# ‘THE RELATION BETWEEN IMPATIENCE AND HEALTH BEHAVIOURS' 

AN ANALYSIS ON STUDENTS, USING THE DIRECT METHOD



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## ABSTRACT

This research examines the relationship between impatience and different types of health behaviours. The behaviours that are investigated concern two types of behaviour; behaviour that reflects negatively on the long term (risky behaviour) and behaviour that reflects positively on the long term (wise behaviour). It is hypothesised that these risky behaviours (drinking alcohol and smoking) coincide with higher levels of impatience and that the wise behaviours (exercising and eating healthy) coincide with lower levels of impatience. The level of impatience is measured with the subjective discount rate. This paper uses a newly developed method of determining subjective discounting called the Direct Method. In total 70 students of the Erasmus University Rotterdam were interviewed. The data was used to estimate multiple probit models, predicting the probability that a student displays certain behaviour. Using the whole sample of data, statistically significant relations were observed between the impatience levels and the behaviours smoking and eating healthy. Using an adjusted sample mild relations were detected between the discount rate and the combination of drinking and smoking. These relations were however inconsistent and not strong, therefore it is concluded that no relation between the impatience level and various health behaviours could be detected in this sample. Besides these findings, also useful insights on using the Direct Method could be taken from this research.

Key words: Impatience, subjective discount rate, the Direct Method, smoking, drinking, exercising, eating healthy, probit model

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## INTRODUCTION

An important part of economic decision-making concerns intertemporal choices. People often need to make a trade-off whether to consume a particular good or spend an amount of money in the present or somewhere in the future (Zauberman et al., 2009). Such questions are often difficult for people and the choices made are not always rational. This is particularly the case when the outcome of such choices affect an individual's financial or health state only later in life (Thaler, 1981). The question arises as to how individuals make such intertemporal decisions, how they evaluate choices with consequences at various moments in time.

The subjective discount rate is the most common approach in economics to asses this decision-making process. This methodology is a proxy that indicates the degree to which an individual is impatient (Samuelson, 1937). From the literature it follows that certain types of behaviour can be linked to the discount rate (Borghans \& Golsteyn, 2006; Joireman et al., 2012). Higher levels of impatience are suggested to correspond with behaviours that provide instant satisfaction but that (possibly) reflect negatively on future well-being (Komlos et al., 2004; Courtemanche et al., 2015). For simplicity, this behaviour will henceforth be referred to as 'risky' behaviour. Similarly, individuals with lower impatience levels are stated to be more likely to display behaviours that are costly in the present, but improve future well-being (Daugherty and Brase, 2010; Dassen et al., 2015). Such behaviour will be referred to as 'wise' behaviour.

This paper will investigate the relation between a number of health behaviours and the subjective discount rate, using students as the target group. The research question that is formulated is the following;
> 'Is there a relation between impatience and health behaviour among students in the Netherlands?'

Multiple methods of determining the subjective discount rate are proposed in the literature (Samuelson, 1937; Komlos et al., 2004; Andersen et al., 2008). The newly proposed 'Direct Method' that was introduced by Attema et al. (2016) will be used in this paper to compute the discount rates of the subjects. Allegedly the main advantage of this method is that it does not require any knowledge of an individual's utility function. It will be used to compute the subjective discount rates of students from the Erasmus University Rotterdam.

Health behaviours can be divided into two categories; 'wise' and 'risky' behaviour. The risky behaviours that are taken into account are smoking and drinking. Considering that the use of alcohol and tobacco is a global concern (Jha \& Peto, 2014; CBS, 2017; Grant et al, 2017), implications of the research could be used to make people aware of the consequences of their impatience and to stimulate them to change their behaviour. This in turn would result in less demand for curing illnesses as a result of smoking and drinking, which in turn could possibly reduce the increasing healthcare costs (CBS, 2017). Alternatively, people could also be made aware of their wise behaviour and stimulated to continue. Therefore, the wise behaviour will focus on exercising and eating healthy. These
behaviours improve the population's health, thereby increasing their well-being and their position on the labour market (Kalwij \& Vermeulen, 2005).

Due to the small sample size, subjects will be selected purposively; only students that both drink and smoke or students that neither drink nor smoke will be questioned. This way possible large differences in their discount rates can be indicated more clearly. Once the data has been collected the discount rates will be calculated and used in probit models to detect relations between impatience and the various types of health behaviours. Based on these models an answer to the research question will be formulated. Besides that, the use of the Direct Method will be evaluated elaborately.

The next section in this paper is the chapter Literature Review. This chapter elaborates on the literature that is available on subjective discounting. It describes the suggested relationship between impatience and various types of behaviour and methods of measuring the subjective discount rate. Besides that, it elaborates on the theory behind the Direct Method. Subsequently, the chapter Hypothesis Development will explain the determination of the hypotheses, followed by the chapter Methods. This chapter explains how the collection and analysis of the data will proceed. These data will be presented and interpreted in the chapter Results. Descriptive statistics will be provided and various models will be estimated in order to be able to draw conclusions from the data. The chapter Discussion and Conclusion provides a summary of the research, an overview of the limitations of the research and suggestions that follow these. In addition, the Direct Method will be evaluated in this chapter. Finally, a conclusion regarding the research question of this thesis will be given. At last, a Reference List will be presented and supplemental information will be provided in the Appendix.

## LITERATURE REVIEW

In the following chapter a summary of the related literature will be provided. Firstly, the concept of subjective time discounting will be explained and its relation with healthrelated behaviour will be illustrated. Secondly, methods of measuring time discounting will be mentioned and the theory behind the Direct Method will be clarified.

## SUBJECTIVE DISCOUNTING

Over time there have been many ideas regarding intertemporal choice. Economists like John Rae, Eugen von Böhm-Bawerk and Irving Fisher looked into the matter and came up with different theories (Loewenstein \& O'donoghue, 2002). The starting point of this research will be the Discounted Utility Model that was introduced by Paul Samuelson in 1937. In his paper he introduced an inductive theory that helps to understand how individuals make intertemporal decisions (Samuelson, 1937). This model predicts a reliable measure of the marginal utility of received money over different moments in time for an individual whose preferences do not change. This model is used to explain intertemporal discounting and it is a parameter that summarizes all the human concerns in intertemporal decision-making. For decisions involving monetary outcomes in multiple periods, it is assumed that the utility of an individual can be described as follows:

$$
\begin{aligned}
U^{t}\left(C_{t}, \ldots, C_{T}\right)= & \sum_{k=0}^{T-t} D(k) U\left(C_{t+k}\right) \\
& \text { Where } D(k)=\left(\frac{1}{1+\delta}\right)^{k}
\end{aligned}
$$

In this equation, $U\left(C_{t+k}\right)$ reflects an individual's utility that is derived from the consumption of good $c$ during period $t+k . D(k)$ reflects an individual's discount factor, meaning the weight that someone attaches to the consumption of a specific good during a certain period. It is determined by the subjective discount rate $\delta$ that measures an individual's time preference over time perspective $k$. This variable $\delta$ thus shows the individual's degree of impatience. Higher values of $\delta$ coincide with more impatient behaviour, and lower values of $\delta$ coincide with less impatient behaviour. Research shows that individuals are generally found to be 'impatient'; they prefer to consume goods earlier than later in time (Thaler, 1981).

## DISCOUNT RATES AND HEALTH BEHAVIOURS

The definition of the discount rate that is given above reflects the impatience level regarding monetary outcomes over various moments in time. In the literature this rate is suggested to be able to tell something about the impatience of people and the result of this impatience on their choices and behaviour in life (Borghans \& Golsteyn, 2006). Multiple types of behaviour entail a consideration between short- and long-term consequences on the health-state of individuals. People make different choices regarding such behaviours and the literature suggests that these differences can be linked to subjective discount rates (Komlos et al., 2004). Specific types of behaviour are linked to
high discount rates, and other types of behaviour are linked to low discount rates (Joireman et al., 2012).

## HIGH DISCOUNT RATES AND RISKY BEHAVIOUR

Various sources report that more impatient individuals often show behaviour that has a negative effect on their future health- or economic-state (Borghans and Golsteyn, 2006; Sutter et al., 2013). Examples of such risky behaviour are smoking, drinking, eating unhealthy food and using drugs. The potential harmful consequences of these choices will only express themselves later in life.

There are various sources that have found weak relations between discount rates and types of risky behaviour. For example, Komlos et al. (2004) investigated whether the increase in worldwide obesity is related to increasing discount rates. They find some evidence that suggests that this correlation is plausible, the estimation however can not identify whether it concerns a parallel trend or a causal relationship. Similarly, Borghans and Golsteyn (2006) found that differences among subject's BMI levels are related to their individual discount rate. Van der Pol (2011) claims that the positive relation between health and education can be explained by a third variable, namely the subjective time preference. The data show that the relation between the two variables decreases, but is still existent when including time-preference in the equation.

Other sources found stronger relations, for example Bickel et al. (1999) investigated the relationship between smoking behaviour of individuals and their discount rate. Their results show that the discount rates of the smokers were higher compared to the discount rates of non-smokers and ex-smokers. Similarly, Bickel and Marsch (2001) investigated the impatience levels of drug addicts. They found that time-orientation is a useful tool in assessing the behaviour of drug-dependent individuals. Drug-dependent individuals show much higher discount rates compared to their non-addicted matches. The loss of control over the addiction is suggested to be influenced by the discount rate. Beenstock et al. (2010) used a cross-sectional survey on British students and found a positive correlation between abusive alcohol-consumption and the 'Consideration of Future Consequences' (CFC) ${ }^{1}$. Sutter et al. (2013) conducted research on children and adolescents. They found strong evidence that the more impatient children have a higher likelihood of spending more money on alcohol and cigarettes later in life. Besides that, these children are also found to be more likely to grow up with higher average BMI levels. Similarly, Courtemanche et al. (2015) investigated the relationship between BMI level and subjective discount rates, but included an interaction between the discount rate and the fluctuating price of food. The results show larger weight gains at low food prices for individuals with high discount rates, compared to individuals with lower discount rates.

[^0]LOW DISCOUNT RATES AND WISE BEHAVIOUR
Besides the fact that high discount rates are found to coincide with particular behaviour, low discount rates are also linked to certain habits. It is suggested that individuals with low discount rates are more considerate with their future state and are therefore more willing to sacrifice their current situation in order to improve future well-being (Joireman et al., 2012). These individuals are more patient and therefore more likely to display such wise behaviour like eating healthy, exercising sports, wearing a safety belt in the car or saving money for later in life. There are various examples in the literature that relate this wise behaviour to low discount rates

Kovač and Rise (2007) for example show in their research that the extent to which an individual is future-oriented has a large influence on the decision and action to stop smoking. Similarly, Adams and Nettle (2009) found that patient individuals are more likely to exercise and that they report lower average BMI levels. Besides that, Daugherty and Brase (2010) investigated the relationship between subjective discount rates and various behaviours. They found that lower discount rates coincide with a higher probability of wearing a safety belt, exercising and eating breakfast. Joireman et al. (2012) found proof of a positive relation between the motivation of people to exercise sports and their CFC. Dassen et al. (2015) looked at the relation between time orientation and whether subjects eat healthy or unhealthy. They found that self-reported healthy eating is positively correlated with future orientation and negatively with present orientation.

## MEASURING SUBJECTIVE DISCOUNTING

Over time multiple methods of measuring subjective discounting have been proposed. The principal measures used in the literature will be discussed below.

A first possible measurement is to look at proxies reflecting subject's daily behaviour. Komlos et al. (2004) for example used net domestic saving rates and the proportion of debt relative to income and compared these proxies to the rates of obesity in the US. Individuals that are more impatient will save less and spend more money on consumption in the present, compared to future consumptions. As for the ratio of debt relative to income, this is an indicator that individuals are impatient to such an extent that they are willing to incur debt in order to consume more in the present. Using this method, Smith et al. (2005) found proof for an empirical relation between saving-behaviour and individual's BMI-scores.

Other more specific methods of measuring impatience have also been proposed in the literature. These methods consist of questions that are used to precisely determine the impatience level by quantifying the discount rate. Borghans and Golsteyn (2006) for example asked their respondents to give their preferred choice between receiving amount $x$ at time $t$, or receiving amount $y(>x)$ at time $t+\tau(\tau>0)$. An example of questions that are asked is the following:
"Please indicate, which alternative you would choose.

1. Receiving 50 euro now
2. Receiving 70 euro a year from now'

The amounts offered are varied over multiple questions and the amount of times that an individual chooses the option earlier in time is used as a proxy of the impatience level. Additionally, in order to validate the measurement also a non-monetary question can be asked. An example of such a question is the following:
'Suppose you win a 10-day holiday trip to an interesting destination. To spread participation, you are asked ifyou can delay your trip by three years in exchange for a longer vacation. How many days should you be offered in addition to accept the offer in 3 years' time?'

Borghans and Golsteyn (2006) found that there is a statistically significant relation between these two measurements of impatience.

Another method of measuring subjective discounting was introduced by Andersen et al. (2008), using similar questions like the ones from Borghans and Golsteyn (2006). Individuals are asked to choose between multiple options of receiving money at various moments in time ${ }^{2}$. The amount of money $x$ that is received in the present stays the same and the amount of money $y$ that is received in the future increases with every option. The first option is such that the respondent will always choose the present option, but as the amount increases it is likely that the preference will switch to the future option. This switching point will then be used to elicit the discount factor by completing the equality $\delta_{t} U(x) \sim \delta_{t+\tau j} U(y)$. Based on the assumed utility curve the discount factor $\delta$ can then be computed.

## THE DIRECT METHOD

When using the methods described above, a limitation is the fact that knowledge on the utility function of an individual is required. Therefore a newly proposed method called the 'Direct Method' will be used in this paper. It is a method of measuring the subjective discount rate that does not involve the utility function (Attema et al., 2016).

The proposed model compares the subjective evaluation of multiple monetary outcome streams at two moments in time until an indifference point is reached. The weight that is attached to a certain period is then defined as C and called the cumulative discount weight. It can be written as follows:

$$
C(0, t)=\sum_{t=0}^{t} \delta_{t}
$$

[^1]The instinct behind the theory is that when an indifference point between two of such monetary outcome streams found it must be that their values of $C$ are the same and utility thus drops from the equation. This will be explained below.

In order to use this method, a time frame has to be chosen, for example 52 weeks ( $\mathrm{T}=52$ ). It is normalized that $\mathrm{C}(0,52)=1$ and from theory it follows that $\mathrm{C}(0)=0$. For simplicity, it can be written that $\mathrm{C}_{\mathrm{p}}=\mathrm{C}^{-1}(\mathrm{p})$, and therefore $\mathrm{C}_{0}=0$ and $\mathrm{C}_{1}=52$. The respondents are asked to indicate their indifference point $C_{1 / 2}$ in the situation: $\alpha_{\left(0, C_{1 / 2)} \sim\right.} \alpha_{(C 1 / 2,52)}$. More specifically, this means that they will be asked for the value $C_{1 / 2}$ that makes them indifferent between receiving amount $\alpha$ every time period during the sequence of time periods 1 to $\mathrm{C}_{1 / 2}$ and receiving amount $\alpha$ every time period during the sequence of time periods $\mathrm{C}_{1 / 2}$ until 52 . This indifference can be written as; $\mathrm{C}\left[0, \mathrm{C}_{1 / 2}\right] \mathrm{U}(\alpha)=\mathrm{C}\left[\mathrm{C}_{1 / 2}, 52\right] U(\alpha)$. Following the equality, $U(\alpha)$ drops out of the equation and from $\mathrm{C}(52)=1$ it can be concluded that $\mathrm{C}\left(\mathrm{C}_{1 / 2}\right)=1 / 2$.

Once this value $\mathrm{C}_{1 / 2}$ is known, the same method can be used to determine the values of $\mathrm{C}_{1 / 4}$ and $\mathrm{C}_{1 / 8}$. This is done by filling in the value $\mathrm{C}_{1 / 2}$ instead of $T$. It follows that $\mathrm{C}\left(\mathrm{C}_{1 / 4}\right)=1 / 4$ and that $\mathrm{C}\left(\mathrm{C}_{1 / 8}\right)=1 / 8$. By repeating the method, values of $C$ can be measured precisely and based on constant discounting the discount rates can be computed using the following formula (Bleichrodt et al., 2016):

$$
C\left(t_{j}\right) \cong \frac{1-\exp \left(-\delta t_{j}\right)}{1-\exp (-\delta T)}
$$

The values of $\mathrm{C}_{1 / 2}, \mathrm{C}_{1 / 4}$ and $\mathrm{C}_{1 / 8}$ with $\mathrm{T}=52$ can be estimated using this approach and the discount rate $\delta$ can be computed. The average of the three discount rates can then be calculated and used as an individual's subjective discount rate.

## HYPOTHESIS DEVELOPMENT

In this chapter the determination of the hypotheses that will be used to answer the research question will be discussed.

As mentioned in the introduction, the research question of this research is as follows:
'Is there a relation between impatience and health behaviour among students in the Netherlands?'

The focus group of this research will be students of the Erasmus University Rotterdam, because they can be used well to show a possible correlation. This is because students are old enough to have the freedom to make their own conscious choices, but young enough to still have to deal with the long-term consequences of these choices. Furthermore, they can easily be influenced by their peers or by other parties (Lau et all, 1990), which provides room for possible implications following the conclusions of this research. Besides that, they will not be difficult to reach and will probably more easily understand the complicated measurement of time discounting that will be used.

As the literature shows that the effect of the discount rate can work in two directions, the research question will be investigated using two hypotheses.

## HYPOTHESIS 1

The first hypothesis regards the behaviour of impatient individuals.

## H1: 'More impatient students show more long-term risky behaviour'

As stated, prior research found significant correlations between high discount rates and behaviour that involves current gratification, but leads to future costs. Therefore, behaviour that will be investigated is whether a student is a heavy drinker and whether a student is a smoker.

According to Voedingscentrum.nl (2017) one glass of alcohol-containing drinks can reduce the probability of getting certain chronic diseases, but can increase the chance of getting breast cancer. Consequently, drinking more than one alcohol-containing drink per day increases the probability of getting a stroke, cancer, liver failure and possibly diabetes type 2. Besides that, the use of alcohol can result in physical and mental addiction.

Dutch people, and especially young adults drink relatively much alcohol. A global survey published that the Dutch population belongs to the third largest alcohol consumers of Europe (Winstock et al., 2016), only the Danish and Irish are found to have more extreme consumption patterns. Particularly the group of men younger than 25 is found to drink relatively often and much. For example, the research shows that $26.4 \%$ of men younger than 25 , and $16.2 \%$ of women younger than 25 'black out' on a monthly basis due to excessive alcohol consumption (Winstock et al., 2016). In this questionnaire, the respondents were also asked to indicate whether they want to reduce their alcohol consumption pattern. Shockingly, the Dutch score in the lowest three average percentages for this category. Besides these results, the Centraal Bureau voor de Statistiek
(CBS) in the Netherlands published in January 2017 that $14.3 \%$ of Dutch people in the age group between 18 and 25 drinks excessively ${ }^{3}$ (Ministerie van Volksgezondheid, Welzijn en Sport, 2016). This compared to a percentage of 9.2 for the age group of 25 and older. It follows that there is room for new policies to control the behaviour of these young adolescents in the Netherlands.

Besides the use of alcohol, smoking also harms the health of many people on the long term. According to the World Health Organization (2017) smoking increases the probability of getting lung cancer or heart diseases. Furthermore, it causes respiratory problems and it is highly addictive. The consequences of smoking are thereby not only harmful to the smoker itself, but also passive smoking causes severe physical damage.

The CBS published that $36.1 \%$ of Dutch people in the age group of 18 to 25 smokes regularly, compared to $24.8 \%$ for the older age group (Ministerie van Volksgezondheid, Welzijn en Sport, 2016). Fortunately, there is a decreasing trend in the amount of smokers in the period from 1990 until 2015 (volksgezondheidszorg.info, 2017). This decrease could be caused by the many policies and promotions by the government that discourage people to smoke. There is still however room for improvement and therefore smoking habits of students will also be taken into account in this research.

Something that cannot go unnoticed is the fact that the combination of these two behaviours is something that occurs quite often. CBS found that of the young adults between 18 and $25,21.4 \%$ shows both smoking and drinking habits, this compared to $7.1 \%$ in the age group of 25 and older (Ministerie van Volksgezondheid, Welzijn en Sport, 2016). The combination of these habits will therefore also be investigated.

If a correlation between the subjective discount rate and risky behaviour would be found, this fact could be used to stimulate students to change their behaviour. It could be done by making them aware of their level of impatience, and the consequence this impatience has on their daily behaviour. This would result in less medical treatments required to cure the consequences of these behaviours and could reduce increasing health care costs (CBS, 2017).

## HYPOTHESIS 2

Besides the assumption that more impatient individuals show more risky behaviour it is also suggested that more patient individuals will act more 'wisely' (Daugherty and Brase, 2010). Therefore the second hypothesis is the following:

H2: 'Less impatient students show more long-term wise behaviour'
Low subjective discount rates are suggested to coincide with behaviour that has a positive effect on the future quality of life. The wise behaviours that will be investigated are exercising and eating healthy food.

[^2]Physical activity improves the strength of muscles and back, and improves the condition and state of the heart and lungs. This behaviour is therefore an investment that is done in the present and reflects positively on the long term. Besides that, is known that a healthy and varied food pattern results in a healthy life. Voedingscentrum.nl (2017) advises to consume food from 5 different categories. This way the probability of getting heart- or vascular-diseases is reduced. Eating healthy in the present is therefore also an investment in the future quality of life.

If a relation between the discount rate and wise behaviour would be found this could also be used to improve societal well-being. People can be made aware of the positive consequences of being more patient and stimulated to continue their wise behaviour, thereby improving the general health state.

A note to make is the fact that individuals might also have other motivations to eat healthy or exercise sports. Examples of such motivations for eating healthy are peer-behaviour or self-identity (Astrosm \& Rise, 2001) and for exercising stress reduction, fun and friends or mental challenges (Gavin et al, 2014). Due to these motivations it is expected that the relation between the subjective discount rate and wise behaviour is lower compared to that same relation with risky behaviour.

## METHODS

In this chapter the methods of conducting the research will be explained. Firstly the data collecting process will be described, after which the methods used to analyse the data will be clarified.

## DATA COLLECTION

As mentioned, the data for this research will be collected from students of the Erasmus University Rotterdam. Due to the fact that it is difficult to determine the values of $\mathrm{C}_{1 / 2}, \mathrm{C}_{1 / 4}$ and $\mathrm{C}_{1 / 8}$ with an online questionnaire, the surveys will be done by interviews. The students that will be questioned are fellow students. As the interviews will take quite long and time for collecting data is limited, the respondent group will not be large and respondents will therefore be recruited purposively. Students that show opposite behaviour will be approached. The first group will be called the 'wise' group and consists of students who do not drink much alcohol and who do not smoke. The second group will be called the 'risky' group and consists of students who smoke and drink regularly. The table below indicates the students that will be selected to interview.

|  | Non-Smoker | Smoker |
| :--- | :---: | :---: |
| Non-drinker | $\bullet$ |  |
| Drinker |  | $\bullet$ |

Table 1: Target group
The subjects will be chosen in such a way that besides these behaviours, their characteristics are as homogenous as possible. In case a correlation between subjective discounting and wise and/or risky health behaviour is present, this target group is more likely to reveal it because they are expected to have large differences in their discount rates.

The students will be approached on Erasmus University campus or by phone. The interview will start by determining the values of $\mathrm{C}_{1 / 2}, \mathrm{C}_{1 / 4}$ and $\mathrm{C}_{1 / 8}$. The time perspective that will be used is one year ( $\mathrm{T}=52$ ), because this is a time period that is relatively easy to imagine. Due to the fact that the Direct Method is quite difficult to understand, the subjects will repeatedly be given two alternative choices until an indifference point is reached. The full list of choices is provided in appendix A. For example; the subjects will be asked to state their preference between receiving €20 every week during week 1 until 26 or receiving €20 every week during week 27 until 52 . After the respondent stated his/her preference, another choice will be presented, for example the choice between receiving $€ 20$ every week during week 1 until 20 or during week 21 until 52 . This will continue until an indifference point is reached. If an individual is indifferent between receiving the money during week 1 until week 25 and between week 26 until week 52 , the value of $\mathrm{C}_{1 / 2}$ is set at 25 . The determination of $\mathrm{C}_{1 / 4}$ will then be done in a similar way, but the obtained value of $\mathrm{C}_{1 / 2}$ will be used as the final week instead of $\mathrm{T}=52$. The same applies for the determination of $\mathrm{C}_{1 / 8}$.

In the paper by Attema et al. (2016), the values of $\mathrm{C}_{1 / 8}, \mathrm{C}_{1 / 4}, \mathrm{C}_{1 / 2}, \mathrm{C}_{3 / 4}$ and $\mathrm{C}_{7 / 8}$ are determined. Due to time constrains and measurement complexity this research will focus on the determination of $\mathrm{C}_{1 / 2}, \mathrm{C}_{1 / 4}$ and $\mathrm{C}_{1 / 8}$. Focussing on these values, an insight in the development of short-term impatience will be provided. Furthermore, these time perspectives are easier to explain to subjects.

After the choice list is completed, the students will be asked to fill in a short questionnaire, which can also be found in appendix A. Given that there is a risk that students will lie about their actual behaviour, they will be asked to complete this survey manually, so that they have a greater feeling of privacy and anonymity when doing so.

Firstly, as the Direct Method is a newly proposed method, it is useful to know how much difficulty subjects experience when answering the questions and how sure they are about their choices. Therefore they will be asked to indicate both the difficulty of the method ${ }^{4}$ as well as the certainty of their answer ${ }^{5}$ on a scale from one to five. Besides that, the students will be asked to indicate their behaviour regarding exercising, eating healthy, drinking alcohol and smoking. The questions that will be used are in a standard format that is applied in multiple Dutch surveys (Rappange et al., 2016; Peretti-Watel et al., 2013). Firstly, the students will be asked to indicate how many days a week they are physically active for at least 30 minutes (walking, cycling or practising sports). Then, they have to indicate how many days a week they eat healthy (a varied pattern, not too much fat and also vegetables and fruits). After that, the students will be asked to indicate how many days a week they drink alcohol, and if they drink alcohol, how many glasses they drink on average. The final behaviour that they will be interrogated about is smoking, they can choose between not smoking, smoking sometimes and smoking on a daily basis.

Following the part on subject's behaviours, also a non-monetary question regarding timepreferences will be asked, similar to the one used by Borghans and Golsteyn (2006). This will be done to check whether this outcome correlates with the discount rates determined with the Direct Method. The subjects will be asked to indicate on a scale from zero to ten whether their focus is more on the present compared to the future. For this question, zero represents complete focus on the present, and ten represents complete focus on the future. Furthermore, it is possible that knowledge on the risk of smoking or drinking affects the decision to show certain behaviour. Therefore a subjective risk-estimation will be included for the consequences of smoking and drinking. The students will be asked to state the amount of years that they think someone who smokes or drinks his/her entire life will live shorter, compared to someone who does not smoke or drink. The survey ends with questions regarding gender, education phase and age.

[^3]
## DATA ANALYSIS

This section elaborates on the models that are used to analyse the data and explains how the variables in these models are determined.

## DETERMINATION OF THE MODELS

It is important to mention that the relation that this research expects to find between the variables is an association. An association can be defined as 'a measure of the strength of the relationship between two random variables' (Kotz \& Johnson, 1981). It should therefore be noted that the expected association between the discount rate and various types of behaviour is not a causal one. This implies that in this research the first phenomenon (the discount rate) does not cause the occurrence of the second phenomenon (a certain type of behaviour), but merely that the two are likely to be observed simultaneously. These associations will be investigated by estimating correlations between variables and by using probit models, which will be described below. The correlations will be evaluated based on the standards set by Cohen (1988). In this evaluation the strength of a correlation can be classified as weak ( $\mathrm{r}=0.10$ to 0.29 ), moderate ( $\mathrm{r}=0.30$ to 0.49 ) or as strong ( $\mathrm{r}=0.50$ to 1.00).

In order to draw reliable conclusions an appropriate model has to be chosen for each hypothesis and each type of behaviour. The statistical model that will be used is a probit model, as is common in economic research (Wiersema \& Bowen, 2009). The dependent variable for these models will be a dummy variable that takes value 1 for showing certain behaviour (e.g. drinking, eating healthy), and value 0 for not showing this behaviour. The model estimates the probability that an individual with certain characteristics has value 1 and thus shows the behaviour. In case an association exists between two variables, the coefficient of the independent variable will be statistically significant. The main independent variable of interest for both hypotheses is the discount rate, and therefore it will be investigated whether the discount rate has a statistically significant effect on the probability of showing certain behaviour. A significant level of $5 \%$ will be applied throughout the paper, unless indicated differently.

The following table shows the different models that will be estimated for each type of behaviour. The variables will be explained below.

|  | Variables of interest |  | Control variables |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  | Discount rate | Future <br> orientation | Education/age | Gender | Risk estimation |
| Model A | $\bullet$ |  |  |  |  |
| Model B |  |  | $\bullet$ | $\bullet$ |  |
| Model C | $\bullet$ | $\bullet$ | $\bullet$ |  |  |
| Model D |  | $\bullet$ | $\bullet$ | $\bullet$ |  |
| Model E | $\bullet$ |  | $\bullet$ | $\bullet$ | $\bullet$ |

Table 2: Models used

As the sample size will not be large, a cautious approach has to be taken when deciding upon which model to use. The control variables that can be used are age, study phase, gender and risk estimation. As study phase and age are expected to be correlated ${ }^{6}$, only one of these will be used in order not to disturb the data too much. This will depend on which variable fits the data best by performing a goodness of fit test. In case the study phase (education) will be used, it will be a dummy variable that takes value 1 for a bachelor student and 2 for a master student. The dummy variable gender takes value 1 for a man and value 2 for a woman. Besides that, in order to see whether a difference in risk-estimation regarding smoking or drinking affects the decision to show this behaviour, students will be asked to estimate how many years they believe an individual lives shorter if he/she drinks or smokes during his/her entire life. The subjects with the highest estimated risk could be less likely to display that type of behaviour. Therefore two dummies will be created that take value 2 for the subjects who estimate the highest $20 \%$ of risk to drinking or smoking and value 1 otherwise. Model E includes these dummies and will only be used to test hypothesis 1 .

## DETERMINATION OF THE VARIABLES

As for the variables, firstly the measures of impatience have to be determined. Based on the collected data the discount rates that match each value of $\mathrm{C}_{1 / 2}, \mathrm{C}_{1 / 4}$, and $\mathrm{C}_{1 / 8}$ will be calculated with on the formula described in the literature review, using mathematical system Wolfram Alpha. The average of these three discount rates will then be calculated and used as the subjective discount rate for that specific individual. For this variable, higher discount rates correspond with more impatience. The non-monetary measure of impatience will be measured on a scale from zero to ten, with zero representing complete focus on the present (impatience), and ten representing complete focus on the future (patience). This impatience measure will be included in the model as a continuous variable.

Secondly, the dependent variables of the probit models are binomial variables that represent either showing or not showing a certain type of behaviour. Therefore the answers on the questions regarding these behaviours have to be converted into such bilateral variables. The following section describes how this distinction will be made per type of behaviour.

In order to answer the first hypothesis, the group will be divided into two groups based on the definition of a heavy drinker that is used in the paper by Rappange et al (2016). For women a heavy drinker is someone who drinks more than fourteen normal-sized glasses of alcohol per week or who drinks more than six glasses at least one day a week. For men a heavy drinker is someone who drinks more than 20 normal-sized glasses of alcohol a week or who drinks more than six glasses at least one day a week. As the average amount of days drinking and the average amount of glasses per day will be asked, only the first condition will be used to determine whether a student is a heavy drinker or not.

[^4]A dummy will therefore be created with value 0 for non-heavy drinkers and value 1 heavy drinkers. Besides that, the first hypothesis takes smoking into account. Therefore the students can choose between not smoking, smoking sometimes and smoking on a daily basis. As mentioned, the group will be split in a group of smokers and a group of nonsmokers. Based on Rappange et al. (2016), the dummy for smoking therefore takes a value 1 for individuals that smoke sometimes or on a daily basis, and value 0 for individuals who never smoke. As the students will be selected in such a way that they either show both behaviours or none of the behaviours, it is expected that the dummies are perfectly correlated. The corresponding probit models will thus predict the probability of a subject being both a heavy drinker and a smoker. The coefficients of the discount rate are predicted to be statistically significant and positive for this hypothesis. The coefficient for the future orientation variable is predicted to be statistically significant and negative for this hypothesis.

For the sake of answering the second hypothesis, two models will be estimated, one for physical activity and one for eating healthy. The variable of exercising will be divided into two groups based on the Dutch recommendation for healthy exercising behaviour. It requires individuals to be active (walking, cycling or practising sports) for at least 30 minutes at least five days a week (Rappange et al., 2016). Therefore a dummy will be created with value 1 for healthy exercising behaviour and value 0 for none-healthy exercising behaviour. The corresponding probit models thus predict the probability of a subject showing healthy exercise behaviour. Furthermore, they will be asked to indicate how many days a week on average they eat healthy (varied, not too much, not too much fat and also vegetables and fruits). A minimum of six days of such behaviour is set as a benchmark of eating healthy (Rappange et al., 2016). The dummy that will be created has value 1 for healthy eating behaviour and value 0 for non-healthy eating behaviour. The corresponding probit models thus predict the probability of a subject having a healthy dietary pattern. For both the exercising and healthy eating model, the coefficients of the discount rate are predicted to be statistically significant and negative and the coefficients for the future orientation variable are predicted to be statistically significant and positive.

Finally, in order to evaluate the use of the Direct Method, students will be asked to indicate how much difficulty they experienced when answering the questions of the Direct Method and how certain they were about their choices. These answers will be collected in a pie-chart to graphically display the difficulty and certainty. Based on these charts conclusions on the use of the Direct Method can be drawn.

## RESULTS

The following chapter provides an overview of the data that was collected. The first part will describe the data, after which the models used to investigate the first and second hypothesis will be provided. Finally, answers regarding the use of the Direct Method will be provided.

## DESCRIPTIVE STATISTICS

In total, 70 students were interviewed, of which $32 \%$ men and $68 \%$ women. The average age was 22.8. Of the students, $35 \%$ was in the bachelor phase, and $65 \%$ was doing their masters.

When looking at the behaviours, subjects drink on average 2.4 days a week with a standard deviation of 1.3 days. The average amount that students drink when they drink is 5.8 glasses, with a standard deviation of 4.3 glasses. Of the respondents, $63 \%$ were classified as non-heavy drinkers and $37 \%$ were classified as being heavy drinkers. Of the subjects, $52 \%$ never smokes, $30 \%$ smokes sometimes and the remaining $18 \%$ smokes on a daily basis. Following this, $52 \%$ of the subjects were defined as non-smokers and $48 \%$ were defined as smokers. The respondents are found to exercise on average 2.6 days a week with a standard deviation of 1.7 days. Consequently $57 \%$ showed healthy exercising behaviour and $43 \%$ showed unhealthy exercising behaviour. The students eat healthy on average 5.5 days a week, with a standard deviation of 1.2 . Therefore $57 \%$ is classified as showing healthy eating behaviour and $43 \%$ as showing unhealthy eating behaviour. The table below provides insight into the correlations between the dummies of the different types of behaviour.

|  | Drinking | Smoking | Exercising | Eating |
| :--- | :--- | :--- | :--- | :--- |
| Drinking | 1.000 |  |  |  |
| Smoking | 0.754 | 1.000 |  |  |
| Exercising | -0.230 | 0.107 | 1.000 |  |
| Eating | -0.230 | 0.165 | 0.300 | 1.000 |

Table 3: Correlations among behaviours
From the table it can be read that there exists a strong correlation between drinking and smoking behaviour. Besides that, drinking is weakly negatively correlated with healthy exercising and eating behaviour. Furthermore, smoking has a weak but positive correlation with physical activity and eating healthy. Finally, the two wise behaviours are moderately positively correlated.

As explained in the methods, the subjects were selected in such a way that they could be categorised in a wise group and a risky group. Some respondents however answered unexpectedly and consequently they could not be directed into a specific group ${ }^{7}$. The table below provides insight into the characteristics of the different groups.

[^5]|  | $\%$ men | \% bachelor | Average age | N |
| :--- | :--- | :--- | :--- | :--- |
| Risky group | $36 \%$ | $68 \%$ | 21.8 | 25 |
| Wise group | $19 \%$ | $11 \%$ | 23.4 | 36 |
| Whole sample | $32 \%$ | $35 \%$ | 22.8 | 70 |

Table 4: Sample per group
The table shows that overall the risky group contains a larger percentage of men, a larger percentage of bachelor students, and that the age of the risky group is lower compared to both the wise group and the whole sample. In total 9 subjects were interviewed that could not be attributed to a specific group.

In the table below descriptive statistics of the values of $\mathrm{C}_{1 / 2}, \mathrm{C}_{1 / 4}$, and $\mathrm{C}_{1 / 8}$ for the whole sample are provided. The values found that were found are similar to the ones determined by Attema et al. (2016). They conducted their research on a similar group of students and the values that they found are tabulated in the last column.

|  | Mean | St. dev. | Min | Max | N | Attema et al. (2016) |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $\mathrm{C}_{1 / 2}$ | 24.4 | 2.5 | 16 | 26 | 70 | 24.5 |
| $\mathrm{C}_{1 / 4}$ | 11.7 | 1.7 | 7 | 13 | 70 | 11.5 |
| $\mathrm{C}_{1 / 8}$ | 5.3 | 0.9 | 3 | 6 | 70 | 5.5 |
| Table 5: Discount weights |  |  |  |  |  |  |

Based the values that were determined, the subjective discount rates were calculated. Details on these rates are tabulated below.

|  | Mean | St. dev. | Min | Max | N |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Risky group | 0.008 | 0.008 | 0.001 | 0.026 | 25 |
| Wise group | 0.005 | 0.007 | 0.001 | 0.033 | 36 |
| Whole sample | 0.007 | 0.008 | 0.001 | 0.033 | 70 |

Table 6: Subjective discount rates
From the table it can be read that the risky group of students has a higher average discount rate and the wise group has a lower average discount rate than the whole sample. These findings are in line with both of the hypotheses. What is quite striking is the fact that the maximum of the risky group is lower than that of the wise group.

From the boxplot displayed below, it can be seen that the spread of the discount rates is low, except for a few outliers. A noteworthy comment is the fact that $50 \%$ of the subjects had the same discount rate of 0.001 ( 0.00118 to be exact). This discount rate is thereby also the lowest discount rate in the sample.


Figure 1: Boxplot discount rate
The question regarding the future orientation of subjects had a mean value of 5.83 and a standard deviation of 2.02 . Based on the literature it is predicted that the discount rate and the future orientation are negatively ${ }^{8}$ correlated (Borghans \& Golsteyn, 2006). The correlation between the two variables was calculated and turned out to be -0.275 . The direction of this correlation is correct, the strength however is weak.

The table below reports the correlation between the dummies of the different types of behaviour and the two measures of impatience.

|  | Drinking | Smoking | Exercising | Eating |
| :--- | :--- | :--- | :--- | :--- |
| Discount rate | 0.129 | 0.247 | -0.118 | -0.222 |
| Future orientation | -0.243 | -0.275 | 0.184 | 0.156 |

Table 7: Correlations behaviours and subjective discounting
It can be seen that the discount rate has a weak positive correlation with risky behaviour and a weak negative correlation with wise behaviour. Besides that, the future orientation variable has a weak negative correlation with risky behaviour and a weak positive relation with the wise behaviours. The directions of all of the correlations are in line with the hypotheses but the strengths are not high.

The subjects were asked to indicate how many years they believe that a person would live shorter if he or she smokes or drinks every day during his or her entire life. Subjects believe that excessive drinking takes 8.9 years of someone's life, with a standard deviation of 5.2 years and that smoking takes 9.1 years with a standard deviation of 4.7 years. The two estimates have a moderate positive correlation of 0.491 . As the focus for this variable is on the subjects with extremely high risk-estimates, a dummy was created for the subjects with the highest $20 \%$ estimates. For drinkers these subjects were the students who estimated a loss in years larger than 11 years. For smokers these subjects were the students who estimated a loss in years larger than 14 years. The table below reports the

[^6]correlations between the two risk dummies and the two measures of impatience that are used.

|  | Discount rate | Future orientation | Drink_high_risk | Smoke_high_risk |
| :--- | :--- | :--- | :--- | :--- |
| Discount rate | 1.000 |  |  |  |
| Future orientation | -0.275 | 1.000 |  |  |
| Smoke_high_risk | 0.050 | 0.113 | 1.000 |  |
| Smoke_high_risk | 0.059 | 0.184 | 0.018 | 1.000 |

Table 8: Correlations risk estimation and subjective discounting
The correlations that are found between the dummies and the discount rate are both positive and weak. For the Future orientation variable the correlations are stronger but still small. Besides that, the correlation between the two dummies is weak.

## HYPOTHESIS TESTING

As mentioned above, when collecting the data the objective was to not include onlysmokers or only-drinkers in the sample. Some respondents answered unexpectedly however and therefore a few of such students were unintentionally included in the sample. A possibility would be to leave out these respondents in the data analysis, but due to the small sample size of 70 the effect of leaving out nine respondents would be large. Therefore the hypotheses will be tested using both the whole sample and the adjusted sample (only the wise and risky group). Firstly, the entire sample will be used to test all separate behaviours, as well as the combination of drinking and smoking. After that, the models will also be estimated for the adjusted sample. For the first hypothesis this will be done for the combination of drinking and smoking ${ }^{9}$ and for the second hypothesis this will be done for the separate behaviours.

The students were asked to state both their age and their education phase. These two variables are however strongly correlated with a value of 0.605 and including both of them might disturb the models. Therefore only one of the variables will be included. The models are estimated using both variables and the values of the Pseudo R², LogLikelihood and the Count $R^{2}$ were compared. For the first hypothesis the variable of age fits the data best, and for the second hypothesis this is the case for the variable of education. Therefore the control variable age will be used to test the first hypothesis and the control variable education to test the second hypothesis.

The following section elaborates on the models that are estimated to test the hypotheses. A table with the different models is displayed per separate behaviour. The tables show the magnitude and sign of the coefficients. Besides that, T-statistics are given between brackets and stars indicate the significance level of coefficients. Finally, the value of the Pseudo $\mathrm{R}^{2}$ for every model is provided.

[^7]
## HYPOTHESIS 1

The first hypothesis that will be tested is the following;

## H1: 'More impatient students show more long-term risky behaviour'

As mentioned above, the coefficients of the discount rate are predicted to be positive for this hypothesis. The coefficients for the future orientation variable are predicted to be negative for this hypothesis.

## DRINKING

Looking at model 1 A , it becomes clear that the discount rate does not have a statistically significant effect on the probability of being a heavy drinker. The coefficient however has a positive sign, which is in line with the hypothesis.

Model 1B includes age and gender; age has a statistically significant and negative effect on the dependent variable, indicating that older students are less likely to be heavy drinkers compared to younger students. Besides that, gender has a negative but insignificant effect on the probability of being a heavy drinker. If significant, this would imply that female students are less likely to be heavy drinkers, compared to men.

When including all the variables in model 1C the sign of the discount rate changes, and the variable remains statistically insignificant. Furthermore, the significance levels and signs of age and gender do not change much.

As mentioned, the future orientation is also used as the independent variable of interest in order to see if this indication of time preference has a statistically significant effect on the probability of smoking (Model 1D). The coefficient of future orientation is insignificant and negative. The variables of age and gender do not differ much from model 1C.

The risk estimation dummy for smoking is also added to model 1 C , creating model E . From the table it can be seen that the dummy has a negative but insignificant effect on the dependent variable. Furthermore, it can be seen that the discount rate variable remains insignificant.

|  | 1A | 1B | 1 C | 1D | 1E |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Heavy drinker | Heavy drinker | Heavy drinker | Heavy drinker | Heavy drinker |
| Discount rate | 19.52 |  | -7.986 |  | -6.393 |
|  | (1.08) |  | (-0.35) |  | (-0.28) |
| Age |  | $-0.499^{* * *}$ | $-0.516^{* * *}$ | $-0.471^{* * *}$ | -0.580 *** |
|  |  | (-3.91) | (-3.75) | (-3.53) | (-3.84) |
| Gender |  | -0.568 | -0.601 | -0.574 | -0.834* |
|  |  | (-1.39) | (-1.44) | (-1.44) | (-1.75) |
| Future-orientation |  |  |  | -0.062 |  |
|  |  |  |  | (-0.73) |  |
| Drink_high_risk |  |  |  |  | -0.582 |
|  |  |  |  |  | (-1.27) |
| _cons | -0.469* | $11.94 * *$ | $12.44 * *$ | $11.68 * *$ | $14.44^{* *}$ |
|  | (-2.31) | (3.87) | (3.63) | (3.74) | (3.78) |
| Pseudo $\mathrm{R}^{2}$ | 0.0125 | 0.2026 | 0.2040 | 0.2085 | 0.2411 |
| $N$ | 70 | 70 | 70 | 70 | 70 |
| $\begin{aligned} & t \text { statistics in parentheses } \\ & { }^{*} p<0.05,{ }^{* *} p<0.01,{ }^{* \prime *} p<0.001 \end{aligned}$ |  |  |  |  |  |

## SMOKING

Looking at model 2 A , it can be stated that the discount rate has a statistically significant (at $5 \%$ ) and positive effect on the probability of being a smoker. This suggests that subjects with higher discount rates are more likely to be smokers, which is in line with hypothesis 1 .

When looking at model 2B, it can be concluded that both age and gender have a statistically significant and negative effect on the probability of being a smoker. Older students and female students are thus found to be less likely to be smokers.

Model 2C includes all thee variables. When all three are included the discount rate variable is no longer statistically significant and the effect of gender and age do not change much compared to model 2B. The fact that the discount rate is no longer statistically significant could suggest that older students are more patient, and thus have lower discount rates. Therefore the correlation between age and the discount rate is determined. A weak correlation of -0.238 was found, this correlation has the right sign but is not strong. This finding can therefore not be used to explain why the discount rate variable is no longer statistically significant.

When using future orientation as the independent variable, it can be seen from that table that this variable is negative and insignificant (model 2D). The variables of Age and gender are not much affected by the change in the model.

The risk estimation dummy for smoking is also added to model 2C, resulting in model 2E. From the model it can be seen that the dummy has a positive but insignificant effect on the dependent variable. Furthermore, it can be seen that the discount rate variable remains positive and insignificant.

|  | 2A | 2B | 2C | 2D | 2E |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Smoker | Smoker | Smoker | Smoker | Smoker |
| Discount rate | $38.07{ }^{*}$ |  | 24.45 |  | 22.33 |
|  | (2.04) |  | (1.07) |  | (0.98) |
| Age |  | $-1.518^{* * *}$ | $-0.498^{* * *}$ | $-0.477^{* * *}$ | $-0.575^{* * *}$ |
|  |  | (-3.84) | (-3.61) | (-3.39) | (-3.77) |
| Gender |  | -0.923* | -0.879* | -0.974* | $-1.024^{*}$ |
|  |  | $(-2.46)$ |  | $(-2.53)$ | $(-2.54)$ |
| Future-orientation |  |  |  |  |  |
|  |  |  |  | (-1.26) |  |
| Smoke_high_risk |  |  |  |  | 0.665 |
|  |  |  |  |  | (1.57) |
| _cons | -0.338 | $13.33^{* * *}$ | $12.65^{* * *}$ | $13.12^{* * *}$ | 14.50 *** |
|  | $(-1.69)$ | $(4.00)$ | (3.68) | $(3.85)$ | (3.84) |
| Pseudo $\mathrm{R}^{2}$ | 0.0445 | 0.2232 | 0.2350 | 0.2399 | 0.2610 |
| $N$ | 70 | 70 | 70 | 70 | 70 |

Table 10: Smoking behaviour

## SMOKING AND DRINKING

When looking at model 3A, it can be stated that the effect of the discount rate on the probability of being both a smoker and a drinker is positive but insignificant.

Model 3B shows that age has a statistically significant and negative effect on the dependent variable, and gender has a negative but insignificant effect. Older students are thus less likely to be both heavy drinkers and smokers.

When combining model 3 A and 3 B , model 3 C is created. From the table it can be concluded that the discount rate has a negative but insignificant effect. The effect of gender and age do not change drasticly from model 3B.

When using future orientation as the independent variable of interest (model 3D), this variable has a negative but insignificant effect. The effects of gender and age are similar to the other models.

The risk estimation dummies for smoking and drinking were also added to create model 3E. From this it can be seen that the two dummies have a negative and insignificant effect on the probability of being both a heavy drinker and a smoker. Furthermore, the discount rate variable remains insignificant and the sign is negative.

|  | 3A | 3B | 3C | 3D | 3E |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Drinker and Smoker | Drinker and Smoker | Drinker and Smoker | Drinker and Smoker | Drinker and Smoker |
| Discount rate | 16.82 |  | -13.10 |  | -10.21 |
|  | (0.93) |  | (-0.57) |  | (-0.43) |
| Age |  | $-0.525^{* * *}$ | $-1.554^{* * *}$ | $-0.495^{* * *}$ | $-0.583^{* * *}$ |
|  |  | (-4.07) | (-3.92) | (-3.67) | (-3.74) |
| Gender |  | -0.440 | -0.495 | -0.444 | -0.622 |
|  |  | (-1.20) | (-1.29) | (-1.20) | (-1.47) |
| Future-orientation |  |  |  | -0.0701 |  |
|  |  |  |  | (-0.82) |  |
| Smoke_high_risk |  |  |  |  | -0.374 |
|  |  |  |  |  | (-0.80) |
| Drink_high_risk |  |  |  |  | -0.712 |
|  |  |  |  |  | (-1.48) |
| _cons | -0.488* | $12.27^{* * *}$ | $13.12^{* * *}$ | $11.99^{* * *}$ | $14.18^{* * *}$ |
|  | (-2.40) | (3.95) | (3.74) | (3.81) | (3.61) |
| Pseudo $\mathrm{R}^{2}$ | 0.0093 | 0.2172 | 0.2208 | 0.2246 | 0.2567 |
| $N$ | 70 | 70 | 70 | 70 | 70 |
| $t$ statistics in parentheses${ }^{*} p<0.05,{ }^{* *} p<0.01,{ }^{* * *} p<0.001$ |  |  |  |  |  |

## ADUSTED SAMPLE

Model 4A was estimate using only the wise group and the risky group. When looking at the table, it can be concluded that for this sample the discount rate has a marginally significant (at $15 \%$ ) and positive effect on the probability of being both a heavy drinker and a smoker ${ }^{10}$. Subjects with higher discount rates are more likely to be heavy drinkers and smokers, which is in line with hypothesis 1 .

Besides that, model 4B shows that both gender and age have a statistically significant and negative effect on the dependent variable. Older students and female students are less likely to be both heavy drinkers and smokers.

Model 4C combines the two models above. When they are combined the discount rate remains positive but is no longer marginally significant. The coefficients of gender and age do not change much.

When future-orientation is added instead of the discount rate (model 4D), it can be seen that this variable has a negative and insignificant effect on the probability of being a heavy drinker and a smoker. Again for gender and age the variables remain similar.

In model 4E also the risk estimation dummies for smoking smoking and drinking are included, which leads to the conclusion that both have negative and insignificant coefficients. Besides that, the discount rate has a positive and insignificant effect on the dependent variable. The effects of age and gender remain statistically significant and negative.

[^8]|  | 4A | 4B | 4C | 4D | 4E |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Drinker and Smoker | Drinker and Smoker | Drinker and Smoker | Drinker and Smoker | Drinker and Smoker |
| Discount rate | 33.15* |  | 18.03 |  | 16.49 |
|  | (1.63) |  | (0.67) |  | (-0.62) |
| Age |  | $-0.676^{* * *}$ | $-0.659^{* * *}$ | $-0.643^{* * *}$ | $-0.669^{* * *}$ |
|  |  | (-4.06) | (-3.90) | (-3.73) | (-3.77) |
| Gender |  | $-0.962^{* * *}$ | -0.951** | $-1.019^{* * *}$ | $-1.050^{* * *}$ |
|  |  | (-2.13) | (-2.09) | (-2.19) | (-2.13) |
| Future-orientation |  |  |  |  |  |
|  |  |  |  | (-1.01) |  |
| Smoke_high_risk |  |  |  |  | -0.0632 |
|  |  |  |  |  | (0.12) |
| Drink_high_risk |  |  |  |  | -0.359 |
|  |  |  |  |  | (-0.67) |
| _cons | $-0.441^{* * *}$ | $16.18{ }^{* * *}$ | $16.29^{* * *}$ | $16.17^{* * *}$ | $16.75{ }^{* * *}$ |
|  | (-2.10) | (4.07) | (3.87) | (3.94) | (3.76) |
| Pseudo $\mathrm{R}^{2}$ | 0.0322 | 0.2995 | 0.3048 | 0.3120 | 0.3105 |
| $N$ | 61 | 61 | 61 | 61 | 61 |
| $\begin{aligned} & t \text { statistics in parentheses } \\ & { }^{*} p<0.15,{ }^{* *} p<0.10,{ }^{* * *} p<0.05 \end{aligned}$ |  |  |  |  |  |

## HYPOTHESIS 2

The second hypothesis that will be investigated is the following:
H2: 'Less impatient students show more long-term wise behaviour'
The coefficients of the discount rate are predicted to be negative for this hypothesis. The coefficients for the future orientation variable are predicted to be positive for this hypothesis.

## PHYSICAL EXERCISE

From model 5A, it follows that the discount rate does not have a statistically significant effect on the probability of being a healthy exerciser. The sign is however correct.

In model 5B, only education and gender are used as independent variables. Both have insignificant effects in this model.

When including all three variables (Model 5C), none of them appears to have a statistically significant effect on the probability of showing healthy exercise behaviour.

In model 5D, future orientation is used as the time-preference variable. This variable is not statistically significant and has a positive coefficient, which is in line with the hypothesis. Furthermore education and gender are both insignificant.

|  | 5A | 5B | 5C | 5D |
| :---: | :---: | :---: | :---: | :---: |
|  | Healthy exerciser | Healthy exerciser | Healthy exerciser | Healthy exerciser |
| Discount rate | -17.73 |  | -13.10 |  |
|  | (-0.98) |  | (-0.67) |  |
| Education |  | 0.513 | 0.449 | 0.404 |
|  |  | (1.62) | (1.36) | (1.21) |
| Gender |  | -0.229 | -0.271 | -0.225 |
|  |  | (-0.68) | (-0.79) | (-0.66) |
| Future-orientation |  |  |  | 0.0864 |
|  |  |  |  | (1.07) |
| _cons | 0.306 | -0.270 | 0.000139 | -0.598 |
|  | (1.54) | (-0.34) | (0.00) | (-0.69) |
| Pseudo R ${ }^{2}$ | 0.0100 | 0.0336 | 0.0383 | 0.0456 |
| $N$ | 70 | 70 | 70 | 70 |

Table 13: Exercising behaviour

## EATING HEALTHY

Model 6A only includes the discount rate in the model. It can be seen that the discount variable is negative and marginally significant (at $10 \%)^{11}$. This indicates that that subjects with lower discount rates are more likely to be healthy exercisers compared to subjects with higher discount rates. This finding is in line with hypothesis 2.

In model 6B only the education phase and gender are included. Gender appears not to have a statistically significant effect on the probability of showing healthy eating behaviour, but education phase does. Subjects that are in their masters have a significantly higher probability of eating healthy, compared to bachelor students.

When combining all three variables in model 6C, the coefficient of the discount rate becomes insignificant. Education phase is still statistically significant and positive in this model, and gender remains insignificant. It could be suggested that the discount rate and education phase are correlated, meaning that master students have lower discount rates. This would result in the fact that the discount rate variable is no longer statistically significant. Therefore the correlation between education level and the discount rate is calculated. A weak correlation of -0.289 was found, leading to the conclusion that this association cannot be used as an explanation of the fact that the discount rate variable is no longer statistically significant.

Using future orientation as the time preference indicator (Model 6D), it can be concluded that this variable does not have a statistically significant effect on the probability of showing healthy eating behaviour. Education phase and gender are not much affected by this change in the model.

[^9]|  | 6A | 6B | 6C | 6D |
| :---: | :---: | :---: | :---: | :---: |
|  | Healthy eater | Healthy eater | Healthy eater | Healthy eater |
| Discount rate | -33.99** |  | -26.57 |  |
|  | (-1.83) |  | (-1.33) |  |
| Education |  | $0.844^{* * *}$ | $0.726^{* * *}$ | $0.794^{* * *}$ |
|  |  | (2.61) | (2.16) | (2.34) |
| Gender |  | -0.213 | -0.306 | -0.207 |
|  |  | (-0.63) | (-0.87) | (-0.61) |
| Future-orientation |  |  |  | 0.0387 |
|  |  |  |  | (0.47) |
| _cons | $0.421^{* * *}$ | -0.838 | -0.299 | -0.992 |
|  | (2.09) | (-1.04) | (-0.33) | (-1.14) |
| Pseudo $\mathrm{R}^{2}$ | 0.0359 | 0.0788 | 0.0974 | 0.0811 |
| $N$ | 70 | 70 | 70 | 70 |

Table 14: Healthy eating behaviour

## ADJUSTED SAMPLE

The models for testing hypothesis 2 were also estimated using the adjusted sample. These models however found few statistically significant results. It can therefore be concluded that except for education, none of the variables have a statistically significant effect on the dependent variable of either showing healthy exercise behaviour or being a healthy eater. No correlation between the discount rate and the two behaviours can be detected using this sample and consequently the models are not tabulated in this paper.

## EVALUATION OF THE DIRECT METHOD

In order to evaluate the Direct Method, the subjects were asked to indicate how much difficulty they experienced when answering the questions, and how sure they were of their answers. The pie-charts below shows the difficulty of the method.

```
- Very easy
- Easy
- Medium
| Difficult
@ Very difficult
```



Figure 2: Difficulty of the Direct Method
From the chart it can be read that the largest portion (33\%) of the subjects experienced the question as easy, after which equal portions (27\%) experienced it as being difficult or medium. $10 \%$ thought the question was very easy, and only $3 \%$ reported to have very much difficulty in answering the question. An important note to make therefore is the fact that $30 \%$ of highly educated subjects had (very much) difficulty with using the Direct Method. This is a considerate amount and the difficulty of the method should therefore not be underestimated.

The pie chart below displays the certainty of the choices of the respondents. The largest part ( $44 \%$ ) indicated to be certain. After that, $29 \%$ indicated medium and $16 \%$ was very uncertain. Furthermore, $11 \%$ reported to be uncertain and nobody was very certain. In total, a considerate amount of $27 \%$ was (very) uncertain about their answer, this fact should therefore also be taken into account when evaluating the Direct Method.


Figure 3: Certainty of answers

In order to see whether there exists a relation between subjects being very certain (value 5 on the scale from 1 to 5 ) and finding the question very difficult (value 5 on the scale from 1 to 5 ) the correlation was calculated. It is expected that there exists a negative correlation between the two ${ }^{12}$. The correlation is indeed negative and has a moderate strength of -0.471 .

Below a cross table of the two variables is given, providing more insight on the distribution of the certainty and difficulty level. From the table a mild pattern can be detected with more certain answers provided by subjects who experienced the task as being easier.

|  | Certainty |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :---: | :--- | :--- |
| Difficulty | 1 | 2 | 3 | 4 | 5 | Total |
| 1 | 0 | 0 | 1 | 2 | 4 | 7 |
| 2 | 0 | 1 | 4 | 14 | 4 | 23 |
| 3 | 0 | 2 | 6 | 8 | 3 | 19 |
| 4 | 0 | 4 | 9 | 6 | 0 | 19 |
| 5 | 0 | 1 | 0 | 1 | 0 | 2 |
| Total | 0 | 8 | 20 | 31 | 11 | 70 |

Table 15: Cross table difficulty and certainty

[^10]
## DISCUSSION AND CONCLUSION

In this chapter first a summary of the results will be provided, which leads to the rejection or acceptance of the hypotheses. Subsequently, multiple limitations and their implications on the research will be discussed, together with improvements for further research. Furthermore, as the Direct Method is a newly proposed method, the use of this method will be evaluated. Finally, a conclusion following the research question and the hypotheses will be provided.

## SUMMARY OF RESULTS

In this research multiple models were estimated in order to detect a possible relation between health behaviours of students and their impatience level. The research question that was investigated is the following:

## 'Is there a relation between impatience and health behaviour among students in the Netherlands?'

The risky behaviours smoking and drinking are suggested to correspond with high levels of impatience (hypothesis 1) and the wise behaviours exercising and eating healthy are suggested to correspond with low levels of impatience (hypothesis 2 ).

In the research, subjects were selected based on the fact that they showed either of the two risky behaviours, or neither of the two behaviours. This way possible large differences in their subjective discount rates could be detected. Unintentionally however, some exceptions were included into the sample. In view of the small sample size the sample was first investigated as a whole, followed by an analysis using an adjusted sample without the erroneous observations.

Initially, hypothesis 1 was tested using the whole sample. First of all, it can be concluded that in this data there exists no statistically significant relation between the probability of heavy drinking and the subjective discount rate. Secondly, based on the results, it can be concluded that when control variables are not included in the model, there exists a statistically significant and positive relation between the probability of smoking and the subjective discount rate. This finding is in line with the first hypothesis. Furthermore, the combination of drinking and smoking is found to be unrelated to the subjective discount rate. When the subjects that either smoke or drink are dropped in the sample however, the discount rate is found to have a marginally significant and positive effect on the probability of a subject being both a heavy drinker and a smoker. This is also in line with the first hypothesis. Using a non-monetary measure of impatience, no significant effects could be found for both behaviours in both samples.

In conclusion, under certain circumstances associations can be detected between the subjective discount rate and smoking or the combination of smoking and drinking. These associations are however inconsistent and not strong and therefore it seems appropriate that the first hypothesis is rejected.

The second hypothesis was tested by looking at two types of behaviour; physical exercise and eating healthy. Firstly, the whole sample was investigated. For exercise behaviour it cannot be concluded that a correlation exists between the discount rate and the probability of healthy exercise behaviour. As for eating behaviour, when the control variables are not included in the model, the discount rate variable is marginally significant and negative. This is in line with the second hypothesis. When the adjusted sample is used, the subjective discount rate appears not to have a statistically significant effect on the two wise behaviours. Also for this hypothesis a non-monetary measurement of impatience does not have a detectable correlation with both wise behaviours for both samples.

Altogether, an association was found between healthy eating behaviour and the subjective discount rate. This relation is however not strong, and therefore is also seems appropriate to reject the second hypothesis.

## LIMITATIONS AND SUGGESTIONS

In this section the limitations of the research will be explained and ways to improve this in further research will be suggested. First, the limitations of the sample will be argued, after which the challenges of the research method will be discussed.

## THE SAMPLE

The first limitation is the small size of the sample. As conducting the interview takes quite some time per respondent, a sample of only 70 students was investigated. This makes it more difficult to detect a possible correlation between the variables. Follow-up research would therefore benefit from investigating more subjects, this way hopefully more consistent results can be detected.

Secondly, the students were selected in such a way that they are homogenous except for two behaviours; smoking and drinking. However, as people cannot exactly be categorised, this selection method is quite subjective. From the data it can consequently be seen that some respondents were interviewed that do not belong to one of the dedicated groups. When these subjects are included in the sample it is harder to indicate a possible relation between the variables. Therefore further research could interview a larger group of students, and then filter out the subjects who do not match the two groups.

As indicated, the subjects were asked some personal questions about their behaviour. They were requested to answer these questions on paper or over the phone. However, as they might not feel completely anonymous, this could result in them not answering the questions truthfully, thereby biasing the results. Future research could therefore try to emphasize this feeling of anonymity even more to be certain of the truthfulness of the answers.

Besides that, the wise behaviours that were investigated concern eating healthy and physical exercise. From the hypothesis it is assumed that students show such behaviour because it will reflect positively on their future life, however both behaviours could also be performed with other objectives. Examples of such motivations for eating healthy are peer-behaviour or self-identity (Astrosm \& Rise, 2001). For exercising these motivations
could be fun, stress relief or mental challenge (Gavin et al, 2014). These motivations can disturb the actual effect of their impatience level and should therefore be taken into account.

Furthermore, from multiple models it follows that there is a statistically significant relation between the probability of showing certain behaviour and the age or education phase of subjects. From theory, it could be suggested that older subjects become less impatient and will thus reduce their risky behaviour. Also from the literature it follows that older age groups are less likely to display certain types of behaviour (Winstock et al., 2016). However, when testing for correlations between the discount rate and age or education, these turned out to be weak. Nevertheless, when drawing conclusions about the research question, the fact that students can become 'older and wiser' should therefore be kept in mind. Future research could investigate whether the impatience level of people actually decreases as they grow older, resulting in certain behavioural changes.

Another possible limitation of the research could be that the association that is investigated works in both ways. It can be suggested that subjects who show risky behaviour become more impatient because they are aware of the harm that their behaviour has on their future well-being. As they know that their future condition will be worse than their present state, they could have the tendency to focus on the present even more, resulting in an even higher level of impatience. This fact would result in different implications following conclusions of this research. Even though this association is hard to determine, future research could possibly investigate it by looking at the development of the subjective discount rate of smokers over time. If they have smoked for a longer period in time, their expectation about their future state will become worse, resulting in an increasing focus on the present. Research could show this by investigating whether smokers indeed have an increasing discount rate over time.

## THE RESEARCH METHOD

Another possible limitation of the paper is the discrepancy between evaluating money and health over time. The used measurement of the discount rate is based on the evaluation of money over time whereas the behaviours affect the health state of an individual. The question is whether the discount rates of these two different domains can be compared. Bos et al. (2005) for example argue that that health should be discounted based on health effects. Future research could possibly perform the same research, using the Direct Method based on health gains and losses.

Besides that, the time perspective of the measurement of the subjective discount rate is different than that of the possible effects of the different types of behaviour. The subjective discount rate is measured over one year whereas especially the consequences of drinking or smoking will only show much later in life (Voedingscentrum.nl, 2017; World Health Organization, 2017). It is possible that the subjective evaluation of life or money over time is different on the (relatively) short term, compared to life-long evaluations. Future research would therefore potentially benefit by matching the time perspectives of the measurement of the discount rate and the consequences of specific behaviour.

Using the models displayed above, not many statistically significant relations could be detected. In order to see if stronger relations could be found when using a non-linear or categorical variable of the impatience level, these models were also estimated. The models however provided no new insights into the hypotheses. They can be found in Appendix B.

## EVALUATION OF THE DIRECT METHOD

In the literature it is already mentioned that measuring the subjective discount rate is a topic that is still under investigation. The Direct Method also has its advantages and disadvantages, these will be discussed below.

A first positive note to make is the fact that the values of $\mathrm{C}_{1 / 2}, \mathrm{C}_{1 / 4}$, and $\mathrm{C}_{1 / 8}$ are similar to the ones that were found by Attema et al. (2016). This indicates that the measurement happened consistently with the original paper and thus shows that the method is repeatable. Besides that, the fact that no knowledge on the utility function of subjects is required is a large advantage. It simplifies the calculation of the discount rate and ensures that no assumptions have to be made.

From the questions regarding the difficulty of understanding the method and the certainty of the provided answer a conclusion can be drawn. Even though a considerate amount of subjects experienced the method as being (very) easy or medium, still $30 \%$ of the subjects thought the questions were difficult. Also regarding the certainty, $27 \%$ was (very) uncertain about their choices. Considering the fact that this group of students is highly educated and that they were provided with an extensive explanation, this indicates that the Direct Method is a complex way of measuring subjective discounting. Future research would therefore benefit by also asking such evaluating questions. In case of a large sample the respondents that are not (very) certain could then be dropped from the sample in order to get a more reliable measurement.

When using this method multiple things were noteworthy. First of all, multiple subjects indicated during the interviews that they rather wanted to receive 'as much money as possible' as opposed to receiving money 'as soon as possible'. They stated that this was such a large amount of money relative to their daily consumption budget that they would be willing to wait for it. Besides that, many students said that when choosing between the first and the second half of the year, they would rather want to receive the money in the second half year. If this was their choice, the reason for their decision was asked; a large portion of the subjects answered that they would like the idea of being able to look forward the money, because they could carefully consider what they would spend it on. Both of these situations result in a considerate amount of subjects choosing an indifference point of $\mathrm{C}_{1 / 2}=26$ and $\mathrm{C}_{1 / 4}=13$ (both corresponding to discount rate 0 ) and $\mathrm{C}_{1 / 8}$ being either 6 or 7. This resulted in a large group of respondents with low discount rates and as such does not correspond with the human tendency to be impatient, like suggested by the literature (Thaler, 1981). In order to validate these low discount rates, future research could possibly focus on a longer time horizon, because subjects might be more indifferent on the relative short term compared, to a longer time span.

Altogether, the Direct Method has advantages and limitations. Advantages are that no knowledge on the utility function of subjects is required and that consistency in measurements were found. Disadvantages are however that the method is time consuming and that a considerate amount of highly educated subjects reported the method to be difficult and were not certain about their choices. Furthermore, when using the method it is important to carefully consider the time perspective, measurement domain and relative impact of the received benefit that is used.

CONCLUSION
Weak and inconsistent associations between the impatience levels and health behaviours of students were observed in this paper. This leads to the rejection of the first and second hypothesis and results in a negative answer on the research question. Between impatience and health behaviours of students in the Netherlands, no relation of any significance was found.

Besides that, this research was used to evaluate the newly developed Direct Method. The disadvantage of this method turned out to be its complexity. That said, the fact that no knowledge on utility is required is a large advantage. It is therefore recommended that future research uses this method in order to evaluate it even further.

Mild relations between various types of health behaviours and the impatience levels were found and therefore it is suggested that future research investigates this association more thoroughly. If a larger sample is used and subjects are selected carefully this could lead to more insight into the effect of impatience on behaviour of people. These findings could be valuable for policies to stimulate and discourage certain types of behaviour.

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## APPENDIX

## APPENDIX A: SURVEY

| Which option do you prefer? Gain $€ 20$ per week |  |  |  |
| :---: | :---: | :---: | :---: |
| Option A | A | B | Option B |
| Nothing (0) | $\bigcirc$ | $\bigcirc$ | Starting week 1 and ending week 52 (52) |
| Starting week 1 and ending week 1 (1) | $\bigcirc$ | $\bigcirc$ | Starting week 2 and ending week 52 (51) |
| Starting week 1 and ending week 2 (2) | $\bigcirc$ | $\bigcirc$ | Starting week 3 and ending week 52 (50) |
| Starting week 1 and ending week 3 (3) | $\bigcirc$ | $\bigcirc$ | Starting week 4 and ending week 52 (49) |
| Starting week 1 and ending week 4 (4) | $\bigcirc$ | $\bigcirc$ | Starting week 5 and ending week 52 (48) |
| Starting week 1 and ending week 5 (5) | $\bigcirc$ | $\bigcirc$ | Starting week 6 and ending week 52 (47) |
| Starting week 1 and ending week 6 (6) | $\bigcirc$ | $\bigcirc$ | Starting week 7 and ending week 52 (46) |
| Starting week 1 and ending week 7 (7) | $\bigcirc$ | O | Starting week 8 and ending week 52 (45) |
| Starting week 1 and ending week 8 (8) | $\bigcirc$ | O | Starting week 9 and ending week 52 (44) |
| Starting week 1 and ending week 9 (9) | $\bigcirc$ | $\bigcirc$ | Starting week 10 and ending week 52 (43) |
| Starting week 1 and ending week 10 (10) | $\bigcirc$ | $\bigcirc$ | Starting week 11 and ending week 52 (42) |
| Starting week 1 and ending week 11 (11) | $\bigcirc$ | $\bigcirc$ | Starting week 12 and ending week 52 (41) |
| Starting week 1 and ending week 12 (12) | $\bigcirc$ | $\bigcirc$ | Starting week 13 and ending week 52 (40) |
| Starting week 1 and ending week 13 (13) | $\bigcirc$ | $\bigcirc$ | Starting week 14 and ending week 52 (39) |
| Starting week 1 and ending week 14 (14) | $\bigcirc$ | $\bigcirc$ | Starting week 15 and ending week 52 (38) |
| Starting week 1 and ending week 15 (15) | $\bigcirc$ | $\bigcirc$ | Starting week 16 and ending week 52 (37) |
| Starting week 1 and ending week 16 (16) | $\bigcirc$ | $\bigcirc$ | Starting week 17 and ending week 52 (36) |
| Starting week 1 and ending week 17 (17) | $\bigcirc$ | $\bigcirc$ | Starting week 18 and ending week 52 (35) |
| Starting week 1 and ending week 18 (18) | $\bigcirc$ | $\bigcirc$ | Starting week 19 and ending week 52 (34) |
| Starting week 1 and ending week 19 (19) | $\bigcirc$ | $\bigcirc$ | Starting week 20 and ending week 52 (33) |
| Starting week 1 and ending week 20 (20) | $\bigcirc$ | $\bigcirc$ | Starting week 21 and ending week 52 (32) |
| Starting week 1 and ending week 21 (21) | $\bigcirc$ | $\bigcirc$ | Starting week 22 and ending week 52 (31) |
| Starting week 1 and ending week 22 (22) | $\bigcirc$ | $\bigcirc$ | Starting week 23 and ending week 52 (30) |
| Starting week 1 and ending week 23 (23) | $\bigcirc$ | $\bigcirc$ | Starting week 24 and ending week 52 (29) |
| Starting week 1 and ending week 24 (24) | $\bigcirc$ | 0 | Starting week 25 and ending week 52 (28) |
| Starting week 1 and ending week 25 (25) | $\bigcirc$ | $\bigcirc$ | Starting week 26 and ending week 52 (27) |
| Starting week 1 and ending week 26 (26) | $\bigcirc$ | $\bigcirc$ | Starting week 27 and ending week 52 (26) |
| Starting week 1 and ending week 27 (27) | $\bigcirc$ | $\bigcirc$ | Starting week 28 and ending week 52 (25) |
| Starting week 1 and ending week 28 (28) | $\bigcirc$ | $\bigcirc$ | Starting week 29 and ending week 52 (24) |
| Starting week 1 and ending week 29 (29) | $\bigcirc$ | $\bigcirc$ | Starting week 30 and ending week 52 (23) |
| Starting week 1 and ending week 30 (30) | $\bigcirc$ | $\bigcirc$ | Starting week 31 and ending week 52 (22) |
| Starting week 1 and ending week 31 (31) | $\bigcirc$ | $\bigcirc$ | Starting week 32 and ending week 52 (21) |
| Starting week 1 and ending week 32 (32) | $\bigcirc$ | $\bigcirc$ | Starting week 33 and ending week 52 (20) |
| Starting week 1 and ending week 33 (33) | $\bigcirc$ | $\bigcirc$ | Starting week 34 and ending week 52 (19) |
| Starting week 1 and ending week 34 (34) | $\bigcirc$ | $\bigcirc$ | Starting week 35 and ending week 52 (18) |
| Starting week 1 and ending week 35 (35) | $\bigcirc$ | $\bigcirc$ | Starting week 36 and ending week 52 (17) |
| Starting week 1 and ending week 36 (36) | $\bigcirc$ | $\bigcirc$ | Starting week 37 and ending week 52 (16) |
| Starting week 1 and ending week 37 (37) | $\bigcirc$ | $\bigcirc$ | Starting week 38 and ending week 52 (15) |
| Starting week 1 and ending week 38 (38) | $\bigcirc$ | $\bigcirc$ | Starting week 39 and ending week 52 (14) |
| Starting week 1 and ending week 39 (39) | $\bigcirc$ | $\bigcirc$ | Starting week 40 and ending week 52 (13) |
| Starting week 1 and ending week 40 (40) | $\bigcirc$ | $\bigcirc$ | Starting week 41 and ending week 52 (12) |
| Starting week 1 and ending week 41 (41) | $\bigcirc$ | $\bigcirc$ | Starting week 42 and ending week 52 (11) |
| Starting week 1 and ending week 42 (42) | $\bigcirc$ | $\bigcirc$ | Starting week 43 and ending week 52 (10) |
| Starting week 1 and ending week 43 (43) | $\bigcirc$ | $\bigcirc$ | Starting week 44 and ending week 52 (9) |
| Starting week 1 and ending week 44 (44) | $\bigcirc$ | $\bigcirc$ | Starting week 45 and ending week 52 (8) |
| Starting week 1 and ending week 45 (45) | $\bigcirc$ | $\bigcirc$ | Starting week 46 and ending week 52 (7) |
| Starting week 1 and ending week 46 (46) | $\bigcirc$ | $\bigcirc$ | Starting week 47 and ending week 52 (6) |
| Starting week 1 and ending week 47 (47) | $\bigcirc$ | $\bigcirc$ | Starting week 48 and ending week 52 (5) |
| Starting week 1 and ending week 48 (48) | $\bigcirc$ | $\bigcirc$ | Starting week 49 and ending week 52 (4) |


| Starting week 1 and ending week 49 (49) | $\circ$ | $\circ$ | Starting week 50 and ending week 52 (3) |
| :--- | :---: | :---: | :--- |
| Starting week 1 and ending week 50 (50) | $\circ$ | $\circ$ | Starting week 51 and ending week 52 (2) |
| Starting week 1 and ending week 51 (51) | $\circ$ | $\circ$ | Starting week 52 and ending week 52 (1) |
| Starting week 1 and ending week 52 (52) | $\circ$ | $\circ$ | Nothing (0) |

## Vragenlijst

Hoe moeilijk vond je het de vorige vraag?
$\square$ Helemaal niet moeilijkNiet moeilijk
$\square$ NeutraalMoeilijk
$\square$ Heel moeilijk
Hoe zeker ben je van je antwoord op de vorige vraag?
$\square$ Niet zekerNeutraal
ZekerHeel zeker

Gemiddeld genomen, hoeveel dagen in de week ben je minstens 30 minuten actief in beweging (wandelen, fietsen of sporten)?
24$\square$

Gemiddeld genomen, hoeveel dagen in de week eet je gevarieerd, niet te veel, niet te vet, en ook groente en fruit?
$\square$ Nooit
1
234$\square 6$
7

Gemiddeld genomen, hoeveel dagen in de week drink je alcoholhoudende dranken?
$\square$ Nooit
1$\square 3$

Op dagen dat je drinkt, hoeveel glazen drink je dan gemiddeld?

Rook je?
$\square$ neeJa, af en toe
$\square$ Ja, dagelijks

Hoe zie je jezelf? Ben je over het algemeen iemand die meer op het heden is gericht of meer op de toekomst?


Hoeveel jaar denk je dat iemand die zijn hele leven rookt korter zal leven?

Hoeveel jaar denk je dat iemand die zijn hele leven drinkt korter zal leven?

Leeftijd

Geslacht

- Man
- Vrouw


## Opleidingsniveau

- WO Bachelor
- WO Master

In order to find correlations between the variables other models are tested. Firstly, the discount rate and the future orientation variable are converted in categorical variables and besides that, the discount rate is also tested nonlinear. The outcome of these models is displayed below.

## CATEGORICAL DISCOUNT RATE

The discount rate variable is divided into the categories low and high. The low category consists of discount rates smaller than or equal to 0.00118 ( $50 \%$ ) and the high category consists of discount rates larger than that.

The future orientation variable is converted into three categories. The variable concerns the extent to which an individual focusses on the future or the present with value 1 being completely focussed on the future, and value 10 being completely focussed on the present. Subjects are categorised as low if they indicate value 3 or lower, as middle if they indicate value 3 until 6 and as high if they indicate value 7 or higher.

|  | 9A | 9C | 9D |
| :---: | :---: | :---: | :---: |
|  | Heavy drinker | Heavy drinker | Heavy drinker |
| Discount categorical | 0.458 | 0.058 |  |
|  | $(1,48)$ | (0.16) |  |
| Age |  | $-0.492^{* * *}$ | $-498{ }^{* * *}$ |
|  |  | (-3.71) | (-3.76) |
| Gender |  | -0.550 | -0.568 |
|  |  | (-1.45) | (-1.56) |
| Future-orientation cat |  |  | 0.00158 |
|  |  |  | (-0.01) |
| _cons | $-1.024^{*}$ | $11.68{ }^{* * *}$ | $11.94 * *$ |
|  | (-2.06) | (3.38) | (3.84) |
| Pseudo $\mathrm{R}^{2}$ | 0.0240 | 0.2029 | 0.2026 |
| $N$ | 70 | 70 | 70 |

Table 16: Drinking behaviour categorical


Table 17: Smoking behaviour categorical

|  | 11 A | 11C | 11D |
| :---: | :---: | :---: | :---: |
|  | Drinker and smoker | Drinker and smoker | Drinker and smoker |
| Discount categorical | 0.386 | -0.0393 |  |
|  | (1.25) | (-0.11) |  |
| Age |  | $-0.529^{* * *}$ | $-0.518^{* * *}$ |
|  |  | (-3.90) | (-3.87) |
| Gender |  | -0.452 | -0.444 |
|  |  | (-1.18) | (-1.20) |
| Future-orientation cat |  |  | -0.0394 |
|  |  |  | (-0.19) |
| _cons | -0.952 | $12.44^{* * *}$ | $12.20{ }^{* * *}$ |
|  | (-1.91) | (3.53) | (3.90) |
| Pseudo R ${ }^{2}$ | 0.0171 | 0.2173 | 0.2176 |
| $N$ | 70 | 70 | 70 |

Table 18: Combination drinking and smoking categorical

|  | 12A | 12C | 12D |
| :---: | :---: | :---: | :---: |
|  | Healthy exerciser | Healthy exerciser | Healthy exerciser |
| Discount categorical | -0.146 | -0.106 |  |
|  | (-0.48) | (-0.33) |  |
| Education |  | 0.489 | 0.426 |
|  |  | (-0.75) | (-0.64) |
| Gender |  | -0.258 | -0.216 |
|  |  | (-0.75) | (-0.64) |
| Future-orientation cat |  |  | 0.167 |
|  |  |  | (0.86) |
| _cons | 0.399 | -0.0219 | -0.506 |
|  | (0.83) | (-0.02) | (-0.60) |
| Pseudo $\mathrm{R}^{2}$ | 0.0024 | 0.0347 | 0.0413 |
| $N$ | 70 | 70 | 70 |

Table 19: Exercising behaviour categorical

|  | 13A | 13C | 13D |
| :---: | :---: | :---: | :---: |
|  | Healthy eater | Healthy eater | Healthy eater |
| Discount categorical | -0.292 | -0.217 |  |
|  | (-0.97) | (-0.65) |  |
| Education |  | $0.798^{*}$ | 0.858* |
|  |  | (2.41) | (2.51) |
| Gender |  | -0.280 | -0.217 |
|  |  | (-0.79) | (-0.64) |
| Future-orientation cat |  |  | -0.0249 |
|  |  |  | (-0.13) |
| _cons | 0.620 | -0.322 | -0.801 |
|  | (1.29) | (-0.29) | (-0.94) |
| Pseudo $\mathrm{R}^{2}$ | 0.0098 | 0.0833 | 0.0790 |
| $N$ | 70 | 70 | 70 |

Table 20: Eating behaviour categorical

## NON-LINEAR DISCOUNT RATE

The nonlinear variable of the discount rate was created by squaring the discount rates. The tables below provide an overview of the models that were created using this variable.

|  | 14A | 14C | 15A | 15C |
| :---: | :---: | :---: | :---: | :---: |
|  | Heavy drinker | Heavy drinker | Smoker | Smoker |
| Discount rate | 107.4 | 66.57 | 123.6 * | 74.38 |
|  | (1.88) | (1.03) | (2.18) | (1.14) |
| Disc2 | -3288.9 | -2907.4 | -3151.3 | -1959.7 |
|  | (-1.60) | (-1.20) | (-1.60) | (-0.81) |
| Age |  | $-0.520^{* * *}$ |  | -0.491*** |
|  |  | (-3.65) |  | (-3.50) |
| Gender |  | -0.577 |  | $-0.821^{*}$ |
|  |  | (-1.50) |  | (-2.12) |
| _cons | $-0.705^{* *}$ | $12.31{ }^{* * *}$ | $-0.564^{*}$ | $12.24{ }^{* * *}$ |
|  | (-2.80) | (3.64) | (-2.30) | (3.49) |
| Pseudo $\mathrm{R}^{2}$ | 0.0418 | 0.2205 | 0.0713 | 0.2420 |
| $N$ | 70 | 70 | 70 | 70 |
| $t$ statistics in parentheses${ }^{*} p<0.05,{ }^{*} p<0.01,{ }^{2} p<0.001$ |  |  |  |  |


|  | 16A | 16C |
| :---: | :---: | :---: |
|  | Drinker and smoker | Drinker and smoker |
| Discount rate | 86.60 | 40.11 |
|  | (1.52) | (0.61) |
| Disc2 | -2611.5 | -2069.9 |
|  | (-1.28) | (-0.85) |
| Age |  | $0.555^{* * *}$ |
|  |  | (-3.85) |
| Gender |  | -0.481 |
|  |  | (-1.24) |
| _cons | $-0.675^{* *}$ | 12.98** |
|  | (-2.69) | (3.61) |
| Pseudo R ${ }^{2}$ | 0.0280 | 0.2290 |
| $N$ | 70 | 70 |

Table 22: Combination drinking and smoking behaviour nonlinear

|  | 17A | 17C | 18A | 18B |
| :---: | :---: | :---: | :---: | :---: |
|  | Healthy exerciser | Healthy exerciser | Healthy eater | Healthy eater |
| Discount rate | -36.00 | -30.72 | -56.39 | -26.25 |
|  | (-0.66) | (-0.53) | (-1.02) | (-0.77) |
| Disc2 | 677.9 | 639.9 | 835.1 | 712.7 |
|  | (0.35) | (0.32) | (0.43) | (0.35) |
| Education |  | 0.432 |  | $0.70{ }^{*}$ |
|  |  | (1.29) |  | (2.09) |
| Gender |  | -0.291 |  | -0.333 |
|  |  | (-0.84) |  | (-0.93) |
| _cons | 0.354 | 0.109 | 0.480 * | -0.171 |
|  | (1.47) | (0.11) | (1.97) | (-0.17) |
| Pseudo $\mathrm{R}^{2}$ | 0.0113 | 0.0393 | 0.0379 | 0.0987 |
| $N$ | 70 | 70 | 70 | 70 |

Table 23: Exercising and eating behaviour nonlinear


[^0]:    ${ }^{1}$ A scale that indicates subject's future time perspective by asking various questions.

[^1]:    ${ }^{2}$ Amount $x$ at time $t$ or amount $y(>x)$ at time $t+\tau$.

[^2]:    ${ }^{3}$ More than 21 glasses of alcohol per week for men and more than 14 per week for women.

[^3]:    ${ }^{4}$ Not difficult at all, not difficult, neutral, difficult, very difficult.
    ${ }^{5}$ Not at all certain, not certain, neutral, certain, very certain.

[^4]:    ${ }^{6}$ Students first need to finish their bachelor before starting their master, and therefore master students are expected to be older.

[^5]:    7 They were either only a smoker or only a drinker.

[^6]:    8 The higher the discount rate, the more emphasis on the present, thus a lower value for the variable future orientation.

[^7]:    ${ }^{9}$ As these behaviours are perfectly correlated the probit model will be estimated once for both behaviours.

[^8]:    10 Note that the table below indicates different significance levels, compared to the other tables.

[^9]:    11 Note that the table below indicates different significance levels, compared to the other tables.

[^10]:    12 I it is more likely that subjects who are more certain (value 4 or 5 ) experienced the task as being easier (value 1 or 2 ).

