

# What drives Procrastination?



Jim van Roon

375999

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Thesis Master Behavioural Economics

Erasmus School of Economics, Erasmus University Rotterdam

Supervisor: prof.dr. K.I.M. Rohde

## **Abstract**

The following paper addresses time inconsistent behaviour, mostly covering procrastination and drivers behind procrastination. What behavioural characteristics and self-control problems influence procrastination behaviour? This is the main research question of this paper and is researched using an experimental survey conducted through qualtrics. The behavioural characteristics and self-control problems that are addressed in this research are: decreasing impatience, impatience, risk aversion, loss aversion, ambiguity aversion, smoking habits, exercise behaviour and educational level.

Significant relationships were found between procrastination and the DI-index (decreasing impatience), procrastination and risk aversion, procrastination and smoking habits, procrastination and educational level, procrastination and age, and procrastination and being a student.

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# 1. Introduction

The university library is always more crowded in the week before exams and more empty in the first week of the next semester. This is because students procrastinate on studying for their exams, procrastination is a large problem among students (Vermeulen, 2018). Steel (2007) did a lot of research on procrastination and also deemed it to be a large societal problem. According to Steel procrastination is part of a group of self control problems that is continuously growing in frequency. In this research I will try to elucidate some self-control problems and behavioural characteristics influencing procrastination, to better understand procrastination behaviour.

As I am writing this introduction, I'm ironically already procrastinating on parts I like the least, in my case, it is the small cost of rereading my draft for the last time. The fact that I'm procrastinating means that I'm violating time consistent behaviour (Fischer, 2001), I'm not acting as a rational agent. A reason why I am procrastinating could be because I have a hyperbolic discounting function for utility, and am therefore violating constant impatience. When constant impatience is violated, an individual satisfies increasing or decreasing impatience. Rohde (2017) found the existence of either increasing or decreasing impatience for over half of her research sample.

Students are not the only procrastinators in our society. One of the most popular new years' resolutions is visiting the gym more often (Armstrong, 2018), something that is often procrastinated (Acland & Levy, 2011). There are a lot of different examples of procrastination that can sneak into your daily lives like for example: doing your taxes, household chores, homework or starting to eat healthier (Ariely & Wertenbroch, 2002). But what is procrastination exactly? Procrastinating is on purpose delaying or postponing tasks that need (immediate) attention. Steel (2007) formulated it as follows: "to procrastinate is to voluntarily delay an intended course of action despite expecting to be worse off for the delay". Procrastinators usually overvalue present cost and undervalue future benefits of certain tasks (O'Donoghue & Rabin, 1999). People who procrastinate, continuously put off unpleasant tasks into the future and are therefore time-inconsistent.

As previously stated, the absence of constant impatience can be a cause of procrastination. Prelec (2004) introduced decreasing impatience as being a violation of time-consistency and as being the “core property” behind hyperbolic and quasi-hyperbolic discounting. Rohde (2017) introduced a way to measure decreasing impatience, called the DI-index. The DI-index can be computed using two indifferences and is used to measure, decreasing, constant and increasing impatience. Rohde did not find any correlation between the DI-index and self reported behavioural variables.

Planning to exercise during the next year, and actually starting to exercise next year, are two very different choices, according to Laibson (1997) due to the difference in time discounting functions. Laibson assumed that people tend to have a relatively high discount rate for the near future and a relatively low discount rate for a further period in time, resulting in decreasing impatience.

I already coined the fact that the absence of constant impatience and the presence of hyperbolic discounting can be a driver for procrastination. There is already a lot of research on ways to overcome procrastination in for example gym attendance (Charness and Gneezy, 2009; Rohde & Verbeke, 2017; März, 2017). März introduced loss aversion to be a possible solution to decrease procrastination and Epper, Fehr-Duda & Bruhin (2009) show in their working paper that risk preferences may also play a role in the magnitude of time discounting. Steel (2007) already did a lot of research on procrastination but also pointed out that procrastination is a problem that grows over time and that research regarding procrastination is far from finished. Steel states that problems concerning procrastination and self-control are increasing, Steel did not research the effect of loss aversion, or risk attitude on procrastination and time-inconsistent behaviour. In previous research smoking and not exercising are also introduced as being self-control problems (Ariely & Wertenbroch, 2002), but is there a connection between these self-control problems and time-inconsistency? In this paper, I will shed some light on how self-control problems relate to procrastination, as a connection has not been thoroughly found/researched before. This has resulted in the following research question:

*How does procrastination relate to other self-control problems and behavioural characteristics?*

Procrastination will be measured using the pure procrastination scale, introduced by Steel (2010). Demographic variables will be used as control variables. Other behavioural characteristics and self control problems that will be addressed are loss aversion, risk attitude, ambiguity aversion, decreasing impatience, smoking behaviour and exercise habits.

The research question will be answered using an experimental survey conducted through Qualtrics. The data will be analysed using statistical software (Stata). In section two, the used literature will be elaborated further, and the to-be-researched hypotheses will be discussed. In the third section the experimental design will be discussed in depth, followed by the research method in section four. In section five the results will be discussed followed by the interpretation and discussion in section six and the conclusion in section seven.

## **2. Literature review**

In the literature review section, prior research and relevant behavioural concepts will be elaborated in the first sub-section, the behavioural concepts will all be related to procrastination. The to-be-discussed concepts are: procrastination, (discounted) utility, risk aversion, decreasing impatience, the endowment effect, loss aversion and ambiguity. In the second sub-section these behavioural characteristics will be used to formulate the to-be-researched hypotheses.

### **2.1. Prior research and characteristics**

#### **2.1.1. Procrastination**

As previously mentioned, procrastination is a self-control problem (Laibson, 1997) that can result in time-inconsistent behaviour. Procrastinating is on purpose delaying or postponing tasks that need (immediate) attention, for example going to the gym. Procrastination can be caused by the presence of a hyperbolic discount rate and the absence of constant impatience. Because of this hyperbolic discount rate, which will be explained later, an individual can overvalue present costs and undervalue future benefits in for example exercising. According to Steel (2007) procrastinating is a voluntary choice, and an individual is aware that the choice to procrastinate will in the end affect his/her utility in a negative way. Steel states that procrastination is a problem that can be found in 3000-year-old literature and that it is a problem that still is not solved. He also states that problems regarding procrastination, temporal discounting and other self control problems are rising in frequency. These problems should be understood better.

#### **2.1.2. Procrastination in gym attendance**

Charness and Gneezy (2009) tried to find a way to decrease procrastination in going to the gym, by boosting gym attendance and creating a habit. They saw higher gym attendance when the participants in their experiment were paid to attend a gym. Rohde and Verbeke (2017) also researched the use of positive financial incentives, to raise gym attendance and stop procrastination. A positive influence is found, yet the magnitude of their results is small. Oliver März (2017) did a similar research, only he differed in the framing of the rewards of



gym attendance. Subjects in März' research had to pay money when before agreed upon attendance levels weren't met. This increased the attendance level of participants compared to participants who were rewarded when attendance levels were met. In the research of März, the existence of loss aversion is presented as a possible solution to overcome procrastination.

### **2.1.3. (Expected) utility and risk preferences.**

A reason why some decisions are procrastinated is because at the moment the decision is made, the choices can be valued differently than at an earlier point in time. But how are decisions made and valued, and how are they ranked by each individual decision maker? Utility is used to measure the total satisfaction that an individual receives from consumption of any good or service. Utility is discussed by Milton Friedman and L. J. Savage (Friedman & Savage, 1952) to be a measure that is used to value decisions. Not only certain goods could be ranked on a scale of utility, but also different choices each yielding a different risk and payoff. To calculate the expected utility, on which choices are normally based, the utility of a payoff is multiplied with the probability of receiving this payoff (Mongin, 1997). Each individual has his own utility function used to calculate their utility, utility functions are usually not known.

The curvature of a persons' utility curve can be used to derive a person's risk attitude (Weber, Blais, & Betz, 2002). A concave utility function indicates that a person is risk averse (Rabin, 2013), a convex utility curve indicates risk seeking preferences, and a linear utility curve indicates risk neutral preferences. According to Epper, Fehr-Duda & Bruhin (2009) risk preferences play a role in time discounting.

### **2.1.4. Discounted Utility and hyperbolic discounting**

Utility, as is discussed in the previous sub-section, can be calculated for different choices each yielding different outcomes and different risk, but utility can also be calculated for choices at different points in time. Utility is discounted over time when inter-temporal choices need to be made (Bleichrodt & Gafni, 1996). The discount rate used in the discounted utility model reflects a persons' preferences regarding inter-temporal consumption choices (Frederick, Loewenstein, & O'donoghue, 2002). Receiving an amount of X now should result in more utility than receiving X at a later point in time, hence discount rates are usually positive. Because a constant discount rate doesn't always give a true view of an individuals'

preferences, a variable discount rate can be used. The biggest downside of using a variable discount rate, is according to Bleichrodt and Gafni (1996) that an individual can show time inconsistent behaviour because of a changing discount rate. This is the case when the same choice is valued differently at a different point in time and yields two different levels of utility.

A variable discount rate can be a hyperbolic discount rate, a term coined by Laibson (1997) that is used to explain a variable discount rate. A hyperbolic discount rate is relatively high over a short horizon of time and low for periods of time that are further away. According to Laibson, time inconsistent behaviour can be caused by having a hyperbolic discount rate, as will be discussed in the next subsection.

#### **2.1.5. Decreasing impatience**

Decreasing impatience is a term coined by Prelec (2004) which can be caused by a hyperbolic discount rate. Decreasing impatience occurs in decisions where an individual has to make a choice between the same two options at two different points in time. Imagine a choice between for example receiving 100 euros now, and 120 euros in one month, and a second choice between 100 euros in a year, and 120 euros in a year and a month. If the same option (e.g. 100) is chosen for both choices, an individual is constantly impatient. If the sooner option is preferred over the later option in the first choice, and the later option is preferred over the sooner option in the second choice, an individual is decreasingly impatient. If the later option is preferred over the sooner option in the first choice, and the sooner option is preferred over the later option in the second choice, an individual is increasingly impatient. Decreasing impatience can be a result of a hyperbolic discount rate and can be a factor in causing procrastination because of changing time-preferences. If an individual now picks the 120-euro-option in a year and a month from now, but, when a year has passed the individual can choose again between 100 now and 120 in a month and he/she picks the 100-euro-option, then this individual is proven to be decreasingly impatient. This indicates time inconsistency because this individual changed his/her choices over time.

### **2.1.6. The endowment effect**

In their 1991 paper, Kahneman, Knetsch and Thaler (1991) present the endowment effect through an experiment using coffee mugs. For this experiment, the participants were divided into three groups, the mug sellers, the mug buyers and the choosers. The sellers were each given a mug and were asked if they would be willing to sell their mug for each price in the 0.25 to 9.25 range. The buyers in the experiment were asked whether they were willing to buy, for each price in the same range as the sellers. The choosers were asked for the same range of prices, whether they would prefer the mug or the money in each option. Kahneman, Knetsch and Thaler found the existence of the endowment effect, meaning that goods are valued higher when they are in a persons' possession (WTA), compared to when they are to be acquired (WTP). They found in their research sample that coffee mugs were valued on average twice as high by the sellers (WTA), opposed to the buyers (WTP) and choosers, who valued the mugs almost equally. This experimental output, the endowment effect, indicates the existence of loss aversion, because giving up a good seems to yield some kind of disutility. Loss aversion can best be explained using the value function introduced by Tversky and Kahneman (1984;1991).

### **2.1.7. Loss aversion**

Loss aversion is a behavioural characteristic that can influence people's choice behaviour. Tverksy and Kahneman (1984;1991) used a value function to display how certain choices are made. This value function has a reference point in the middle, an example of a value function can be found in appendix A. This asymmetric s-shaped value function is concave for gains and convex for losses. This value function has diminishing sensitivity for gains and for losses and is used to explain loss aversion. Because of loss aversion, a loss of X will have a bigger impact on the value than an equally sized gain, the threat of losing X is therefore valued heavier than the gain of X. The framing of decisions can hence influence the outcome. Because each individual has a different value function and therefore a different magnitude of loss aversion, each individual makes decisions based on his/her own behavioural characteristics.

### **2.1.8. Ambiguity**

Ambiguity aversion is a behavioural anomaly that can also influence a persons' choices. It can best be explained by a choice where probabilities of outcomes aren't specified. A clear

example of ambiguity can be displayed using the Ellsberg paradox (Ellsberg, 1961). To reveal a subjects' attitude towards ambiguity, a subject is asked to answer two questions in the same setting; There are two urns, each urn contains 100 balls which are black and red. In the first urn there are 50 red balls and 50 black balls, and in the second urn, the distribution is unknown. In the first question, the subjects are told they can win 100 euro's if they pick a red ball, and asked from which urn they would want to pick a ball. In the second question, the same is asked for a black ball. If a subject picks urn 1 in both choices, it is proven that this subject is ambiguity averse, and doesn't like uncertainty. If the first urn is chosen twice in the Ellsberg Paradox, a persons' preferences are inconsistent with expected utility theory (Fox & Tversky, 1995). If an individual chooses a red ball to be picked from urn 1, this individual believes that the second urn contains less red balls compared to black ones. And therefore, if this individual is asked to pick a black ball, the second urn should be chosen, if this is not the case, expected utility theory is violated.

## **2.2. Research hypotheses**

In the next sub-section of the literature review, the to-be-researched hypothesis will be discussed. These hypotheses will be formed using the previously discussed literature and behavioural characteristics.

### **2.2.1. The effect of (decreasing) impatience on procrastination**

As I already mentioned in the introduction, violating constant impatience could be a driver for procrastination, something that is already shortly discussed in previous literature (Prelec, 2004). But to test whether there is a real connection between decreasing impatience and procrastination, in this research, the following hypotheses will be tested:

*H1a: People who are more impatient, procrastinate more.*

*H1b: Procrastinators will have a higher degree of decreasing impatience.*

### **2.2.2. The impact of risk attitude**

With the use of a persons' utility function, a utility curve can be plotted. A persons' risk attitude can be derived from the shape of a persons' utility curve (Weber, Blais, & Betz, 2002). Kahneman and Tversky (1984) define risk preferences in three different attitudes, risk averse (1), where a sure gain of, for example, 100 is preferred over the gamble with the same expected value. Risk neutral (2), where the subject is indifferent between winning 100 for sure and a gamble with an expected value of 100. And risk seeking (3), where a subject prefers the riskier gamble over the sure gain with the same expected value. MacCrimmon and Wehrung (1990) researched the risk attitudes of business executives using 13 different risk measures and 11 socioeconomic variables, analysed through factor analysis and linear discriminant analysis. They found that the most successful executives are risk seeking and that the most risk averse executives were the most mature executives. According to Epper, Fehr-Duda & Bruhin (2009) risk preferences play a role in time discounting. And I expect more mature individuals to be more cautious and to better evaluate their decisions and therefore procrastinate less. The expectations in my paper are therefore, that subjects who procrastinate are more risk seeking than people who do not procrastinate. Putting a task off into the future is riskier than doing it now, hence the second hypothesis is formulated as follows:

*H2: People who are more risk seeking tend to procrastinate more.*

### **2.2.3. The effect of ambiguity aversion**

Ambiguity aversion is a behavioural anomaly influencing choices. It can best be explained by a choice where probabilities of at least one outcome aren't specified. A clear example of ambiguity aversion can be displayed using the Ellsberg paradox (Ellsberg, 1961). If the first urn is chosen twice in the Ellsberg Paradox, a persons' preferences are inconsistent with expected utility theory (Fox & Tversky, 1995) and this individual is possibly ambiguity averse. People who are ambiguity averse, commonly select choices with known probabilities. Because there is no clear link made in previous research between ambiguity aversion and procrastination, I will not base my hypothesis on previous research. This hypothesis will be included because it can be of additional value to the research because other behavioural

characteristics and self control problems are also assessed. The hypothesis regarding ambiguity will be different from other hypotheses as the possible effect of ambiguity aversion on procrastination will be researched.

*H3: Ambiguity aversion is related to procrastination.*

#### **2.2.4. The effect of loss aversion**

März (2017), in his research, presented the existence of loss aversion to be one of the factors able to decrease procrastination. Loss aversion was used to incentivise participants to attend the gym more often, as going to the gym is proven to be an activity that is often procrastinated (Acland & Levy, 2011). März (2017) found in his research, that the use of framing and loss aversion worked to overcome procrastination in going to the gym. Because März found a connection between procrastination and loss aversion, I would like to further research this connection and its direction. To test whether loss aversion is related to procrastination, the following hypothesis is formulated:

*H4: loss aversion is related to procrastination.*

#### **2.2.5. The effect of a healthy lifestyle**

Smoking and Exercise are two different factors that can have a lot of influence on a persons' health. Where usually smoking has a negative influence on health (Seymour, 2017) and exercise has a positive influence on health (World Health Organization, N.D.). I Expect that people who do not smoke, and people who exercise, to procrastinate less. Smoking and not exercising enough are in previous research both identified as self-control problems (Ariely & Wertenbroch, 2002). Non-smokers are aware of the big 'costs' of smoking in the future and decide not to go for a small 'gain' (the pleasure of smoking a cigarette) right now. For people who exercise on a regular basis, small cost now (visiting a gym to exercise) and large gains in the future are preferred over the small gain of not exercising now, and the big cost of being less healthy in the future. Based on this theory, the following hypotheses are formulated:

*H5a: People who do not smoke procrastinate less.*

*H5b: People who exercise more procrastinate less*

*H5c: People who do not smoke and exercise regularly procrastinate less*

### **2.2.6. The effect of educational level**

In April of this year (2018) an article on procrastination was published in the Dutch newspaper “de volksrant” (Vermeulen, 2018). This article stated that students (people who follow a high level of education) are among the worst procrastinators. This contradicts Burks et, al. (2009) who found that subjects with higher cognitive skills, mostly measured through IQ, took more calculated risks and better evaluated their decisions. Something that is also confirmed by Steel (2007) who stated that people should procrastinate less as they age and learn. To test whether it is true that more highly educated individuals procrastinate less, the following hypothesis is formulated:

*H6: people with a higher level of education tend to procrastinate less.*

In the research for these hypotheses, it is believed that more intelligent people, in this case, the people who completed a higher level of education better overthink their decisions and are therefore believed to act more rational.

### **2.2.7. The total effect on procrastination**

For the final hypothesis, the joint effect of all pre-discussed behavioural characteristics, anomalies and self-control problems on procrastination will be tested. All variables that will be included are, the DI-index, impatience, risk attitude, ambiguity aversion, loss aversion, smoking habits and exercise behaviour. Separate regressions will be used each including either impatience or the Di-index. The hypothesis that will be researched is as follows:

*H7: All behavioural characteristic variables included in this research will have a joint effect on procrastination.*

For each of the pre-discussed hypotheses control variables for age, gender, current occupation and educational level will be added to expand the model. The research methods for all hypotheses will be discussed in the methods sections of this paper.



### **3. Experimental design**

All Data that will be used in this research will be obtained by the use of an experimental survey conducted through Qualtrics. This survey will be distributed online and in-person (on the Erasmus University campus) but will always be completed on a data carrying device using Qualtrics (e.g. tablet or laptop). For the experiment, there will be no restrictions on participation, but there will be a demographical variable separating students, working class and retired participants, as Klassen et, al. (2008), found students to very likely have similar procrastination tendencies. The order of the survey will be partly randomized. The participants will start with the most important variable, the pure procrastination scale, and end with the demographic questions. The rest of the questions will all show in between, in randomized order.

#### **3.1. Demographic variables**

The survey participants will be asked a number of demographical questions and they will be asked a number of experimental questions. The demographical variables that will be used in this research are: age, on a ratio scale. Gender, on a nominal scale. Smoking habit, on an ordinal scale, with: Never smoked (1), used to smoke (2), occasional smoker (3), current smoker (4) and as a dummy variable, indicating a smoking habit or not. Level of education, on an ordinal scale with: High school (1), MBO (practical education) (2), HBO (University of applied science) (3), University Bachelor (4), University master (5), PhD (6). The average amount of exercise in a regular week, on a ratio scale. And current occupation, on a nominal scale, creating a difference between students (1), gap year (2), starters (3), working (4) and retired (5).

#### **3.2. Experimental variables**

##### **3.2.1. Procrastination**

The first experimental variable that will be collected will be an interval variable indicating procrastination. Procrastination will be measured according to the pure procrastination scale introduced by Steel (2010). This is a set of 12 questions that will be answered on a 7 point Likert scale. These 12 answers combined will reveal a persons' level of

procrastination, with a minimum score of  $(12 \times 1 =)$  12 and a maximum score of  $(12 \times 7 =)$  84. The questions are presented in the table below. For this variable, a higher outcome means a person procrastinates more than someone with a lower outcome.

<b>Pure Procrastination Measures</b>	
1	I delay making decisions until it's too late
2	Even after I make a decision I delay acting upon it
3	I waste a lot of time on trivial matters before getting to the final decisions
4	In preparation for some deadlines, I often waste time by doing other things
5	Even jobs that require little else except sitting down and doing them, I find that they seldom get done for days
6	I often find myself performing tasks that I had intended to do days before
7	I am continually saying "I'll do it tomorrow"
8	I generally delay before starting on work I have to do
9	I find myself running out of time
10	I don't get things done on time
11	I am not very good at meeting deadlines
12	Putting things off till the last minute has cost me money in the past

### **3.2.2. Loss aversion**

The second experimental variable is an interval variable indicating loss aversion, where a higher value yields more loss aversion. Loss aversion will be calculated using a choice list (Holt & Laury, 2002) where 11 different dilemmas are proposed. A similar method to reveal a persons' loss aversion has been used by (Schmidt & Traub, 2002). The left row of the list is the same throughout all dilemmas and contains a sure gain of 5 euros. In the right row, there is a 50/50 bet between a sure gain of 15 and a loss of 10, where the loss of 10 decreases in steps of 1 to a loss of 0 for the last choice. An individuals' switching point towards the right row will be used as a variable indicating loss aversion.

### **3.2.3. Risk attitude**

The third experimental variable that will be used is an interval variable indicating risk attitude. The measure that will be used to measure risk attitude will be a choice list. (Holt & Laury, 2002) where 15 choices will be proposed, choice A will be a 'safe' and fixed bet and choice B will be a risky bet. The amount that can be won will be 100 euros with 75% chance for choice A and 300 euros for choice B. The risk in choice B will start at a 5% chance to win 300 euros, growing in 5%-steps until 300 can be won with a 75% chance. Each subjects' switching point will be used as a measure for risk preference. An early switching point will indicate a more risk seeking preference, and a late switching point will indicate a more risk averse preference.

### **3.2.4. Ambiguity**

The fourth experimental variable that will be used in this research is a nominal variable indicating ambiguity aversion calculated through an Ellsberg paradox (Ellsberg, 1961). To reveal a subjects' attitude towards ambiguity, a subject is asked to answer two questions in the same setting; there are two urns, each urn contains 100 balls which are black and red. In the first urn there are 50 red balls and 50 black balls, and in the second urn, the distribution is unknown. In the first question, the subjects are told they can win 100 euro's if they pick a red ball, and asked from which urn they would want to pick a ball. In the second question, the same is asked for a black ball. If a subject picks urn 1 in both choices, it is proven that this subject is ambiguity averse, and doesn't like uncertainty. If an individual chooses a red ball to be picked from urn 1, this individual believes that the second urn contains less red balls compared to black ones. And therefore, if this individual is asked to pick a black ball, the second urn should be chosen, if this is not the case, expected utility theory is violated. If an individual picks urn 2 in both cases, expected utility is also violated and a person is considered to be ambiguity seeking.

### **3.2.5. DI-index**

The fifth experimental variable that will be obtained will be a person's Di-index. The Di-index will be calculated using two indifferences stated by the survey participants (Rohde, 2017). The DI-index can be zero, positive, or negative. A DI-index of zero indicates constant

impatience, and a deviation from zero indicates decreasing impatience if the deviation is positive and increasing impatience if the deviation is negative.

The indifferences that are used to calculate the DI-index are as follows: in the first indifference, the participant is asked to state their indifference between receiving a 1000 euros in 5 months or receiving 1500 euros in  $t$  months. For this indifference the person gets a drop-down list to choose a value for  $t$ , which should always be at least as high as 5, indicating a lower number will not be possible. For the second indifference the participant is asked to choose between receiving a 1000 euros in 11 months or receiving 1500 euros in  $q$  months, and again a drop-down list will be shown to choose a value for  $q$ , which should be at least as high as 11. After these indifferences are filled in, the DI-index can be calculated using the following formula (Rohde, 2017), where ' $t$ ' from the description of the first question will be subtracted from ' $q$ ' in the second question to find ' $\tau$ ' which is used to calculate the DI-index, as well as ' $\sigma$ ' which has a value of 6 (11-5). The respective outcomes of 1000 and 1500 are represented by ' $x$ ' and ' $y$ '.

$$DI\_Index = \frac{\tau - \sigma}{\sigma(t - s)}$$

All these variables can be calculated using the mathematical formulation of both indifferences which are formulated as follows:

$$(s, x) \sim (t, y) \tag{1}$$

$$(s + \sigma, x) \sim (t + \tau, y) \tag{2}$$

In the following representation of the DI-index formula, all 'fixed' values are already filled in and only the variable values are denoted by ' $t$ ' and ' $q$ '.

$$DI\_Index = \frac{q - t - 6}{6(t - 5)}$$

### 3.2.6. Impatience

With the use of the data collected to calculate the DI-index, a person's level of impatience can also be calculated. This variable will be used to test the effect of impatience on procrastination for the first hypothesis. To display a person's level of impatience, the monthly discount rate will be calculated for both indifferences, and the average of these two will be chosen. The monthly discount rate will be calculated using the following formula:

$$x * (1 + r)^n = y \quad (3)$$

In this formula, 'x' and 'y' represent the same values as in the DI-index calculations, 1000 and 1500 respectively. 'r' represents the to-be-calculated monthly discount rate and 'n' represents the number of months between receiving both amounts of money at the indifference point. This formula will be solved for 'r' for each individual for both of the dilemmas to calculate their level of impatience.

## 4. Research Method

In the following section, the research method for each of the hypothesis will be elaborated in detail.

### 4.1. H1 – The effect of (decreasing) impatience

For the first hypotheses, the effect of impatience and decreasing impatience on procrastination will be tested using a robust OLS regression. The choice is made to use a robust OLS regression because an OLS regression fits the dependent and independent variables best, and a robust regression reduces the error term because it puts less weight on outliers (UCLA Statistical Consulting Group, N.D.). A similar research method is used by Rohde and Verbeke (2017). At first, the effect of impatience will be tested on procrastination (1a). Thereafter effect of decreasing impatience on procrastination will be tested (1b). The following regression equation will be used to test for the first hypothesis:

$$PPSi = \alpha_i + \beta_{1i} * IMPi + \epsilon_i \quad (1a)$$

In this regression equation, PPS is the pure procrastination measure for each individual  $i$ , IMP is the impatience measure for each individual  $i$ . To further expand this model, demographical variables for age, gender, current occupation and educational level will be added to the regression, this holds for all hypotheses that will be discussed in this section.

To test for the effect of the DI-index on procrastination, the following regression equation will be tested:

$$PPSi = \alpha_i + \beta_{1i} * DI\_Indexi + \epsilon_i \quad (1b)$$

In this regression equation, DI\_Index represents the DI-index for each individual  $i$ .

#### 4.2. H2 – The impact of risk attitude

For the second hypothesis, the effect of risk attitude on procrastination will be tested using a robust OLS regression. The regression equation that will be tested for this hypothesis is as follows:

$$PPSi = \alpha_i + \beta_{1i} * RAI + \varepsilon_i \quad (2)$$

In this regression equation, RA stands for risk attitude for person i as explained in the previous section.

#### 4.3. H3 – The effect of ambiguity aversion

For the third hypothesis, the effect of ambiguity aversion on procrastination will be tested using a robust OLS regression. The regression equation that will be tested for this hypothesis is as follows:

$$PPSi = \alpha_i + \beta_{1i} * AAVi + \varepsilon_i \quad (3)$$

In this regression equation, AAV represents the dummy variable indicating whether a person is ambiguity averse.

#### 4.4. H4 – The effect of loss aversion

For the fourth hypothesis, the effect of loss aversion on procrastination will be tested using a robust OLS regression. The regression equation that will be tested for this hypothesis is as follows:

$$PPSi = \alpha_i + \beta_{1i} * LAVi + \varepsilon_i \quad (4)$$

In this regression equation, LAV represents a persons' magnitude of loss aversion.

#### 4.5. H5 – The effect of smoking and exercise

For the fifth hypotheses, the effects of smoking and exercise on procrastination will be tested using a robust OLS regression. First, the effect of smoking on procrastination will be tested. The regression equation that will be tested for this hypothesis is as follows:

$$PPSi = \alpha_i + \beta_{1i} * SmokeDumi + \epsilon_i \quad (5a1)$$

In this regression equation, SmokeDum represents whether person i is a smoker or not. To further expand this model, demographical variables for age, gender, current occupation and educational level will be added. After the test with a binary smoking variable, a second regression equation regarding smoking habit will be tested. This regression equation will look as follows:

$$PPSi = \alpha_i + \beta_{1i} * i.SmokeHabiti + \epsilon_i \quad (5a2)$$

In this regression equation, SmokeHabit displays a persons' smoking habit, testing for a difference in smoking habits.

For the following hypothesis, the effect of exercise on procrastination will be tested using a robust OLS regression. The regression equation that will be tested for this hypothesis is as follows:

$$PPSi = \alpha_i + \beta_{1i} * Exnumi + \epsilon_i \quad (5b)$$

In this regression equation, Exnum represents the number of times a person exercises in a regular week.

The following hypotheses will be a combination of the hypotheses we saw in in 5a and 5b. For this hypotheses the effect of not smoking and exercise on procrastination will be tested using the following regression equation:

$$PPSi = \alpha_i + \beta_{1i} * SmokeDumi + \beta_{2i} * Exnum + \epsilon_i \quad (5c1)$$

$$PPSi = \alpha_i + \beta_{1i} * i.SmokeHabiti + \beta_{2i} * Exnum + \epsilon_i \quad (5c2)$$



#### 4.6. H6 – The effect of education

For the sixth hypothesis, the effect of level of education on procrastination will be tested using a robust OLS regression. The regression equation that will be tested for this hypothesis is as follows:

$$PPSi = \alpha_i + \beta_{1i} * EDULi + \epsilon_i \quad (6)$$

In this regression equation, EDUL represents a persons' educational level.

#### 4.7. H7 – The total effect on procrastination

For this last and final hypothesis, the joint effect of all pre-discussed behavioural characteristics will be tested. The regression equations that will be used to test the joint effect will be:

$$PPSi = \alpha_i + \beta_{1i} * DI_{Indexi} + \beta_{2i} * RAI + \beta_{3i} * AAVi + \beta_{4i} * LAVi + \epsilon_i \quad (7a)$$

$$PPSi = \alpha_i + \beta_{1i} * IMPi + \beta_{2i} * RAI + \beta_{3i} * AAVi + \beta_{4i} * LAVi + \epsilon_i \quad (7b)$$

After the first model regression is ran with only the behavioural characteristics, the self control problems will be added to the model, followed by all pre-discussed control variables.

## **5. Results**

In the results section, at first the data will be described, second, a Spearman rank correlation will be performed. I have chosen to use a Spearman rank correlation because variables on the ordinal scale can be used and relations between variables do not have to be linear (Hauke & Kossowski, 2011). Thereafter the regression analyses for each hypothesis will be executed and shortly discussed.

### **5.1. Descriptive statistics**

#### **5.1.1. Demographical variables**

The amount of participants who completed the survey experiment is 102, with 41.2% of the participants being male, and an average age of 30.9 years. Most participants (34) indicated a bachelors' degree, followed by a masters' degree (25) and University of applied science (24), 14 participants indicated 'M.B.O.', 4 indicated high school, and 1 participant indicated a PhD. Only 31.4% of the participants is a smoker, and the average amount of weekly exercise is 2.3 times a week. 62 of the participants are students, 35 are working of whom 4 considers themselves 'starters', 4 are retired and only 1 is currently taking a gap year. Detailed descriptive statistics and tabulations can be found in appendix B. Because the current occupation variable almost only contains students and working people, the choice was made to use this variable to create a 'student' dummy.

#### **5.1.2. Experimental variables**

For a detailed overview of all characteristics of the experimental variables, you are directed to appendix B. The average pure procrastination scale is 43.2, 3 observations were omitted due to insufficient response. The risk aversion measure has an average of 8 and the loss aversion measure has an average of 5.4, 71 participants are ambiguity averse, the average impatience measure is 0.040 and the average di-index is 0.077. 41% of the participants are found to have increasing impatience, 17% are found to have constant impatience and 42% are decreasingly impatient. The number of observations differs between the experimental variables; this is due to the fact that some observations were omitted due to insufficient response.

## 5.2. Spearman rank correlation

A Spearman rank correlation analysis is used to reveal any relationships between variables. A Significant relation at the 5% level is found between the pure procrastination scale and impatience. Significant relations at the 1% level are found between the pure procrastination scale and age, the smoke dummy and current occupation. Other interesting correlations (the significance levels are indicated as follows: \*=10%, \*\*=5% and \*\*\*=1% significance) are 0.308\*\*\* between risk aversion and loss aversion, 0.270\*\* between loss aversion and ambiguity aversion, -0.247\*\* between loss aversion and impatience, -0.226\*\* between risk aversion and the DI-index and 0.193\* between risk aversion and amount of exercise. An overview of all correlations, significant at at least the 10% level, will be displayed in appendix C.

## 5.3. Regression output

In the following sub-section, all regression output will be discussed, for each regression that is discussed in the methodology section, a separate table with results will be displayed. In this table, the first regression will just be the dependent variable and the independent variable(s), and after that one demographical variable will be added in each column.

### 5.3.1. H1 – The effect of (decreasing) impatience

Testing for the first hypothesis resulted in the following regression output. As can be seen in Table H1A, impatience on its own does not have a significant effect on procrastination and the adjusted  $R^2$  in this simple model is very small. The fifth model, with all demographical variables added fits the data best because age, educational level and the student dummy all have a significant effect on procrastination, this is also the model with the smallest standard deviation and highest adjusted  $R^2$ .

Table H1A

	1	2	3	4	5
Constant	43.644***	55.904***	54.946***	61.281***	53.986***
Impatience	-10.168	45.066	58.196	41.488	37.446
Age		-0.470***	-0.486***	-0.523***	-0.337**
Male			2.153	2.154	2.375
Educational level				-1.241	-2.185*
Student					8.292**
N	99	99	99	99	99
Adjusted R-Squared	-0.010	0.225	0.223	0.224	0.250
Root MSE	13.604	11.916	11.932	11.926	11.722

\*= significant at the 10% level

\*\* = significant at the 5% level

\*\*\* = significant at the 1% level

In table H1B, the results of regression analysis 1b are displayed. It can be seen that the DI-index on its own does not have a significant effect on procrastination, but when age is added to the model, the effect of the di-index on procrastination is significant. The model that fits the data best is the fifth model, with significant coefficients for the Di-index, educational level and the student dummy, and the highest adjusted R<sup>2</sup>.

Table H1B

	1	2	3	4	5
Constant	43.850***	55.200***	54.732***	63.625***	53.587***
Di-index	0.836	2.782***	2.581**	3.406**	4.079***
Age		-0.388***	-0.397***	-0.450***	-0.217
Male			1.672	1.864	2.016
Educational level				-1.975	-2.863**
Student					9.553**
N	81	81	81	81	81
Adjusted R-Squared	-0.012	0.132	0.125	0.139	0.175
Root MSE	13.171	12.198	12.249	12.152	11.895

\*= significant at the 10% level

\*\* = significant at the 5% level

\*\*\* = significant at the 1% level

### 5.3.2. H2 – The impact of risk attitude

Table H2 displays the results of the second hypothesis. Risk aversion in every model does not have a significant effect on procrastination. But the most extensive model has the highest explanatory power with significant effects for age, educational level and the student dummy on procrastination.

	1	2	3	4	5
Constant	38.612***	54.612***	53.715***	60.316***	54.479***
Risk Aversion	0.580	0.383	0.417	0.399	0.269
Age		-0.467***	-0.488***	-0.533***	-0.364***
Male			3.158	3.274	3.333
Educational level				-1.397	-2.229*
Student					7.581*
N	96	96	96	96	96
Adjusted R-Squared	0.006	0.243	0.248	0.252	0.272
Root MSE	13.471	11.751	11.712	11.681	11.527

\*= significant at the 10% level  
 \*\* = significant at the 5% level  
 \*\*\* = significant at the 1% level

### 5.3.3. H3 – The effect of ambiguity aversion

In Table H3, the effect of ambiguity aversion on procrastination is displayed. Ambiguity aversion does not have a significant effect on procrastination, even when more demographical variables are added the coefficient remains insignificant. The model with most demographical variables has the highest adjusted  $R^2$  and the lowest standard deviation, with significant coefficients for age, educational level and the student dummy.

Table H3

	1	2	3	4	5
Constant	40.710***	55.241***	54.643***	60.953***	52.934***
Ambiguity Aversion	3.687	3.173	3.342	3.455	3.762
Age		-0.462***	-0.476***	-0.520***	-0.326**
Male			2.127	2.223	2.495
Educational level				-1.389	-2.370**
Student					8.655**
N	99	99	99	99	99
Adjusted R-Squared	0.006	0.235	0.233	0.237	0.266
Root MSE	13.495	11.838	11.853	11.826	11.595

\*= significant at the 10% level

\*\* = significant at the 5% level

\*\*\* = significant at the 1% level

#### 5.3.4. H4 – The effect of loss aversion

In table H4, the results of the 4<sup>th</sup> hypothesis are shown. Loss aversion does not have any significant effect on procrastination, but the most extensive model has the highest explanatory power and lowest standard deviation, and significant coefficients for age, educational level and the student dummy.

Table H4

	1	2	3	4	5
Constant	43.706***	58.117***	57.661***	65.202***	57.301***
Loss Aversion	-0.001	0.227	0.217	0.240	0.119
Age		-0.500***	-0.514***	-0.568***	-0.356***
Male			2.171	2.290	2.352
Educational level				-1.652	-2.673**
Student					9.359**
N	93	93	93	93	93
Adjusted R-Squared	-0.011	0.271	0.269	0.279	0.315
Root MSE	13.519	11.478	11.492	11.417	11.128

\*= significant at the 10% level

\*\* = significant at the 5% level

\*\*\* = significant at the 1% level

### 5.3.5. H5 – The effect of smoking and exercise

In the following tables, the effect of smoking behaviour and exercise habits will be elaborated. In the first table, table H5A1, that will be discussed a dummy variable is be used for people who smoke (on occasion). The smoke dummy has a significant effect on procrastination in every model, indicating that smokers do procrastinate significantly more compared to non-smokers. In the most extended model, significant coefficients are also found for age, educational level and the student dummy, as well as the highest adjusted R<sup>2</sup>.

	1	2	3	4	5
Constant	39.896***	53.388***	53.402***	59.020***	51.561***
Smokedum	10.354***	7.765***	7.837***	7.731***	7.706***
Age		-0.412***	-0.410***	-0.450***	-0.265**
Male			-0.235	-0.131	0.115
Educational level				-1.210	-2.144*
Student					8.276**
N	99	99	99	99	99
Adjusted R-Squared	0.120	0.294	0.287	0.288	0.315
Root MSE	12.695	11.373	11.432	11.422	11.207

\* = significant at the 10% level

\*\* = significant at the 5% level

\*\*\* = significant at the 1% level

In table H5A2, the effect of smoking habits on procrastination is tested, for this analysis smoking habits were divided into: non-smokers (1), people who used to smoke (2), occasional smokers (3) and current smokers (4). In this regression, I used non-smokers as the base case because this group had most observations. As can be seen in table H5A2 below, occasional smokers and current smokers procrastinate significantly more than non-smokers, this effect continues throughout all models, where in the most detailed model, age, educational level and the student dummy also have a significant effect on procrastination.

Table H5A2

	1	2	3	4	5
Constant	40.931***	54.705***	54.732***	60.269***	52.667***
Smoking habit					
2 (used to)	-7.709**	4.817	4.828	4.638	4.110
3 (occasional)	9.614***	7.200**	7.294**	7.118**	6.693**
4 (current)	8.669*	9.871**	9.997**	10.004**	10.706***
Age		-0.472***	-0.470***	-0.507***	-0.314***
Male			-0.341	-0.241	-0.017
Educational level				-1.198	-2.175*
Student					8.506**
N	99	99	99	99	99
Adjusted R-Squared	0.129	0.288	0.281	0.282	0.311
Root MSE	12.634	11.418	11.478	11.470	11.238

\*= significant at the 10% level

\*\* = significant at the 5% level

\*\*\* = significant at the 1% level

Table H5B represents the effect of exercise on procrastination. In none of the models does exercise have a significant effect on procrastination. The fifth model does have the highest adjusted  $R^2$  and the lowest standard deviation, with significant coefficients for age, educational level and the student dummy.



Table H5B

	1	2	3	4	5
Constant	44.438***	58.365***	57.893***	63.663***	55.922***
Exercise Habit	-0.510	-0.375	-0.345	-0.272	-0.087
Age		-0.464***	-0.476***	-0.517***	-0.335**
Male			1.811	1.907	2.187
Educational level				-1.289	-2.250*
Student					8.260**
N	99	99	99	99	99
Adjusted R-Squared	-0.006	0.225	0.222	0.223	0.249
Root MSE	13.575	11.913	11.942	11.929	11.732

\*= significant at the 10% level

\*\* = significant at the 5% level

\*\*\* = significant at the 1% level

Table H5C1 captures the regression results in a model in which both the smoke dummy and the exercise habit are used. The smoke dummy still has a significant effect on procrastination, while exercise has no such effect in any of the models. The highest explanatory power was found in the most extensive model, which also has significant coefficients for age, educational level and the student dummy.

Table H5C1

	1	2	3	4	5
Constant	40.315***	53.715***	53.735***	59.143***	51.271***
Smokedum	10.277***	7.705***	7.780***	7.702***	7.754***
Exercise Habit	-1.68	-0.134	-0.135	-0.070	0.119
Age		-0.412***	-0.410***	-0.449***	-0.263**
Male			-0.249	-0.139	0.131
Educational level				-1.199	-2.172*
Student					8.368**
N	99	99	99	99	99
Adjusted R-Squared	0.112	0.287	0.280	0.280	0.308
Root MSE	12.757	11.430	11.490	11.482	11.263

\* = significant at the 10% level

\*\* = significant at the 5% level

\*\*\* = significant at the 1% level

In Table H5C2, the outcome of a regression analysis on procrastination with smoking habit and exercise behaviour as independent variables is shown. Exercise behaviour does not show a significant effect on procrastination in any model while smoking habit does. Occasional smokers and current smokers procrastinate significantly more than non-smokers, and in the most extensive model, age, educational level and the student dummy also have a significant effect on procrastination, this model also has the highest adjusted  $R^2$ .

Table H5C2

	1	2	3	4	5
Constant	41.078***	55.158***	55.191***	60.466***	52.377***
Smoking Habit					
2 (used to)	-7.673**	4.945	4.958	4.720	4.019
3 (occasional)	9.600***	7.155**	7.253**	7.095**	6.712**
4 (current)	8.626*	9.748**	9.878**	9.931**	10.788**
Exercise Habit	-0.061	-0.176	-0.178	-0.108	0.112
Age		-0.473***	-0.471***	-0.507***	-0.312***
Male			-0.357	-0.253	-0.002
Educational level				-1.180	-2.204*
Student					8.604**
N	99	99	99	99	99
Adjusted R-Squared	0.120	0.281	0.274	0.274	0.303
Root MSE	12.700	11.475	11.536	11.531	11.298

\* = significant at the 10% level

\*\* = significant at the 5% level

\*\*\* = significant at the 1% level

### 5.3.6. H6 – The effect of education

In this sub-section, the effect of educational level on procrastination will be discussed. The educational level variable is divided into 6 classes with: High school (1), MBO (practical education) (2), HBO (University of applied science) (3), University Bachelor (4), University master (5), PhD (6). In this regression, university bachelor is chosen as base case because university bachelor has the most observations. The regression output is displayed in table H6. In the first model, mbo, hbo and university master students procrastinate significantly less than university bachelors, but these coefficients become insignificant as soon as age is added as a control variable. PhD students and high school students procrastinate significantly more than university bachelors, according to models 2,3 and 4, but because only one survey participant indicated PhD and only four indicated high school, these results are not based on sufficient data. University master students procrastinate significantly less than university bachelors according to models, 1,3 and 4 of which model 4, the most extensive model has the highest adjusted  $R^2$ , as well as significant coefficients for age and the student dummy.

Table H6

	1	2	3	4
Constant	48.324***	59.605***	59.426***	49.471***
Educational level				
1 (high school)	5.676	8.514***	7.377**	9.327**
2 (mbo)	-13.157***	-1.495	-1.332	1.659
3 (hbo)	-9.324**	-3.897	-4.547	-2.142
5 (master)	-5.866*	-5.145	-5.756*	-5.929*
6 (phd)	-3.324	10.809***	9.458**	11.676***
Age		-0.471***	-0.487***	-0.344**
Male			2.398	2.433
Student				7.398*
N	99	99	99	99
Adjusted R-Squared	0.097	0.253	0.252	0.269
Root MSE	12.860	11.702	11.710	11.586

\* = significant at the 10% level

\*\* = significant at the 5% level

\*\*\* = significant at the 1% level

### 5.3.7. H7 – The total effect on procrastination

In the last two tables of this section, the total effect on procrastination by all behavioural characteristics and self control problems will be displayed. In the first table, the Di-index is used in the models and in the second table the impatience measure is used. These two variables are not used within the same regression because they are both computed from the same exact observations. The first table that will be discussed is table H7A, risk aversion and the DI-index both have significant coefficients in most models. With the significant risk aversion coefficient dropping out when the student dummy is added to the model. The most extended model has the highest explanatory power and the lowest standard deviation, with significant coefficients for the DI-index, the smoke dummy, educational level, and the student dummy.

In table H7B, impatience does not show any significant effect on procrastination, as well as any other of the behavioural characteristics, except for risk aversion which shows significant coefficients in model 2 and 3. The smoke dummy shows significant coefficients in every model, while exercise does not. The most extensive model has the highest explanatory power.

Table H7A

	1	2	3	4	5	6	7
Constant	40.541***	36.014***	37.198***	46.172***	56.131***	56.179***	47.315***
Di-Index	1.701	2.437**	2.073*	3.813***	3.798***	4.736***	5.580***
Risk Aversion	1.024*	1.106**	1.190**	1.089**	1.090*	1.036**	0.772
Ambiguity Aversion	1.715	1.627	1.776	1.661	1.684	2.093	2.036
Loss Aversion	-1.028*	-0.879	-0.885	-0.522	-0.522	-0.547	-0.641
Smokedum		9.170***	8.681***	7.066***	7.027**	7.032**	7.128**
Exercise habit			-0.693	-0.237	-0.236	-0.135	0.297
Age				-0.361***	-0.362***	-0.424***	-0.171
Male					0.125	0.630	0.369
Educational level						-2.206**	-3.299***
Student							10.630**
N	78	78	78	78	78	78	78
Adjusted R-Squared	0.005	0.112	0.107	0.235	0.224	0.249	0.299
Root MSE	12.789	12.080	12.115	11.214	11.294	11.114	10.735

\*= significant at the 10% level

\*\* = significant at the 5% level

\*\*\* = significant at the 1% level

Table H7B

	1	2	3	4	5	6	7
Constant	37.420***	32.052***	33.066***	45.053***	44.540***	51.415***	45.204***
Impatience	-8.762	23.243	16.665	95.189	102.755	86.193	79.035
Risk Aversion	0.705	0.798*	0.830*	0.566	0.564	0.532	0.381
Ambiguity Aversion	4.106	3.740	3.845	3.135	3.284	3.382	3.735
Loss Aversion	-0.342	-0.268	-0.294	0.0378	0.032	0.048	-0.031
Smokedum		10.034***	9.841***	7.010***	6.731**	6.618**	6.337**
Exercise habit			-0.380	-0.103	-0.059	0.011	0.219
Age				-0.447***	-0.459***	-0.502***	-0.313***
Male					1.285	1.377	1.583
Educational level						-1.355	-2.378**
Student							8.691**
N	78	78	78	78	78	78	78
Adjusted R-							
Squared	0.003	0.120	0.112	0.327	0.321	0.325	0.356
Root MSE	13.426	12.615	12.672	11.029	11.077	11.045	10.792

\* = significant at the 10% level

\*\* = significant at the 5% level

\*\*\* = significant at the 1% level

## 6. Interpretation and Discussion

In the following section, the experimental results will be reviewed and the research hypotheses will be answered followed by the research question. After which the research method, limitations and future recommendations will be discussed.

### 6.1. Interpretation

To answer the research question, first, all hypotheses will be discussed. For the first hypotheses the effect of impatience and decreasing impatience on procrastination are tested. Impatience does not have a significant effect on procrastination in any of the models, but the DI-index did have a significant (positive) effect on procrastination, indicating that people who are more decreasingly impatient are also bigger procrastinators.

For the second hypothesis, the effect of risk attitude on procrastination is researched, a significant relationship has not been found and the hypothesis is therefore not confirmed.

For the third and fourth hypothesis, the effect of respectively ambiguity and loss aversion on procrastination were researched, but a significant relationship was not found in for either hypothesis, these are therefore not confirmed.

For the fifth hypotheses, multiple regression models are tested. The main result from these hypotheses regarding exercise are that no significant relationship between exercise and procrastination is found in any of the models. For smoking habits, significant relationships are found. The smoke-dummy shows significant relations to procrastination and also when the exact smoking habits are tested, occasional smokers and current smokers show significant higher levels of procrastination compared to non-smokers.

For the sixth hypothesis, the effect of education on procrastination is tested. In the most extensive model, only master students show significantly less procrastination than bachelor students.

The seventh and last hypothesis tests all behavioural characteristics and self-control problems combined, in the first regression, including the DI-index, a significant coefficient is found for the DI-index as soon as age is added to the model, and for risk aversion a significant coefficient is found in all models except for the last one, both of these coefficients are positive. The smoking dummy shows significant coefficients in all models, while exercise

habit shows no significant coefficient in any of the models. In the second regression, including impatience, only risk aversion shows significant coefficients in the second and third model, all other behavioural characteristics show no significant coefficients. The smoking dummy again shows significant coefficients in all models, while exercise habits again does not show any significant coefficients.

To answer the research question (*How does procrastination relate to other self-control problems and behavioural characteristics?*) in this research only significant relationships between procrastination and decreasing impatience, procrastination and smoking habits, procrastination and educational level and procrastination and risk attitude (in some models) are found. It is interesting that a positive relationship has been found between decreasing impatience and procrastination. I also found that university bachelor students procrastinate significantly more than university master students. And current and occasional smokers procrastinate significantly more than non-smokers. A relationship between gender and procrastination has not been found in any of the models, and in most models, it is found that procrastination decreases with age and students procrastinate more than people who aren't students.

## **6.2. Discussion and Limitations**

This papers' research question covers the effect on procrastination of self-control problems and behavioural characteristics. For most behavioural characteristics (impatience, loss aversion, risk attitude and ambiguity aversion) no, or minor significant results have been found. Loss aversion and risk attitude were measured using choice lists containing 11 and 15 choices respectively. The switching points for these choice lists were used as an indicator of loss aversion or risk attitude. For future research I would propose different measures for at least loss aversion, to check if there is any effect between loss aversion and procrastination. This recommendation is made because the mean of both the loss aversion and the risk aversion measures were close to the middle of the choice list, this can be because the participants anchored towards the middle of the choice list, influencing the observations. Regarding risk attitude, a significant result on procrastination was found in the first six models



of hypothesis 7A, the significant effect dropped out as soon as the student dummy was added as a control variable.

Between ambiguity aversion and procrastination, no significant relationship was found. For further research, I recommend to measure ambiguity on an interval scale and not as a nominal variable to gain a better understanding of the effect of ambiguity aversion on procrastination. Moore and Eckel (2003) proposed a way to measure ambiguity using a choice list with 20 choices, resulting in a magnitude of ambiguity aversion.

Regarding the research sample, a more varied sample would be more similar to the real (Dutch) population. But because I did not use money as an incentive and I only distributed the survey on the Erasmus University campus and my own (social) network the sample is influenced. Most of these effects are controlled using demographic (control) variables. The smoking habit variable is skewed towards non-smoking, less than half of the research sample smokes. According to the American cancer society (2018), 26.2% of the Dutch population consumes tobacco on a daily bases. Also, the Educational level variable is skewed towards the higher educations (university of applied sciences and higher). For follow-up research, the education could be spread out between all levels of education. Education could also be measured by the total amount of years someone has had education. This way the variable is easier to use in regression analysis, but would also yield different results.

## 7. Conclusion

To conclude this paper, significant relationships are found between procrastination and decreasing impatience, procrastination and risk aversion, procrastination and smoking behaviour, procrastination and educational level, procrastination and age and procrastination and being a student. The results found in this study are as follows. When you age, you start to procrastinate less, when you are in your master's, you procrastinate less than students in their bachelors', when you are a student in general, you procrastinate more than non-students. But for some of these relations, the direction is not that clear. Procrastination and decreasing impatience are most likely both influenced by the presence of a hyperbolic discount rate, but this has to be proven in further research. And, is someone risk averse because he or she procrastinates? Or does someone procrastinate because he/she is risk averse? Does someone smoke because they are procrastinating? Or does someone procrastinate because he/she is a smoker? A relation between procrastination and exercise had not been found, this research did not find any proof that procrastinators attend the gym less than non-procrastinators.

Further research still needs to be done to better understand procrastination behaviour. But, in this research, I found some personal (behavioural) characteristics which resulted in more/less procrastination behaviour, these could be used to for example overcome procrastination among students or in gym attendance. As Steel (2007) stated procrastination is societal problem that needs solving.

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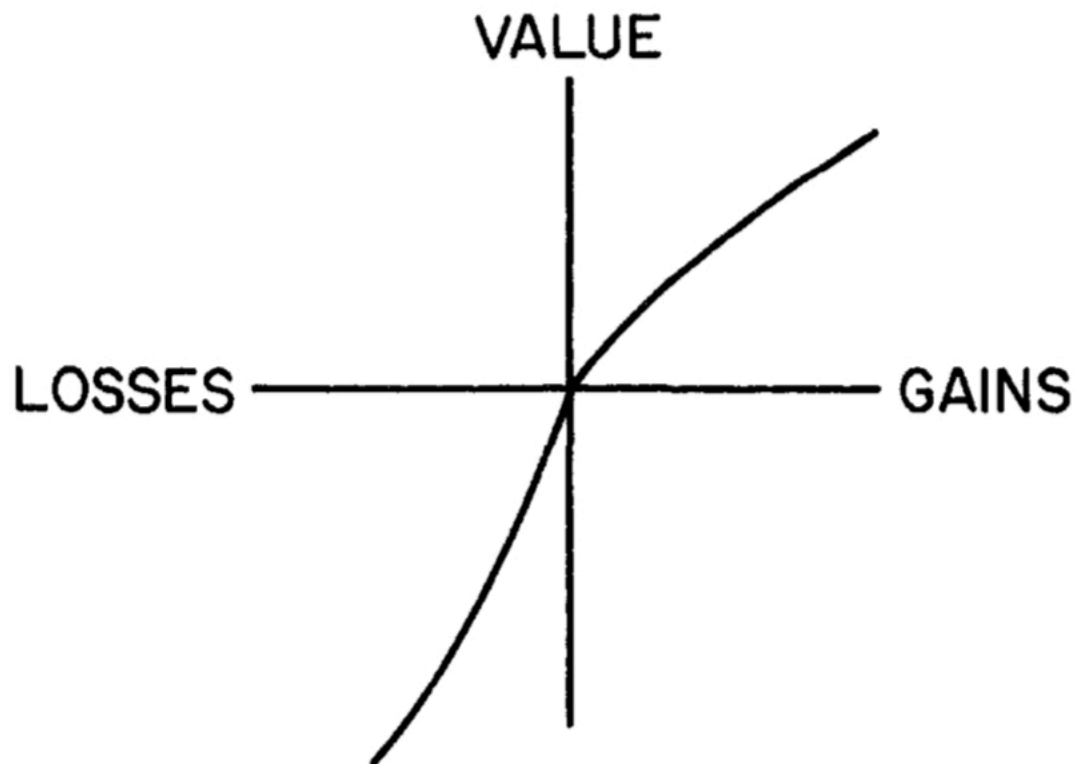
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## 9. Appendix

### Appendix A - Example of a value function (Kahneman & Tversky, 1984)



## Appendix B – Descriptive statistics

Descriptive statistics of all variables.

<b>Descriptive statistics</b>					
	Observations	Mean	Std. Deviation	Min	Max
Pure procrastination scale	99	43.242	13.535	15	69
Risk aversion	99	7.960	2.972	0	15
Loss aversion	96	5.448	2.741	0	11
Ambiguity aversion	102	0.696	0.462	0	1
Di-index	83	0.077	0.445	-0.167	3.917
Impatience	102	0.040	0.014	0.008	0.061
Age	102	30.931	14.657	17	75
Male dummy	102	0.412	0.495	0	1
Smoking habit	102	1.814	1.088	1	4
Smoke dummy	102	0.314	0.466	0	1
Educational level	102	3.637	1.141	1	6
Exercise behaviour	102	2.343	1.816	0	8
Student dummy	102	0.608	0.0491	0	1

Tabulation of the smoking habit variable:

<b>Smoking habit</b>			
	Frequency	Percentage	Cumulative %
1 (never smoked)	61	59.80	58.80
2 (used to)	9	8.82	68.63
3 (occasional)	22	21.57	90.20
4 (curent)	10	9.80	100.00
Total	102	100.00	

Tabulation of the educational levels:

<b>Educational level</b>			
	Frequency	Percentage	Cumulative %
1 (high school)	4	3.92	3.92
2 (mbo)	14	13.73	17.65
3 (hbo)	24	23.53	41.18
4 (bachelor)	34	33.33	74.51
5 (master)	25	24.51	99.02
6 (phd)	1	0.98	100.00
Total	102	100.00	

Tabulation of the current occupation variable:

<b>Current occupation</b>			
	Frequency	Percentage	Cumulative %
1 (student)	62	60.78	60.78
2 (gap year)	1	0.98	61.76
3 (starter)	4	3.92	65.69
4 (working)	31	30.39	96.08
5 (retired)	4	3.92	100.00
Total	102	100.00	



## Appendix C - Spearman rank correlation

Below you will find the results of the spearman rank correlation, where all correlation coefficients with at least 10% significance are shown, with their p-values between brackets.

Spearman Rank Correlation							
	pps	ra	lav	aav	di_index	imp	age
pps	1.000						
ra		1.000					
lav		0.308 (0.006)	1.000				
aav			0.270 (0.017)	1.000			
di_index		-0.226 (0.046)			1.000		
imp	0.233 (0.039)		-0.247 (0.030)			1.000	
age	-0.480 (0.000)						1.000
male							
smokehabit	0.3241 (0.034)						
smokedum	0.320 (0.004)						-0.235 (0.039)
education							
exnum		0.193 (0.090)			-0.267 (0.018)		
currentoc	-0.440 (0.000)						0.728 (0.000)
student	-0.440 (0.000)						-0.689 (0.000)

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**Spearman Rank  
Correlation**

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	male	smokehabit	smokedum	education	exnum	currentoc	student
male	1.000						
smokehabit	0.305 (0.007)	1.000					
smokedum	0.2256 (0.024)	0.916 (0.000)	1.000				
education				1.000			
exnum					1.000		
currentoc				-0.465 (0.000)	0.190 (0.095)	1.000	
student				0.443 (0.000)		-0.9843 (0.000)	1.000

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