell & Rustichini, 2009).

To determine 2D:4D, photocopies of participants' right hands on HP Scanner (resolution 1200 dpi) were obtained. Participants were instructed to remove all rings and place their right hands on the flatbed scanner with palms down, fingers apart and light pressure. For detailed instructions see Appendix 10. Right-hand digit ratios have been previously found to display more robust sex differences and are thus thought to be more sensitive to prenatal androgens. That is why a 2D:4D ratio was determined only from right-hand measurement (Coates, Gurnell & Rustichini, 2009). Digit lengths were measured from the ventral proximal crease of the digit to the central point of the fingertip using AutoMetric (DeBruine, 2004) as

shown in Figure 2, which was developed specifically for measuring digit ratios. What is more, it has been shown to have the highest precision and interrater reliability of the common measurement methods (Kemper & Schwerdtfeger, 2009).

Figure 2: 2D:4D measurement using AutoMetric

Source: Own work.

2.1.10 fWHR

Growing literature suggests facial masculinity is an indicator or a proxy of pubertal exposure to testosterone (Dreber, Gerdes, Gränsmark & Little, 2013). Facial masculinity, especially within men, is considered to be an outcome of craniofacial bone growth during the pubertal stage, which is influenced and regulated by testosterone administration (Ahmed, Silhvonen & Vähämaa, 2019). This results in a higher face width-to-height ratio (fWHR), which is linked to higher testosterone levels among males and masculine behavioral traits such as increased risk tolerance (Apicella et al., 2008), aggression (Ahmed, Silhvonen & Vähämaa, 2019) and sensation-seeking (Roberti, 2004). fWHR was identified as a sexually dimorphic trait, specifically that men's fWHRs are larger than women's (Wong, Ormiston & Haselhuhn, 2011).

fWHR is defined as a ratio between vertical lines, which represent the distance between the left and the right zygion (bizygomatic width) and horizontal lines, which represent distance between the upper lip and brow (upper facial height) as is shown in Figure 3 (Carre & McCormick, 2008b).

Figure 3: fWHR measurement using ImageJ

Source: Own work.

Full frontal facial photographs with neutral facial expressions were taken with a camera (Nikon D750) during the experiment. Participants were asked to remove their glasses and hats. For detailed instructions see Appendix 11. ImageJ (Rasband, 1997) was used to measure the height of the upper face and bizygomatic width.

2.2 Sample

Sample consists of 36 postgraduate students (21 females, 15 males), aged from 21 to 27 (M=23.6, SD=1.30) from the first year of International Full-Time Master Program in Business (IMB) at School of Economics and Business of University of Ljubljana, who voluntarily decided to participate in the experiment. Our sample consists of 31 Slovenian students, one Croatian, one Russian, one from Monaco, one from the United States of America, and one from Azerbaijan. Therefore, our sample is almost entirely Caucasian, except for one American student. IMB students were informed about the experiment at one of their Financial Management lectures. Those who participated in the experiment and successfully passed the Financial Management exam, received a 5% bonus for the final score.

2.3 Experimental design

The experiment took place on March 27, 2019, from 9:00 a.m. to approximately noon. Firstly, we introduced experimental procedures and design, followed by taking the first

saliva sample. After that, participants completed the Balloon Analogue Risk Task, two lottery games (Eckel & Grossman Risk Task and Holt-Laury Measure of Risk-Aversion) and a few questionnaires (DOSPERT, SSS-V, ZKPQ, Demographic Questionnaire). In between, we also had their right hand scanned for 2D:4D ratio measurement and portrait photo was taken for fWHR measurements. At the end of the experiment, second saliva samples were obtained.

2.4 Research ethics

The experiment and all procedures were approved by the Committee on Ethics and Research at the School of Economics and Business (hereinafter: SEB) of University of Ljubljana. Written consent was obtained from all subjects before participating in the experiment. Several measures have been developed to guarantee participants' total anonymity and confidentiality. Every data item/image/lab result/any other personal data we collected was handled under a code given to participants at the beginning of the experiment. The key to the codes is maintained by the IMB administration. It is not known to researchers, lab personnel, helpers at the experiment, photographer, etc. No individual results were not and will not be disseminated anywhere under any circumstances. Individual results are available to participants only on their demand in which individual's data will be released to a participant by the IMB administration. Participants consented us to collect, store, manipulate the data we obtained, and to submit the photos to an external online photo-image analyzer. We store a copy of the raw data (without the key) on a permanent medium and deposit it in the safe deposit at the SEB, University of Ljubljana, under a code accessible only to the IMB administration upon the Dean's approval (subject to any future data handling requirements the Committee on Ethics in Research at SEB might adopt in the future). This is to ensure proper research ethics. Only synthetic results/summaries/descriptive statistics will ever be released, primarily as output from various analyses (e.g., summary statistics, estimated regression coefficients, etc.). Saliva samples, analyzed by an external lab, were destroyed immediately after the analysis. See Appendix 12 for details on Informed Consent to participate in research "The influence of hormones and personal traits on the propensity for risk-taking".

3 EMPIRICAL ANALYSIS

The third chapter discusses the data set, namely methodology and descriptive statistics, regression analyses results, and a brief discussion of results. The empirical analysis was conducted using econometric software, i.e., STATA, a software developed specifically for 2D:4D measurements, i.e., AutoMetric (DeBruine, 2004), and a software commonly used for fWHR measurements, i.e., ImageJ (Rasband, 1997).

3.1 Methodology

Each participant was randomly assigned an ID number, which served as a connecting variable in the analysis since it was used to merge observations for each participant.

Data collected from the Demographic Questionnaire were gender, age, nationality, smoking, time of smoking, alcohol consumption in a typical week, highest completed education thus far, self-assessment of the propensity for risk on a scale from 1 – very low to 5 – very high, expected future age as a measure of optimism/pessimism, and whether participants had any broken fingers on their right hand, which is a marker commonly used (Coates, Gurnell, & Rustichini, 2009) to exclude observations from analysis in order to provide more accurate 2D:4D measurements. I have run regression analyses by, firstly, using all observations, and secondly, excluding observations that have been reported to have had a broken finger on the right hand. Since the sample size is small and there were no visible differences between broken and non-broken fingers, I decided to use all observations in the analyses.

Results of saliva samples of testosterone (Sal-T) analysis were given in pmol/L, while the results of saliva samples of cortisol (Sal-C) analysis were given in nmol/L. According to instructions, which I received from Medicare PLUS Laboratory, these hormone values had to be transformed using reference values they provided. Testosterone values had to be adjusted for gender and age differences as shown in Equation (1). SalT is a salivary testosterone level of testosterone (in pmol/L), T is reported testosterone level from laboratory analysis (in pmol/L). $M_{age,\ gender}$ is a median value of testosterone (in pg/mL) for women and men regarding age interval. $M_{age,\ gender}$ had to be multiplied with a factor of 3,47 to provide the same measurement units (pmol/L).

$$SalT = \frac{T}{M_{age,gender} \times 3{,}47} \tag{1}$$

On the other hand, cortisol values had to be adjusted for a time after awakening, since cortisol changes depend on when we wake up in the morning (i.e., cortisol levels are the highest in the morning and then start to decrease following its circadian cycle). Cortisol calculation is shown in Equation (2), where SalC is salivary cortisol level (in nmol/L), C is reported cortisol level from laboratory analysis (in nmol/L), and $M_{time\ after\ awakening}$ is the median value of cortisol regarding time after awakening (in nmol/L). Salivary cortisol values were then converted to pmol/L to have the same units for both hormone levels, i.e., testosterone and cortisol.

$$SalC = \frac{C}{M_{time\ after\ awakening}} \tag{2}$$

In this manner, salivary levels of testosterone and cortisol before and after the experiment were calculated (*Sal-T1, Sal-T2, Sal-C1, Sal-C2*). Since hormone levels follow the circadian cycle during the day and are less variable in the afternoon, I have decided to use the second salivary samples in the analyses, which were obtained after the experiment at around noon.

To test the dual-hormone hypothesis, salivary testosterone and salivary cortisol levels were mean-centered and multiplied to create an interaction term (*Sal-T2 x Sal-C2*).

I have also inspected the same correlations using absolute salivary testosterone and cortisol levels. However, I do not present these results due to the length of the thesis.

One method to measure the propensity for risk-taking is using the Balloon Analogue Risk Task. Variable BART is defined as the average number of pumps excluding balloons that exploded (i.e., the average number of pumps on each balloon prior to money collection) (Lejuez et al., 2002). Therefore, BART was calculated as sum of pumps of unexploded balloons divided by the number of unexploded balloons.

Another measure of risk-taking, which is domain-specific, is DOSPERT Scale (Blais & Weber, 2006b). DOSPERT Scale contains three separate response scales, i.e., Risk-Taking, Risk Perception, and Expected Benefits. Each response scale uses the same items from the five domain subscales (Ethical, Financial, Health/Safety, Recreational, Social). Altogether there are 30 items. Participants had to provide answers using a 7-point Likert scale, which differs for each response scale. Scores for each domain were determined by calculating a sum of points from Likert scale and log-transformed to reduce the skewness of the data. Higher scores for each domain indicate a higher propensity for risk of each domain. Further on in the analysis, only DOSPERT Risk-Taking scale was used since it measures the likelihood that participants would engage in the described activity or behavior if they were to find themselves in the described situation.

Eckel & Grossman Risk Task (Eckel & Grossman, 2002; 2008) was another used measure of the propensity for risk. Based on a simple lottery game, participants had to choose a gamble from 1 (extreme risk-aversion) to 6 (risk-seeking). Their gamble choice was then used as an Eckel & Grossman Risk Task variable.

Similar to Eckel & Grossman Risk Task is Holt-Laury Measure of Risk-Aversion (Holt & Laury, 2002). Participants make 10 choices between Option A and Option B, where Option A is considered to be a safe choice, while Option B is considered to be a risky choice. The number of safe choices a person makes is therefore used to infer the degree of risk-aversion. Participants are assessed on a scale of one to ten, where one safe option means a person is highly risk-loving, while a choice of nine to ten safe options mean a person is classified as "stay in bed" (Laury, 2006).

Sensation-seeking characteristics were measured using Sensation-Seeking Scale Form V (Zuckerman, 1994), which consists of four subscales, namely Thrill and Adventure Seeking (TAS), Experience Seeking (ES), Disinhibition (Dis), and Boredom Susceptibility (BS). Participants have to provide a True or False answer for each of the 40 statements in the questionnaire. Final score for each subscale is calculated according to coding instructions (Zuckerman, 1994), that is, adding one point for certain statements. The maximum score for each subscale is 10, therefore, a maximum total score for SSS-V is 40.

Personal traits were measured using the ZKPQ (Zuckerman, Kuhlman, Joireman, Teta & Kraft, 1993; Zuckerman, 2002; Zuckerman & Aluja, 2015), which includes five subscales, namely Activity (Act), Aggression-Hostility (Agg-Host), Impulsive Sensation-Seeking (ImpSS), Neuroticism-Anxiety (N-Anx), and Sociability (Sy). Each subscale consists of 10 statements to which participants have to provide a True or False answer. The final score for each subscale is calculated according to coding instructions (Aluja et al., 2006; Aluja A. et al., 2018), that is adding one point for certain statements, therefore, a maximum score for each subscale is 10.

Prenatal testosterone exposure was measured as a 2D:4D ratio, which was calculated as the length of the second finger divided by the length of the fourth finger, both on the right hand. Lengths of fingers have been determined using AutoMetric software (DeBruine, 2004).

Facial masculinity, which is considered to be a proxy for pubertal testosterone exposure, was measured as fWHR. To obtain a fWHR measure, firstly, facial width (i.e., the distance between the left and the right zygion) and facial height (i.e., the distance between the upper lip and brow) were determined using the ImageJ software (Rasband, 1997). Secondly, fWHR measure was calculated as a ratio between facial width and facial height.

Ordinary least squares (OLS) regressions were run among all independent and dependent variables to examine correlations between variables. Based on our predictions of relations between independent and dependent variables, one- or two-tailed tests were calculated. Two-sided t-tests were performed, except on some correlations (see Appendix 13 for details), one-sided t-tests were performed according to previous literature findings and my predictions. The Jarque-Berra test was conducted to check for normality of the disturbances, and it showed the null hypothesis cannot be rejected. Therefore, the stochastic variables are normally distributed. I have also applied robust variance estimator in some regressions to provide linear unbiased estimators because residual variances appeared to be heteroscedastic.

Hypotheses were tested using OLS regressions. Risk propensity was assessed using various dependent variables, i.e., BART, Eckel & Grossman Risk Task score, Holt-Laury Measure of Risk-Aversion score (which, in contrast with other research techniques, measures risk-aversion), Ethical, Financial, Health/Safety, Recreational, and Social domain (all domains from DOSPERT Risk-Taking Scale), and TAS, BS, ES, DIS, and Total score of Sensation-Seeking Scale Form V. All regression models were tested for normality of disturbances, multicollinearity and heteroscedasticity. The Jarque-Berra test was conducted to check for normality of the disturbances, and it showed the null hypothesis cannot be rejected. Therefore, stochastic variables are normally distributed. When testing for multicollinearity, I have found variables smoker and time smoking to be highly collinear (VIF=21.72 and VIF=23.87, respectively). However, I kept both variables in models, since they are supposed to be collinear. For example, time smoking is greater than 0 only when smoker is equal to 1.

I have also applied robust variance estimator in some regressions in order to provide linear unbiased estimators, because some residual variances appeared to be heteroscedastic.

3.2 Descriptive statistics

There were 30 variables used in multiple regression analyses when testing hypotheses and 32 when testing bivariate correlations among variables. No observations were excluded from the analysis. There was only one missing value in the dataset of DOSPERT Risk-Taking questionnaire, which was replaced with a corresponding mean value for this question. Descriptions of all variables used in analyses are available in Appendix 14.

Descriptive statistics (i.e., number of observations, mean, standard deviation, minimum, maximum, and frequency distributions) are presented in the following tables down below. As shown in Table 4, the sample consists of 15 males and 21 females.

Table 4: Frequency distribution for gender

Gender	Freq.	Percent	Cum.
Male	15	41.67	41.67
Female	21	58.33	100.00
Total	36	100.00	

Source: Own work.

Table 5 displays descriptive statistics for age, time smoking, alcohol consumption, self-assessment of the propensity for risk-taking, and expected future age. As presented in Table 5, the average age of participants is 23.58. Furthermore, average time of smoking including all participants is 2.22 years, although only 11 participants smoke. On average, participants drink 3.64 alcohol units per week. Their average self-assessment of the propensity for risk-taking is 3.11, which is defined as risk-neutral. The average expected future age of participants is 88.39.

Table 5: Descriptive statistics for age, time smoking, alcohol, risk self-assessment and expected future age

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	36	23.5833	1.2956	21	27
Time smoking	36	2.2222	3.5546	0	12
Alcohol consumption	36	3.6389	5.1445	0	25
Risk	36	3.1111	0.9791	1	5
Expected future age	36	88.3889	15.5256	50	150

Source: Own work.

Descriptive statistics for nationality are presented in Table 6 and, as is shown there, our sample is mostly Caucasian, only one person comes from the USA.

Table 6: Frequency distribution for nationality

Nationality	Freq.	Percent	Cum.
Slovenian	31	86.11	86.11
United States of America	1	2.78	88.89
Russian	1	2.78	91.67
Croatian	1	2.78	94.44
Azerbaijani	1	2.78	97.22
Monégasque	1	2.78	100.00
Total	36	100.00	

Source: Own work.

Table 7 shows data on smokers and non-smokers. Sample consists of 11 smokers and 25 non-smokers.

Table 7: Frequency distribution for smokers and non-smokers

Smoker	Freq.	Percent	Cum.
No	25	69.44	69.44
Yes	11	30.56	100.00
Total	36	100.00	

Source: Own work.

As shown in Table 8, 33 participants had already gained bachelors' degrees and three had already gained masters' degrees.

Table 8: Frequency distribution for completed education thus far

Education	Freq.	Percent	Cum.
Bachelor's degree	33	91.67	91.67
Master's degree	3	8.33	100.00
Total	36	100.00	

Notes: Education states the highest completed education thus far.

Source: Own work.

Table 9 presents frequency distribution for self-assessment of the propensity for risk-taking, which is almost normally distributed. Most participants described themselves as risk-neutral.

Table 9: Frequency distribution for self-assessment of the propensity for risk-taking

Risk	Freq.	Percent	Cum.
Very low	1	2.78	2.78
Low	9	25.00	27.78
Risk neutral	14	38.89	66.67
High	9	25.00	91.67
Very high	3	8.33	100.00
Total	36	100.00	

Source: Own work.

Table 10 shows descriptive statistics for salivary levels of testosterone and cortisol. In line with theory, the values from the second measurement are lower compared to the first measurement. Since hormones follow a circadian rhythm, their values usually peak in the morning.

Table 10: Descriptive statistics for salivary levels of testosterone and cortisol

Variable	Obs	Mean	Std. Dev.	Min	Max
Sal-T1	36	0.94	0.49	0.20	2.01
Sal-C1	36	1761.87	944.21	467.39	4265.84
Sal-T1 x Sal-C1	36	252.71	505.07	-386.72	2685.01
Sal-T2	36	0.59	0.34	0.12	1.44
Sal-C2	36	820.92	389.48	278.26	1999.53
Sal-T2 x Sal-C2	36	14.13	115.12	-254.35	376.00

Notes: Salivary levels of testosterone and cortisol are presented in pmol/L

Source: Own work.

Table 11 displays descriptive statistics for BART, 2D:4D ratio, and fWHR. The average number of pumps on balloons that did not explode in BART is 53.76, the average 2D:4D ratio is 0.98, and the average fWHR is 2.06.

Table 11: Descriptive statistics for BART, 2D:4D, fWHR

Variable	Obs	Mean	Std. Dev.	Min	Max
BART	36	53.7631	12.0023	29.6800	85.6000
2D:4D	36	0.9775	0,0288	0.9210	1.0590
fWHR	36	2.0576	0,1092	1.8548	2.2329

Source: Own work.

Table 12 presents frequency distribution for Eckel & Grossman Risk Task, while Table 13 shows frequency distribution for the Holt-Laury Measure of Risk-Aversion. As shown in Table 12, participants mostly chose Gamble 5, which is supposed to be the risk-neutral

choice. As shown in Table 13, most participants chose four safe options in Holt-Laury Measure of Risk-Aversion, which is also considered to be risk-neutral.

Table 12: Frequency distribution for Eckel & Grossman Risk Task

Eckel & Grossman	Freq.	Percent	Cum.
1	2	5.56	5.56
2	1	2.78	8.33
3	6	16.67	25.00
4	7	19.44	44.44
5	15	41.67	86.11
6	5	13.89	100.00
Total	36	100.00	

Source: Own work.

Table 13: Frequency distribution for Holt-Laury Measure of Risk-Aversion

Holt & Laury	Freq.	Percent	Cum.
1	1	2.78	2.78
2	2	5.56	8.33
3	4	11.11	19.44
4	14	38.89	58.33
5	5	13.89	72.22
6	8	22.22	94.44
7	1	2.78	97.22
8	1	2.78	100.00
Total	36	100.00	

Source: Own work.

Table 14 presents descriptive statistics for DOSPERT Risk-Taking Scale. As Table 14 displays, participants' scores range from 2.77 to 3.49 which is described as moderately unlikely to somewhat unlikely likelihood to engage in riskier domain decisions.

Table 14: Descriptive statistics for DOSPERT Risk-Taking Scale

Variable	Obs	Mean	Std. Dev.	Min	Max
Ethical	36	2.7691	0.3732	1.7918	3.3673
Financial	36	3.1229	0.3643	2.0794	3.5553
Health/Safety	36	3.0209	0.3289	2.3026	3.5835
Recreational	36	3.2533	0.3965	1.9459	3.7136
Social	36	3.4891	0.1566	3.1355	3.6889

Notes: DOSPERT domain scores are obtained as sums of all items in each domain of Risk Taking scale and then log-transformed.

Source: Own work.

Tables 15 and 16 show descriptive statistics for SSS-V and ZKPQ, respectively. As Table 15 shows, the highest average score was measured for TAS, 7.19 points, while the lowest score was measured for BS, 3.50 points. As Table 16 shows, participants on average scored the highest scores in the Impulsive Sensation-Seeking Scale, indicating a higher propensity for impulsive sensation-seeking behavior. On the other hand, they on average scored the lowest on Neuroticism-Anxiety, which indicates a lower propensity for neuroticism and anxious behavior.

Table 15: Descriptive statistics for SSS-V

Variable	Obs	Mean	Std. Dev.	Min	Max
TAS	36	7.1944	2.7236	1	10
ES	36	5.8333	1.7647	2	9
BS	36	3.5000	2.0213	0	8
Dis	36	6.5278	2.3480	1	10
Total	36	23.0556	5.8746	9	34

Source: Own work.

Table 16: Descriptive statistics for ZKPQ

Variable	Obs	Mean	Std. Dev.	Min	Max
Act	36	5.8333	2.3964	2	10
AggHost	36	5.9722	1.9196	1	10
ImpSS	36	7.1389	2.4512	1	10
N-Anx	36	3.6111	3.0545	0	10
Sy	36	5.4444	2.3958	0	10

Source: Own work.

3.3 Results

This section provides empirical results. Firstly, correlations between variables are investigated and presented in a way they should appear in results according to previous findings in the literature. Secondly, bivariate regression analyses results are presented along with its discussion. Finally, results from multiple regression models, which were used for testing hypotheses, are presented.

3.3.1 Correlations based on reviewed literature

Several studies have been conducted from this field of research, giving some insights into what the potential associations between variables are. Correlations based on the literature review are described below.

BART. Some authors report that older adults are more risk-averse than their younger counterparts on the BART (Henninger, Madden, & Huettel, 2010). Impulsivity and self-

assessment of risk were also found to be positively correlated to BART (Lejuez et al., 2002). Mehta, Mor, Yap, and Prasad (2015) study the dual-hormone hypothesis concerning the risk propensity. In one of two studies, they show that a higher endogenous testosterone level was associated with greater risk-taking, but only for individuals with a low endogenous cortisol level. There are also some indications fWHR predicts risk-taking when measured with BART, but only when individuals perceive their status as low (Welker, Goetz & Carre, 2015).

Holt-Laury Measure of Risk-Aversion. Empirical evidence suggests a negative correlation between salivary testosterone concentrations and risk-aversion measured with Holt-Laury Measure of Risk-Aversion (Sapienza, Zingales & Maestripieri, 2009; Branas-Garza & Rustichini, 2011).

Eckel & Grossman Risk Task. Eckel and Grossman (2002; 2008) found that women are on average significantly more risk-averse than men. Garbarino, Slonim, and Sydnor (2011) found that subjects with a lower 2D:4D ratio tend to choose riskier options.

DOSPERT. It has been found that risk-taking tendencies in the financial domain reduce steeply in an older age. Risk-taking in the social domain increases slightly, especially from young to middle age, while recreational risk reduces more steeply from young to middle age than later in life. Ethical and health/social risk-taking reduce relatively smoothly with age (Rolison, Hanoch, Wood & Liu, 2013). Furthermore, smokers are more likely to take risks that concern their health but are no more risk-taking in other domains than non-smokers (Hanoch, Johnson & Wilke, 2006). What is more, women appeared to be more risk-averse in all domains except for the social domain (Blais & Weber, 2006a). Authors also suggest that a lower 2D:4D ratio predicts greater risk propensity in the social, recreational, and financial domain (Stenstrom, Saad, Nepomuceno & Mendenhall, 2011). Education was also found to be positively correlated with financial risk tolerance (Chang, DeVaney & Chiremba, 2004).

Sensation-Seeking Scale Form V (SSS-V). Literature suggests men have lower 2D:4D ratios, but score higher on SSS-V. Furthermore, 2D:4D in males is negatively correlated with Total SSS-V, and Boredom subscale (Fink, Neave, Laughton & Manning, 2006). Roberti (2004) reviews several studies reporting following findings, low cortisol level is associated with high sensation-seeking, impulsivity is associated with sensation-seeking, sensation-seeking declines with age, males usually have higher TAS, Dis, BS, and Total scores, age is negatively correlated with all SSS subscales except for BS (no effect found). Last but not least, alcohol consumption is associated with Dis and ES (Roberti, 2004).

Described correlations based on reviewed literature and personal intuition are presented in Appendix 13.

3.3.2 Bivariate correlation analyses: results and discussion

Ordinary least squares (OLS) regressions were run among all independent and dependent variables to examine correlations between variables. Results are presented in Table 17.

I will firstly sum up and discuss the most important results regarding correlations among demographical variables and different risk-taking propensity measures. Findings suggest that on average ceteris paribus women tend to behave more risk-averse when making ethical (b=-0.41, p=0.00), health/safety (b=-0.22, p=0.033), and recreational (b=-0.24, p=0.067) decisions compared to men, which is in line with previous findings (Blais & Weber, 2006a). I also find that on average ceteris paribus women tend to have lower scores on TAS compared to men (b=-1.76, p=0.046), which means their desire to engage in extreme sports that provide unusual and intense experience is on average ceteris paribus lower compared to men. This finding is consistent with Roberti's (2004) results. However, recent studies indicate that gender differences, especially in financial risk tolerance, are explained by gender differences in the individual determinants of financial risk tolerance, and that the disparity does not result from gender in and of itself (Fisher & Yao, 2017).

I find a significant and positive correlation (b=0.55, p=0.073) between age and Boredom Susceptibility. Also, results suggest that on average ceteris paribus smokers tend to express their desire to engage in disinhibited social behavior (b=1.73, p=0.014) more compared to non-smokers. What is more, consistent with my predictions and previous findings (Hanoch, Johnson & Wilke, 2006), I find that on average ceteris paribus smokers tend to make riskier health/safety decisions (b=0.23, p=0.050) compared to non-smokers. The same goes for correlation between time of smoking and disinhibited social behavior (b=0.21, p=0.059), and for correlation between time of smoking and health/safety decisions (b=0.03, p=0.077).

I also find alcohol consumption to be negatively correlated with Holt-Laury Measure of Risk-Aversion (b=-0.09, p=0.052). In line with Roberti's findings (2004), I also find alcohol consumption positively correlated with disinhibited social behavior (b=0.15, p=0.045), ethical (b=0.02, p=0.056) and financial (b=0.02, p=0.042) decisions in DOSPERT. However, I do not find any statistically significant effect between education and any risk-taking measure.

In line with my predictions, self-assessment of the propensity for risk-taking is significant and positively correlated with almost all risk-taking measures, namely BART (b=5.91, p=0.003), Eckel & Grossman Risk Task (b=0.56, p=0.016), TAS (b=1.62, p=0.00), ES (b=0.94, p=0.001), Total SSS-V (b=3.27, p=0.001), financial (b=0.11, p=0.072), health/safety (b=0.12, p=0.040), and recreational (b=0.24, p=0.00) decisions. Therefore, if self-assessment of the propensity for risk-taking increases by one point from the questionnaire, then on average ceteris paribus average number of pumps on balloons in BART that did not explode increase by 5.91 pumps, indicating a higher propensity for risk-taking. If self-assessment of the propensity for risk-taking increases by one point, then on

Table 17: Bivariate regression analyses results

y/x	Gender	Age	Smoker	Time smoking	Alcohol	Education	Risk	Future age	2D:4D	fWHR	Act	AggHost	ImpSS	N-Anx	Sy	Sal-T2	Sal-C2
BART	-3.6713	0.2745	5.4218	0.5503	0.2322	-0.5379	**5.9113****	**0.2224***	100.3945	11.6070	0.7951	1.0516	**2.7357*****	**-1.2150***	**1.5998***	0.4571	0.0023
	(-0.90)	(0.17)	(1.26)	(0.96)	(0.58)	(-0.07)	**(3.21)**	**(1.75)**	(1.14)	(0.62)	(0.94)	(0.99)	**(3.93)**	**(-1.90)**	**(1.96)**	(0.07)	(0.45)
Holt & Laury	0.4667	0.0014	-0.2873	-0.0244	**-0.0927***	1.3030	-0.3543	-0.0067	-4.7866	-0.9066	0.0987	0.1665	-0.1539	**0.1764****	-0.0625	-0.8806	0.0003
Measure of Risk Aversion	(0.94)	(0.01)	(-0.54)	(-0.35)	**(-2.01)**	(1.50)	(-1.42)	(-0.42)	(-0.55)	(-0.40)	(0.95)	(1.30)	(-1.56)	**(2.31)**	(-0.46)	(-1.21)	(0.44)
Eckel & Grossman	-0.0476	-0.0922	0.4764	0.0714	0.0356	-0.6969	**0.5596****	-0.0017	-9.8324	0.4171	0.4395	-0.1449	0.1687	-0.0390	0.0951	-0.5176	0.0001
Risk Task	(-0.11)	(-0.54)	(1.01)	(1.16)	(0.83)	(-0.88)	**(2.70)**	(-0.12)	(-0.97)	(0.20)	(0.36)	(-1.27)	(1.53)	(-0.53)	(1.03)	(-0.79)	(0.21)
TAS	**-1.7238****	-0.4440	0.7673	0.0530	0.0459	-0.9393	**1.6159*****	**0.0601****	-2.2291	3.9738	**0.6675*****	0.0015	**0.6991*****	**-0.3132****	**0.3429***	1.0042	0.0001
	(-2.07)	(-1.26)	(0.77)	(0.40)	(0.51)	(-0.57)	**(4.16)**	**(2.13)**	(-0.14)	(0.80)	**(4.23)**	(0.01)	**(4.72)**	**(-2.19)**	**(1.84)**	(0.88)	(0.05)
BS	-0.1714	**0.5532***	-0.0655	0.0271	0.0113	0.9090	0.0596	-0.0146	2.0736	1.5025	0.1493	-0.0271	**0.2686***	-0.1623	0.1543	0.2546	-0.001
	(-0.25)	**(1.85)**	(-0.09)	(0.28)	(0.17)	(0.74)	(0.17)	(-0.66)	(0.17)	(0.47)	(1.05)	(-0.15)	**(2.01)**	(-1.48)	(1.08)	(0.25)	(-1.11)
Dis	-0.9238	0.2199	**1.7273****	**0.2098****	**0.1531****	0.5151	0.6523	0.0027	4.0263	-0.5878	**0.3590****	0.0506	**0.5581*****	**-0.2162***	**0.4508****	1.0848	**0.0018***
	(-1.26)	(0.76)	**(2.59)**	**(1.95)**	**(2.08)**	(0.36)	(1.65)	(0.10)	(0.29)	(-0.16)	**(2.30)**	(0.24)	**(3.94)**	**(-1.71)**	**(3.02)**	(0.96)	**(1.78)**
ES	0.0571	0.0936	0.3709	0.0641	-0.0380	0,9090	**0.9438*****	-0.0055	1.3479	3.5730	0.1343	-0.2029	**0.4319*****	**-0.2062****	0.1377	0.0983	-0.0003
	(0.09)	(0.40)	(0.58)	(0.76)	(-0.65)	(0.85)	**(3.58)**	(-0.28)	(0.13)	(1.32)	(0.86)	(-1.32)	**(4.37)**	**(-2.23)**	(1.11)	(0.11)	(-0.34)
Total SSS-V	-2.7619	0.4227	2.8000	0.3540	0.1724	1.3939	**3.2715*****	0.0427	5.2187	8.4615	**1.3101****	-0.1779	**1.9577*****	**-0.8979****	**1.0857****	2.4419	0.0006
	(-1.41)	(0.59)	(1.61)	(1.28)	(0.89)	(0.39)	**(3.79)**	(0.66)	(0.15)	(0.93)	**(3.69)**	(-0.34)	**(8.26)**	**(-3.08)**	**(2.88)**	(0.84)	(0.22)
ln(Ethical)	**-0.4068*****	0.0219	0.1751	0.0209	**0.0233***	-0.1243	0.0781	0.0032	0.1874	0.8765	0.0243	0.0097	**0.0571****	**-0.0330***	0.0026	**0.3492***	-0.0001
	(-4.22)	(0.44)	(1.74)	(1.19)	**(1.098)**	(-0.55)	(1.22)	(0.78)	(0.08)	(1.55)	(0.92)	(0.29)	**(2.36)**	**(-1.75)**	(0.10)	**(1.94)**	(-0.36)
ln(Financial)	-0.1756	-0.0340	0.1239	0.0201	**0.0242****	-0.2059	**0.1129***	0.0011	-2.6558	-0.0395	0.0230	-0.0049	**0.0477***	**-0.0525****	0.0219	**0.4358****	**0.0003****
	(-1.45)	(-0.45)	(0.94)	(1.17)	**(2.12)**	(-0.94)	**(1.86)**	(0.27)	(-1.25)	(-0.07)	(0.89)	(-0.15)	**(1.98)**	**(-2.47)**	(0.85)	**(2.57)**	**(2.12)**
ln(Health/Safety)	**-0.2186****	-0.0099	**0.2321**	**0.0276***	0.0108	-0.2084	**0.1154****	0.0045	1.6549	0.4427	0.0015	-0.0236	**0.0575****	-0.0277	0.0083	0.1796	-0.0002
	(-2.22)	(-0.23)	**(2.04)****	**(1.82)**	(1.53)	(-1.05)	**(2.13)**	(1.26)	(0.85)	(0.87)	(0.06)	(-0.81)	**(3.39)**	(-1.55)	(0.36)	(1.09)	(-1.18)
ln(Recreational)	**-0.2445***	0.0164	0.1304	0.0160	0.0122	-0.1403	**0.2392*****	0.0056	1.7526	0.8894	0.0567	0.0005	**0.1213*****	-0.0349	**0.0474***	0.1981	0.0001
	(-1.89)	(0.31)	(0.91)	(0.85)	(0.94)	(-0.58)	**(4.27)**	(1.31)	(0.75)	(1.47)	(1.44)	(0.01)	**(6.61)**	(-1.63)	**(1.74)**	(0.99)	(0.36)
ln(Social)	-0.0345	0.0096	0.0108	0.0017	0.0070	-0.0262	0,0232	-0.0021	**-1.8121****	-0.0755	0.0116	-0.0154	**0.0251****	**-0.0288*****	0.0035	0.0815	**0.0001***
	(-0.70)	(0.47)	(0.19)	(0.23)	(1.38)	(-0.27)	(0.85)	(-1.24)	**(-2.06)**	(-0.31)	(1.05)	(-1.12)	**(2.49)**	**(-3.97)**	(0.31)	(1.12)	**(1.99)**

Significance is displayed at the 10% (*), 5% (**) and 1% (***) levels with t-statistics listed below the coefficients.

Source: Own work.

average ceteris paribus participants choose riskier gambles for 0.56 points in Eckel and Grossman Risk Task. If self-assessment of the propensity for risk-taking increases by one point, then on average ceteris paribus participants score higher on TAS (describes engaging in extreme sports that provide unusual and intense experience) for 1.62 points from questionnaire indicating a higher propensity for risk-taking. If self-assessment of the propensity for risk-taking increases by one point, then on average ceteris paribus participants score higher on ES (describes seeking novel experience through mind and senses) for 0.94 points from questionnaire, indicating a higher propensity for risk-taking. If self-assessment of risk increases by one point, then on average ceteris paribus participants score higher on Total SSS-V for 3.27 points, which means their desire for sensation-seeking behavior is greater. If self-assessment of the propensity for risk-taking increases by one point, then on average ceteris paribus participants' likelihood to engage in riskier financial decisions increases by 4.77%, for health/safety decisions by 5.75%, and for recreational decisions by 12.13%. All indicating a higher propensity for risk-taking. All in all, these findings suggest that implemented measures of the propensity for risk-taking (i.e., BART, Eckel & Grossman Risk Task, Holt-Laury Measure of Risk-Aversion, SSS-V, DOSPERT) might be useful tools in the assessment of the propensity for risk-taking.

Last but not least, I find expected future age as a measure of optimism to be positively correlated with BART (b=0.22, p=0.089) and with TAS (b=0.06, p=0.041), indicating a higher propensity for risk-taking.

Results do not show any significant statistical correlation among fWHR and risk-taking measures. However, this might be due to the small sample. What is more, other studies from this field report inconsistent findings (Ahmed, Silhvonen, & Vähämaa, 2019; Kamiya, Kim, & Soohyun, 2018; Lefevre, Lewis, Perrett, & Penke, 2013; Welker, Goetz, & Carre, 2015), which indicates it needs more research or even a conceptual refinement.

The same goes for 2D:4D ratio, although I find a significant negative correlation (b=-1.81, p=0.047) between 2D:4D ratio and social decisions, which is consistent with Stenstrom, Saad, Nepomuceno and Mendenhall (2011). Therefore, if participants' 2D:4D ratio decreases by one unit, then on average ceteris paribus participants' likelihood to engage in riskier social decisions increases by 181% at a significance level of 5%.

Next group of independent variables is related to personal traits, which were measured with ZKPQ. Results show positive significant correlations between Activity and TAS (b=0.67, p=0.00), between Activity and Disinhibition (b=0.36, p=0.028), between Activity and Total SSS-V (b=1.31, p=0.001). I find no statistically significant correlations between Aggression-Hostility and any risk-taking measure.

What is more interesting, I find positive and mostly highly significant correlations between Impulsive Sensation-Seeking (i.e., tendency to act impulsively without thinking and the willingness to take risks just for the sake of it) and almost all risk-taking measures, i.e.,

BART (b=2.74, p=0.00), TAS (b=0.70, p=0.00), Dis (b=0.56, p=0.00), ES (b=0.43, p=0.00), BS (b=0.27, p=0.052), Total SSS-V (b=1.96, p=0.00), ethical (b=0.06, p=0.024), financial (b=0.05, p=0.056), health/safety (b=0.06, p=0.002), recreational (b=0.12, p=0.00), and social (b=0.03, p=0.018) decisions. These findings suggest that higher tendency to impulsive behavior results in a higher propensity for risk-taking assessed with several risk-taking measures. For example, if impulsive sensation-seeking behavior increases by one point from the questionnaire, then on average ceteris paribus average number of pumps on balloons in BART that did not explode increase by 2.74 pumps, indicating a higher propensity for risk-taking. Also, if impulsive sensation-seeking behavior increases by one point from the questionnaire, then on average ceteris paribus the likelihood for participants to engage in riskier financial decisions increases by 4.77%. Other studies also report about positive relations among BART and Impulsive Sensation-Seeking (Roberti, 2004).

I also find significant and negative correlations (except for Holt-Laury Measure of Risk-Aversion, which is supposed to be positive) between Neuroticism-Anxiety and most of the risk propensity measures, i.e., BART (b=-1.22, p=0.066), Holt-Laury Measure of Risk-Aversion (b=0.18, p=0.027), TAS (b=-0.31, p=0.036), Dis (b=-0.22, p=0.097), ES (b=-0.21, p=0.033), Total SSS-V (b=0.90, p=0.004), ethical (b=-0.03, p=0.089), financial (b=-0.05, p=0.007), and social decisions (b=-0.03, p=0.00). For example, if neuroticism and anxiety increase by one point from the questionnaire, then on average ceteris paribus average number of pumps on balloons in BART that did not explode decrease by 1.22 pumps, indicating a lower propensity for risk-taking. Furthermore, if neuroticism and anxiety increase by one point from the questionnaire, then on average ceteris paribus the likelihood for participants to engage in riskier financial decisions decreases by 5.25%, which also indicates a lower propensity for risk-taking.

I also find significant and positive correlations between Sociability and some of the risk-propensity measures, i.e., BART (b=1.60, p=0.058), TAS (b=0.34, p=0.074), Dis (b=0.45, p=0.005), Total SSS-V (b=1.09. P=0.007), and recreational decisions (b=0.05, p=0.091).

More importantly, I also find significant correlations among salivary testosterone level and DOSPERT domains, i.e., ethical (b=0.35, p=0.061) and financial (b=0.44, p=0.015). Therefore, if salivary level of testosterone increases by one pmol/L, then on average ceteris paribus the likelihood for participants to engage in riskier financial decisions increases by 44% at a significance level of 5%. Furthermore, I find significant correlations among salivary cortisol and Dis (b=0.0018, p=0.083), financial (b=0.0003, p=0.041), and social (b=0.0001, p=0.055) decisions. For example, if salivary cortisol level increases by one pmol/L, then on average ceteris paribus the likelihood for participants to engage in riskier financial decisions increases by 0.03% at a significance level of 5%. All in all, important findings of this correlation analysis are that both salivary testosterone and cortisol levels influence financial decisions. That is, participants who have higher salivary testosterone or cortisol levels are more likely to engage in riskier financial decisions. However, not all

correlations between salivary testosterone or cortisol levels and dependent variables appeared to be significant or consistent with other studies. This might be due to the variability in hormone levels during a 24-hour cycle. As it has been discussed in the theoretical section, hormones follow circadian rhythm (Science Daily, n.d.). It has been shown that testosterone levels are the highest and most variable in the morning, while in the afternoon, the hormone is more stable and lower (Mazur & Booth, 1998). Cortisol levels are less stable compared to testosterone, since morning cortisol levels can be 4-5 times higher than those in the evening (Herbet, 2018). Specifically, it has been found that, on average, cortisol is at the lowest at 4:00 a.m. and it peaks at 8:00 am (Schipper, 2015). Furthermore, compared to testosterone, cortisol levels vary less between sexes, although morning levels of cortisol are around 20% higher in females (Herbet, 2018). Saliva samples in this study have been obtained at around noon, which could have influenced the results. It might have been better to obtain saliva samples in the afternoon to control for diurnal variation (Carre & McCormick, 2008a). Another important fact is that sample size is small, which has very likely influenced results as well.

3.3.3 Multiple regression analyses: results and discussion

To test the hypotheses, OLS regressions were conducted. Regression results are presented below. To test each hypothesis, two regression models were conducted. First model included only key independent variables (denoted as column (1)), while the second model (denoted as column (2)) included control variables, namely demographic characteristics (i.e., gender, age, smoker, alcohol, education, risk, future age) and personal traits (i.e., Act, Agg-Host, ImpSS, N-Anx, Sy).

3.3.3.1 H1a: Higher concentrations of testosterone and lower concentrations of cortisol result in a higher propensity for risk-taking

To test the first hypothesis (H1a), the following model was developed. It includes main independent variables, such as salivary testosterone level, salivary cortisol level and interaction term of salivary testosterone and cortisol levels. Also, control variables were included, namely demographic characteristics (i.e., gender, age, smoker, time smoking, alcohol, education, self-assessment of risk, and future age) and personal traits (i.e., Activity, Aggression-Hostility, Impulsive Sensation-Seeking, Neuroticism-Anxiety, and Sociability). OLS regression results are presented in Table 18. Column (1) represents regression results including only main independent variables, while column (2) represents results of the whole model.

I find mixed results when testing dual-hormone hypothesis. For example, if salivary testosterone level increases by one pmol/L, then on average ceteris paribus average number of pumps on balloons in BART that did not explode decrease by 8.00 pumps, when salivary cortisol is equal to 0. Since salivary cortisol level is not equal to 0, then for one pmol/L increase in salivary testosterone level, on average ceteris paribus average number of pumps

Table 18: Multiple regression analyses results (H1a, H1b)

	BART		Eckel & Grossman Risk Task		Holt & Laury Measure of Risk Aversion		ln(Ethical)		ln(Financial)		ln(HealthSafety)		ln(Social)		ln(Recreational)		TAS		BS		ES		Dis		Total SSS-V	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Sal-T2	-0.2218	-8.0027	-0.6047	-0.7205	-0.8127	-0.1665	**0.3416***	-0.0287	**0.3832****	0.3148	0.1934	-0.1292	0.0649	-0.0625	0.1907	-0.0514	0.9983	-0.1089	0.3872	-0.4203	0.1604	0.3953	0.8088	-0.6006	2.3548	-0.7345
	(-0.04)	(-1.28)	(-0.93)	(-0.81)	(-1.23)	(-0.20)	**(1.94)**	(-0.11)	**(2.41)**	(1.52)	(1.18)	(-0.57)	(0.84)	(-0.70)	(0.92)	(-0.24)	(0.70)	(-0.08)	(0.37)	(-0.27)	(0.17)	(0.39)	(0.69)	(-0.41)	(0.81)	(-0.27)
Sal-C2	0.0036	0.0026	0.0002	0.0004	0.0003	0.0005	-0.0001	-0.0001	**0.0003****	**0.0004****	-0.0002	-0.0002	**0.0001***	**0.0002****	0.0000	0.0017	-0.0001	0.0001	-0.0010	-0.0015	-0.0003	-0.0002	**0.0017***	0.0014	0.0004	-0.0002
	0.44	(0.57)	0.42	(0.65)	(0.45)	(0.76)	(-0.49)	(-0.49)	**(2.16)**	**(2.59)**	(-1.25)	(-0.90)	**(1.85)**	**(2.37)**	(0.25)	(1.06)	(-0.02)	(0.05)	(-1.12)	(-1.26)	(-0.38)	(-0.25)	**(1.73)**	(1.32)	(0.14)	(-0.09)
Sal-T2 x Sal-C2	-0.012	**-0.0302***	**-0.0033***	-0.0012	**0.0059****	**0.0042***	**-0.0010***	-0.0010	**-0.0008***	-0.0006	-0.0005	0.0001	-0.0000	0.0002	-0.0000	0.0003	-0.0006	-0.0007	0.0001	-0.0016	0.0013	0.0026	-0.0030	-0.0034	-0.0021	-0.0031
	(-1.15)	**(-1.84)**	**(-1.74)**	(-0.50)	**(3.08)**	**(1.89)**	**(-1.97)**	(-1.43)	**(-1.81)**	(-1.14)	(-1.11)	(0.23)	(-0.14)	(0.96)	(-0.05)	(0.53)	(-0.13)	(-0.18)	(0.03)	(-0.39)	(0.49)	(0.96)	(-0.89)	(-0.88)	(-0.22)	(-0.43)
Gender		5.6942		-0.2330		-0.5837		**-0.4508****		-0.0642		-0.2394		-0.0149		-0.0262		-0.9949		0.3040		0.2770		0.4766		0.0626
		(1.17)		(-0.33)		(-0.89)		**(-2.28)**		(-0.40)		(-1.36)		(-0.21)		(-0.16)		(-0.88)		(0.25)		(0.35)		(0.41)		(0.03)
Age		0.2376		0.1136		-0.2442		-0.1163		**-0.1171***		-0.0534		-0.0157		0.05837		-0.3117		0.4279		0.1474		0.0610		0.3246
		(0.13)		(0.43)		(-0.98)		(-1.54)		**(-1.89)**		(-0.79)		(-0.59)		(0.92)		(-0.72)		(0.91)		(0.48)		(0.14)		(0.40)
Smoker		**31.5774****		-2.4621		-2.8817		-0.4125		**-1.1965****		0.3171		-0.0112		0.1203		1.0903		1.2968		0.7465		2.6366		5.7703
		(2.21)		(-1.20)		(-1.50)		(-0.71)		**(-2.52)**		(0.61)		(-0.06)		(0.25)		(0.33)		(0.36)		(0.32)		(0.78)		(0.93)
Time smoking		**-5.1141****		0.3362		**0.5484**		0.0642		**0.1674****		-0.0317		-0.0003		-0.0378		-0.1555		-0.2476		-0.0985		-0.2752		-0.7768
		(-2.60)		(1.19)		**(2.07)***		(0.80)		**(2.55)**		(-0.44)		(-0.01)		(-0.56)		(-0.34)		(-0.50)		(-0.30)		(-0.59)		(-0.91)
Alcohol		-0.6399		0.0677		-0.0358		0.0047		0.0171		-0.0091		0.0027		-0.0041		-0.0572		-0.0532		-0.0895		0.0430		-0.1569
		(-1.71)		(1.26)		(-0.71)		(0.31)		(1.37)		(-0.60)		(0.50)		(-0.32)		(-0.66)		(-0.56)		(-1.45)		(0.49)		(-0.97)
Education		-0.3695		-0.9362		**2.2446****		0.3857		0.1152		-0.1372		-0.1146		-0.3234		-0.2647		-0.2408		0.2682		0.2437		0.0065
		(-0.05)		(-0.84)		**(2.13)**		(1.21)		(0.44)		(-0.48)		(-1.02)		(-1.20)		(-0.15)		(-0.12)		(0.21)		(0.13)		(0.00)
Risk		-4.1958		**0.8792****		-0.1292		-0.0899		0.0779		-0.0562		-0.0340		0.0906		0.5939		-0.6345		0.7977		-0.8372		-0.0801
		(-1.49)		**(2.18)**		(-0.34)		(-0.79)		(0.83)		(-0.55)		(-1.11)		(0.94)		(0.91)		(-0.89)		(1.72)		(-1.26)		(-0.07)
Future age		**0.2773****		-0.0033		0.0031		-0.0024		-0.0005		-0.0006		-0.0022		0.0053		0.0311		-0.0151		-0.0184		0.0069		0.0443
		(2.25)		(-0.19)		(0.19)		(-0.47)		(-0.11)		(-0.13)		(-1.22)		(1.26)		(1.09)		(-0.49)		(-0.91)		(0.24)		(0.08)
Act		**-2.4747**		0.1165		**0.2875****		0.0122		0.0298		-0.0474		-0.0128		-0.0095		**0.4086***		-0.0499		-0.1037		0.1305		0.3854
		(-2.65)**		(0.87)		**(2.29)**		(0.32)		(0.96)		(-1.40)		(-0.96)		(-0.30)		**(1.89)**		(-0.21)		(-0.67)		(0.59)		(0.95)
Agg-Host		**3.3113****		**-0.4381****		0.0912		0.0228		-0.0279		-0.0127		-0.0116		-0.0368		-0.1973		0.1154		-0.2648		0.0160		-0.3307
		(2.98)		**(-2.76)**		(0.62)		(0.51)		(-0.76)		(-0.32)		(-0.73)		(-0.97)		(-0.77)		(0.41)		(-1.45)		(0.06)		(-0.69)
ImpSS		**5.1648*****		0.1161		-0.1472		0.0522		-0.0065		**0.0853***		**0.03557***		**0.1167****		0.3449		0.3737		0.3088		**0.6382****		**1.6656****
		(4.19)		(1.22)		(-0.89)		(1.04)		(-0.16)		**(1.91)**		**(2.01)**		**(2.76)**		(1.21)		(1.20)		(1.52)		**(2.20)**		**(3.12)**
N-Anx		**-1.322***		0.0570		**0.1670***		-0.0121		-0.0216		-0.0205		**-0.0291****		0.0182		0.0028		-0.1292		-0.0678		-0.0021		-0.1964
		(-1.98)		(0.44)		**(1.86)**		(-0.45)		(-0.98)		(-0.85)		**(-3.04)**		(0.80)		(0.02)		(-0.77)		(-0.62)		(-0.01)		(-0.68)
Sy		0.9548		-0.7205		**-0.2220***		-0.0336		-0.0461		0.0063		-0.0117		0.0093		-0.1089		0.2386		0.0143		0.1899		0.4953
		(1.06)		(-0.81)		**(-1.83)**		(-0.92)		(-1.54)		(0.19)		(-0.91)		(0.30)		(-0.08)		(1.05)		(0.10)		(0.89)		(1.27)

Significance is displayed at the 10% (*), 5% (**) and 1% (***) levels with t-statistics listed below the coefficients.

Source: Own work.

on balloons in BART that did not explode decrease by 32.79 pumps at a significance level of 10%, which indicates a lower propensity for risk-taking, when controlled for personal traits and demographic characteristics. In the same manner, if salivary cortisol level decreases by one pmol/L, then on average ceteris paribus average number of pumps on balloons in BART that did not explode increase by 0.03 pumps at a significance level of 10%, which indicates a higher propensity for risk-taking, when salivary testosterone level is not equal to 0 and when controlled for personal traits and demographic characteristics.

Secondly, if salivary testosterone level increases by one pmol/L, then on average ceteris paribus participants choose safer Gamble options in Eckel & Grossman Risk Task for 0.60 points, when salivary cortisol is equal to 0. Since salivary cortisol level is not equal to 0, then for one pmol/L increase in salivary testosterone level, on average ceteris paribus participants choose safer Gamble options in Eckel & Grossman Risk Task for 3.31 points at a significance level of 10%, which indicates a lower propensity for risk-taking. In the same manner, if salivary cortisol level decreases by one pmol/L, then on average ceteris paribus participants choose riskier Gamble options in Eckel & Grossman Risk Task for 0.0029 at a significance level of 10%, which indicates a higher propensity for risk-taking, when salivary testosterone level is not equal to zero.

What is more, if salivary testosterone level increases by one pmol/L, then on average ceteris paribus the number of safe options chosen in Holt-Laury Measure of Risk-Aversion decrease by 0.81 points, when salivary cortisol is equal to 0. Since salivary cortisol level is not equal to 0, then for one pmol/L increase in salivary testosterone level, on average ceteris paribus the number of safe options chosen in Holt-Laury Measure of Risk-Aversion increase by 4.03 points at a significance level of 5%, which indicates a lower propensity for risk-taking. In the same manner, if salivary cortisol level decreases by one pmol/L, then on average ceteris paribus the number of safe options chosen in Holt-Laury Measure of Risk-Aversion decrease by 0.0058 points at a significance level of 5%, which indicates a higher propensity for risk-taking, when salivary testosterone level is not equal to zero. I find statistically significant, only smaller effects when controlled for personal traits and demographic characteristics, as well.

Last but not least, if salivary testosterone level increases by one pmol/L, then on average ceteris paribus the likelihood to engage in riskier financial decisions increases by 38.32%, when salivary cortisol is equal to 0. Since salivary cortisol level is not equal to 0, then for one pmol/L increase in salivary testosterone level, on average ceteris paribus the likelihood to engage in riskier financial decisions decreases by 27.35% at a significance level of 10%, which indicates a lower propensity for risk-taking. In the same manner, if salivary cortisol level decreases by one pmol/L, then on average ceteris paribus the likelihood to engage in riskier financial decisions increases by 0.05% at a significance level of 10%, which indicates a higher propensity for risk-taking, when salivary testosterone level is not equal to 0.

Based on these findings, I conclude that testostrone and cortisol interact with each other. However, the results are mixed and I can not fully reject or confirm the dual-hormone hypothesis. I only find that lower concentrations of cortisol result in a higher propensity for risk-taking, when salivary testosterone is not equal to zero. I do not find support for the other part of the hypothesis, namely that higher salivary testosterone concentrations result in a higher propensity for risk-taking, when salivary cortisol is not equal to zero.

3.3.3.2 H1b: Lower concentrations of testosterone and higher concentrations of cortisol result in a lower propensity for risk-taking

To test the first hypothesis (H1b), I ran the same model as described in the previous section and I find mixed results, as well. As presented in Table 18, I find that if salivary testosterone level decreases by one pmol/L, then on average ceteris paribus average number of pumps on balloons in BART that did not explode increase by 8.00 pumps, when salivary cortisol is equal to 0. Since salivary cortisol level is not equal to 0, then for one pmol/L decrease in salivary testosterone level, on average ceteris paribus average number of pumps on balloons in BART that did not explode increase by 32.79 pumps at a significance level of 10%, which indicates a higher propensity for risk-taking, when controlled for personal traits and demographic characteristics. Furthermore, if salivary cortisol level increases by one pmol/L, then on average ceteris paribus average number of pumps on balloons in BART that did not explode decrease by 0.03 pumps, when salivary testosterone level is not equal to 0, at a significance level of 10%, which indicates a lower propensity for risk-taking.

Furthermore, if salivary testosterone level decreases by one pmol/L, then on average ceteris paribus participants choose riskier Gamble options in Eckel & Grossman Risk Task for 0.60 points, when salivary cortisol is equal to 0. Since salivary cortisol level is not equal to 0, then for one pmol/L decrease in salivary testosterone level, on average ceteris paribus participants choose riskier Gamble options in Eckel & Grossman Risk Task for 3.31 points at significance of 10%, which results in a higher propensity for risk-taking. Furthermore, if salivary cortisol level increases by one pmol/L, then on average ceteris paribus participants choose safer Gamble options in Eckel & Grossman Risk Task for 0.0029 points, at a significance level of 10%, which indicates a lower propensity for risk-taking.

What is more, if salivary testosterone level decreases by one pmol/L, then on average ceteris paribus the number of safe options chosen in Holt-Laury Measure of Risk-Aversion increase by 0.81 points, when salivary cortisol is equal to 0. Since salivary cortisol level is not equal to 0, then for one pmol/L decrease in salivary testosterone level, on average ceteris paribus the number of safe options chosen in Holt-Laury Measure of Risk-Aversion decreases by 4.03 points at a significance level of 5%, which results in a higher propensity for risk-taking. Furthermore, if salivary cortisol level increases by one pmol/L, then on average ceteris paribus the number of safe options chosen in Holt-Laury Measure of Risk-Aversion increase by 0.0058, at a significance level of 5%, which indicates a lower propensity for risk-taking.

I find statistically significant, only smaller effects when controlled for personal traits and demographic characteristics as well.

Last but not least, if salivary testosterone level decreases by one pmol/L, then on average ceteris paribus the likelihood to engage in riskier financial decisions decreases by 38.32%, when salivary cortisol is equal to 0. Since salivary cortisol level is not equal to 0, then for one pmol/L decrease in salivary testosterone level, on average ceteris paribus the likelihood to engage in riskier financial decisions increases by 27.35% at a significance level of 10%, which results in a higher propensity for risk-taking. Furthermore, if salivary cortisol level increases by one pmol/L, then on average ceteris paribus the likelihood to engage in riskier financial decisions decreases by 0.05%, at a significance level of 10%, which indicates a lower propensity for risk-taking.

Based on these findings, I conclude testostrone and cortisol interact with each other. However, the results are mixed and I can not fully reject or confirm the dual-hormone hypothesis. I only find that higher concentrations of cortisol result in a lower propensity for risk-taking, when salivary testosterone is not equal to zero. I do not find support for the other part of the hypothesis, namely that lower salivary testosterone concentrations result in a lower propensity for risk-taking, when salivary cortisol is not equal to zero.

3.3.3.3 H2: A lower 2D:4D ratio results in a higher propensity for risk-taking

To test the second hypothesis, the following model was developed. It includes main independent variable 2D:4D ratio and control variables, namely demographic characteristics (i.e., gender, age, smoker, time smoking, alcohol, education, self-assessment of risk, and future age) and personal traits (i.e., Activity, Aggression-Hostility, Impulsive Sensation-Seeking, Neuroticism-Anxiety, and Sociability). OLS regression results are presented in Table 19. Column (1) represents regression results including only the main independent variable, while column (2) represents results of the whole model. I can not fully confirm my hypothesis, since there were no significant correlations between 2D:4D ratio and dependent variables (i.e., various risk-taking measures), except for bivariate correlation between 2D:4D and social decisions (b=-1.81, p=-0.047). That is, if 2D:4D ratio decreases by one unit, then on average ceteris paribus the likelihood to engage in riskier social decisions increases by 181.2% at a significance level of 5%, indicating a higher propensity for risk-taking. Stenstrom, Saad, Nepomuceno and Mendenhall (2011) also find that a lower 2D:4D ratio was predicitive of greater risk-taking in social domain.

3.3.3.4 H3: A higher fWHR results in a higher propensity for risk-taking

To test the third hypothesis, the following model was developed. It includes main independent variable fWHR and control variables, namely demographic characteristics (i.e., gender, age, smoker, time smoking, alcohol, education, self-assessment of risk, and future age) and personal traits (i.e., Activity, Aggression-Hostility, Impulsive Sensation-Seeking, Neuroticism-Anxiety, and Sociability). OLS regression results are presented in Table 20.

Table 19: Multiple regression analyses results (H2)

	BART		Eckel & Grossman Risk Task		Holt & Laury Measure of Risk Aversion		ln(Ethical)		ln(Financial)		ln(HealthSafety)		ln(Social)		ln(Recreational)		TAS		BS		ES		Dis		Total SSS-V	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
2D:4D	100.3945	-61.0594	-9.8323	-12.4531	-4.7866	-3.8125	0.1874	3.4642	-2.6558	-0.7859	1.6549	1.3122	**-1.8120****	-1.5186	1.7526	1.1810	-2.2291	4.8135	2.0736	2.3806	1.3479	-2.9753	4.0263	5.2176	5.2186	9.4364
	(1.14)	(-0.77)	(-0.97)	(-1.24)	(-0.55)	(-0.37)	(0.08)	(1.18)	(-1.25)	(-0.27)	(0.85)	(0.50)	**(-2.06)**	(-1.35)	(0.75)	(0.48)	(-0.14)	(0.30)	(0.17)	(0.13)	(0.13)	(-0.25)	(0.29)	(0.30)	(0.15)	(0.31)
Gender		7.9913		0.1571		-0.3524		**-0.5404****		-0.2339		-0.1977		0.0233		-0.0488		-1.0988		0.5466		0.3468		0.2035		-0.0018
		(1.61)		(0.25)		(-0.54)		**(-2.95)**		(-1.28)		(-1.21)		(0.33)		(-0.31)		(-1.08)		(0.47)		(0.47)		(0.18)		(0.00)
Age		1.1492		0.2292		-0.2579		-0.1306		-0.1290		-0.0554		-0.0086		0.0440		-0.3397		0.4813		0.1299		0.0290		0.3105
		(0.56)		(0.88)		(-0.95)		(-1.71)		(-1.69)		(-0.81)		(-0.29)		(0.68)		(-0.80)		(1.00)		(0.45)		(0.06)		(0.39)
Smoker		**40.7602****		-1.1570		-2.5567		-0.6318		-0.9079		-0.1503		0.1880		0.1450		0.8765		0.3661		0.5697		3.5756		5.3879
		(2.59)		(-0.58)		(-1.24)		(-1.09)		(-1.56)		(0.29)		(0.84)		(0.29)		(0.27)		(0.10)		(0.24)		(1.02)		(0.89)
Time smoking		**-6.0053****		0.1828		0.4721		0.0998		0.1350		-0.0114		-0.0275		-0.0438		-0.1231		-0.1134		-0.0980		-0.3675		-0.7020
		(-2.78)		(0.67)		(1.67)		(1.25)		(1.69)		(-0.16)		(-0.90)		(-0.65)		(-0.28)		(-0.22)		(-0.30)		(-0.77)		(-0.84)
Alcohol		**-0.7592***		0.0433		-0.0498		0.0115		0.0168		-0.0063		-0.0010		-0.0036		-0.0496		-0.0439		-0.0942		0.0458		-0.1419
		(-1.82)		(0.82)		(-0.91)		(0.74)		(1.09)		(-0.46)		(-0.17)		(-0.27)		(-0.58)		(-0.45)		(-1.50)		(0.49)		(-0.88)
Education		-5.1459		-1.1365		**2.9974****		0.2426		0.0122		-0.1058		-0.0669		-0.2410		-0.3275		-0.6063		0.6394		-0.1064		-0.4009
		(-0.66)		(-1.15)		**(2.93)**		(0.84)		(0.04)		(-0.41)		(-0.61)		(-0.99)		(-0.20)		(-0.33)		(0.55)		(-0.06)		(-0.13)
Risk		-2.2385		**1.0070****		-0.2174		-0.0566		0.0359		-0.03521		-0.0444		0.0918		0.6325		-0.5025		0.6684		-0.6706		0.1279
		(-0.80)		**(2.83)**		(-0.59)		(-0.54)		(0.35)		(-0.38)		(-1.11)		(1.02)		(1.10)		(-0.76)		(1.58)		(-1.07)		(0.12)
Future age		**0.2592***		0.0008		0.0058		-0.0055		-0.0035		-0.0004		-0.0220		0.0030		0.0257		-0.0059		-0.0107		-0.0156		-0.0065
		(1.87)		(0.04)		(0.32)		(-1.06)		(-0.69)		(-0.08)		(-1.13)		(0.68)		(0.90)		(-0.76)		(-0.51)		(-0.50)		(-0.12)
Act		**-2.8535****		0.0442		**0.2904***		0.0309		0.0071		-0.0323		-0.0209		0.0006		**0.4395***		-0.0187		-0.1175		0.1499		0.4532
		(-2.58)		(0.32)		**(2.00)**		(0.76)		(0.17)		(-0.88)		(-1.33)		(0.02)		**(1.93)**		(-0.07)		(-0.71)		(0.61)		(1.06)
Agg-Host		**3.0409****		**-0.3898****		0.2035		-0.0171		-0.0196		-0.0233		0.0047		-0.0333		-0.2361		0.0234		-0.20		-0.0420		-0.4547
		(2.51)		**(-2.54)**		(1.28)		(-0.38)		(-0.44)		(-0.58)		(0.27)		(-0.88)		(-0.95)		(0.08)		(-1.10)		(-0.16)		(-0.97)
ImpSS		**4.6417****		-0.1366		-0.1154		0.0316		-0.0063		**0.0801***		**0.0357***		**0.1076****		0.3137		0.3736		**0.3694***		**0.5142***		**1.5710****
		(3.58)		(-0.83)		(-0.68)		(0.66)		(-0.13)		**(1.87)**		**(1.94)**		**(2.65)**		(1.18)		(1.23)		**(1.90)**		**(1.78)**		**(3.13)**
N-Anx		**-1.2397***		0.1211		**0.1700***		-0.0106		-0.0392		-0.0135		**-0.0304****		0.0173		0.0046		-0.0925		-0.0701		-0.0195		-0.1775
		(-1.80)		(1.39)		**(1.88)**		(-0.42)		(-1.54)		(-0.60)		**(-3.12)**		(0.80)		(0.03)		(-0.57)		(-0.68)		(-0.13)		(-0.67)
Sy		1.2392		0.1133		-0.1855		-0.0489		-0.0114		-0.0096		0.0024		0.0168		0.0424		0.1258		0.0109		0.2727		0.4518
		(1.34)		(0.96)		(-1.52)		(-1.42)		(-0.33)		(-0.31)		(0.18)		(0.58)		(0.30)		(0.58)		(0.08)		(0.30)		(1.26)

Significance is displayed at the 10% (*), 5% (**) and 1% (***) levels with t-statistics listed below the coefficients.

Source: Own work.

Table 20: Multiple regression analyses results (H3)

	BART		Eckel & Grossman Risk Task		Holt & Laury Measure of Risk Aversion		ln(Ethical)		ln(Financial)		ln(HealthSafety)		ln(Social)		ln(Recreational)		TAS		BS		ES		Dis		Total SSS-V	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
fWHR	11.6070	10.8732	0.4171	-3.5109	-0.9066	-0.2945	0.8765	-0.0578	-0.0395	**-1.1287***	0.4427	-0.4305	-0.0755	-0.1152	-0.9926	-0.0166	3.9738	-1.7136	1.5025	5.2811	3.5730	4.6437	-0.5878	-3.4931	8.4615	4.7181
	(0.62)	(0.56)	(0.20)	(-1.45)	(-0.40)	(-0.12)	(1.55)	-0.08	(-0.07)	**(-1.95)**	(0.87)	(-0.68)	(-0.31)	(-0.40)	(-0.89)	(-0.03)	(0.80)	(-0.43)	(0.47)	(1.20)	(1.32)	(1.70)	(-0.16)	(-0.82)	(0.93)	(0.63)
Gender		7.6617		-0.4321		-0.4617		**-0.4708****		**-0.3682****		-0.2086		-0.0200		-0.0247		-1.1509		1.1079		0.7057		-0.0020		0.6322
		(1.53)		(-0.69)		(-0.70)		**(-2.48)**		**(-2.17)**		(-1.28)		(-0.27)		(-0.16)		(-1.13)		(0.96)		(1.00)		(0.00)		(0.33)
Age		1.0571		0.0187		-0.2962		-0.1067		**-0.1779****		-0.0560		-0.0238		0.0523		-0.3611		0.6758		0.2731		-0.0489		0.5389
		(0.51)		(0.07)		(-1.08)		(-1.34)		**(-2.51)**		(-0.88)		(-0.78)		(0.80)		(-0.85)		(1.43)		(0.93)		(-0.11)		(0.68)
Smoker		**39.9649****		-2.9864		-2.8897		-0.4240		**-1.3334****		0.1100		0.0559		0.2168		0.6899		2.0575		1.7282		2.8973		7.3730
		(2.50)		(-1.50)		(-1.38)		(-0.70)		**(-2.46)**		(0.21)		(0.24)		(0.43)		(0.21)		(0.57)		(0.77)		(0.83)		(1.21)
Time smoking		**-5.9264****		0.4178		**0.5142***		0.0739		**0.1905****		-0.0055		-0.0108		-0.0527		-0.0966		-0.3344		-0.2513		-0.2762		-0.9590
		(-2.69)		(1.53)		**(1.78)**		(0.88)		**(2.55)**		(-0.08)		(-0.33)		(-0.76)		(-0.22)		(-0.67)		(-0.81)		(-0.58)		(-1.14)
Alcohol		**-0.7231***		0.0828		-0.0420		0.0063		**0.0253****		-0.0060		0.0021		-0.0053		-0.0476		-0.0773		**-0.1155***		0.0571		-0.1833
		(-1.74)		(1.60)		(-0.77)		(0.40)		**(1.80)**		(-0.44)		(0.34)		(-0.41)		(-0.56)		(-0.82)		**(-1.98)**		(0.63)		(-1.16)
Education		-4.7735		-0.9890		**3.0328****		0.2145		0.0349		-0.1114		-0.0528		-0.2506		-0.3462		-0.6921		0.06061		-0.1063		-0.5383
		(-0.61)		(-1.02)		**(2.97)**		(0.72)		(0.13)		(-0.44)		(-0.46)		(-1.02)		(-0.22)		(-0.39)		(0.55)		(-0.06)		(-0.18)
Risk		-2.4024		**1.0911****		-0.2077		-0.0587		0.0631		-0.0276		-0.0405		0.0894		0.6630		-0.6132		0.5760		-0.6039		0.0218
		(-0.84)		**(3.07)**		(-0.56)		(-0.54)		(0.65)		(-0.30)		(-0.97)		(1.00)		(1.14)		(-0.95)		(1.44)		(-0.97)		(0.02)
Future age		0.2102		-0.0108		0.0025		-0.0025		-0.0046		0.0006		**-0.0036***		0.0040		0.0293		-0.0024		-0.0120		-0.0121		0.0028
		(1.72)		(-0.71)		(0.16)		(-0.54)		(-1.10)		(0.15)		**(-1.98)**		(1.03)		(1.17)		(-0.09)		(-0.70)		(-0.45)		(0.06)
Act		**-2.7546****		0.1276		**0.3160****		0.0076		0.0123		-0.0412		-0.0107		-0.0074		**0.4071***		-0.0343		-0.0971		0.1146		0.3900
		(-2.41)		(1.05)		**(2.47)**		(0.21)		(0.37)		(-1.29)		(-0.75)		(-0.24)		**(2.05)**		(-0.15)		(-0.71)		(0.54)		(1.05)
Agg-Host		**2.7546****		**-0.4711****		0.1818		0.0014		-0.0290		-0.0180		-0.0040		-0.0270		-0.2169		0.0574		-0.1975		-0.0278		-0.3849
		(2.41)		**(-3.32)**		(1.22)		(0.03)		(-0.75)		(-0.48)		(-0.24)		(-0.75)		(-0.93)		(0.22)		(-1.23)		(-0.11)		(-0.88)
ImpSS		**4.2920****		-0.1436		-0.1263		-0.0107		0.0052		**0.0898****		0.0313		**0.1122****		0.3509		0.3232		0.3062		**0.5729***		**1.5531****
		(3.33)		(-0.90)		(-0.75)		(-0.38)		(0.12)		**(2.13)**		(1.66)		**(2.78)**		(1.34)		(1.11)		(1.69)		**(2.04)**		**(3.16)**
N-Anx		**-1.3779**		**0.9260***		**0.1752***		-0.0107		-0.0206		-0.0078		**-0.0284****		0.0172		0.0277		-0.1684		-0.1354		0.0288		-0.2473
		(-1.85)*		**(1.89)**		**(1.80)**		(-0.38)		(-0.82)		(-0.32)		**(-2.60)**		(0.74)		(0.18)		(-1.00)		(-1.30)		(0.18)		(-0.87)
Sy		1.1875		0.0418		-0.1990		-0.04		**-0.0272***		-0.0106		-0.0030		0.0199		0.0374		0.1885		0.5211		0.2498		0.5278
		(1.27)		(0.36)		(-1.63)		(-1.13)		**(-1.95)**		(-0.35)		(-0.22)		(0.68)		(0.20)		(0.90)		(0.40)		(1.23)		(1.49)

Significance is displayed at the 10% (*), 5% (**) and 1% (***) levels with t-statistics listed below the coefficients.

Source: Own work.

Column (1) represents regression results including only the main independent variable, while column (2) represents results of the whole model. I can not confirm my hypothesis, since there was only one statistically significant result of correlation between fWHR and financial decisions (b=-1.29, p=0.065) and it is in the opposite direction as I predicted. Results suggest the following, if fWHR increases by one unit, then on average ceteris paribus the likelihood to engage in riskier financial decisions decreases by 112.87% at a significance level of 10%, indicating a lower propensity for risk-taking.

3.3.3.5 H4: A higher propensity for impulsive sensation-seeking behavior results in a higher propensity for risk-taking

To test the fourth hypothesis, the following model was developed. It includes main independent variables representing personal traits (i.e., Activity, Aggression-Hostility, Impulsive Sensation-Seeking, Neuroticism-Anxiety, and Sociability) and control variables, namely demographic characteristics (i.e., gender, age, smoker, time smoking, alcohol, education, self-assessment of risk, and future age). OLS regression results are presented in Table 21. Column (1) represents regression results including only the main independent variable, while column (2) represents results of the whole model. I can confirm my hypothesis, since Impulsive Sensation-Seeking appears to be posivitely and significantly correlated with many of the risk propensity measures (e.g., BART, Eckel & Grossman Risk Task, Ethical, Health/ Safety domain, Recreational domain, TAS, ES, Dis and Total SSS-V). The impulsivity items involve a lack of planing and the tendency to act impulsively without thinking, while sensation-seeking items describe experience seeking, or the willingness to take risks for the sake of excitement or novel experience. For example, if Impulsive Sensation-Seeking behavior increases by 1 point from the ZKPQ, then on average ceteris paribus average number of pumps on balloons in BART that did not explode increase by 4.41 pumps (indicating a higher propensity for risk-taking), when controlled for demographic characteristics at a significance level of 5%.

3.3.3.6 H5: A higher propensity for neuroticism and anxiety results in a lower propensity for risk-taking

To test the fifth hypothesis, the following model was developed. It includes main independent variables representing personal traits (i.e., Activity, Aggression-Hostility, Impulsive Sensation-Seeking, Neuroticism-Anxiety, and Sociability) and control variables, namely demographic characteristics (i.e., gender, age, smoker, time smoking, alcohol, education, self-assessment of risk, and future age). OLS regression results are presented in Table 21. Column (1) represents multiple regression results including only main independent variable, while column (2) represents multiple regression results of the whole model. I can confirm the fifth hypothesis, since I find negative and statistically significant correlations between Neuroticism-Anxiety and BART, Neuroticism-Anxiety and financial decisions, Neuroticism-Anxiety and social decisions. I also find a positive correlation between

Table 21: Multiple regression analyses results (H4, H5)

	BART		Eckel & Grossman Risk Task		Holt & Laury Measure of Risk Aversion		ln(Ethical)		ln(Financial)		ln(HealthSafety)		ln(Social)		ln(Recreational)		TAS		BS		ES		Dis		Total SSS-V	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Gender		6.6709		-0.1122		-0.4349		**-0.4655****		-0.2509		-0.1694		-0.0095		-0.0232		-0.9947		0.5981		0.2825		0.3164		0.2023
		(1.45)		(-0.19)		(-0.73)		**(-2.68)**		(-1.49)		(-1.12)		(-0.14)		(-0.16)		(-1.06)		(0.56)		(0.41)		(0.31)		(0.11)
Age		0.6932		0.1362		-0.2864		-0.1047		**-0.1349***		-0.0456		-0.0120		0.0528		-0.3037		0.4991		0.1177		0.0680		0.3810
		(0.35)		(0.54)		(-1.13)		(-1.42)		**(-1.89)**		(-0.71)		(-0.70)		(0.87)		(-0.76)		(1.10)		(0.41)		(0.16)		(0.51)
Smoker		**36.8004****		-1.9646		-2.8040		-0.4072		**-0.9589***		0.2353		0.0895		0.2216		1.1886		0.5205		0.3768		3.9139		5.9998
		(2.50)		(-1.03)		(-1.47)		(-0.73)		**(-1.78)**		(0.49)		(0.42)		(0.48)		(0.40)		(0.15)		(0.17)		(1.21)		(1.07)
Time smoking		**-5.5110****		0.2836		**0.5030***		0.0717		**0.1413***		-0.0220		-0.0152		-0.0533		-0.1621		-0.1326		-0.0739		-0.4097		-0.7783
		(-2.70)		(1.07)		**(1.90)**		(0.93)		**(1.90)**		(-0.33)		(-0.51)		(-0.84)		(-0.39)		(-0.28)		(-0.24)		(-0.91)		(-1.00)
Alcohol		-0.6622		0.0631		-0.0437		0.0060		0.0181		-0.0084		0.0014		-0.0054		-0.0572		-0.0477		-0.0894		0.0375		-0.1568
		(-1.68)		(1.24)		(-0.85)		(0.40)		(1.25)		(-0.59)		(0.25)		(-0.44)		(-0.71)		(-0.52)		(1.53)		(0.43)		(-1.04)
Education		-4.6377		-1.0329		**3.0291****		0.2137		0.0188		-0.1167		-0.0543		-0.2508		-0.3676		-0.6261		0.6641		-0.1498		-0.4794
		(-0.60)		(-1.04)		**(3.04)**		(0.74)		(0.07)		(-0.46)		(-0.48)		(-1.05)		(-0.24)		(-0.35)		(0.58)		(-0.09)		(-0.16)
Risk		-2.1792		**1.0190****		-0.2137		-0.0599		0.0367		-0.0365		-0.0429		0.0890		0.6278		-0.5048		0.6713		-0.6756		0.1187
		(-0.78)		**(2.83)**		(-0.59)		(-0.57)		(0.36)		(-0.41)		(-1.06)		(1.03)		(1.11)		(-0.78)		(1.62)		(-1.10)		(0.11)
Future age		**0.2072***		-0.0098		0.0026		-0.0025		-0.0042		-0.0007		**-0.0035***		0.0040		0.0298		-0.0038		-0.0133		-0.0111		0.0015
		(1.71)		(-0.63)		(0.17)		(-0.55)		(-0.96)		(-0.17)		**(-2.01)**		(1.06)		(1.22)		(-0.14)		(-0.74)		(-0.42)		(0.03)
Act	-0.9908	**-2.4431****	-0.0103	0.1279	**0.2385****	**0.3161****	-0.0070	0.0076	-0.0098	0.0124	-0.0349	-0.0411	-0.0027	-0.0107	0.0043	-0.0074	**0.4493****	**0.4072****	0.0145	-0.0347	-0.0583	-0.0975	0.1027	0.1149	**0.5081***	0.3898
	(-1.17)	**(-2.54)**	(-0.10)	(1.03)	**(2.16)**	**(2.53)**	(-0.23)	(0.21)	(-0.34)	(0.35)	(-1.46)	(-1.36)	(-0.24)	(-0.76)	(0.12)	(-0.25)	**(2.67)**	**(2.09)**	(0.09)	(-0.16)	(-0.50)	(-0.68)	(0.64)	(0.54)	**(1.92)**	(1.06)
Agg-Host	1.1137	**2.7111****	-0.1893	**-0.4571**	0.0818	0.1829	0.0186	0.0016	0.0085	-0.0238	-0.0166	-0.0162	-0.0074	-0.0035	-0.0152	-0.0269	-0.1599	-0.2101	-0.0399	0.0363	-0.2136	-0.2161	-0.076	-0.0138	-0.4893	-0.4038
	(1.15)	**(2.41)**	(-1.57)	**(-3.15)****	(0.65)	(1.25)	(0.54)	(0.04)	(0.26)	(-0.58)	(-0.61)	(-0.45)	(-0.59)	(-0.21)	(-0.51)	(-0.77)	(-0.83)	(-0.92)	(-0.21)	(0.14)	(-1.21)	(-1.30)	(-0.45)	(-0.06)	(-1.62)	(-0.94)
ImpSS	**2.6196****	**4.414****	**0.1873***	-0.1830	-0.1699	-0.1296	**0.0571***	0.0446	0.0280	-0.0092	**0.0846****	**0.0850***	0.0171	0.0300	**0.1244****	**0.1120****	**0.4849****	0.3316	0.2068	0.3824	**0.4453*****	**0.3583***	**0.4264****	**0.5337***	**1.5634*****	**1.6061****
	(3.03)	**(3.53)**	**(1.74)**	(-1.13)	(-1.51)	(-0.80)	**(1.86)**	(0.95)	(0.95)	(-0.20)	**(3.48)**	**(2.02)**	(1.52)	(1.64)	**(3.14)**	**(2.88)**	**(2.82)**	(1.31)	(1.20)	(1.32)	**(4.47)**	**(1.93)**	**(2.29)**	**(1.94)**	**(5.79)**	**(3.36)**
N-Anx	-0.5811	**-1.2228***	0.0574	0.1246	**0.1660***	**0.1710***	-0.0231	-0.0115	**-0.0471****	-0.0390	-0.0091	-0.0139	**-0.0250****	**-0.0300****	0.0111	0.0169	-0.0075	0.0033	-0.0732	-0.0931	-0.0475	-0.0692	0.0209	-0.0210	-0.1073	-0.1801
	(-0.88)	**(-1.80)**	(0.69)	(1.42)	**(1.93)**	**(1.94)**	(-0.98)	(-0.45)	**(-2.09)**	(-1.57)	(-0.49)	(-0.62)	**(-2.90)**	**(-3.02)**	(0.50)	(0.80)	(-0.06)	(0.02)	(-0.55)	(-0.59)	(-0.55)	(-0.69)	(0.14)	(-0.14)	(-0.52)	(-0.69)
Sy	0.5271	1.0719	0.0719	0.0791	-0.0191	-0.1959	-0.0277	-0.0394	-0.0033	-0.0135	-0.0150	-0.0060	-0.0098	-0.0018	0.0045	0.0200	0.0502	0.0556	0.0516	0.1323	-0.0031	0.0027	0.2764	0.2870	0.3750	0.4776
	(0.66)	(1.20)	(0.72)	(0.68)	(-0.18)	(-1.69)	(-0.97)	(-1.17)	(-0.12)	(-0.41)	(-0.66)	(-0.18)	(-0.94)	(-0.14)	(0.32)	(0.72)	(0.31)	(0.31)	(0.32)	(0.64)	(-0.03)	(0.02)	(1.48)	(1.46)	(1.50)	(1.40)

Significance is displayed at the 10% (*), 5% (**) and 1% (***) levels with t-statistics listed below the coefficients.

Source: Own work.

Neuroticism-Anxiety and Holt-Laury Mesaure of Risk-Aversion, which indicates a lower propensity for risk-taking. Neuroticism-Anxiety describes being emotionally upset, experiencing tension, worry, fearfulness, obsessive indecision, lack of self-confidence, and sensitivity to criticism. For example, if Neuroticism-Anxiety increases by 1 point from the ZKPQ, then on average ceteris paribus average number of pumps on balloons in BART that did not explode decrease by 1.22 pumps (indicating a lower propensity for risk-taking) when controlled for demographic characterictics, at a significance level of 10%. Also, if Neuroticism-Anxiety increases by 1 point from the ZKPQ, then on average ceteris paribus the likelihood to engage in riskier financial decisions decreases by 4.71% (indicating lower propensity for risk-taking), at a significance level of 5%.

3.3.3.7 H6: Demographic characteristics such as smoking and greater alcohol consumption result in a higher propensity for risk-taking

To test the sixth hypothesis, the following model was developed. It includes main independent variables representing demographic characteristics (i.e., gender, age, smoker, time smoking, alcohol, education, self-assessment of risk, and future age) and control variables (i.e., Activity, Aggression-Hostility, Impulsive SensationSeeking, Neuroticism-Anxiety, and Sociability). OLS regression results are presented in Table 22. Column (1) represents multiple regression results including only the main independent variable, while column (2) represents multiple regression results of the whole model. Sixth hypothesis can not be fully confirmed, since the results are mixed. However, I find positive and statistically significant correlation between smoking and BART. Therefore, on average ceteris paribus smokers make more average pumps on balloons in BART that did not explode for 36.80 pumps compared to non-smokers (indicating a higher propensity for risk-taking) when controlled for demographic characterictics, at a significance level of 5%. Also, a negative and significant correlation is found between smokers and financial decisions from DOSPERT. However, the direction of this correlation is not in accordance with my predictions. I do not find any statistically significant correlations between alcohol consumption and any risk-taking measure.

3.3.3.8 H7: Optimism results in a higher propensity for risk-taking

To test the seventh hypothesis, the following model was developed. It includes main independent variables representing demographic characteristics (i.e., gender, age, smoker, time smoking, alcohol, education, self-assessment of risk, and future age) and control variables (i.e., Activity, Aggression-Hostility, Impulsive Sensation-Seeking, Neuroticism-Anxiety, and Sociability). OLS regression results are presented in Table 22. Column (1) represents multiple regression results including only main independent variable, while column (2) represents multiple regression results of the whole model. The seventh hypothesis can not be fully confirmed, since the results are mixed. However, I find positive and statistically significant correlation of expected future age on BART. Therefore, if

Table 22: Multiple regression analyses results (H6, H7)

	BART		Eckel & Grossman Risk Task		Holt & Laury Measure of Risk Aversion		ln(Ethical)		ln(Financial)		ln(HealthSafety)		ln(Social)		ln(Recreational)		TAS		BS		ES		Dis		Total SSS-V	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Gender	3.9669	6.6709	0.1476	-0.1122	-0.4762	-0.4349	**-0.4837****	**-0.4655****	-0.2610	-0.2509	-0.1814	-0.1694	-0.0307	-0.0095	-0.0483	-0.0232	-1.2532	-0.9947	0.3591	0.5981	0.2453	0.2825	-0.0381	0.3164	-0.6868	0.2023
	(0.73)	(1.45)	(0.23)	(-0.19)	(-0.67)	(-0.73)	**(-2.92)**	**(-2.68)**	(-1.58)	(-1.49)	(-1.15)	(-1.12)	(-0.38)	(-0.14)	(-0.29)	(-0.16)	(1.13)	(-1.06)	(0.35)	(0.56)	(0.32)	(0.41)	(-0.03)	(0.31)	(-0.26)	(0.11)
Age	2.4785	0.6932	-0.0549	0.1362	-0.2680	-0.2864	-0.0728	-0.1047	**-0.1267***	**-0.1349***	-0.0153	-0.0456	-0.0025	-0.0120	0.0741	0.0528	-0.2377	-0.3037	0.6090	0.4991	0.2163	0.1177	0.1512	0.0680	0.7389	0.3810
	(1.12)	(0.35)	(-0.21)	(0.54)	(-0.93)	(-1.13)	(-1.09)	(-1.42)	**(-1.89)**	**(-1.89)**	(-0.24)	(-0.71)	(-0.08)	(-0.70)	(1.10)	(0.87)	(-0.53)	(-0.76)	(1.46)	(1.10)	(0.70)	(0.41)	(0.33)	(0.16)	(0.70)	(0.51)
Smoker	18.3785	**36.8004****	-1.0517	-1.9646	-1.3120	-2.8040	-0.3653	-0.4072	**-0.9945***	**-0.9589***	0.0758	0.2353	-0.0500	0.0895	0.0662	0.2216	1.0127	1.1886	-0.8611	0.5205	-0.2374	0.3768	2.1569	3.9139	2.0711	5.9998
	(1.11)	**(2.50)**	(-0.54)	(-1.03)	(-0.61)	(-1.47)	(-0.73)	(-0.73)	**(-1.98)**	**(-1.78)**	(0.16)	(0.49)	(-0.20)	(0.42)	(0.13)	(0.48)	(-0.30)	(0.40)	(-0.27)	(0.15)	(-0.10)	(0.17)	(0.62)	(1.21)	(0.26)	(1.07)
Time smoking	-2.3501	**-5.5110****	0.1521	0.2836	0.2373	**0.5030***	0.0624	0.0717	**0.1372***	**0.1413***	0.0104	-0.0220	0.0037	-0.0152	-0.0189	-0.0533	-0.1791	-0.1621	0.0882	-0.1326	0.0441	-0.0739	-0.1286	-0.4097	-0.1754	-0.7783
	(-1.06)	**(-2.70)**	(-0.59)	(1.07)	(-0.82)	**(1.90)**	(0.93)	(0.93)	**(2.04)**	**(1.90)**	(0.16)	(-0.33)	(0.11)	(-0.51)	(-0.28)	(-0.84)	(-0.40)	(-0.39)	(0.21)	(-0.28)	(0.14)	(-0.24)	(-0.28)	(-0.91)	(-0.17)	(-1.00)
Alcohol	-0.0379	-0.6622	0.0299	0.0631	-0.0921	-0.0437	0.0052	0.0060	0.0202	0.0181	-0.0031	-0.0220	0.0066	0.0014	-0.0005	-0.0054	-0.0458	-0.0572	0.0006	-0.0477	-0.0682	-0.0894	0.0987	0.0375	-0.0146	-0.1568
	(-0.09)	(-1.68)	(0.60)	(1.24)	(-1.65)	(-0.85)	(0.40)	(0.40)	(1.56)	(1.25)	(-0.25)	(-0.33)	(1.05)	(0.25)	(-0.04)	(-0.44)	(-0.53)	(-0.71)	(0.01)	(-0.52)	(-1.15)	(1.53)	(1.11)	(0.43)	(-0.07)	(-1.04)
Education	-1.7237	-4.6377	-0.3212	-1.0329	1.6770	**3.0291****	0.0730	0.2137	0.0588	0.0188	-0.0896	-0.0084	-0.0063	-0.0543	0.1621	-0.2508	0.0605	-0.3676	0.0013	-0.6261	1.0944	0.6641	1.0135	-0.1498	2.1697	-0.4794
	(-0.22)	(-0.60)	(-0.35)	(-1.04)	-1.63	**(3.04)**	(0.31)	(0.74)	(0.25)	(0.07)	(-0.39)	(-0.65)	(-0.05)	(-0.48)	(-0.68)	(-1.05)	(-0.04)	(-0.24)	(0.00)	(-0.35)	(1.00)	(0.58)	(0.62)	(-0.09)	(0.58)	(-0.16)
Risk	**6.1515****	-2.1792	**0.5294****	**1.0190****	-0.3569	-0.2137	0.0057	-0.0599	0.0503	0.0367	0.0677	-0.1167	0.0234	-0.0429	**0.2469*****	0.0890	**1.4422****	0.6278	0.2817	-0.5048	**1.1302*****	0.6713	0.4877	-0.6756	**3.3419****	0.1187
	(2.83)	(-0.78)	**(2.08)**	**(2.83)**	-1.26	(-0.59)	(0.09)	(-0.57)	(0.76)	(0.36)	(1.08)	(-0.46)	(0.73)	(-1.06)	**(3,73)**	(1.03)	**(3.25)**	(1.11)	(0.69)	(-0.78)	**(3.74)**	(1.62)	(1.08)	(-1.10)	**(3.22)**	(0.11)
Future age	0.2161	**0.2072***	-0.0050	-0.0098	-0.0090	0.0026	-0.0028	-0.0025	-0.0032	-0.0042	0.0015	-0.0365	-0.0028	**-0.0035***	0.0041	0.0040	0.0296	0.0298	-0.0012	-0.0038	-0.0078	-0.0133	-0.0092	-0.0111	0.0115	0.0015
	(1.52)	**(1.71)**	(-0.30)	(-0.63)	(-0.48)	(0.17)	(-0.66)	(-0.55)	(-0.74)	(-0.96)	(0.36)	(-0.40)	(-1.32)	**(-2.01)**	(0.96)	(1.06)	(1.02)	(1.22)	(-0.04)	(-0.14)	(-0.39)	(-0.74)	(-0.31)	(-0.42)	(0.17)	(0.03)
Act		**-2.4431****		0.1279		**0.3161****		0.0076		0.0124		0.0007		-0.0107		-0.0074		**0.4072****		-0.0347		-0.0975		0.1149		0.3898
		(-2.54)		(1.03)		**(2.53)**		(0.21)		(0.35)		(0.19)		(-0.76)		(-0.25)		**(2.09)**		(-0.16)		(-0.68)		(0.54)		(1.06)
Agg-Host		**2.7111****		**-0.4571**		0.1829		0.0016		-0.0238		-0.0411		-0.0035		-0.0269		-0.2101		0.0363		-0.2161		-0.0138		-0.4038
		(2.41)		**(-3.15)****		(1.25)		(0.04)		(-0.58)		(-1.31)		(-0.21)		(-0.77)		(-0.92)		(0.14)		(-1.30)		(-0.06)		(-0.94)
ImpSS		**4.4140****		-0.1830		-0.1296		0.0446		-0.0092		-0.0162		0.0300		**0.1120****		0.3316		0.3824		**0.3583***		**0.5337***		**1.6061****
		(3.53)		(-1.13)		(-0.80)		(0.95)		(-0.20)		(-0.44)		(1.64)		**(2.88)**		(1.31)		(1.32)		**(1.93)**		**(1.94)**		**(3.36)**
N-Anx		**-1.2228***		0.1246		**0.1710***		-0.0115		-0.0390		**0.0850****		**-0.0300****		0.0169		0.0033		-0.0931		-0.0692		-0.0210		-0.1801
		(-1.80)		(1.42)		**(1.94)**		(-0.45)		(-1.57)		**(2.07)**		**(-3.02)**		(0.80)		(0.02)		(-0.59)		(-0.69)		(-0.14)		(-0.69)
Sy		1.0719		0.0791		-0.1959		-0.0394		-0.0135		-0.0060		-0.0018		0.0200		0.0556		0.1323		0.0027		0.2870		0.4776
		(1.20)		(0.68)		(-1.69)		(-1.17)		(-0.41)		(-0.21)		(-0.14)		(0.72)		(0.31)		(0.64)		(0.02)		(1.46)		(1.40)

Significance is displayed at the 10% (*), 5% (**) and 1% (***) levels with t-statistics listed below the coefficients.

Source: Own work.

expected future age increases by one year, then on average ceteris paribus average number of pumps on balloons in BART that did not explode increase by 0.21 pumps (indicating a higher propensity for risk-taking) when controlled for personal traits, at a significance level of 10%. Also, a negative and significant correlation is found between expected future age and social decisions from DOSPERT, however, the direction of this correlation is not in accordance with my predictions.

CONCLUSION

Neuroeconomics is an interdisciplinary field of research combining economics, neuroscience, and psychology to determine how individuals make economic decisions. In practical terms, neuroeconomics involves analyzing the brain functions behind decision-making process. Additionally, it includes psychological insights to explain how, for example, personal traits and emotions influence decision making (Torkington, 2016). Neuroeconomics is still in its infancy. However, it has provided some valuable insights into how humans process information and how we use this information to make decisions (Sahi, 2012).

I have examined how hormones, especially testosterone and cortisol, and personal traits influence the propensity for risk-taking. The main findings regarding the influence of hormones are the following. Testosterone and cortisol interact with each other, implying some support for the dual-hormone hypothesis. I only find that lower salivary cortisol level results in a higher propensity for risk-taking when salivary testosterone is not equal to zero, and a higher salivary cortisol level results in a lower propensity for risk-taking when salivary testosterone in not equal to zero. However, I do not find the significant and positive correlation between salivary testosterone level and the propensity for risk-taking as hypothesized in the dual-hormone hypothesis. Furthermore, we should keep in mind that research on the dual-hormone hypothesis is still in its early stages. Further research is needed or even further theoretical and conceptual refinement to draw more serious conclusions (Grebe et al., 2019). Moreover, I find a significant and positive bivariate correlation between salivary testosterone level and financial decisions from DOSPERT questionnaire, and salivary cortisol level and financial decisions from DOSPERT questionnaire. Results indicate that if the salivary level of testosterone increases by one pmol/L, then on average ceteris paribus the likelihood for participants to engage in riskier financial decisions increases by 44% at a significance level of 5%. Furthermore, if salivary cortisol level increases by one pmol/L, then on average ceteris paribus the likelihood for participants to engage in riskier financial decisions increases by 0.03% at a significance level of 5%. It should be taken into account that the sample size was relatively small. Therefore, not all results have proven to be statistically significant or in the right direction.

I do not find any evidence of higher prenatal testosterone exposure (therefore, lower 2D:4D ratio) on the propensity for risk-taking, except for making social decisions in the context of DOSPERT questionnaire, which has also been found by Stenstrom, Saad, Nepomuceno and

Mendenhall (2011). However, existing literature on 2D:4D ratio and the propensity for risk-taking reports about mixed findings from this field (Dreber & Hoffman, 2007; Apicella et al., 2008; Coates, Gurnell & Rustichini, 2009; Sapienza, Zingales & Maestripieri, 2009; Branas-Garza & Rustichini, 2011; Garbarino, Slonim & Sydnor, 2011; Cueva et al., 2015; Drichoutis & Nayga, Jr., 2015; Schipper, 2015; Chicaiza-Beccera & Garcia-Molina, 2017). Additionally, I do not find any statistically significant correlation between higher pubertal testosterone exposure (therefore higher fWHR) and the propensity for risk-taking, except for making financial decisions in the context of DOSPERT questionnaire. However, the direction of the effect is the opposite of what I hypothesized and what the theory suggests. Since this is a very recent research question, little examinations have been done in this field and the findings are mixed. It appears more work needs to be done to draw more specific conclusions (Lefevre, Lewis, Perrett & Penke, 2013).

Furthermore, I have investigated how personal traits measured with Zuckerman-Kuhlman Personality Questionnaire and demographic characteristics influence propensity for risk-taking. I hypothesized a higher propensity for Impulsive Sensation-Seeking (ImpSS) behavior results in a higher propensity for risk-taking. Results confirm this hypothesis since ImpSS appears to be positively and significantly correlated with many of the risk propensity measures (e.g., BART, Eckel & Grossman Risk Task, Ethical, Health/Safety, and Recreational decisions, TAS, ES, Dis and Total SSS-V). ImpSS is combined of impulsivity and sensation-seeking. The impulsivity items involve a lack of planing and the tendency to act impulsively without thinking, while sensation-seeking intems describe experience seeking, or the willingness to take risks for the sake of excitement or novel experience. Existing literature also find impulsivity to be positively correlated to BART (Lejuez et al., 2002). Additionally, almost all bivariate correlations between impulsive sensation-seeking and risk-taking measures turned out to be positive.

On the other hand, I expected Neuroticism-Anxiety (i.e., being emotionally upset, experiencing tension, worry, fearfulness, obsessive indecision, lack of self-confidence, and sensitivity to criticism) to be negatively correlated with the propensity for risk-taking, indicating that higher propensity for neuroticism and anxious behavior results in a lower propensity for risk-taking. Results confirm this hypothesis since Neuroticism-Anxiety is negatively correlated with BART, financial and social decisions in the context of DOSPERT questionnaire. I also find a positive correlation between Neuroticism-Anxiety and Holt-Laury Measure of Risk-Aversion, indicating a higher risk-aversion (therefore, a lower propensity for risk-taking). Additionally, almost all bivariate correlations between Neuroticism-Anxiety and risk-taking measures turned out to be negative, confirming hypothesized correlation.

I have also investigated how demographic characteristics influence the propensity for risk-taking and I find mixed results. I find smokers tend to express higher propensity for risk-taking compared to non-smokers in BART. However, I find a negative correlation between smoker and financial decisions from DOSPERT, which indicates smokers tend to express

lower propensity for risk-taking when making financial decisions. This finding is not in line with my predictions. I also hypothesized greater alcohol consumption results in a higher propensity for risk-taking. However, I did not find any statistically significant correlation between alcohol and risk-taking measures in multiple regression models. Although, I find statistically significant and positive bivariate correlation between alcohol consumption and financial decisions in the context of DOSPERT questionnaire.

Last hypothesis states optimism results in a higher propensity for risk-taking. Optimism was measured as an individual's expectation of age they are going to reach in their lives. Multiple regression analyses show mixed results, although I find expected future age to be positively correlated with BART, indicating a higher propensity for risk-taking. For future research, more detailed optimism/pessimism measures could be adopted. For example, SOP questionnaire (Kemper, Wassermann, Hoppe, Beierlein & Rammstedt, 2015) or optimism scale of the Extended Life Orientation Test (ELOT) (Chang, D'Zurilla & Maydeu-Olivares, 1994).

All in all, I can conclude there are effects of hormones, especially testosterone and cortisol, and personal traits on the propensity for risk-taking. For example, I find higher salivary testosterone and higher salivary cortisol levels separately result in higher propensity for risk-taking. Additionally, testosterone and cortisol interact in a way that lower salivary cortisol level results in higher propensity for risk-taking when making financial decisions, when salivary testosterone level is not equal to zero. Furthermore, a higher salivary cortisol level results in a lower propensity for risk-taking, when salivary testosterone is not equal to zero. Also, a greater tendency to impulsive sensation-seeking behavior results in a higher propensity for risk-taking, while higher propensity for neuroticism and anxious behavior results in a lower propensity for risk-taking. Last but not least, I find mixed results when examining whether smokers behave riskier compared to non-smokers. I also find mixed results for optimism and its influence on the propensity for risk-taking. I do not find support for prenatal, pubertal testosterone exposure, and alcohol consumption on the propensity for risk-taking.

However, there are number of limitations with this study that should be taken into account in future research. Firstly, it might be due to the small sample size that not all the effects are visible. What is more, the sample consists only of SEB students. Future research should include a bigger sample and more diverse sets of participants, which will allow for drawing more general conclusions. Secondly, neuroeconomics is an interdisciplinary field combining economics, psychology, and neuroscience. Since I have examined the influence of hormones and personal traits on the propensity for risk-taking, it would be desired to collaborate with an endocrinologist and/or psychologist to help me better understand specifically how hormones work. However, a psychologist has participated in this research by inspecting and confirming psychological questionnaires. An important remark for future research is also to obtain saliva samples in the afternoon, if possible, to avoid higher variability in the hormone levels in the morning. It has been shown that testosterone levels are the highest and most

variable in the morning, while in the afternoon, they are more stable and lower (Mazur & Booth, 1998). Cortisol follows a circadian cycle, as well, and it has been found that on average, it is the lowest at 4:00 a.m. and it peaks at 8:00 am (Schipper, 2015).

To conclude, it should be also taken into account that neuroeconomics is a relatively new field of research and more work needs to be done to draw more specific conclusions. What is more, some theories might even need further theoretical or conceptual refinement. However, based on the described findings, I believe this is a prospective field and should be investigated in more depth in the future.

REFERENCE LIST

1. Ackert, L. F. (2014). Traditional and Behavioral Finance. In K. H. Baker & V. Ricciardi, *Investor Behavior: The Psychology of Financial Planning and Investing* (pp. 25–41). New Jersey: Wiley.
2. Ahmed, S., Silhvonen, J. & Vähämaa, S. (2019). CEO Facial Masculinity and Bank Risk-Taking. *Personality and Individual Differences, 138*, 133–139.
3. Aluja, A., Rossier, J., Garcia, L. F., Angleitner, A., Kuhlman, M. & Zuckerman, M. (2006). A Cross-Cultural Shortened Form of the ZKPW (ZKPQ-50-cc) Adapted to English, French, German and Spanish Languages. *Personality and Individual Differences, 41*, 619–628.
4. Aluja, A., Rossier, J., García, L. F., Angleitner, A., Kuhlman, M. & Zuckerman, M. (2018, January). *Zuckerman–Kuhlman Personality Questionnaire (Shortened, ZKPQ-50-CC) survey code*. Retrieved June 23 2019, from https://www.psytoolkit.org/survey-library/zkpq-50-cc.html#refs
5. Apicella, C. L., Carré, J. M. & Dreber, A. (2015). Testosterone and Economic Risk Taking: A Review. *Adaptive Human Behavior and Physiology, 1*(3), 358–385.
6. Apicella, C. L., Dreber, A. & Mollestrom, J. (2014). Salivary Testosterone Change Following Monetary Wins and Losses Predicts Future Financial Risk-Taking. *Psychoneuroendocrinology, 39*, 58–64.
7. Apicella, C. L., Dreber, A., Campbell, B., Gray, P. B., Hoffman, M. & Little, A. C. (2008). Testosterone and Financial Risk Preferences. *Evolution and Human Behavior, 29*, 384–390.
8. Apicella, C. L., Gray, P. B., Little, A. C., Dreber, A., Hoffman, M. & Campbell, B. C. (2011). Androgens and Competitivness in Men. *Journal of Neuroscience, Psychology, and Economics, 4*(1), 54–62.
9. Archer, J. (2006). Testosterone and Human Aggression: An Evaluation of the Challenge Hypothesis. *Neuroscience and Biobehavioral Review, 30*, 319–345.
10. Barel, E. (2017). 2D:4D, Optimism, and Risk Taking. *Current Psychology, 38*(1), 204–212.
11. Berk, J. & DeMarzo, P. (2017). *Corporate Finance, 4th Edition.* Boston: Pearson.
12. Blais, A. R. & Weber, E. U. (2006a). *DOSPERT Scale: Scoring Instructions*. Retrieved May 17 2019, from https://sites.google.com/a/decisionsciences.columbia.edu/dospert/scoring-instructions
13. Blais, A. R. & Weber, E. U. (2006b). A Domain-Specific Risk-Taking (DOSPERT) Scale for Adult Populations. *Judgement and Decision Making, 1*(1), 33–47.
14. Branas-Garza, P. & Rustichini, A. (2011). Organizing Effects of Testosterone and Economic Behavior: Not Just Risk Taking. *PLoS One, 6*(12), 1–8.
15. Campbell, B. C., Dreber, A., Apicella, C. L., Eisenberg, D. T., Gray, P. B., Little, A. C., Garcia, J. R., Zamore, R. S. & Lum, J. K. (2010). Testosterone Exposure,

Dopaminergic Reward, and Sensation-Seeking in Young Man. *Physiology & Behavior, 99*, 451–456.

16. Carhart, M. M. (1997). On Persistence in Mutual Fund Performance. *The Journal of Finance, 52*(1), 57–82.
17. Carre, J. M. & McCormick, C. M. (2008a). Aggresive Behavior and Change in Salivary Testosterone Concentrations Can Predict Willigness To Engage in a Competitive Task. *Hormones and Behavior, 54*, 403–409.
18. Carre, J. M. & McCormick, C. M. (2008b). In Your Face: Facial Metrics Predict Aggressive Behavior in the Laboratory and in Varsity and Professional Hockey Players. *Proceedings of the Royal Society B, 275*, 2651–2656.
19. Chang, C., DeVaney, S. A. & Chiremba, S. T. (2004). Determinants of Subjective and Objective Risk Tolerance. *Journal of Personal Finance, 3*, 53–67.
20. Chang, E. C., D'Zurilla, T. J. & Maydeu-Olivares, A. (1994). Assessing the Dimensionality of Optimism and Pessimism Using a Multimeasure Approach. *Cognitive Therapy and Research, 18*(2), 143–160.
21. Charness, G., Gneezy, U. & Imas, A. (2013). Experimental Methods: Eliciting Risk Preferences. *Journal of Economic Behavior & Organization, 87*, 43–51.
22. Chicaiza-Beccera, L. A. & Garcia-Molina, M. (2017). Prenatal Testosterone Predicts Financial Risk Taking: Evidence from Latin America. *Personality and Individual Differences, 116*, 32–37.
23. Coates, J. M. & Herbert, J. (2008). Endogenous Steroids and Financial Risk Taking on a London Trading Floor. *PNAS, 105*(16), 6167–6172.
24. Coates, J. M., Gurnell, M. & Rustichini, A. (2009). Second-to-Fourth Digit Ratio Predicts Success Among High-Frequency Financial Traders. *PNAS, 106*(2), 623–628.
25. Cronqvist, H., Previtero, A., Siegel, S. & White, R. E. (2015). The Fetal Origins Hypothesis in Finance: Prenatal Environment, the Gender Gap, and Invester Behavior. *The Review of Financial Studies, 29*(3), 739–786.
26. Cueva, C., Roberts, R. E., Spencer, T., Rani, N., Tempest, M., Tobler, P. N., Herbert, J. & Rustichini, A. (2015, July 02). *Cortisol and Testosterone Increase Financial Risk Taking and May Destabilize Markets.* Retrieved April 10 2019, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4489095/
27. Dave, C., Eckel, C. C., Johnson, C. A. & Rojas, C. (2010). Eliciting Risk Preferences: When Is Simple Better? *Journal of Risk and Uncertainty, 41*(3), 219–243.
28. DeBruine, L. M. (2004). *AutoMetric Software*. Retrieved April 10 2019 from http://facelab.org/debruine/Programs/autometric.php
29. Dekkers, T. J., Agelink van Rentergem, J. A., Meijer, B., Popma, A., Wagemaker, E. & Huizenga, H. M. (2019). A Meta-Analytical Evaluation of the Dual-Hormone Hypothesis: Does Cortisol Moderate the Relationship Between Testosterone and Status, Dominance, Risk Taking, Aggression, and Psychopathy? *Neuroscience and Biobehavioral Reviews, 96*, 250–271.

30. Dohmen, T., Quercia, S. & Willrodt, J. (2018). Willigness to Take Risk: The Role of Risk Conception and Optimism. *IZA Discussion Paper No. 11642*.
31. Dolvin, S. D. & Pyles, M. K. (2007). Seasonal Affective Disorder and the Pricing of IPOs. *Review of Accounting and Finance, 6*(5), 214–228.
32. Dreber, A. & Hoffman, M. (2007). *Portfolio Selection in Utero*. Stockholm: Stockholm School of Economics.
33. Dreber, A., Gerdes, C., Gränsmark, P. & Little, A. C. (2013). Facial Masculinity Predicts Risk and Time Preferences in Expert Chess Players. *Applied Economics Letters, 20*(16), 1477–1480.
34. Drichoutis, A. C.,& Nayga, Jr., R. M. (2015). Do Risk and Time preferences Have Biological Roots? *Southern Economic Journal, 82*(1), 235–256.
35. Eckel, C. C. & Grossman, P. J. (2002). Sex Differences and Statistical Stereotyping in Attitudes Toward Financial Risk. *Evolution and Human Behavior, 23*(4), 281–295.
36. Eckel, C. C. & Grossman, P. J. (2008). Forecasting Risk Attitudes: An Experimental Study of Actual and Forecast Risk Attitudes of Women and Man. *Journal of Economic Behavior & Organization, 68*(1), 1–17.
37. Ert, E. & Haruvy, E. (2017). Revisiting Risk Aversion: Can Risk Preferences Change With Experience? *Economics Letter, 151*, 91–95.
38. Fama, E. F. & French, K. R. (1993). Common Risk Factors in the Returns of Stocks and Bonds. *Journal of Financial Economics, 33*, 3–56.
39. Figner, B., Mackinlay, R. J., Wilkening, F. & Weber, E. U. (2009). Affective and Deliberative Processes in Risky Choice: Age Differences in Risk Taking in the Columbia Card Task. *Journal of Experimental Psychology, 35*(3), 709–730.
40. Fink, B., Neave, N., Laughton, K. & Manning, J. T. (2006). Second to Fourth Digit Ratio and Sensation Seeking. *Personality and Individual Differences, 41*, 1253-1262.
41. Fisher, P. J. & Yao, R. (2017). Gender Differences in Financial Risk Tolerance. *Journal of Economic Psychology, 61*, 191–202.
42. Garbarino, E., Slonim, R. & Sydnor, J. (2011). Digit Ratios (2D:4D) as Predictors of Risky Decision Making for Both Sexes. *Journal of Risk and Uncertainty, 42*(1), 1–26.
43. Gibson, R., Michayluk, D. & Van der Venter, G. (2013). Financial Risk Tolerance: An Analysis of Unexplored Factors. *Financial Services Review, 22*(1), 23–50.
44. Grable, J. E., McGill, S. & Britt, S. (2009). Risk Tolerance Estimation Bias: The Age Effect. *Journal of Business and Economics Research, 7*(7), 1–12.
45. Gray, J. M. & Wilson, M. A. (2007). A Detailed Analysis of the Reliability and Validity of the Sensation Seeking Scale in a UK Sample. *Personality and Individual Differences, 42*, 641–651.
46. Grebe, N. M., Giudice, M. D., Thompson, M. E., Nickels, N., Ponzi, D., Zilioli, S., Maestripieri, D. & Gangestad, S. W. (2019). Testosterone, Cortisol, and Status-Striving Personality Features: A Review and Empirical Evaluation of the Dual Hormone Hypothesis. *Hormones and Behavior, 109*, 25–37.

47. Gregory, A., Tharyan, R. & Christidis, A. (2013). Constructing and Testing Alternative Versions of the Fama-French and Carhart Models in the UK. *Journal of Business Finance and Accounting, 40*(1, 2), 172–214.
48. Hanoch, Y., Johnson, J. G. & Wilke, A. (2006). Domain Specificity in Experimental Measures and Participant Recruitment. *Psychological Science, 17*, 300–304.
49. Harley, A. (2016, June 16). *Prospect Theory and Loss Aversion: How Users Make Decisions*. Retrieved April 11 2019, from https://www.nngroup.com/articles/prospect-theory/
50. Hartgens, F. & Kuipers, H. (2004). Effects of Androgenic-Anabolic Steroids in Athletes. *Sports Medicine, 34*, 513–554.
51. Henninger, D. E., Madden, D. J. & Huettel, S. A. (2010). Processing Speed and Memory Mediate Age-Related Differences in Decision Making. *Psychology and Aging, 25*, 262–270.
52. Herbet, J. (2018). Testosterone, Cortisol and Financial Risk Taking. *Frontiers in Behavioral Neuroscience, 12*(Article ID 101).
53. Holt, C. A. & Laury, S. K. (2002). Risk Aversion and Incentive Effects. *American Economic Review, 92*(5), 1644–1655.
54. Hopko, D. R. Lejuez, C. W., Daughters, S. B., Aklin, W. M., Osborne, A., Simmons, B. L., & Strong, D. R. (2006). Construct Validity of the Balloon Analogue Risk Task (BART): Relationship with MDMA Use by Inner-City Drug Users in Residential Treatment. *Journal of Psychopathology and Behavioral Assessment, 28*(2), 95–101.
55. Hunt, M. K., Hopko, D. R., Bare, R., Lejuez, C. W. & Robinson, E. V. (2005). Construct Validity of the Balloon Analog Risk Task (BART): Associations With Psychopathy and Impulsivity. *Assesment, 12*(4), 416–428.
56. Kahneman, D., Rosenfield, A. M., Gandhi, L. & Blasser, T. (2016). Noise: How to Overcome the High, Hidden Cost of Inconsistent Decision Making. *Harvard Business Review, 94*(10), 36–43.
57. Kamiya, S., Kim, Y. H. & Soohyun, P. (2018). The Face of Risk: CEO Facial Masculinity and Firm Risk. *European Financial Management, 25*(2), 239–270.
58. Kandasamy, N., Hardy, B., Page, L., Schaffner, M., Graggaber, J., Powlson, A. S., Fletcher, P. C., Gurnell, M. & Coates, J. (2014). Cortisol Shifts Financial Risk Preferences. *PNAS, 111*(9), 3608–3613.
59. Kapoor, S. & Prosad, J. M. (2017). Behavioral Finance: A Review. *Procedia Computer Science, 122*, 50–54.
60. Kemper, C. J. & Schwerdtfeger, A. (2009). Comparing Indirect Methods of Digit Ratio (2D:4D) Measurement. *American Journal of Human Biology, 21*(2), 188–191.
61. Kemper, C. J., Wassermann, M., Hoppe, A., Beierlein, C. & Rammstedt, B. (2015). Measuring Dispositional Optimism in Large-Scale Studies. *European Journal of Psychological Assessment, 33*, 403–408.
62. Kenton, W. (2018, September 3). Risk neutral. *Investopedia*. Retrieved April 7 2019, from https://www.investopedia.com/terms/r/riskneutral.asp

63. Kluen, L. M., Agorastos, A., Wiendemann, K. & Schwabe, L. (2017). Cortisol Boosts Risky Decision-Making Behavior in Men But Not in Women. *Psychoneuroendocrinology, 84*, 181–189.
64. Knight, F. (1921). *Risk, Uncertainty and Profit.* New York: Sentry Press.
65. Kurath, J. & Mata, R. (2018). Individual Differences in Risk Taking and Endogeneous Levels of Testosterone, Estradiol, and Cortisol: A Systematic Literature Search and Three Independent Meta-Analyses. *Neuroscience & Biobehavioral Reviews, 90*, 428–446.
66. Laury, S. K. (2006). *Pay One or Pay All: Random Selection of One Choice For Payment*. Retrieved April 16 2019, from https://EconPapers.repec.org/RePEc:exc:wpaper:2006-24
67. Lefevre, C. E., Lewis, G. J., Perrett, D. I. & Penke, L. (2013). Telling Facial Metrics: Facial Width is Associated With Testosterone Levels in Men. *Evolution in Human Behavior, 34*, 273–279.
68. Lejuez, C. W., Aklin, W. M., Zvolensky, M. J., & Pedulla, C. P. (2003). Evaluation of the Balloon Analogue Risk Task (BART) as a Predictor of Adolescent Real-World Risk-Taking Behaviours. *Journal of Adolescence, 26*(4), 475–479.
69. Lejuez, C. W., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L., Strong, D. R. & Brown, R. A. (2002). Evaluation of a Behavioral Measure of Risk Taking: The Balloon Analogue Risk Task (BART). *Journal of Experimental Psychology: Applied, 8*(2), 75–84.
70. Lintner, J. (1965). The Valuation of Risk Assets on the Selection of Risky Investments in Stock Portfolios and Capital Budgets. *Review of Economics and Statistics, 47*, 13–37.
71. MacLean, R. R., Pincus, A. L., Smyth, J. M., Geier, C. F. & Wilson, S. J. (2018). Extending the Balloon Analogue Risk Task to Asses Naturalistic Risk Taking via a Mobile Platform. *Journal of Psychopathology and Behavioral Assessment, 40*(1), 107–116.
72. Mayo Clinic Staff. (n.d.). Positron Emission Tomography Scan. *Mayo Clinic*. Retrieved April 19 2019 from https://www.mayoclinic.org/tests-procedures/pet-scan/about/pac-20385078
73. Mazur, A., & Booth, A. (1998). Testosterone and Dominance in Men. *Behavioral & Brain Sciences, 21*, 353–397.
74. Mehta, P. H. & Prasad, S. (2010). Testosterone and Cortisol Jointly Regulate Dominance: Evidence from a Dual-Hormone Hypothesis. *Hormones and Behavior, 58*, 898–906.
75. Mehta, P. H. & Prasad, S. (2015). The Dual-Hormone Hypothesis: A Brief Review and Future Research Agenda. *Current Opinion in Behavioral Science, 3*, 163–168.
76. Mehta, P. H., Mor, S., Yap, A. J. & Prasad, S. (2015). Dual-Hormone Changes are Related to Bargaining Performance. *Psychological Science, 26*(6), 866–876.

77. Mhlanga, M. (2012). Investigating the Role of Testosterone on Risk-Taking Behavior in Male Sprague Dawley Rats. *Eukaryon, 8*.
78. Miendlarzewska, E. A., Kometer, M. & Preuschoff, K. (2019). Neurofinance. *Organizational Research Methods, 22*(1), 196–222.
79. *Millisecond.com*. (n.d.). Retrieved March 3 2019, from https://www.millisecond.com/download/library/v5/bart/bart/bart.web
80. Nadler, A., Peiran, J., Johnson, C. J., Alexander, V. & Zak, P. J. (2018). The Bull of Wall Street: Experimental Analysis of Testosterone and Asset Trading. *Management Science, 64*(9), 4032–4051.
81. Nicholson, N., Soane, E., Fenton-O'Creevy, M. & Williams, P. (2005). Personality and Domain-Specific Risk Taking. *Journal of Risk Research, 8*(2), 157–176.
82. Nofsinger, J. R., Patterson, F. M. & Shank, C. A. (2018). Decision-Making, Financial Risk Aversion, and Behavioral Biases: The Role of Testosterone and Stress. *Economics and Human Biology, 29*, 1–16.
83. Peterson, R. L. (2007). *Inside the Investor's Brain: The Power of Mind Over Money.* Hoboken, New Jersey: Wiley.
84. Peterson, R. L. (2010). Neuroeconomics and Neurofinance. In H. K. Baker, & J. R. Nofsinger, *Behavioral Finance: Investors, Corporations, and Markets* (pp. 73–94). Haboken, New Jersey: John Wiley & Sons, Inc.
85. Popa, L., Selejan, O., Scott, A., Mureşanu, D. F., Balea, M. & Rafila, A. (2015). Reading Beyond the Glance: Eye Tracking in Neurosciences. *Neurological Sciences, 36*(5), 683–688.
86. Puri, M., & Robinson, D. (2005). Optimism and Economic Choice. *NBER Working Paper Series*.
87. Rao, H., Korczykowski, M., Pluta, J., Hoand, A. & Detre, J. A. (2008). Neural Correlates of Voluntary and Involuntary Risk Taking in the Human Brain: An fMRI Study of the Balloon Analogue Risk Task (BART). *NeuroImage, 42*, 902–910.
88. Rasband, W. (1997). *National Institutes of Health and the Laboratory for Optical and Computional Insturmentation*. Retrieved April 28 2019 from https://imagej.nih.gov/ij/
89. Ricciardi, V. (2010). The Psychology of Risk: The Behavioral Finance Perspective. In H. K. Baker, & J. R. Nofsinger, *Behavioral Finance: Investors, Corporations, and Markets* (pp. 131-150). Hoboken, New Jersey.
90. Roberti, J. W. (2004). A Review of Behavioral and Biological Correlates of Sensation Seeking. *Journal of Research in Personality, 38*, 256–279.
91. Rolison, J. J., Hanoch, Y., Wood, S., & Liu, P. J. (2013). Risk-Taking Differences Across the Adult Life Span: a Question of Age and Domain. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 69*(6), 870–880.
92. Ronay, J. R., Mahler, S. V. & Maestripieri, D. (2003). Behavioral and Hormonal Responses of Men to Brief Interactions With Women. *Evolution and Human Behavior, 24*, 365–375.

93. Ronay, R. & Von Hippel, W. (2009). Power, Testosterone, and Risk-Taking. *Journal of Behavioral Decision Making, 23*(5), 473–482.
94. Sahi, S. K. (2012). Neurofinance and Investment Behaviour. *Studies in Economics and Finance, 29*(4), 246–267.
95. Sandnes, F. E. (2014). *Measuring 2D:4D Finger Lenght Ratios with Smartphone Cameras.*, (pp. 1697–1701). San Diego, CA: IEEE International Conference on Systems, Man, and Cybernetics (SMC).
96. Sapienza, P., Zingales, L. & Maestripieri, D. (2009). Gender Differences in Financial Risk Aversion and Career Choices Are Affected by Testosterone. *PNAS, 106*(36), 15268–15273.
97. Schipper, B. C. (2015). *Sex Hormones and Choice Under Risk*. Retrieved May 2019, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2046324
98. *Science Daily*. (n.d.). Retrieved May 3 2019, from https://www.sciencedaily.com/terms/circadian_rhythm.htm
99. Sharpe, W. F. (1964). Capital Assets Prices: A Theory of Market Equilibrium Under Conditions of Risk. *Journal of Finance, 19*, 425-442.
100. Stanton, S. J. (2017). The Role of Testosterone and Estrogen in Consumer Behavior and Social & Economic Decision Making: A Review. *Hormones and Behavior, 92*, 155–163.
101. Stanton, S. J., Mullette-Gillman, O. A., McLaurin, R. E., Kuhn, C. M., LaBar, K. S., Platt, M. L. & Huettel, S. A. (2011). Low- and High-Testosterone Individuals Exhibit Decreased Aversion to Economic Risk. *Psychological Science, 22*(4), 447–453.
102. Stenstrom, E., Saad, G., Nepomuceno, M. V. & Mendenhall, Z. (2011). Testosterone and Domain-Specific Risk: Digit Ratios (2D:4D and rel2) as Predcitors of Recreational, Financial, and Social Risk-Takng Behaviors. *Personality and Individual Differences, 51*, 412–416.
103. Suryawanshi, P. B. & Jumle, A. G. (2016). Comparison of Behavioral Finance and Traditional Finance: For Investment Decisions. *International Journal of Commerce, Business and Management, 5*(3), 81-85.
104. Torkington, S. (2016, October 13). *World Economic Forum*. Retrieved August 12 2019, from https://www.weforum.org/agenda/2016/10/everything-you-need-to-know-about-neuroeconomics/
105. Weber, E. U. & Johnson, E. J. (2009). Decisions Under Uncertainty: Psychological, Economic, and Neuroeconomic Explanations of Risk Preference. In P. W. Glimcher, C. F. Camerer, E. Fehr, & R. A. Poldrack, *Neuroeconomics: Decision Making and the Brain* (pp. 127–142). San Diego, CA: Elsevier Academic Press.
106. Weber, E. U., Blais, A. R. & Betz, N. E. (2002). A Domain-Specific Risk-attitude Scale: Measuring Risk Perceptions and Risk Behavior. *Journal of Behavioral Decision Making, 15*, 263–290.

107. Welker, K. M., Goetz, S. M. & Carre, J. M. (2015). Perceived and Experimentally Manipulated Status Moderates the Relationship Between Facial Structure and Risk-Taking. *Evolution and Human Behavior, 36*, 423–429.
108. White, R. E., Thornhill, S. & Hampson, E. (2006). Enterpreneurs and Evolutionary Biology: The Relationship Between Testosterone and New Venture Creation. *Organizational Behavior and Human Decision Processes, 100*, 21–34.
109. Wikipedia. (n.d.). *Risk.* Retrieved April 18 2019, from https://en.wikipedia.org/wiki/Risk
110. Wong, E. M., Ormiston, M. E., & Haselhuhn, M. P. (2011). A Face Only an Investor Could Love: CEO's Facial Structure Predicts Their Firm's Financial Performance. *Psychological Science, 22*(12), 1478–1483.
111. Yao, R., Gutter, M. & Hanna, S. (2005). The Financial Tolerance of Blacks, Hispanics, and Whites. *Journal of Financial Counseling and Planning, 16*, 51–62.
112. Yao, R., Sharpe, D. L. & Wang, F. (2011). Decomposing the Age Effect on Risk Tolerance. *The Journal of Socio-Economics, 40*, 879–887.
113. You and Your Hormones. (2018, February). *Testosterone*. Retrieved May 22 2019, from http://www.yourhormones.info/hormones/testosterone/
114. Zethraeus, N., Kocoska-Maras, L., Ellingsen, T., Schoultz, B., Hirschberg, A. L. & 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), 6536–6538.
115. Zuckerman, M. (1994). *Behavioral Expressions and Biosocial Bases of Sensation Seeking.* New York: Cambridge University Press.
116. Zuckerman, M. (2002). Zuckerman-Kuhlman Personality Questionnaire (ZKPQ): An Alternative Five-Factorial Model. In B. D. Raad, & M. Perugini, *Big Five Assesment* (pp. 377–396). Göttingen: Hogrefe & Huber Publishers.
117. Zuckerman, M. (2007). *Sensation Seeking and Risky Behavior*. Washington DC: Amerian Psychological Association.
118. Zuckerman, M. & Aluja, A. (2015). Measure of Sensation Seeking. In G. J. Boyle, D. H. Saklofske, & G. Matthews, *Measures of Personality and Social Psychological Constructs* (pp. 352–377). Elsevier/Academic Press.
119. Zuckerman, M. & Kuhlman, D. M. (2002). Personality and Risk Taking: Common Biosocial Factors. *Journal of Personality, 68*(6), 999–1029.
120. Zuckerman, M. Kuhlman, D. M., Joireman, J., Teta, P., & Kraft, M. (1993). A Comparison of Three Structural Models for Personality: The Big Three, the Big Five, and the Alternative Five. *Journal of Personality and Social Psychology, 65*(4), 757–768.

APPENDICES

Appendix 1: Summary in Slovenian language

Tradicionalne finančne teorije v glavnem temeljijo na predpostavkah o racionalnih investitorjih, ki se odločajo na podlagi relativno stabilnih preferenc skozi čas s končnim ciljem maksimizacije njihove koristi. Finančni modeli, ki temeljijo na omenjenih predpostavkah, so se izkazali za relativno dobre pri računskih finančnih odločitvah, medtem ko ne delujejo dobro pri pojasnjevanju tržnih anomalij ali finančnih kriz, kot je bila na primer finančna kriza leta 2007–2009 in pozneje (Kandasam in drugi, 2014). Tako so se začela razvijati nova raziskovalna področja, kot je na primer nevroekonomija, s ciljem boljšega razumevanja širšega spektra dejavnikov, ki vplivajo na nagnjenost k tveganju (Peterson, 2010).

Glavni namen magistrskega dela je pridobiti nova spoznanja s področja nevroekonomije. Poleg tega raziskava predstavlja obsežni učni eksperiment za izvajalce z Ekonomske fakultete Univerze v Ljubljani oziroma druge udeležene na strani raziskovalcev. Pomembni deli raziskave so se na Ekonomski fakulteti izvajali prvič, zato pričakujemo številna nova spoznanja (npr. pri aplikaciji različnih merskih instrumentov).

Glavni cilj magistrskega dela je pridobiti nova spoznanja o tem, kako vrednosti hormonov, predvsem testosterona in kortizola, predrojstvena vrednost testosterona, vrednost testosterona v puberteti (izražena z obraznimi značilnostimi), osebnostne in demografske značilnosti vplivajo na nagnjenost k tveganju. Nagnjenost k tveganju sem izmerila na več načinov, in sicer s pomočjo računalniške igre Balloon Analogue Risk Task (v nadaljevanju BART) (Lejuez in drugi, 2002), loterijskih iger Eckel & Grossman Risk Task (Eckel & Grossman, 2002; Eckel & Grossman, 2008) in Holt-Laury Measure of Risk-Aversion (Holt & Laury, 2002), Domain-Specific Risk-Taking Scale (v nadaljevanju DOSPERT) (Blais & Weber, 2006b; Weber, Blais & Betz, 2002) in Sensation-Seeking Scale Form V (Zuckerman, 1994; Zuckerman & Kuhlman, 2002). Neodvisne spremenljivke v analizi bi lahko razdelili v tri glavne skupine: i) vrednosti hormonov (testosterona in kortizola), izmerjene neposredno preko vzorca sline in posredno preko predrojstvene vrednosti testosterona, izražene kot razmerje med kazalcem in prstancem na desni roki (v nadaljevanju 2D:4D razmerje), in razmerja med širino in višino obraza (angl. facial width-to-height ratio, v nadaljevanju fWHR) (vrednost testosterona v puberteti), ii) demografske značilnosti in življenjske navade (spol, starost, izobrazba, etnične značilnosti, značilnosti o kajenju, uživanju alkohola, optimizem/pesimizem) in iii) osebnostne značilnosti (npr. impulzivno vedenje, nevrotičnost in anksioznost).

Na podlagi zbrane literature s tega področja sem si zastavila 7 raziskovalnih hipotez:

H1a: Višja raven testosterona in nižja raven kortizola vodita v višjo nagnjenost k tveganju.

H1b: Nižja raven testosterona in višja raven kortizola vodita v nižjo nagnjenost k tveganju.

H2: Nižje 2D:4D razmerje vodi v višjo nagnjenost k tveganju.

H3: Višje fWHR razmerje vodi v višjo nagnjenost k tveganju.

H4: Bolj impulzivno vedenje vodi v višjo nagnjenost k tveganju.

H5: Nevrotičnost in anksioznost vodita v nižjo nagnjenost k tveganju.

H6: Demografske značilnosti, kot sta kajenje in uživanje alkohola, vodita v višjo nagnjenost k tveganju.

H7: Optimizem vodi v višjo nagnjenost k tveganju.

Magistrsko delo je razdeljeno na tri glavne vsebinske sklope: teoretični, zasnova eksperimenta in empirični del. V teoretičnem delu povzemam razvoj finančnih teorij od tradicionalnih do novejših, kot so na primer vedenjske finance in nevroekonomija. Opisan je tudi koncept tveganja, podrobneje finančnega tveganja in različni pristopi merjenja nagnjenosti k tveganju. Predstavljene so tudi glavne značilnosti hormonov, podrobneje testosterona in kortizola, dvojne hormonske hipoteze, raziskave o vplivu osebnostnih in demografskih značilnosti. V poglavju o zasnovi eksperimenta so podrobneje predstavljeni vsi uporabljeni merski instrumenti, opisan je tudi vzorec, potek eksperimenta in raziskovalna etika. V zadnjem, empiričnem delu pa so predstavljene ključne opisne statistike spremenljivk, metodologija, rezultati in diskusija. Magistrsko delo zaključujem s sklepom, kjer so zapisane glavne ugotovitve.

Nevroekonomija za boljše razumevanje finančnih odločitev vključuje tudi spoznanja s področja psihologije in nevroznanosti. S slednjega si sposodi predvsem raziskovalne metode za merjenje možganske aktivnosti, kot so funkcionalna magnetna resonanca (fMRI), elektroencefalogija (EEG), pozitronska emisijska tomografija (PET) in t. i. sledenje očesnim premikom (angl. eye tracking) (Miendlarzewska, Kometer & Preuschoff, 2019). Ključna prednost nevroekonomije je, da nam omogoča vpogled v delovanje človeškega telesa (npr. možganske aktivnosti in gibanje ravni hormonov) pri sprejemanju finančnih odločitev, medtem ko je glavna slabost povezana predvsem s stroški tovrstnih raziskav. Uporaba že prej omenjenih instrumentov je zelo draga, kar po navadi rezultira v majhih vzorcih (20 posameznikov ali manj) in posledično manj zanesljivih rezultatih (Peterson, 2010).

Koncept tveganja bi težko enoznačno opredelili, vendar v splošnem lahko rečemo, da gre za možnost izgube nečesa, kar za nas predstavlja vrednost. Vrednost je lahko fizična, zdravstvena, povezana s socialnim statusom, čustvenim ali finančnim stanjem (Wikipedia, brez datuma). Do sedaj je bilo odkritih kar nekaj dejavnikov, ki vplivajo na nagnjenost k tveganju, na primer: trenutna raven hormonov, predvsem testosterona in kortizola (Apicella in drugi, 2008; Cueva in drugi, 2015; Mehta & Prasad, 2015; Nofsinger, Patterson & Shank, 2018; Sapienza, Zingales & Maestripieri, 2009; Schipper, 2015 in drugi) predrojstvena izpostavljenost testosteronu (2D:4D razmerje) (Chicaiza-Beccera & Garcia-Molina, 2017; Coates, Gurnell & Rustichini, 2009; Dreber, Gerdes, Gränsmark & Little, 2013; Garbarino, Slonim & Sydnor, 2011), obrazne karakteristike, izmerjene kot razmerje med širino in višino

obraza (fWHR) (Ahmed, Silhvonen & Vähämaa, 2019; Apicella in drugi, 2008; Dreber, Gerdes, Gränsmark & Little, 2013; Kamiya, Kim & Soohyun, 2018; Welker, Goetz & Carre, 2015), osebnostne značilnosti (Zuckerman, 1994; Zuckerman & Aluja, 2015; Zuckerman & Kuhlman, 2002), optimizem in pesimizem (Barel, 2017; Dohmen, Quercia & Willrodt, 2018; Puri & Robinson, 2005), psihične motnje (Dolvin & Pyles, 2007) itd. Prav tako naj bi na nagnjenost k tveganju vplivale tudi t. i. demografske značilnosti, kot so starost (Gibson, Michayluk & Van der Venter, 2013; Yao, Sharpe & Wang, 2011), izobrazba (Chang, DeVaney & Chiremba, 2004), spol (Eckel & Grossman, 2002; 2008) in etnične značilnosti (Yao, Gutter & Hanna, 2005).

V okviru nevroekonomije se razvija pomemebno področje, ki bi z endokrinološkim pristopom lahko prav tako pripomoglo k boljšemu razumevanju človeških odločitev v ekonomskem in finančnem kontekstu (Apicella, Carré & Dreber, 2015). Endokrinologija proučuje hormone, to so biokemične substance, ki po telesu potujejo po krvnem obtoku in tako vplivajo na bolj oddaljene celice in organe. Njihovo delovanje uravnavajo centri v hipotalamusu (Zuckerman, 1994). Zaradi bioloških značilnosti sta testosteron in kortizol najbolj pomembna v procesu sprejemanja finančnih odločitev (Herbet, 2018).

Testosteron je poznan tudi kot moški spolni hormon in je tako pri moških prisoten v večjih količinah kot pri ženskah (You and Your Hormones, 2018). V prenatalnem obdboju testosteron vpliva na spol zarodka v maternici, medtem ko v puberteti sodeluje pri razvoju sekundarnih spolnih značilnosti (Ronay & Von Hippel, 2009). V zadnjih 20 letih so raziskave pokazale povezave med testosteronom in nasilnim vedenjem (Archer, 2006; Carre & McCormick, 2008b), dominantnim vedenjem (Mazur & Booth, 1998; Carre & McCormick, 2008b), impulzivnim vedenjem posameznika, ki išče vznemerljive dogodke v življenju in je pripravljen tvegati samo zaradi občutkov, ki jih tako tveganje prinese (Roberti, 2004), sovražnim vedenjem (Hartgens & Kuipers, 2004), iskanju partnerjev (Ronay, Mahler & Maestripieri, 2003) in nagnjenostjo k finančnemu tveganju (Apicella in drugi, 2008). Vsa našteta vedenja tako ali drugače vključujejo komponento tveganja (Mhlanga, 2012).

Nekateri avtorji (Coates & Herbert, 2008; Cueva in drugi, 2015; Nadler, Peiran, Johnson, Alexander & Zak, 2018) so proučevali tudi vpliv eksogenega testosterona na nagnjenost k tveganju in ugotovili, da obstaja pozitivna povezava. Zaradi pravnih, etičnih in operativnih razlogov se je v literaturi kot merjenje trenutne ravni hormonov v človeškem telesu uveljavill postopek odvzema vzorca sline (Campbell in drugi, 2010). Večina raziskav s tega področja poroča o pozitivni povezavi med vrednostjo testosterona v vzorcu sline in nagnjenostjo k tveganju (Apicella, Carré & Dreber, 2015; Apicella in drugi, 2008; Dreber, Gerdes, Gränsmark & Little, 2013; Nofsinger, Patterson & Shank, 2018; Sapienza, Zingales & Maestripieri, 2009; Schipper, 2015; Stanton in drugi, 2011).

Prav tako zaradi etičnih razlogov se je v literaturi tudi za merjenje predrojstvene vrednosti testosterona v človeškem telesu uveljavila meritev razmerja med kazalcem in prstancem na desni roki (2D:4D razmerje) (Campbell in drugi, 2010). Omenjeno razmerje se razlikuje

glede na spol in sicer naj bi moški imeli nižje razmerje, kar je indikator višje vrednosti testosterona v predrojstveni fazi (Apicella, Carré & Dreber, 2015). Rezultati raziskav so zelo različni, večina sicer poroča o negativni povezavi med 2D:4D razmerjem in nagnjenostjo k tveganju (Branas-Garza & Rustichini, 2011; Chicaiza-Beccera & Garcia-Molina, 2017; Coates, Gurnell & Rustichini, 2009; Garbarino, Slonim & Sydnor, 2011; Stenstrom, Saad, Nepomuceno & Mendenhall, 2011), nekaj avtorjev pa te povezave ni dokazalo (Apicella in drugi, 2008; Cueva in drugi, 2015; Drichoutis & Nayga, Jr., 2015; Sapienza, Zingales & Maestripieri, 2009; Schipper, 2015).

Najnovešje spoznanje povezano s testosteronom in nagnjenostjo k tveganju je, da večje količine testosterona v puberteti pripomorejo k rasti obrazne kosti, kar se odraža v višjem fWHR razmerju in posledično višji nagnjenosti k tveganju (Kamiya, Kim & Soohyun, 2018). Raziskav s tega področja je malo, rezultati pa so si zelo različni. Kljub vsemu jih je nekaj uspelo potrditi to domnevo (Ahmed, Silhvonen & Vähäamaa, 2019; Apicella in drugi, 2008; Lefevre, Lewis, Perrett & Penke, 2013).

Drugi pomembni hormon, ki vpliva na finančne odločitve, je kortizol. Vrednosti kortizola se kot odgovor na fizične in psihološke stresne situacije povečajo, zato mu pravimo tudi stresni hormon (Cueva in drugi, 2015). Zaradi enakih razlogov kot pri testosteronu je tudi pri kortizolu najprimernejši način za analizo vrednosti odvzem vzorca sline (Kandasamy in drugi, 2014). Prav tako avtorji, ki proučujejo povezavo med kortizolom in nagnjenostjo k tveganju, prihajajo do različnih zaključkov. Na primer Schipper (2015) poroča o pozitivni povezavi med vrednostjo kortizola in nenaklonjenostjo k tveganju pri ženskah. Nofsinger, Patterson in Shank (2018) ugotavljajo, da je vrednost kortizola negativno povezana z višjo nagnjenostjo k tveganju. Kluen, Agorastos, Wiedemann in Schwabe (2017) ugotavljajo, da višja vrednost kortizola povečuje nagnjenost k tveganju pri moških, ne pa tudi pri ženskah. Kurath in Mata (2018) nista dokazala statistično značilne povezave med vrednostjo testosterona in nagnjenostjo k tveganju.

Hormoni delujejo v interakciji, tako naj bi tudi testosteron in kortizol vzajemno vplivala na delovanje enega in drugega (Schipper, 2015). Mehta in Prasad (2010) sta na podlagi te ugotovitve formirala t. i. dvojno hormonsko hipotezo, ki pravi takole: višja vrednost testosterona vpliva na višjo nagnjenost k tveganju samo takrat, kadar je vrednost kortizola nizka. Rezultati raziskav te domneve so ponovno različni, čeprav jo je nekaj avtorjem uspelo dokazati (Mehta & Prasad, 2015; Nofsinger, Patterson & Shank, 2018). Za bolj utemeljeno potrditev domneve bo potrebno opraviti še več raziskav ali pa morda koncept celo teoretično izboljšati oz. prilagoditi (Grebe in drugi, 2019).

Pridobljene vrednosti testosterona in kortizola sem po danih navodilih iz Medicare PLUS laboratorija pretvorila tako, da so vrednosti prilagojene za spol, starost in pri kortizolu tudi za čas od prebujenja. Vse vrednosti testosterona in kortizola sem pretvorila v pmol/L in tako zagotovila isto mersko enoto. Za testiranje dvojne hormonske hipoteze sem izračunala t. i. interakcijo med spremenljivkama vrednost testosterona in vrednost kortizola kot njun

zmnožek, pri čemer sta bili obe vrednosti prilagojeni za povprečno vrednost posameznega hormona.

Osebnostne značilnosti lahko izmerimo na različne načine. Med najbolj prepoznavne tehnike spadata Big Five Personality Test in njegova alternativa, Zuckerman-Kuhlman Personality Questionnaire (v nadaljevanju ZKPQ). ZKPQ naj bi za razliko od Big Five Personality Test temeljil na osebnostnih značilnosti z biološko in evolucionalno osnovo. To so t. i. aktivnost (angl. Activity), nevrotičnost in anksioznost (angl. Neuroticism-Anxiety), agresija in nasilje (angl. Aggression-Hostility), impulzivno vedenje posameznika, ki išče vznemerljive dogodke v življenju in je pripravljen tvegati samo zaradi občutkov, ki jih tako tveganje prinese (angl. Impulsive Sensation-Seeking) in družabnost (angl. Sociability). Prejšnje študije so že dokazale povezave predvsem med impulzivnostjo in tveganim obnašanjem (Lejuez in drugi, 2002; Zuckerman & Kuhlman, 2002).

Poleg osebnostnih značilnosti na nagnjenost k tveganju vplivajo tudi demografske značilnosti, kot so starost (Gibson, Michayluk & Van der Venter, 2013; Yao, Sharpe & Wang, 2011), izobrazba (Chang, DeVaney & Chiremba, 2004), spol (Eckel & Grossman, 2002; Eckel & Grossman, 2008) in etnične značilnosti (Yao, Gutter & Hanna, 2005). Izkazalo se je tudi, da je uživanje alkohola povezano z določenimi dimenzijami Sensation-Seeking Scale Form V (SSS-V) (Roberti, 2004). Pozitivna korelacija je bila dokazana tudi med impulzivnostjo in BART (Lejuez in drugi, 2002).

Kot že omenjeno, sem v raziskavi uporabila veliko različnih raziskovalnih tehnik. S kratkim demografskim vprašalnikom sem pridobila informacije o posameznikovem spolu, starosti, državljanstvu, kajenju, uživanju alkohola, dokončani izobrazbi, samooceni nagnjenosti k tveganju in o optimizmu/pesimizmu, izmerjenem s pričakovano življenjsko dobo.

Nagnjenost k tveganju (odvisno spremenljivko) sem izmerila na več načinov. Eden izmed načinov je bila uporaba računalniške igre BART (Lejuez in drugi, 2002), ki se v literaturi redno uporablja za merjenje posameznikove nagnjenosti k tveganju. Koncept igre je sledeč: igralci napihujejo balone, ki se prikazujejo na ekranu in z vsakim vpihom zaslužijo 5 centov. Baloni lahko kadarkoli počijo in s tem igralci izgubijo prislužen denar, razen če ga pred tem ne shranijo. Spremenljivka za merjenje posameznikove nagnjenosti k tveganju, ki sem jo kasneje uporabila v analizi, je bila prilagojeno povprečno število vpihov v balone, ki niso počili, torej povprečno število vpihov v balone, preden posameznik shrani zaslužen denar. Večje kot je število vpihov pri posameznem balonu, višja je posameznikova nagnjenost k tveganju, saj je verjetnost, da bo balon počil večja (Lejuez in drugi, 2002).

Drugi način merjenja nagnjenosti k tveganju je bila relativno enostavna loterijska igra Eckel & Grossman Risk Task (Eckel & Grossman, 2002). Udeležnci igre imajo na voljo 6 izbir (angl. gamble), kjer jim vsaka ponuja 50 % verjetnost za višje izplačilo nagrade in 50 % verjetnost za nižje izplačilo nagrade. Tveganje, merjeno s standardim odklonom, narašča in je najvišje pri zadnji, šesti izbiri. Igra je zasnovana tako, da bodo posamezniki, ki niso

naklonjeni tveganju, izbirali predvsem tiste možnosti z nižjim standardnim odklonom, to so izbire od 1 do 4 (angl. gamble 1-4), medtem ko bodo nevtralni posamezniki izbrali izbiro 5 (angl. gamble 5), posamezniki nagnjeni k višjemu tveganju pa izbiro 6 (angl. gamble 6). Ko posamezniki izberejo izbiro, vržemo 6-strano kocko. Če pade 1, 2 ali 3, se izplača nižje izplačilo. Če pade 4, 5 ali 6, se izplača višje plačilo. Verjetnost, da se zgodi prvi (nižje izplačilo) ali drugi (višje izplačilo) dogodek, je enaka (Dave, Eckel, Johnson & Rojas, 2010).

Tretji način merjenja nagnjenosti k tveganju je Holt-Laury Measure of Risk-Aversion (Holt & Laury, 2002), kjer pravzaprav merimo posameznikovo nenaklonjenost k tveganju. Loterijska igra je sestavljena iz 10 parov, t. i. loterijskih odločitev, kjer morajo udeleženci eksperimenta izbirati med različnimi izplačili povezanimi z različnimi verjetnostimi. Izplačila pri izbiri A so manj variabilna kot pri bolj tvegani izbiri B. Ko se verjetnost za višje izplačilo dovolj poveča, bo igralec preskočil na opcijo B. Tudi oseba, ki je najmanj nagnjena k tveganju, bi morala spremeniti izbiro do 10. poskusa, saj opcija B nudi gotovo izplačilo v višji vrednosti. Nenaklonjenost k tveganju merimo s številom izbranih varnih izbir (angl. option A) (Holt & Laury, 2002).

Četrti način merjenja nagnjenosti k tveganju je z DOSPERT vprašalniki, ki merijo nagnjenost k tveganju na petih področjih, in sicer: finančne, zdravstvene/varnostne, rekreacijske, etične in socialne odločitve. Udeleženci rešijo tri iste vprašalnike, vendar z različnimi 7-stopenjskimi lestvicami odgovorov (Blais & Weber, 2006). S prvim vprašalnikom merimo nagnjenost k tveganju (angl. risk-taking), z drugim vprašalnikom merimo dojemanje tveganja (angl. risk perception) in s tretjim vprašalnikom merimo pričakovane koristi (angl. expected benefits). Večje število točk kot dobi posamezna domena oz. področje, višjo nagnjenost k tveganju, dojemanje tveganja ali pričakovane koristi na tem področju izkazujejo posamezniki (Blais & Weber, 2006). V empirični analizi sem uporabila le vprašalnik, ki neposredno meri nagnjenost k tveganju (angl. risk-taking). Po posameznih domenah sem seštela vrednosti odgovorov in jih logaritmirala, da bi bila porazdelitev bolj normalna.

Zadnji, peti način za merjenje posameznikove nagnjenosti k tveganju je SSS-V. Le-ta meri vedenje posameznika, ki išče vznemerljive dogodke v življenju in je pripravljen tvegati samo zaradi občutkov, ki jih tako tveganje prinese, z naslednjimi spremenljivkami: angl. Thrill and Adventure Seeking (v nadaljevanju TAS), angl. Experience Seeking (v nadaljevanju ES), angl. Disinhibition (v nadaljevanju Dis) in angl. Boredom Susceptibility (v nadaljevanju BS). Vsak omenjeni faktor sestavlja 10 trditev, udeleženci eksperimenta se morajo odločiti, katera jih bolje opiše oz. jim je bližje. TAS zajema željo, da se vključujemo v ekstremne športe. ES vključuje iskanje izkušenj preko različnih čutov, ki pridejo do izraza v glasbi, umetnosti, potovanjih, socialnem anti-konformizmu in povezovanju z istomislečimi ljudmi oz. skupinami ljudmi. Dis zajema željo po obnašanju brez zadržkov, v povezavi z alkoholom na zabavah in impulzivnih spolnih aktivnostih. BS izraža netoleranco do rutinskega dela in dolgočasnih ljudi (Zuckerman & Aluja, 2014; Zuckerman, 1994).

V nadaljevanju predstavljam neodvisne spremenljivke v raziskavi. Raven hormonov (testosterona in kortizola) je izmerilo osebje iz zunanjega, akreditiranega laboratorija Medicare PLUS s pomočjo odvzema dveh vzorcev sline. Osebje laboratorija je priskrbelo navodila za odvzem vzorca sline, o katerih so bili udeleženci v raziskavi predhodno obveščeni.

Osebnostne značilnosti sem izmerila z uporabo ene izmed krajših različic ZKPQ, ki je sestavljena iz 50 trditev, na katere morajo udeleženci odgovoriti, ali zanje držijo ali ne. Vprašalnik sestavlja 5 dimenzij: angl. Impulsive Sensation-Seeking (v nadaljevanju ImpSS), angl. Neuroticism-Anxiety (v nadaljevanju N-Anx), angl. Aggression-Hostility (v nadaljevanju Agg-Host), angl. Sociability (v nadaljevanju Sy) in angl. Activity (v nadaljevanju Act). Impulsive Sensation-Seeking vključuje naslednje elemente: pomanjkanje načrtovanja, tendenco k hitremu, impulzivnemu odločanju brez razmišljanja, potrebo po vznemirjenju, razburjenju, željo po nepredvidenih situacijah ter potrebo po spremembah in novostih. Neuroticism-Anxiety vključuje čustvene pretrese, napetosti, skrbi, strah, neodločnost, pomanjkanje samozavesti in občutljivost na kritiko. Agression-Hostility zajema pripravljenost na verbalno agresijo, nesramno, nepremišljeno in nesocialno obnašanje, maščevalnost, hitro jezo in nepotrpežljivost z drugimi ljudmi. Sociability vključuje trditve, ki kažejo na to, da imamo radi zabave, komunikacijo z različnimi ljudmi in stopnjo (ne)tolerantnost do socialne izolacije. Activity opisuje potrebo po aktivnosti in neučakanost, ko ničesar ne počnemo. Sem spadajo tudi preference po trdem delu in različnih izzivih ter veliko energije za delo oz. različna opravila (Zuckerman, 2002).

2D:4D razmerje, ki je pokazatelj predrojstvene vrednosti testosterona v človeškem telesu, sem izmerila tako, da smo udeležencem raziskave najprej skenirali desno roko. Z uporabo ustrezne programske opreme Autometric (DeBruine, 2004) sem izmerila dolžino prstov od vrha/konice prsta do ventralne proksimalne gube (tj. guba med prstom in dlanjo, ki je najbližje dlani) in izračunala 2D:4D razmerje (Kemper & Schwerdtfeger, 2009). Nižje 2D:4D razmerje pomeni višjo vrednost testosterona v človeškem telesu (Coates, Gurnell & Rustichini, 2009).

Za fWHR razmerje, ki je pokazatelj vrednosti testosterona v puberteti, smo udeležence eksperimenta najprej portretno fotografirali, brez očal in pokrival ter z nevtralnim izrazom na obrazu. Nato sem s pomočjo programske opreme ImageJ (Rasband, 1997) izmerila razdaljo med zgornjo ustnico in točko pod obrvjo (obrazna višina) in najdaljšo razdaljo med lateralnima deloma ličnih lokov (obrazna širina). Sledil je izračun fWHR kot razmerje med obrazno širino in višino (Carre & McCormick, 2008b). Višje fWHR pomeni višjo vrednost testosterona v puberteti (Apicella in drugi, 2008).

Eksperiment je potekal 27. marca 2019 od 9. ure zjutraj do približno 12. ure. Udeležencem sem predstavila potek eksperimenta, ki mu je sledila izvedba. Najprej jim je osebje laboratorija odvzelo prvi vzorec sline, potem je sledila izvedba BART, Eckel & Grossman Risk Task, Holt-Laury Risk Task, DOSPERT, SSS-V, ZKPQ in demografskega vprašalnika.

Med eksperimentom smo udeležencem skenirali desno dlan in posneli potrtretne fotografije. Na koncu so udeležencem odvzeli še drugi vzorec sline. V eksperimentu je sodelovalo 36 študentov (21 žensk in 15 moških) IMB programa na Ekonomski fakulteti v Ljubljani. Povprečna starost udeležencev je 23,58 let. Etična komisija za znanstvenoraziskovalno delo Ekonomske fakultete Univerze v Ljubljani je predhodno potrdila zasnovo celotnega eksperimenta. Prav tako so udeleženci v raziskavi pred izvedbo podali pisno soglasje o sodelovanju v eksperimentu.

V empirični analizi je bilo uporabljenih 32 spremenljivk, s katerimi sem analizirala bivariatne povezave med spremenljivkami, in 30 spremenljivk, ki so bile vključene v multiple regresijske modele. S pomočjo programske opreme STATA sem izvedla OLS regresijske analize in preverila naslednje predpostavke OLS modela: normalno porazdelitev slučajne spremenljivke, odsotnost multikolinearnosti in homoskedastičnost. Nekaj regresijskih modelov sem zaradi prisotnosti heteroskedastičnosti popravila z uporabo robustnih standardnih napak.

V nadaljevanju predstavljam glavne rezultate raziskave. Ugotovila sem, da testosteron in kortizol delno delujeta v odvisnosti, kar predstavlja delni dokaz o t. i. dvojni hormonski hipotezi. Izkazalo se je, da je statistično značilna le negativna povezava med vrednostjo kortizola in nagnjenostjo k tveganju, ne pa tudi pozitivna povezava med testosteronom in nagnjenostjo k tveganju. Potrebno se je zavedati, da dvojna hormonska hipoteza še ni bila velikokrat empirično preizkušena, zato bodo na tem področju potrebne dodatne raziskave (Grebe in drugi, 2019). Ugotavljam tudi pozitivno bivariatno korelacijo med vrednostjo testosterona in finančnimi odločitvami iz DOSPERT vprašalnika ter med vrednostjo kortizola in finančnim odločitvami iz DOSPERT. Rezultati kažejo, da povišanje vrednosti testosterona za en pmol/L, v povprečju ceteris paribus poveča verjetnost za sprejemanje bolj tveganih finančnih odločitev za 44 %. Prav tako ugotavljam, da povečanje vrednosti kortizola za en pmol/L, v povprečju ceteris paribus poveča verjetnost za sprejemanje bolj tveganih finančnih odločitev za 0,03 %. Nekateri ostali rezultati niso bili statistično značilni oz. niso kazali prave smeri, kar je lahko posledica relativno majhnega vzorca.

Rezultati regresijske analize niso dokazali, da bi višja predrojstvnega vrednost testosterona (torej nižje 2D:4D razmerje) vplivalo na nagnjenost k tveganju, razen v primeru sprejemanja socialnih odločitev iz DOSPERT vprašalnika. Slednje so dokazali tudi Stenstrom, Saad, Nepomuceno in Mendenhall (2011), sicer pa so rezultati v literaturi s tega področja zelo različni (Dreber & Hoffman, 2007; Apicella in drugi, 2008; Coates, Gurnell & Rustichini, 2009; Sapienza, Zingales & Maestripieri, 2009; Branas-Garza & Rustichini, 2011; Garbarino, Slonim & Sydnor, 2011; Cueva in drugi, 2015; Drichoutis & Nayga, Jr., 2015; Schipper, 2015; Chicaiza-Beccera & Garcia-Molina, 2017). Prav tako nisem ugotovila, da bi višja vrednost testosterona v puberteti (torej višje fWHR razmerje) vplivala na nagnjenost k tveganju, razen v primeru sprejemanja finančnih odločitev iz DOSPERT vprašalnika. Povezava je sicer negativna, kar ni v skladu s postavljeno hipotezo in s teorijo s tega področja. Potrebno se je zavedati, da je to še zelo novo raziskovalno področje in bo potrebno

opraviti več empiričnih raziskav, če želimo podati bolj natančne zaključke (Lefevre, Lewis, Perrett & Penke, 2013).

V nadaljevanju sem raziskovala tudi vpliv osebnostnih značilnosti na nagnjenost k tveganju. Ugotovila sem, da v skladu s postavljeno hipotezo impulzivno vedenje (angl. Impulsive Sensation-Seeking) vodi v višjo nagnjenost k tveganju (pri BART, angl. Eckel & Grossman Risk Task, etičnih, zdravstvenih/varnostnih, in rekreacijskih odločitvah iz DOSPERT vprašalnika, TAS, ES, Dis in skupnem SSS-V). Prav tako so skoraj vse bivariatne povezave med impulzivnostjo in instrumenti za merjenje nagnjenosti k tveganju statistično značilne in pozitivne. Povezava impulzivnega vedenja in višje nagnjenosti k tveganju pri igri BART je bila v literaturi že dokazana (Lejuez in drugi, 2002).

V peti hipotezi sem predpostavljala, da bolj nevrotično in anksiozno vedenje vodita v nižjo nagnjenost k tveganju. Negativna korelacija med nevrotičnim, anksioznim vedenjem in BART, finančnimi in socialnimi odločitvami iz DOSPERT vprašalnika ter pozitivna korelacija med Holt-Laury Measure of Risk-Aversion (kaže na nižjo nagnjenost k tveganju) potrjujejo postavljeno hipotezo. Prav tako so se skoraj vse bivariatne korelacije med nevrotičnim, anksioznim vedenjem in odvisnimi spremenljivkami, ki merijo nagnjenost k tveganju, izkazale za negativne, kar ponovno potrjuje postavljeno hipotezo.

Šesta hipoteza pravi, da demografski značilnosti, kot sta kajenje in uživanje alkohola, vodita v višjo nagnjenost k tveganju. Rezultati so mešani, saj sem ugotovila, da so kadilci bolj nagnjeni k tveganju kot nekadilci pri igranju BART, medtem ko so pri sprejemanju socialnih odločitev (DOSPERT) manj nagnjeni k tveganju. Rezultati multiple regresije pa niso pokazali statistično značilnih povezav med uživanjem alkohola in nagnjenostjo k tveganju, medtem ko so bivariatne korelacije med uživanjem alkohola in finančnimi odločitvami iz DOSPERT vprašalnika pozitivne, kar je v skladu s postavljeno hipotezo.

Mešane rezultate ugotabljam tudi pri testiranju sedme hipoteze, ki pravi, da so bolj optimistični posamezniki bolj nagnjeni k tveganju. Pozitivno povezavo sem ugotovila le za korelacijo med optimizmom in BART, medtem ko je korelacija med optimizmom in socialnimi odločitvami (DOSPERT) negativna. Optimizem sem izmerila kot odgovor na vprašanje o pričakovani življenjski dobi. V prihodnjem raziskovalnem delu s tega področja bi lahko optimizem izmerili tudi bolj celostno z uporabo SOP vprašalnika (Kemper, Wassermann, Hoppe, Beierlein & Rammstedt, 2015) ali lestvice optimizma iz Extended Life Orientation Test (ELOT) (Chang, D'Zurilla & Maydeu-Olivares, 1994).

Zaključim lahko, da hormoni, predvsem testosteron in kortizol, in osebnostne značilnosti vplivajo na posameznikovo nagnjenost k tveganju. Ugotovila sem, da testosteron in kortizol tako posamezno kot delno tudi soodvisno vplivata na nagnjenost k tveganju. Prav tako bolj impulzivno vedenje vodi v višjo nagnjenost k tveganju, medtem ko nevrotičnost in anksioznost vodita v nižjo nagnjenost k tveganju. Pri proučevanju vpliva demografskih dejavnikov, kot so optimizem, kajenje in uživanje alkohola ugotavljam mešane rezultate. Za

slednje analiza ni pokazala statistično značilnih povezav. Analiza prav tako ni pokazala statistično značilnih povezav, ki bi potrdile vpliv predrojstvene vrednosti testosterona in vrednosti testosterona v puberteti na nagnjenost k tveganju.

Kljub vsemu se moramo zavedati omejitev raziskave in možnih izboljšav v prihodnosti. Prvič, vzorec študentov je relativno majhen in posledično vsi učinki niso bili statistično značilni. Prav tako vzorec sestavljajo samo študenti Ekonomske fakultete v Ljubljani. V prihodnjih raziskavah bi bilo potrebno povečati vzorec in vanj vključiti čim bolj raznolike posameznike, da bi pridobili bolj splošne ugotovitve. Drugič, nevroekonomija je interdisciplinarno področje, ki ga sestavljajo ekonomija, psihologija in nevroznanost. Zaradi proučevanja delovanja hormonov in osebnostnih značilnosti bi bilo smiselno sodelovati z endokrinologom, saj bi mi le-ta lahko pomagal pri boljšem razumevanju delovanja hormonov. V raziskavi sem sicer sodelovala s psihologinjo, ki je pregledala in potrdila vprašalnike. Pomembna implikacija za prihodnje raziskave s tega področja je tudi odvzem vzorcev sline za analizo vrednosti hormonov v popoldanskem času, če je le to mogoče. S tem bi se izoginili višji variabilnosti vrednosti hormonov v jutranjih urah. Dokazano je, da testosteron in kortizol sledita cirkadiadnemu ritmu in imata zato najvišje vrednosti v jutranjih urah, medtem ko so vrednosti v popoldanskih urah bolj stabilne in nižje (Mazur & Booth, 1998; Schipper, 2015). Pri vsem skupaj je potrebno upoštevati tudi dejstvo, da je nevroekonomija še zelo mlado raziskovalno področje. Potrebno bo izvesti več empiričnih raziskav, da bi lahko izpeljali bolj natančne sklepe. Določene teorije (npr. dvojno hormonsko teorijo, 2D:4D, fWHR) bi bilo mogoče potrebno še enkrat pregledati in dopolniti ali nekoliko prilagoditi. Ne glede na vse menim, da je to perspektivno raziskovalno področje, ki se ga splača v prihodnosti še raziskovati.

Appendix 2: Demographic Questionnaire

1. Please write the identification code you received at the beginning of the experiment.

2. What is your gender?

3. How old are you?

4. What is your nationality?

5. Are you a smoker? Please answer yes or no.

6. If you answered the previous question with yes, please write for how long you have been a smoker. If you answered the previous question with no, please write 0.

7. How many units of alcohol do you consume in a typical week? (1 beer = 2 units, 1 shot of vodka or other spirit = 1 unit, 1 glass of wine - small glass 125 ml not fully filled = 1 unit)

8. What is your educational background? Please state your highest completed degree thus far.

9. How would you evaluate yourself on being a risk-taking person on a scale from 1 to 5?

1 – very low

2 – low

3 – neutral

4 – high

5 – very high

10. What age will you reach in your opinion?

11. Have you ever had a broken finger on your right hand?

Appendix 3: Saliva sample instructions

Instructions by MedicarePlus

General remarks before providing saliva sample

- **Do not** eat, drink, smoke, chew, brush and floss your teeth, take medicine and get involved in physical activity **at least 30 minutes** before providing saliva sample.
- You can drink a glass of water before, but you should wait at least 5 minutes before providing saliva sample.
- It is not recommended to provide saliva sample in case you have some kind of a gum disease or infection due to possibility of contaminating saliva sample with blood. In case blood is detected in your sample, please throw it away, rinse the ampule with water and provide new saliva sample after 10 minutes.
- Please carefully follow instructions in order to provide good quality saliva samples.

Saliva sample procedure

1. **Provide saliva sample**

   Take applicable ampule and provide your saliva sample. There should be approximately 1/3 to 2/3 of ampule filled with saliva.
2. **Mark the ampule**

   When you are done providing saliva sample, close the ampule and mark date and time of sampling.

Appendix 4: Balloon Analogue Risk Task (BART) instructions

Please, write your ID number in the space below.

ID number

Please be very careful to write number of pumps in the "Number of pumps" column before you click the button »Collect $$$«. If the balloon explodes before you click »Collect $$$«, mark **X**.

Link for BART: https://www.millisecond.com/download/library/v5/bart/bart/bart.web

Balloon number	Number of pumps
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Balloon number	Number of pumps
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	

Total winnings: _____

Appendix 5: DOSPERT Scale

DOSPERT – risk-taking

For each of the following statements, please indicate the **likelihood** that you would engage in the described activity or behavior if you were to find yourself in that situation. Provide a rating from *Extremely Unlikely* to *Extremely Likely*, using the following scale:

1	2	3	4	5	6	7
Extremely Unlikely	Moderately Unlikely	Somewhat Unlikely	Not Sure	Somewhat Likely	Moderately Likely	Extremely Likely

1. Admitting that your tastes are different from those of a friend. (S)
2. Going camping in the wilderness. (R)
3. Betting a day's income at the horse races. (F/G)
4. Investing 10% of your annual income in a moderate growth diversified fund. (F/I)
5. Drinking heavily at a social function. (H/S)
6. Taking some questionable deductions on your income tax return. (E)
7. Disagreeing with an authority figure on a major issue. (S)
8. Betting a day's income at a high-stake poker game. (F/G)
9. Having an affair with a married man/woman. (E)
10. Passing off somebody else's work as your own. (E)
11. Going down a ski run that is beyond your ability. (R)
12. Investing 5% of your annual income in a very speculative stock. (F/I)
13. Going whitewater rafting at high water in the spring. (R)
14. Betting a day's income on the outcome of a sporting event. (F/G)
15. Engaging in unprotected sex. (H/S)
16. Revealing a friend's secret to someone else. (E)
17. Driving a car without wearing a seat belt. (H/S)
18. Investing 10% of your annual income in a new business venture. (F/I)
19. Taking a skydiving class. (R)
20. Riding a motorcycle without a helmet. (H/S)
21. Choosing a career that you truly enjoy over a more secure one. (S)
22. Speaking your mind about an unpopular issue in a meeting at work. (S)
23. Sunbathing without sunscreen. (H/S)
24. Bungee jumping off a tall bridge. (R)
25. Piloting a small plane. (R)
26. Walking home alone at night in an unsafe area of town. (H/S)
27. Moving to a city far away from your extended family. (S)
28. Starting a new career in your mid-thirties. (S)
29. Leaving your young children alone at home while running an errand. (E)
30. Not returning a wallet you found that contains 200€. (E)

Note. E = Ethical, F = Financial, H/S = Health/Safety, R = Recreational, and S = Social.

DOSPERT – risk perception

People often see some risk in situations that contain uncertainty about what the outcome or consequences will be and for which there is the possibility of negative consequences. However, riskiness is a very personal and intuitive notion, and we are interested in **your gut level assessment of how risky** each situation or behavior is.

For each of the following statements, please indicate **how risky you perceive** each situation. Provide a rating from *Not at all Risky* to *Extremely Risky*, using the following scale:

1	2	3	4	5	6	7
Not at all Risky	Slightly Risky	Somewhat Risky	Moderately Risky	Risky	Very Risky	Extremely Risky

1. Admitting that your tastes are different from those of a friend. (S)
2. Going camping in the wilderness. (R)
3. Betting a day's income at the horse races. (F/G)
4. Investing 10% of your annual income in a moderate growth diversified fund. (F/I)
5. Drinking heavily at a social function. (H/S)
6. Taking some questionable deductions on your income tax return. (E)
7. Disagreeing with an authority figure on a major issue. (S)
8. Betting a day's income at a high-stake poker game. (F/G)
9. Having an affair with a married man/woman. (E)
10. Passing off somebody else's work as your own. (E)
11. Going down a ski run that is beyond your ability. (R)
12. Investing 5% of your annual income in a very speculative stock. (F/I)
13. Going whitewater rafting at high water in the spring. (R)
14. Betting a day's income on the outcome of a sporting event. (F/G)
15. Engaging in unprotected sex. (H/S)
16. Revealing a friend's secret to someone else. (E)
17. Driving a car without wearing a seat belt. (H/S)
18. Investing 10% of your annual income in a new business venture. (F/I)
19. Taking a skydiving class. (R)
20. Riding a motorcycle without a helmet. (H/S)
21. Choosing a career that you truly enjoy over a more secure one. (S)
22. Speaking your mind about an unpopular issue in a meeting at work. (S)
23. Sunbathing without sunscreen. (H/S)
24. Bungee jumping off a tall bridge. (R)

25. Piloting a small plane. (R)
26. Walking home alone at night in an unsafe area of town. (H/S)
27. Moving to a city far away from your extended family. (S)
28. Starting a new career in your mid-thirties. (S)
29. Leaving your young children alone at home while running an errand. (E)
30. Not returning a wallet you found that contains 200€. (E)

Note. E = Ethical, F = Financial, H/S = Health/Safety, R = Recreational, and S = Social.

DOSPERT – expected benefits

For each of the following statements, please indicate **the benefits** you would obtain from each situation. Provide a rating from **1 – No benefits at all** to **7 – Great Benefits**, using the following scale:

1	2	3	4	5	6	7
No benefits At all			Moderate Benefits			Great Benefits

1. Admitting that your tastes are different from those of a friend. (S)
2. Going camping in the wilderness. (R)
3. Betting a day's income at the horse races. (F/G)
4. Investing 10% of your annual income in a moderate growth diversified fund. (F/I)
5. Drinking heavily at a social function. (H/S)
6. Taking some questionable deductions on your income tax return. (E)
7. Disagreeing with an authority figure on a major issue. (S)
8. Betting a day's income at a high-stake poker game. (F/G)
9. Having an affair with a married man/woman. (E)
10. Passing off somebody else's work as your own. (E)
11. Going down a ski run that is beyond your ability. (R)
12. Investing 5% of your annual income in a very speculative stock. (F/I)
13. Going whitewater rafting at high water in the spring. (R)
14. Betting a day's income on the outcome of a sporting event. (F/G)
15. Engaging in unprotected sex. (H/S)
16. Revealing a friend's secret to someone else. (E)
17. Driving a car without wearing a seat belt. (H/S)
18. Investing 10% of your annual income in a new business venture. (F/I)
19. Taking a skydiving class. (R)
20. Riding a motorcycle without a helmet. (H/S)
21. Choosing a career that you truly enjoy over a more secure one. (S)

22. Speaking your mind about an unpopular issue in a meeting at work. (S)
23. Sunbathing without sunscreen. (H/S)
24. Bungee jumping off a tall bridge. (R)
25. Piloting a small plane. (R)
26. Walking home alone at night in an unsafe area of town. (H/S)
27. Moving to a city far away from your extended family. (S)
28. Starting a new career in your mid-thirties. (S)
29. Leaving your young children alone at home while running an errand. (E)
30. Not returning a wallet you found that contains 200€. (E)

Note. E = Ethical, F = Financial, H/S = Health/Safety, R = Recreational, and S = Social.

Appendix 6: Eckel & Grossman Risk Task

Instructions: From among six different gambles down below, please select the one gamble you would like to play. The six different gambles are listed below.

You must select one and only one of these gambles.

To select a gamble, place an **X** in the appropriate box.

Each gamble has two possible outcomes (Roll Low or Roll High) with the indicated probabilities of occurring. Your compensation for this part of the study would be determined by: - Which of the six gambles you select; and

- Which of the two possible payoffs occur.

For example, if you select Gamble 4 and Roll High occurs, you would be paid 52 €. If Roll Low occurs, you would be paid 16 €.

For every gamble, each Roll has a 50% chance of occurring.

At the end of the game, you will roll a six-sided die to determine which event will occur. If you roll a 1, 2, or 3 Roll Low will occur. If you roll a 4, 5 or 6 Roll High will occur. Firstly, mark your gamble selection with an **X** in the last box across from your preferred gamble. Secondly, please **circle** which event occurred (Roll Low or Roll High) after you rolled a six-sided die.

Eckel & Grossman Risk Task

Please, write your ID number in the space below.

ID number

	Roll	Payoff	Chance	Your Selection **Mark only one**
Gamble 1	Low	28 €	50%	
	High	28 €	50%	
Gamble 2	Low	24 €	50%	
	High	36 €	50%	
Gamble 3	Low	20 €	50%	
	High	44 €	50%	
Gamble 4	Low	16 €	50%	
	High	52 €	50%	
Gamble 5	Low	12 €	50%	
	High	60 €	50%	
Gamble 6	Low	2 €	50%	
	High	70 €	50%	

Appendix 7: Holt-Laury Measure of Risk-Aversion

Instructions: Your decision sheet shows ten decisions listed on the left. Each decision is a paired choice between »Option A« and »Option B«. You will make ten choices and record these in the final column, but only one of them would be used in the end to determine your earnings.

A ten-sided die will be used to determine payoffs; the faces are numbered from 1 to 10 (the »0« face of the die will serve as 10). After you have made all of your choices, you will throw this die twice, once to select one of the ten decisions to be used, and a second time to determine what your payoff is for the option you chose, A or B, for the particular decision selected.

Now, please look at Decision 1 at the top. Option A pays 2,00€ if the throw of the ten-sided die is 1, and it pays 1,60€ if the throw is 2-10. Option B yields 3,85€ if the throw of the die is 1, and it pays 0,10€ if the throw is 2-10. The other Decisions are similar, except that as you move down the table, the chances of the higher payoff for each option increase. In fact, for Decision 10 in the bottom row, the die will not be needed since each option pays the highest payoff for sure, so your choice here is between 2,00€ or 3,85€.

To summarize, you will make ten choices: for each decision row you will have to choose between Option A and Option B. You may choose A for some decision rows and B for other rows, and you may change your decisions and make them in any order. When you are finished, you will throw the ten-sided die to select which of the ten Decisions will be used. Then you will throw the die again to determine your money earnings for the Option your earnings.

So now please look at the empty boxes on the right side of the record sheet. You will have to write a decision, A or B in each of these boxes, and then the die throw will determine which one is going to count. You will look at the decision that you made for the choice that counts, and **circle it in the first column**, before throwing the die again to determine your earnings for this part. Then you will **write your potential earnings in the space at the bottom of the next page (»Money earnings« section)**.

	Option A		Option B		Mark your decision (A or B)
1	1/10 of 2,00€	9/10 of 1,60€	1/10 of 3,85€	9/10 of 0,10€	
2	2/10 of 2,00€	8/10 of 1,60€	2/10 of 3,85€	8/10 of 0,10€	
3	3/10 of 2,00€	7/10 of 1,60€	3/10 of 3,85€	7/10 of 0,10€	
4	4/10 of 2,00€	6/10 of 1,60€	4/10 of 3,85€	6/10 of 0,10€	
5	5/10 of 2,00€	5/10 of 1,60€	5/10 of 3,85€	5/10 of 0,10€	
6	6/10 of 2,00€	4/10 of 1,60€	6/10 of 3,85€	4/10 of 0,10€	
7	7/10 of 2,00€	310 of 1,60€	7/10 of 3,85€	3/10 of 0,10€	
8	8/10 of 2,00€	2/10 of 1,60€	8/10 of 3,85€	2/10 of 0,10€	
9	9/10 of 2,00€	1/10 of 1,60€	9/10 of 3,85€	1/10 of 0,10€	
10	10/10 of 2,00€	0/10 of 1,60€	10/10 of 3,85€	0/10 of 0,10€	

Appendix 8: Sensation-Seeking Scale Form V (SSS-V)

Please take a few moments and complete this survey by clicking on Next page. Each of the items below contains two choices A and B. Please indicate which of the choices most describes your likes or the way you feel.

1. Please indicate which of the following scenarios you would prefer.
   A - I like “wild” uninhibited parties.
   B - I prefer quiet parties with good conversation.

2. Please indicate which of the following scenarios you would prefer.
   A - There are some movies I enjoy seeing a second or even a third time.
   B - I can't stand watching a movie that I've seen before.

3. Please indicate which of the following scenarios you would prefer.
   A - I often wish I could be a mountain climber.
   B - I can't understand people who risk their necks climbing mountains.

4. Please indicate which of the following scenarios you would prefer.
   A - I dislike all body odors.
   B - I like some of the earthy body smells.

5. Please indicate which of the following scenarios you would prefer.
   A - I get bored seeing the same old faces.
   B - I like the comfortable familiarity of everyday friends.

6. Please indicate which of the following scenarios you would prefer.
   A – I like to explore a strange city or section of town by myself, even if it means getting lost.
   B - I prefer a guide when I am in a place, I do not know well.

7. Please indicate which of the following scenarios you would prefer.
   A - I dislike people who do or say things just to shock or upset others.
   B - When you can predict almost everything a person will do and say, he or she must be a bore.

8. Please indicate which of the following scenarios you would prefer.
   A - I usually don't enjoy a movie or play where I can predict what will happen in advance.
   B - I don't mind watching a movie or a play where I can predict what will happen in advance.

9. Please indicate which of the following scenarios you would prefer.
   A - I have tried marijuana or would like to.
   B - I would like to try some of the new drugs that produce hallucinations.

10. Please indicate which of the following scenarios you would prefer.
    A - I would not like to try any drug which might produce strange and dangerous effects on me.
    B - I would like to try some of the new drugs that produce hallucinations.

11. Please indicate which of the following scenarios you would prefer.
    A - A sensible person avoids activities that are dangerous.
    B - I sometimes like to do things that are a little frightening.

12. Please indicate which of the following scenarios you would prefer.
    A - I dislike "swingers" *(people who are uninhibited and free about sex)*.
    B - I enjoy the company of real "swingers".

13. Please indicate which of the following scenarios you would prefer.
    A - I find that stimulants make me uncomfortable.
    B - I often like to get high (drinking liquor or smoking marijuana).

14. Please indicate which of the following scenarios you would prefer.
    A - I like to try new foods that I have never tasted before.
    B - I order the dishes with which I am familiar so as to avoid disappointment and unpleasantness.

15. Please indicate which of the following scenarios you would prefer.
    A - I enjoy looking at home movies or travel slides.
    B - Looking at someone's home movies or travel slides bores me tremendously.

16. Please indicate which of the following scenarios you would prefer.
    A - I would like to take up the sport of water skiing.
    B - I would not like to take up water skiing.

17. Please indicate which of the following scenarios you would prefer.
    A - I would like to try surf boarding.
    B - I would not like to try surf boarding.

18. Please indicate which of the following scenarios you would prefer.
    A - I would like to take off on a trip with no preplanned or definite routes or timetable.
    B - When I go on a trip, I like to plan my route and timetable fairly carefully.

19. Please indicate which of the following scenarios you would prefer.
    A - I prefer the “down to earth” kinds of people as friends.
    B - I would like to make friends in some of the “far out” groups like artists or “hippies”.

20. Please indicate which of the following scenarios you would prefer.
    A - I would not like to learn to fly an airplane.
    B - I would like to learn to fly an airplane.

21. Please indicate which of the following scenarios you would prefer.
    A - I prefer the surface of the water to the depths.
    B - I would like to go scuba diving.

22. Please indicate which of the following scenarios you would prefer.
    A - I would like to meet some persons who are homosexual (men or women).
    B - I stay away from anyone I suspect of being “gay or lesbian”.

23. Please indicate which of the following scenarios you would prefer.
    A - I would like to try parachute jumping.
    B - I would never want to try jumping out of a plane - with or without a parachute.

24. Please indicate which of the following scenarios you would prefer.
    A - I prefer friends who are excitingly unpredictable.
    B - I prefer friends who are reliable and predictable.

25. Please indicate which of the following scenarios you would prefer.
    A - I am not interested in experience for its own sake.
    B - I like to have new and exciting experiences and sensations even if they are a little frightening / unconventional or illegal.

26. Please indicate which of the following scenarios you would prefer.
    A - The essence of good art is in its clarity / symmetry of form and harmony of colors.
    B - I often find beauty in the clashing colors and irregular forms of modern paintings.

27. Please indicate which of the following scenarios you would prefer.
    A - I enjoy spending time in the familiar surroundings of home.
    B - I get very restless if I have to stay around home for any length of time.

28. Please indicate which of the following scenarios you would prefer.
    A - I like to dive off the high board.
    B - I don't like the feeling I get standing on the high board (or I don't go near it at all).

29. Please indicate which of the following scenarios you would prefer.
    A - I like to date members of the opposite sex who are physically exciting.
    B - I like to date members of the opposite sex who share my values.

30. Please indicate which of the following scenarios you would prefer.
    A - Heavy drinking usually ruins a party because some people get loud and boisterous *(=noisy, energetic and cheerful)*.
    B - Keeping the drinks full is the key to a good party.

31. Please indicate which of the following scenarios you would prefer.
    A - The worst social sin is to be rude.
    B - The worst social sin is to be a bore.

32. Please indicate which of the following scenarios you would prefer.
    A – A person should have considerable sexual experience before marriage.
    B – It's better if two married persons begin their sexual experience with each other.

33. Please indicate which of the following scenarios you would prefer.
    A - Even if I had the money, I would not care to associate with flight rich persons like those in the "jet set" *(=wealthy and fashionable people who travel widely and frequently for pleasure)*.
    B - I could conceive of myself seeking pleasures around the world with the "jet set".

34. Please indicate which of the following scenarios you would prefer.
    A - I like people who are sharp and witty even if they do sometimes insult others.
    B - I dislike people who have their fun at the expensive of hurting the feelings of others.

35. Please indicate which of the following scenarios you would prefer.
    A - There is altogether too much portrayal of sex in movies.
    B - I enjoy watching many of the "sexy" scenes in movies.

36. Please indicate which of the following scenarios you would prefer.
    A - I feel best after taking a couple of drinks.
    B - Something is wrong with people who need liquor to feel good.

37. Please indicate which of the following scenarios you would prefer.
    A - People should dress according to some standard of taste / neatness and style.
    B - People should dress in individual ways even if the effects are sometimes strange.

38. Please indicate which of the following scenarios you would prefer.
    A – Sailing long distances in small sailing crafts is foolhardy (=*adventurous, bold, daring, irresponsible…*).
    B – I would like to sail a long distance in a small but seaworthy sailing craft.

39. Please indicate which of the following scenarios you would prefer.
    A - I have no patience with dull or boring persons.
    B - I find something interesting in almost every person I talk to.

40. Please indicate which of the following scenarios you would prefer.
    A – Skiing down a high mountain slope is a good way to end up on crutches (=*a long stick with a crosspiece at the top, used as a support under the armpit by a lame person).*
    B – I think I would enjoy the sensations of skiing very fast down a high mountain slope.

Appendix 9: Zuckerman-Kuhlman Personality Questionnaire (ZKPQ)

Zuckerman-Kuhlman Personality Questionnaire Cross Cultural 50-item version (ZKPQ-50-cc)

On this page, you will find a series of statements that people might use to describe themselves. Read each statement and decide whether or not it describes you. If you agree with a statement or decide that it describes you, answer TRUE, marking the letter T with a cross. If you disagree with a statement or feel that it is not descriptive of you, answer FALSE, marking the letter F with a cross.[1]

Act	1	T F	I do not like to waste time just sitting around and relaxing.
Agg-Host	2	T F	When I get mad, I say ugly things.
Agg-Host	3	T F	It's natural for me to curse when I am mad.
Sy	4	T F	I do not mind going out alone and usually prefer it to being out in a large group.
Act	5	T F	I lead a busier life than most people.
ImpSS	6	T F	I often do things on impulse.
Agg-Host	7	T F	I almost never feel like I would like to hit someone.
Sy	8	T F	I spend as much time with my friends as I can.
N-Anx	9	T F	My body often feels all tightened up for no apparent reason.
N-Anx	10	T F	I frequently get emotionally upset.
Agg-Host	11	T F	If someone offends me, I just try not to think about it.
Act	12	T F	I like to be doing things all of the time.
ImpSS	13	T F	I would like to take off on a trip with no preplanned or definite routes or timetables.

[1] Participants' copy of the questionnaire did not include the information of which statement belong to which factor (Act, Agg-Host, Sy, N-Anx, ImpSS).

N-Anx	14	T F	I tend to be oversensitive and easily hurt by thoughtless remarks and actions of others.
Sy	15	T F	I do not need a large number of casual friends.
Act	16	T F	I can enjoy myself just lying around and not doing anything active.
ImpSS	17	T F	I enjoy getting into new situations where you can't predict how things will turn out.
N-Anx	18	T F	I am easily frightened.
Agg-Host	19	T F	If people annoy me, I do not hesitate to tell them so.
Sy	20	T F	I tend to be uncomfortable at big parties.
Act	21	T F	I do not feel the need to be doing things all of the time.
N-Anx	22	T F	I sometimes feel panicky.
Sy	23	T F	At parties, I enjoy mingling with many people whether I already know them or not.
ImpSS	24	T F	I sometimes like to do things that are a little frightening.
Act	25	T F	When on vacation I like to engage in active sports rather than just lie around.
ImpSS	26	T F	I'll try anything once.
N-Anx	27	T F	I often feel unsure of myself.
Sy	28	T F	I would not mind being socially isolated in some place for some period of time.
Act	29	T F	I like to wear myself out with hard work or exercise.
ImpSS	30	T F	I would like the kind of life where one is on the move and travelling a lot, with lots of change and excitement.
N-Anx	31	T F	I often worry about things that other people think are unimportant.
Agg-Host	32	T F	When people disagree with me, I cannot help getting into an argument with them.
Sy	33	T F	Generally, I like to be alone so I can do things I want to do without social distractions.

ImpSS	34	T F	I sometimes do "crazy" things just for fun.
Agg-Host	35	T F	I have a very strong temper.
Act	36	T F	I like to be active as soon as I wake up in the morning.
Agg-Host	37	T F	I can't help being a little rude to people I do not like.
Sy	38	T F	I am a very sociable person.
ImpSS	39	T F	I prefer friends who are excitingly unpredictable.
N-Anx	40	T F	I often feel like crying sometimes without a reason.
Act	41	T F	I like to keep busy all the time.
ImpSS	42	T F	I often get so carried away by new and exciting things and ideas that I never think of possible complications.
N-Anx	43	T F	I don't let a lot of trivial things irritate me.
Agg-Host	44	T F	I am always patient with others even when they are irritating.
Sy	45	T F	I usually prefer to do things alone.
N-Anx	46	T F	I often feel uncomfortable and ill at ease for no real reason.
Sy	47	T F	I probably spend more time than I should socializing with friends.
Act	48	T F	When I do things, I do them with lots of energy.
ImpSS	49	T F	I like "wild" uninhibited parties.
Agg-Host	50	T F	When people shout at me, I shout back.

Appendix 10: 2D:4D ratio

Instructions for 2D:4D ratio measurement:

Please remove all rings and place your right hand on a flatbed scanner with palms down, fingers apart and light pressure. Hold still until the scanning process is finished.

Appendix 11: fWHR measurement

Instructions for Facial features measurement:

Please remove glasses and hats. Stand still in front of the camera with a normal facial expression.

Appendix 12: Informed consent to participate in research "The influence of hormones and personal traits on the propensity for risk-taking"

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INFORMED CONSENT TO PARTICIPATE IN RESEARCH

"The influence of hormones and personal traits on risk taking"

1. General and brief description. You are kindly invited to participate in the research titled »*The influence of hormones and personal traits on risk taking*«, designed by Urša Ferjančič, a master's student at the Faculty of Economics, University of Ljubljana (FELU), and professor Aljoša Valentinčič, PhD. The research is part of Urša Ferjančič's master's thesis. The purpose of the research is to study the correlation between attitudes towards risk taking on the one hand and levels of hormones, personal traits, some demographic characteristics on the other. Attitudes towards risk are important in determining the discount rate (the required rate of return) that is fundamental parameter in a number of economic decisions.

2. Persons, responsible for research, observers, etc. i) *Primary investigator*: Professor Aljoša Valentinčič; ii) *Researcher*: Urša Ferjančič; iii) *Assistants*: asist. dr. Riste Ichev, asist. Katarina Sitar Šuštar, MBA, CPA; iv) *External services, supervision, etc.* 1. analysis of testosterone and cortisol levels: Medicare PLUS d.o.o., Erbežnikova 2, SI-1000 Ljubljana; 2. overview of various questionnaires, assistance and observer: Mojca Brezavšček, MSc (Phsycology), Brezavšček Psihologija, s.p., Pod Hribom 55, 1000 Ljubljana.

3. Summary of main tasks. if you agree to participate in the research, your tasks will briefly be the following (please note: detailed instructions will be provided separately):

- play an online test with balloons (the BART experiment);
- decide between pairs of pay-outs determined by varying amounts and/or varying probabilities ("lotteries")
- solve several online questionnaires on attitudes towards risk, sensation seeking, personality traits and a few basic demographic parameters (standard research questionnaires)
- deposit two sample of your saliva pre- and post-experiment
- have a photo taken on site
- provide a scan of your right hand

4. Duration. The whole process will last no more than 4 hrs (9h-13h), but we expect to finish much sooner. While every effort was attempted to anticipate as many factors that might influence the timing as possible, delays are possible.

5. Rewards for participation. This research is a small part of your Financial Management course at the IMB programme. If you participate, you will receive an additional 5% as an additional bonus over the

grades you achieve at the exam (provided the exam is positive). We will also randomly draw three participants that will receive a gift certificate in the amount earned via the BART experiment. We do hope that the participation in this research will in itself allow you to see how modern research in behavioural economics is done, broaden your knowledge and perhaps give you an idea or two for your masters' thesis and beyond.

6. Right to decline to participate. You may decline to participate altogether or drop out or refuse to cooperate in a part of research without any penalties whatsoever.

7. Privacy protection and data handling. We have developed a number of measures to guarantee your total anonymity and confidentiality. Every data item/image/lab result/any other personal data we collect will be handled under a code given to you at the beginning of the experiment. The key to the codes will be maintained by the IMB administration. It will not be known to researchers, lab personnel, helpers at the experiment, photographer, etc. No individual results will be disseminated anywhere under any circumstances, except on your demand in which case your data will be released to you and only to you by the IMB administration. You consent us to collect, store, manipulate the data we obtain, and to submit the photos to an external online photo-image analyser. We will store a copy of the raw data (without the key) on a permanent medium and deposit it in the safe deposit at the faculty of Economics, University of Ljubljana, under a code accessible only to the IMB administration upon the Dean's approval (subject to any future data handling requirements The committee on ethics in research at FELU might adopt in the future). This is to ensure proper research ethics. Only synthetic results/summaries/descriptive statistics will ever be released, primarily as output from various analyses (e.g. summary statistics, estimated regression coefficients, etc.). Saliva samples, to be analysed by an external lab, will be destroyed immediately after the analysis.

8. Contacts. Should you have any additional questions, concerns, wanted to know more details, etc., please do not hesitate to contact the following:

- Principal investigator: Professor Aljoša Valentinčič, PhD, aljosa.valentincic@ef.uni-lj.si
- The committee on ethics in research at FELU (Etična komisija za znanstveno-raziskovalo delo Ekonomske fakultete Univerze v Ljubljani): eticna.komisijaZRD@ef.uni-lj.si
- External lab (saliva sample): laboratorij@medicareplus.si

Name, Family Name, Signature of participant	Date
Name, Family Name, Signature of researcher	Date
Name, Family Name, Signature of principal researcher	Date

Appendix 13: Bivariate correlations based on reviewed literature and personal intuition

y/x	Gender	Age	Smoker	Time smoking	Alcohol	Education	Risk	Future age	2D:4D	fWHR	Act	AggHost	ImpSS	N-Anx	Sy	Sal-T2	Sal-C2
BART		-					+	+	-	+	+		+	-		+	+
Holt & Laury Measure of Risk Aversion							-	-	+	-				+		-	-
Eckel & Grossman Risk Task	-						+	+	-	+				-		+	+
TAS	-	-	+	+			+	+	-	+	+		+	-		+	+
BS	-						+		-								
Dis	-	-	+	+	+		+	+	-	+	+	+	+	-		+	+
ES	-	-			+		+	+					+	-			
Total SSS-V	-	-					+	+	-	+	+		+	-			-
ln(Ethical)	-	-					+	+									
ln(Financial)	-	-				+	+	+	-	+			+	-		+	+
ln(Health/Safety)	-	-	+	+	+		+	+	-				+	-			
ln(Recreational)	-	-					+	+	-					-			
ln(Social)		+					+	+				+		-	+		

Source: Own work.

Appendix 14: Summary and description of variables used in empirical analyses

VARIABLE NAME	FULL NAME	VARIABLE TYPE	CODING and UNITS	DESCRIPTION
idnumber	ID number	Continuous	/	Please write the identification code you received at the beginning of the experiment.
gender	Gender	Dummy	1 = Female, 0 = Male	What is your gender?
age	Age	Continuous	In years	How old are you?
nationality	Nationality	Categorical	1 = Slovenian, 2 = United States of America, 3 = Russian, 4 = Croatian, 5 = Azerbaijani, 6 = Monégasque	What is your nationality?
smoker	Smoker	Dummy	1 = Yes, 0 = No	Are you a smoker? Please answer yes or no.
timesmoking	Time smoking	Continuous	In years	If you answered previous question with yes, please write for how long you have been a smoker. If you answered previous question with no, please write 0.
alcohol	Alcohol consumption	Continuous	In units of alcohol in a typical week	How many units of alcohol do you consume in a typical week? (1 beer = 2 units, 1 shot of vodka or other spirit = 1 unit, 1 glass of wine - small glass 125 ml not fully filled = 1 unit)
education	Completed education	Dummy	1 = Master's degree, 0 = Bachelor's degree	What is your educational background? Please state your highest completed degree thus far.
risk	Self assesment of propensity for risk taking	Categorical (Ordinal)	1 = Very low, 2 = Low, 3 = Risk neutral, 4 = High, 5 = Very high	How would you evaluate yourself on being a risk-taking person on a scale from 1 to 5?
futureage	Expected future age	Continuous	In years	What age will you reach in your opinion?
brokenfinger	Broken finger	Dummy	1 = Yes, 0 = No	Have you ever had a broken finger on your right hand?
tas	TAS: Thrill and Adventure Seeking SSS-V	Continuous	/	Factor measures desire to engage in extreme sports that provide unusual and intense experiences or that can provide intense sensations in their expressions through speed and extreme risk.
es	ES: Experience Seeking SSS-V	Continuous	/	Factor describes seeking novel experiences through the mind and the senses as in music, art, travel, social nonconformity and association with like-minded individuals and groups.
dis	Dis: Disinhibiton SSS-V	Continuous	/	Describes a desire to engage in disinhibited social behaviour as faciliated by alcohol in parties and impulsive sexual activities.
bs	BS: Boredom Susceptibility SSS-V	Continuous	/	Expresses intolerance for routine work and boring people. There is an expressed need for change and unpredictability in stimulation.
total	Total SSS-V score	Continuous	Sum of TAS, ES, Dis, BS scores	Total score of SSS-V
eg	Eckel & Grossman Risk Task	Categorical (Ordinal)	1 = Extreme risk aversion, 2-4 = Risk aversion, 5 = Risk neutral, 6 = Risk taking	Eckel & Grossman Risk Task score = gamble choice
hl	Holt & Laury Risk Task	Categorical (Ordinal)	Number of safe choices (1 = Highly risk loving...10 = Stay in bed)	Holt & Laury Risk Task score = number of safe choices

digits	2D:4D ratio	Continuous	ratio	Ratio between second and fourth finger on right hand (2D:4D)
fwhr	Facial Width-to-Height Ratio	Continuous	ratio	fWHR = ratio between facial width (bizygomatic width) and height (distance between upper lip and the highest part of the eyelids).
bart	Balloon Analogue Risk Task	Continuous	Average number of pumps excluding balloons that exploded	BART: Average number of pumps on each balloon before money collection (adjusted average)
act	Activity (ZKPQ)	Continuous	/	Activity (ZKPQ): About half of the items describe the need for activity and an inability to relax and do nothing when the opportunity presents itself. The other part portrays a preference for hard or challenging work, an active busy life, and a high energy level.
agghost	Aggression-Hostility (ZKPQ)	Continuous	/	Aggression-Hostility (ZKPQ): The aggression items describe a readiness to express verbal aggression, while hostility items concern rude, thoughtless, or antisocial behaviour, vengefulness, and spitefulness.
impss	Impulsive Sensation Seeking (ZKPQ)	Continuous	/	Impulsive Sensation Seeking (ZKPQ): The impulsivity items involve a lack of planning and the tendency to act impulsively without thinking, while sensation seeking items describe experience seeking, or the willingness to take risks for the sake of excitement or novel experience.
nanx	Neuroticism-Anxiety (ZKPQ)	Continuous	/	Neuroticism-Anxiety (ZKPQ): describes being emotionally upset, tension, worry, fearfulness, obsessive indecision, lack of self-confidence, and sensitivity to criticism.
sy	Sociability (ZKPQ)	Continuous	/	Sociability (ZKPQ): includes the number of friends one has, and the amount spent with them outgoingness at parties, and a preference for being with others as opposed to being alone and pursuing solitary activities.
lnethical	Ethical domain (DOSPERT)	Continuous	Sum of domain's answers (DOSPERT Risk taking scale), log-transformed	Example: Passing off somebody else's work as your own.
lnfinancial	Financial domain (DOSPERT)	Continuous	Sum of domain's answers (DOSPERT Risk taking scale), log-transformed	Example: Investing 5% of your annual income in a very speculative stock.
lnhealth/safety	Health & Safety domain (DOSPERT)	Continuous	Sum of domain's answers (DOSPERT Risk taking scale), log-transformed	Example: Driving a car without wearing a seat belt.
lnrecreational	Recreational domain (DOSPERT)	Continuous	Sum of domain's answers (DOSPERT Risk taking scale), log-transformed	Example: Bungee jumping off a tall bridge.
lnsocial	Social domain (DOSPERT)	Continuous	Sum of domain's answers (DOSPERT Risk taking scale), log-transformed	Example: Moving to a city far away from your extended family.
salt2	Salivary Testosterone 2	Continuous	in pmol/L	Salivary testosterone level in pmol/L
salc2	Salivary Cortisol 2	Continuous	in pmol/L	Salivary cortisol level in pmol/L
salt2xsalc2	Interaction term SalT2 x SalC2	Continuous	in pmol/L	Interaction term of salivary testosterone and salivary cortisol level in pmol/L. Salivary testosterone and salivary cortisol levels were mean centered before multiplication.

Source: Own work.