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Research Report

We cannot snooze our need for sleep

Time-inconsistency in sleeping habits among young adults

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This study investigates whether there exists time-inconsistency in sleep habits among young adults. Therefore, a one sample t-test is conducted. Furthermore, the study also looks at the predictive power of a monetary present bias and a sleep present bias on time-inconsistency. This is done by a logistic regression and a quantile regression. The data is collected by three surveys. The results show the existence of time-inconsistent preferences, but time-inconsistent behavior showed no significant result. No evidence was found for the explanatory power of the monetary present bias on time-inconsistency. However, the quantile regression results for the sleep present bias on time-inconsistent preferences show a significantly negative effect. Individuals facing a sleep present bias face also larger time-inconsistent preferences. This is line with the quasi-hyperbolic model of time discounting, and provides the first evidence that present-biased preferences for sleep indeed result in time inconsistency in preferences for sleep.

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1. Introduction

Everyone has probably experienced once that they wanted to go to bed early, but then getting lost on social media or watching television. And then they ended up going to bed much later than was planned. The next morning, they wake up tired and make again plans to go to bed early. However, in the evening it again does not work out. It seems like a vicious circle that worsens sleep and negatively impacts our health. The average Dutch person sleeps around one third of his life and 7.12 hours per day (Hersenstichting, 2021). Although this sound like a lot, around 63 percent of the Dutch citizens is unhappy about the quality of sleep (Hersenstichting, 2021).

Young adults often do not sleep enough and also the quality of the sleep is not good enough (Hersenstichting, 2021). Roenneberg (2013) collected data on sleeping behavior and found that people sleep on average 38 minutes less on working days than they did ten years ago. He also found that people switch between different time zones in a week. This means that people go to bed at different times in the workweek, compared to the weekend. This causes sometimes a 'social jetlag', where people switch between under sleeping in the workweek and over sleeping in the weekend. One cause of this unhealthy sleeping behavior may be stress. In that case bad sleeping behavior could cause one to fail to perform at important moments at work or school, which then increases the level of stress even more (Meijer, 2020). Stress and being tired also stimulates that people relapse in bad health behaviors like smoking, drinking or eating fat food (Meijer, 2020). Thus, a good quality and quantity of sleep seems important for our health.

Sleep deprivation has also impact on chronic diseases, health, cognitive skills, decision making, human capital and productivity (Avery, Giuntelle & Jiao, 2019). This risky health behavior becomes more important and is prevalent in modern societies, which leads to negative health and economic consequences (Avery, Giuntelle & Jiao, 2019). All these negative consequences make us face the fact, that sleep deprivation may threaten our public health. It is socially relevant to look at the determinants to counteract this increasing problem. When we know more about the determinants, we can use them and take these into account when setting up new interventions to improve the quantity and quality of sleep.

Some determinants for bad sleep may be stress, making homework late in the evening, looking at phone screens and lack of rules (Hersenstichting, 2021). Only little is known about

the behavioral determinants on sleeping preferences and behavior. This study puts the focus on a behavioral phenomenon in sleeping behavior, time-inconsistency. This study investigates time-inconsistent preferences and time-inconsistent behavior. Time-inconsistent preferences are preferences that differ over time, while time-inconsistent behavior is behavior that fails to succeed the ex-ante plans (O'Donoghue & Rabin, 1999). This means that people plan and prefer to go to bed early, but then do not stick to the plan. Whether time-inconsistent preferences result in time-inconsistent behavior depends on people's beliefs about their behavior in the future (Strotz, 1995; Phelps & Pollak, 1968). Sophisticated people know that their future self-control problems will lead to problems in following up their ex-ante plans, while naïve persons think that they will follow up the ex-ante plans. Sophisticated people predict correctly how they behave in the future, while naïve persons do not. Over time, some naïve people learn about their self-control problems and become sophisticated in the future. However, also some people do not. Especially in sleep behavior this is interesting, because we sleep every day. This makes it interesting to look at whether people learn from it and are sophisticated or are still naïve which results in time-inconsistent behavior. Because there is a gap of knowledge about the effect of time-inconsistency on sleep deprivation, it is scientifically relevant to look at time-inconsistent preferences and behavior in sleeping habits.

The aim of this research is to gain more knowledge about time-inconsistency in sleeping habits. This study focuses on time-inconsistent preferences and behavior of young adults. In the direction of sleeping behavior, this would mean that people say that they go to bed early, but at the end they do not stick to this plan. The first research question is due to that reason:

Are there time-inconsistent preferences and behaviors in sleeping habits of young adults?

The second part of the study focuses on one of the most popular drivers of time-inconsistency, the Present Bias. This means that individuals overweight outcomes now, compared to future outcomes. This is theoretically a popular driver of time-inconsistency, since it the self-control problems of individuals. It indicates that people are relatively patient when they make decisions for the future. However, when the decisions contain costs or benefits for now, these people are relatively impatient. This may lead to self-control problems and lead to time-inconsistent preferences or behavior, which makes it one of the most popular

drivers of time-inconsistency. Time-inconsistency and present-bias are not the same, but being present biased can lead to time-inconsistent preferences and behavior. Even though it is theoretically a popular driver in economics, empirical research on it is lacking (Delaney & Lades, 2017). This lack of knowledge makes it interesting to investigate whether the present bias drives time-inconsistency. In the case of sleeping behavior, being present biased could mean that people make plans to go to bed at 10pm, however when it is 10pm the benefits of staying up late loom larger. These people will postpone bedtime and say that they will go to bed early tomorrow. That is why the second research question is:

Is Present Bias a strong predictor for time-inconsistent preferences and behavior in sleeping habits of young adults?

This paper starts with the theoretical framework for sleeping behavior, time-inconsistency and time-inconsistency that occurs in risky health behaviors. The data is collected by three surveys to test whether the predictions of bedtime differ from the actual bedtimes. The next part explains the data and analysis methods that are used in this research to investigate time-inconsistency in sleeping behavior. This research uses a logistic regression and a quantile regression to estimate the effect of two different present biases on time-inconsistency. It looks at both a monetary and sleep present bias. After the data and methodology, the results are shown. Finally, the conclusion and discussion are presented.

2. Theoretical Framework

Although there is some literature about sleeping behavior and time inconsistency separately, little is known about these two combined. This part starts with the existing literature about sleeping behavior. After sleeping behavior, the existing knowledge about time-inconsistency is discussed. The last part explains the knowledge about other risky health behaviors and time-inconsistency, to gain a better view of time-inconsistency in risky health behavior.

2.1 Sleeping behavior

Before looking at the existing literature about sleep, it is necessary to first look at what sleep is and what function sleep has for our body. Sleep is a periodic, normal, resting status, which is associated with a decrease in consciousness. The body and mind can relax in this state (Vlasblom et al., 2017). Sleep makes it possible for the brain to clean up itself for the next day. A night of good sleep improves the way how people can process their emotions and how they remember things they have learned during the day (Hersenstichting, 2021). The function of sleep is to recover physically and mentally.

Sleep consists of several phases that can be subdivided into two types of sleep (Vlasblom et al., 2017). The first type of sleep is the REM sleep, which means Rapid Eye Movement or active sleep. During the REM-sleep, people dream a lot, the body is relaxed, only eyes are actively moving. The second type of sleep is the non-REM, which is a superficial and deep sleep. The non-REM sleep can be divided into light non-REM sleep (phase one and two) and deep non-REM sleep (phase three). The different phases of sleep alternate during the total sleep cycle. After the REM sleep follows the light non-REM sleep, whereafter the deep non-REM sleep follows. After this deep non-REM sleep, the light non-REM sleep succeeds and then we again fall into the REM-sleep.

Effectiveness of sleep depends quantity as well as quality. The need for hours of sleep diminishes as a person gets older. The National Sleep Foundation (NSF) formulated guidelines based on literature, experts and opinions of experts (Hirskowitz et al., 2015). Our group of aim, young adults between the age of 16 and 30, need according to the guidelines on average 7-9 hours of sleep. According to Leone et al. (2018), on average 10% of the Dutch citizens sleep less than this recommended amount of sleep. This study, which was a collaboration of Hersenstichting, RIVM and Trimbos instituut, investigated whether bad sleep is a problem for

public health and how to improve the knowledge and prevention of this problem. Bad sleep is acknowledged as insufficient or much sleep, and also a bad quality of sleep. They state that it can be caused by different factors, for example bad sleeping habits (sporting or eating before sleep), drug use, environmental factors (a snoring partner), physical or mental illness, screen use and unfavorable working conditions (irregular shifts).

Rugulies et al. (2012) did a cross-sectional and longitudinal study about the effect of deadlines at work on sleep quality. They measured sleep quality with a Total Sleep Quality Score and two indexes, namely the Awakening Index and Disturbed Sleep Index. Their Cross-sectional and longitudinal results show that frequent deadlines are associated with worse sleep quality on the three different types of measures. They recommend to look at these results and do more research about the devastating effects of frequent deadlines.

Leone et al. (2018) also takes a look at negative effects of bad sleep on health, functioning and costs. Bad sleep can increase the risk on different negative health or functioning outcomes. There are correlations between sleep duration and common diseases, for example obesity, diabetes, cancer, coronary heart diseases, strokes and depressions. Specifically for the youth, outcomes like cognitive functioning and behavioral problems are also associated with sleep duration. This implies that it is possible to assume that sleep deprivation can be seen as a bad and risky health behavior.

In addition to negative consequences for our health, it also entails high costs. Hafner et al. (2017) examined the economic burden of insufficient sleep. The study investigated the economic costs that resulted by insufficient sleep, for five different OECD countries (Canada, Germany, United Kingdom, United States & Japan). The results showed that the costs of insufficient sleep vary between 1.35 percent and 2.92 percent of a countries GDP. If this would also be the case in the Netherlands, these costs would be between 12.3 and 26.6 billion USD. This study also investigated what the effect would be if everyone that sleeps less than 6 hours, would increase their amount of sleep to 6-7 hours. The costs may vary between 0.85 percent and 1.85 percent, which means that the costs could be decreased rapidly if the sleep quantity would be increased.

Another study, that was done in Australia Hillman (2017), looked at the economic costs of inadequate sleep. These costs were based on different factors, which were healthcare costs, absenteeism and mortality due to sleep deprivation. The findings suggested that the costs of insufficient sleep were 66.3 billion Australian dollars, whereof 26.2 billion were

financial costs (absenteeism) and 40.1 billion by reduced wellbeing. Both studies show that sleep deprivation can cause very high costs.

To conclude, the existing literature shows that the function of sleep is to clean up the body and mind, so that we are able to function properly, absorb information and not feel tired the next day. The efficacy of sleep depends on both, quality and quantity of sleep. Bad sleep can cause negative health effects, for example higher risk for coronary heart diseases, obesity and behavioral problems. Besides negative health consequences, sleep deprivation can also entail high costs. All this together, makes it an important topic for research and public attention.

2.2 Time-inconsistency & Present bias

The concept time inconsistency may help us to understand why people always procrastinate cleaning your room, exercising, saving money or going to bed early. Time-inconsistent decision-makers can be described as having different desires at different points in time, which may result in different choices at different points of time. An example of this is the first of January. After New Year's Eve, people have healthy intentions for the new year. They plan to stop smoking, exercise at least once a week and plan to eat healthier. Unfortunately, this often stops after a week and does not work out as the intention was.

Time-inconsistent preferences and behavior are not the same. Time-inconsistent preferences are preferences that differ over time. Time-inconsistent behavior is behavior, that fails to succeed the ex-ante plans (O'Donoghue & Rabin, 1999). Strotz (1955), Phelps and Pollak (1968) discussed that the behavior of people with time-inconsistent preferences fully depends on their own beliefs about their behavior in the future. Sophisticated people know that their future self-control problems not lead to their beforehand preferences. Naïve persons are not aware of these self-control problems and are think that they will behave as their beforehand preferences. Therefore, sophisticated people predict correctly how they behave in the future, while naïve persons do not. Over time, most of the naïve decisionmakers become sophisticated decisionmakers, but this is not always the case. Especially in the context of sleep this is very interesting. We sleep every day, so it would be obvious that we learn about this naivety and become sophisticated. However, some do not. Different types of decisionmakers will lead to variations in the behavior. Because sophisticated individuals recognize their time-inconsistent preferences, they may use commitment devices. An

example might be to throw away the chocolate, because a sophisticated person knows that at night, he wants to eat this. On the other hand, naïve persons are convinced that they do not need commitment devices, because they think that their preferences stay the same over time. This means that time-inconsistent preferences will only lead to time-inconsistent behavior when the respondents are naïve (O'Donoghue & Rabin, 2006).

A lot of standard economic models, ideas and policy recommendations assume that people's preferences stay the same over time. They assume that it does not matter whether the outcomes are moved forward with the same amount of time for the preference order between two identical options. Economists normally conceptualize the intertemporal choice model as the model from Samuelson (1937), which is the discounted utility model (DUT). This model assumes that it does not matter for the decision maker to make the choice at time t or at time t + d, because the choice will stay the same over time. According to this model, the discount rate does not change over time, which means that the choice between A and B is the same at time t, as the choice at time t + d. Thus, this model states that people make time-consistent choices over time.

However, the validity of the DUT has been questioned, because evidence suggests that people often violate these assumptions (Frederick, Loewenstein & O'Donoghue, 2002). When people think about doing things next week, they do not take their future preferences into account. This entails that the short run preferences do not match with the long run preferences, which is a case of time-inconsistency. People do not think on the fact, when they have to make the choice, that tomorrow becomes today and the preferences may have changed. In the end, we smoke more, exercise less and eat more unhealthily than planned. This causes unhealthy behavior.

Strotz (1955) was the first economist, who worked out his idea about time-inconsistent preferences. His concept explained the nonstationary of preferences. He recommended a model where time inconsistency was caused by a preference for immediate gratification. He explained that an individual may prefer €100,- today over €110,- tomorrow, even if the same individual may prefer €110,- in a month and one day over €100,- in one month. The difference in Euros and time between the two choices has not changed, but the preferences have changed.

A lot of years later Laibson (1997) formalized this model and used a model that was studied by Phelps and Pollak (1968). Their model showed a person's intertemporal preferences at time t by:

$$U^t(u_t, \dots, u_T) \equiv u_t + \beta \sum_{T=t+1}^{T} \delta^{T-t} u_\tau ,$$

This model is the quasi-hyperbolic discounting model. u_τ is instantaneous utility in period τ and β represents the time-inconsistent preference for immediate gratification (Adams et al., 2014). Preference for immediate gratification implies that individuals value immediate outcomes more, compared to outcomes in the near future. This is the definition of present bias. Thus, a present bias occurs because a person has time-inconsistent preferences to immediate gratification. One drawback the model from Laibson (1997) is that it does not account for strong decreasing impatience. Decreasing impatience means that people are strongly more willing to wait with additional delay, so that people become less impatient over time.

Rohde (2018) introduced a flexible method to measure the extent of changing impatience over time, which does account for this. The index is the decreasing impatience index (from now DI-index). The DI-index is defined by Equation 1.

$$(1)\ DI = \frac{\tau - \sigma}{\sigma(t-s)}$$

The index considers t and s as different time points, where s is earlier than t. τ and σ are the different points in delay. The difference between τ and σ is the degree of decreasing impatience, where a larger difference means a larger degree of impatience. The difference between t and s is the level of impatience. The impatience is constant when the DI-index is zero. Impatience is decreasing when the DI-index is positive, and impatience is increasing when the DI-index is negative. The DI measures whether people are more willing to wait with additional delay. This means that if people can choose between €100,- now or 150,- in 5 weeks, they will choose for €100,-. However, when they have to choose between €100,- in 2 weeks of €150,- in 7 weeks, they will choose for €150,-. This looks strange since the difference in both cases is 5 weeks. However, if you take into account that they already have to wait 2 weeks for €100,-, they may consider that 5 weeks extra waiting is not so bad for €50,- extra. This study uses this method to measure the extent of changing impatience over time, the present bias.

To measure time-inconsistency, this study uses the method of Ameriks et al (2007). They investigated how lack of self-control could lead to overconsumption and low wealth accumulation. Their method measures self-control problems, based on hypothetical choice scenarios.

(2) $Relative\ Time\ inconsistent\ preferences = \frac{Ideal\ Time - Actual\ Time}{Ideal\ Time}$

(3) $Relative\ Time\ inconsistent\ behavior = \frac{Predicted\ Time - Actual\ Time}{Predicted\ Time}$

(4) $Absolute\ Time\ inconsistent\ preferences = Ideal\ Time - Actual\ Time$

(5) $Absolute\ Time\ inconsistent\ behavior = Predicted\ Time - Actual\ Time$

2.3 Time inconsistency and risky health behaviors

After looking at sleeping behavior and time inconsistency, it is interesting to look at time inconsistency that occurs in unhealthy behaviors. Examples of these unhealthy behaviors are physical inactivity, eating unhealthy food, but also addictive habits like smoking or drinking alcoholics are risky health behaviors. McGinnis and Foege (1993) identified and quantified the major external factors that contribute to death in the United States. Their findings suggest that approximately half of the deaths in the United States in 1990 were caused by external preventable risk factors. The usage of tobacco, poor diet, too little physical activity, and alcohol consumption were responsible for 38 percent of the deaths. Also, another study from Mokdad et al. (2004) showed that these factors in 2000 still accounted for 36 percent of deaths in the United States. It is therefore important to look at these risky health behaviors and look at what the occurrence of the behaviors increases to prevent it.

When we look at smoking and time-inconsistency, it will be about the procrastination of quitting smoking. Today a naïve individual says tomorrow I will quit smoking, but when tomorrow comes his preferences of yesterday are true for this day and he will again procrastinate the quitting process. Strulik and Werner (2019) investigated this type of unhealthy consumption, smoking. They offer a model and compare the realized life-cycle behavior of a time-inconsistent average American with the originally planned life-cycle behavior. Their results show that time-inconsistent individuals do not stick to their plans to reduce the unhealthy consumption, to save more and to invest more in their health. They calculate that this failure of sticking to the plans may cost the individuals around 5 years of life and 2 percent of their value of life. In this study they assume death as endogenous and as

dependent on the decisions that the individuals make in their life cycle. Likewise, Machado and Sinha (2007) offer a simple model of intertemporal choice to explain how planned versus actual behaviors evolve for time-inconsistent smokers. They show that when individuals constantly revise their plans quitting smoking, it is a result of the trade-off between the cessation effect and the procrastination effect. They also provide preliminary evidence that tobacco firms as well as public policy initiatives can have a positive influence on smoking behavior.

Besides smoking, another similar unhealthy behavior is alcohol consumption. A time-inconsistent consumer enjoys a drink today and promises himself that he will not be drinking tomorrow. However, when this day arrives, he again enjoys a drink. A lot of countries try to limit alcohol consumption by their public health policy. One commonly used method is to restrict the number of days when individuals can buy alcohol in stores. Marit Hinnosaar (2016) studies whether this commitment device by public health policy helps to limit the time-inconsistent alcohol consumption. She constructed a model of alcohol purchasing, consuming and storing and allows consumers to be time-inconsistent. She uses scanner data and finds that only 16 percent of the beer purchasers are time-inconsistent. The sales restrictions may increase aggregate consumer welfare, but when the aim is to reduce alcohol consumption, taxes would be better. From this we could conclude that alcohol users are not necessarily time-inconsistent in purchasing alcohol, but maybe they are in using it.

Besides of the above addictive behaviors, there are also other risky health behaviors that have nothing to do addictiveness. One of these risky health behaviors is getting not enough physical activity. This behavior again has to do with procrastinating healthy behavior. When individuals feel less fit, they might think that they have to start with physical activities to become fitter. However, in a lot of cases this will then not happen immediately but will be postponed to tomorrow and when tomorrow comes it will be postponed to the day after tomorrow. Hunter et al. (2018) investigated the relationship between time preferences and physical activity. They explain that the decision to do physical exercises, involves the trade-off between the short-term cost (for example time and effort) against the long-term health benefit. By face-to-face multiple price lists and monetary trade-offs, they measured present-bias and discount rate. The results showed that the individuals that had higher discount rates and were present-biased and had significantly lower physical activity than the non-present biased individuals. A 3 percent lower discount rate and a 1.14 decrease in present-bias

parameter was associated with 30 minutes more physical activity per week. Especially for younger individuals, married adults and individuals with a higher staff class this negative association was more significant.

This study focusses on sleep deprivation, as unhealthy behavior. At the moment there is a large knowledge gap between the reasons why people do not sleep the recommended hours of sleep. Avery, Giuntelle & Jiao (2019) tried to figure out the mechanisms that affect the choices when and how much individuals sleep. They did a field experiment among college students, to get more knowledge about the reasons for sleep deprivation. They also looked at whether monetary incentives and commitment devices can promote healthy sleep habits. It is necessary to understand how to improve it and how to promote healthy behavior, when we want to counteract on the problems that are caused by sleep deprivation. They used activity trackers, surveys and time-use diaries, to collect data for the experiment and provided the treatment group with monetary incentives and commitment devices to sleep. They found that people underestimate the impact of current actions on their future health and that they discount the future too much and that this is an important characteristic of sleeping behavior. Their results show that monetary incentives and commitment devices to improve sleep worked, as the likelihood of sleeping between 7-9 hours per day significantly increased by 19 percent.

Li et al. (2020) looked at whether procrastinators do get worse sleep by a cross-sectional study among US undergraduate and graduate students. Procrastinating is one type of time inconsistency, since people procrastinate to do something at the first moment and they will then possibly also procrastinate at the second moment. They found evidence that procrastination was associated with more social jetlag, shorter sleep duration, and worse sleep quality. These findings show that procrastinating behavior or time-inconsistent behavior can both be risky factors for poor health. They state in their research that procrastination treatment programs would be valuable, to reduce procrastination on going to bed.

According to the existing literature about time inconsistency and sleep (Avery, Giuntelle & Jiau, 2019; Li et al., 2020) and other risky health behaviors (Hunter et al, 2018; Strulik & Werner, 2019), my expectations are that there will occur time-inconsistency in sleeping habits, in behavior as well as in preferences. That is why the first and second hypothesis are:

H1: There exist time-inconsistent preferences in sleeping habits among young adults.
H2: There exists time-inconsistent behavior in sleeping habits among young adults.

The second research question of this paper looks at whether the present bias is a strong predictor for time-inconsistent preferences and behavior in sleeping habits of young adults. The monetary present bias is measured by a method of Kirsten Rohde (2018). The sleep present bias is measured with various official general statements (Ringer, 2017), self-contrived sleep-related statements with a 7-point Likert scale and characteristics that fit to a person that is presently biased (Gottfredson & Hirschi, 1990). This is explained in more detail in the next section. Although specifically the predictive power of the present bias was not investigated earlier, Avery, Giuntelle & Jiao (2019) found that people underestimate the impact of current actions on their future health and that they discount the future too much. My expectations are therefore that the monetary and sleep present bias will have predictive power on time inconsistency in sleeping habits among young adults. That is why the third and fourth hypothesis are:

H3: The monetary present bias has a predictive power on time-inconsistent preferences and behavior in sleeping habits among young adults.
H4: The sleep present bias has a predictive power on time-inconsistent preferences and behavior in sleeping habits among young adults.

3. Data & Methodology

This part consists of the data, the survey design and analysis methods. The data explains what kind of data is used and gives a short description of the data. The survey design explains how the data is collected, what the surveys look like and which methods are used in the survey. The analysis methods clarify the analysis and different methods that are used to conduct the research.

3.1 Data

This research uses a quantitative research design and collected its own data to conduct the analysis about time-inconsistency in sleeping behavior. Three Dutch online surveys, are used to collect the data about adults between 16 and 30 years old. The respondents were recruited by social media, as LinkedIn, Facebook, Instragram and Whatsapp. The data is from Dutch students with distinct levels of education or young working individuals. Looking at distinct levels of education and working people, contributes to the diversity of this research and improves the external validity of the research. The reason to choose for young adults is that the length and the quality of sleep is often not good enough in this specific group, which makes this group interesting to look at (Hersenstichting, 2021). Young adults are often studying or starting their career. That is why thig target group needs a good quality of sleep, since they have to learn and absorb a lot of information at this stage of their lives.

After the surveys were done, the raw data contained a lot of information. The raw data contained the ideal bedtime of the individuals, their planned bedtime and their actual bedtime, which were used to calculate the time-inconsistency to answer the first research question. The data also contains the information about two types of present bias to answer the second research question. The sleep (quality) related information and demographic information can be used as controls, but also to look at other causes for time-inconsistency in sleeping habits. Information about use of possible commitment devices was also asked. Table 3.1 includes all variables that were used in this paper and their explanation. First the dependent variables are showed, the relative time-inconsistent preferences and behavior. Then, the variables for the two different present biases are showed. After that, the variables about sleep and sleep quality are showed in Table 3.1. Lastly, the demographic variables and variables about commitment devices are showed. There were also two open questions, about

the temptations that people experience before going to bed and what the reason was for not going to bed at the planned time. This information can be used to better understand the results.

The intention was initially to use only two surveys. Unfortunately, there was not enough and not the right data to measure the monetary present bias. That is why a third survey was sent out. The aim was to have a minimum sample of 100 participants. To encourage participants to answer also the second survey, a bol.com gift voucher of €20,- was raffled off. 125 respondents filled in the first survey, but only 70 respondents filled in the second survey. It was deliberately chosen not to send another reminder, in addition to the email sent for the second survey. This could have resulted in more responses, but then there would have been too much time between the first and second survey. This would have made the answers less reliable, with respect to the actual bedtime. Only 45 respondents filled in the third survey about the monetary present bias. Thus, for the analysis for the explanatory power of the monetary present bias, a sample of 45 respondents is used. This means that respondents dropped out after the first survey and second survey. This lowers the chance that there will be any significant effects in the regressions, but the information can still be useful. The high drop-out rate may be caused by the fact that it took them too much time to fill in more surveys, they forgot to fill in the second survey, or because a lack of interest.

It was necessary to edit and filter the data for several reasons. The first reason was that people filled in the time after midnight as 00.00. To get a right calculation for the time-inconsistency, it was necessary to add 12 “hours” when a respondent filled in a time after 00.00. Besides, it was also necessary to rebuild for example 30 minutes to 0.5 hours. This was all done by hand. Furthermore, some respondents filled in extra capital letters or commas in the e-mail addresses. This also had to be edited manually, to make the data possible to merge the first and second survey into one file. After merging the data, the e-mails were deleted to make the data anonymous. After the data was edited, the analysis could be performed. In results section the descriptive statistics are shown.

Table 3.1: Summary of variables

Variables	Variable Description
Relative time-inconsistent preferences (Relative TIP)	The relative difference between ideal bedtime and actual bedtime.
Relative time-inconsistent behavior (Relative TIB)	The relative difference between predicted bedtime and actual bedtime.
Absolute time-inconsistent preference (Absolute TIP)	The absolute difference between ideal bedtime and actual bedtime.
Absolute time-inconsistent behavior (Absolute TIB)	The absolute difference between ideal bedtime and actual bedtime.
DI-index	The DI-index to measure the monetary present bias.
Monetary Present Bias	Dummy Variable taking value 1 if the participant suffers from a monetary present bias, and 0 otherwise.
Sleep Present Bias	Dummy Variable taking value 1 if the participant suffers from a sleep present bias, and 0 otherwise.
Social Jetlag	Dummy Variable taking value 1 if the difference between the participants' bedtime during the week and bedtime in the weekend is more than 1 hour, and 0 otherwise.
Average Hours of sleep	The average hours of sleep, in hours.
Tired	Level of tiredness, measured by a 7-point Likert scale. People are tired if the score is larger than 4.
Stress	Level of stress, measured by a 7-point Likert scale. People are stressed if the score is larger than 4.
Social pressure	Level of social pressure, measured by a 7-point Likert scale. People are stressed if the score is larger than 4.
FOMO	Level of FOMO, measured by a 7-point Likert scale. People are suffering from FOMO if the score is larger than 4.
Use of blue screen	Level of using blue screen devices, measured by a 7-point Likert scale. People use it when the score is larger than 4.
Wake-up time	The wake-up time of the participant.
Snooze	A categorical variable that indicates how much the participant snoozes when their alarm goes off, measured by a 5-point Likert scale.
Easy sleeper	A categorical variable that indicates whether the participant falls easy asleep easily (0), whether this is very different (1), or whether it is difficult to fall asleep (3).
Self-reported quality	The self-reported quality of sleep between 0 and 10.
Age	Age of the participant in years, between 18 and 30.
Female	Gender of the participant, takes 1 if participant is female, 0 if participant is male.
Job	Dummy variable taking value 1 if participant has job, and 0 otherwise
Education	Education level of the participant, takes value 1 if no diploma, takes value 2 if higher vocational training, takes value 3 if higher professional education bachelor, takes value 4 if university education bachelor, takes value 5 if university education master and takes value 6 if PhD.
Job Hours	The number of job hours that the participant works per week, in hours.
Extra Work	Dummy variable taking value 1 if the participant works overtime in addition to their actual working hours, and 0 otherwise.
Association member	Dummy variable taking value 1 if participant is member of a study- or student association, and 0 otherwise
Household	Categorical variable that indicates the household of the participant, takes value 1 if the participant lives on its own, takes value 2 if participant lives with roommates, takes value 3 if participant lives by its parents, takes value 4 if participant lives with partner and takes value 5 if participants live with partner and their kids.
Smoking	Categorical variable that indicates the smoking behavior, takes value 1 if participant smokes, and 0 otherwise.
Alcohol	Dummy variable taking value 1 if participant drinks alcohol, and 0 otherwise.

Exercise	Categorical variable that indicates the amount of sport hours per week, takes value 0 if participant does not exercise, takes value 1 if participant exercises 0-3 hours per week, takes value 2 if participant exercises 3-6 hours per week, and takes value 3 if participant sport 7 hours per week or more.
Commitment use	Dummy variable taking value 1 if participant uses commitment device to sleep at their planned/ideal time, and 0 otherwise.
Option for device	Dummy variable taking value 1 if participant want to use a strict commitment device that blocks their phone, and 0 otherwise.

Note: The variables used in the analysis with an explanation and their possible values.

Table 3.2: Descriptive Statistics of all variables

Variables	Observations	Mean	Standard Deviation	Min	Max
Time-Inconsistency:					
Relative TIP	70	-0.04	0.05	-0.25	0.05
Relative TIB	70	-0.00	0.04	-0.11	0.10
Absolute TIP	70	-0.89	1.15	-6.00	1.25
Absolute TIB	70	-0.05	0.86	-3.00	-2.5
Present Bias & Sleep Related:					
DI-index	45	0.39	1.71	-0.32	9.9
Sleep Present Bias	70	3.75	0.84	2.25	5.75
Average Hours of sleep	70	7.32	0.86	5	9
Wake-up time	70	7.31	0.84	5.45	9.00
Self-reported quality (0-10)	70	6.81	1.52	3	9
Social Jetlag	70	0.67	0.47	0	1
Commitment use	70	0.10	0.30	0	1
Option for device	70	0.17	0.38	0	1
Demographic:					
Age	70	22.9	3.02	18	30
Female	70	0.64	0.48	0	1
Job	70	0.87	0.34	0	1
Job Hours	70	19.87	14.24	0	50
Work Overtime	70	0.24	0.43	0	1
Association member	70	0.29	0.46	0	1
Smoking	70	0.16	0.37	0	1
Alcohol	70	0.91	0.28	0	1

Note: All variables used in the analysis and their mean; standard deviation; minimum value; maximum value.

Table 3.2 shows the descriptive statistics of the data. The table starts with the absolute and relative time-inconsistency measures. When these time-inconsistency measures are below zero, it means that they are time-inconsistent under sleepers. It is possible to see that, on average, people in this sample sleep on average 4% later, than their ideal bedtime. The relative time-inconsistent behavior is negative, but the mean is too small to detect the difference in relative measure. This shows that, on average, people in this sample sleep on average on the same time as their predicted time. The mean of relative time-inconsistent preferences shows

that on average people go to bed The mean of absolute time-inconsistent preferences shows that people on average go to bed 0.89 hours later than their ideal bedtime, which is around 53 minutes. Thereby, the mean of absolute time-inconsistent behavior shows that people on average go to bed 0.05 hours later than their predicted time, which is only 3 minutes. On average the people in this sample score 0.39 on the DI-index. If people score above zero, they are facing decreasing impatience and thus present biased on monetary level. This means that on average, people are monetary present biased in this case. Furthermore, individuals in this sample score on average 3.75 on the sleep present bias scale. When people score above 5 on this scale, they are present biased for sleep. This means that on average, this sample is not present biased for sleep.

Below the time-inconsistency variables, the variables for the two different present biases are showed and sleep-quality related variables. Thereafter, the demographic and other health-related control variables are showed. It is interesting to mention that the average hours of sleep are 7.32 hours, what satisfies the guidelines of the National Sleep Foundation of 7-9 hours per day (Hirshkowitz, 2015). Leone et al. (2018) said that around 10 percent of the people in the Netherlands are under sleepers. In this sample 13 individuals reports less than 7 hours sleep, which is almost 20 percent instead of 10 percent. This is a remarkable result. The survey contained also 7-point Likert scale questions. These questions were about being tired, facing stress, feeling social pressure, having FOMO and using their screen before bedtime. Because it is not informative to show these statistics, some information about the variables will now be provided. 65.71 percent of the respondents filled in that they were tired and 62.86 percent of the respondents were facing stress. Only 8.57 percent feel social pressure to go to bed later than they planned. 42.86 percent of the respondents reported that they were suffering from FOMO. 81.43 percent of the respondents, reported that they were using their phone or other bluescreen devices, before going to bed. This is a very large fraction of the sample. Besides this, 42.86 percent filled in that they fall in sleep easily and 40 percent says that it differs a lot whether they fall in sleep easily or not. 47.14 percent of the respondents report that they snooze regularly, often or always.

There is also demographic information that is not in Table 3.2, since these variables are categorical and the mean does not say a lot about this kind of data. However, some percentages and numbers are still interesting to look at. One variable is how much people exercise per week. 5.71 percent of the respondents does not exercise, 41.43 percent reports

that it exercises 0-3 hours per week, 41.43 percent exercises 3-6 hours per week and 11.43 percent reports that it exercises more than 7 hours per week. Another variable that is interesting is what the education level is and how this is divided. Only 1 respondent has no diploma, 8 respondents have intermediate vocational education (in Dutch MBO), 29 respondents have a bachelor in higher professional education (in Dutch HBO), 12 respondents have a bachelor in higher education (in Dutch WO), 19 respondents have a Master degree in higher education and 1 respondent has a PhD. This means that the most respondents have a bachelor (HBO or WO) or a master degree. The last variable is how the respondents live, when you look at household. The most respondents, 34 individuals, are living with their parents, while only 2 respondents live alone with no other household members. 18 respondents live with roommates and 10 respondents live together with their partner. 6 respondents of the sample are living with their partner and young children.

3.2 Survey design

Three anonymous, sequential surveys were used to collect the data. Although the surveys were anonymous, the e-mails were used to link the surveys to each other. Participants also had the choice to participate in a draw of a bol.com voucher of €20 euros. After the linking the data and raffling the voucher, the e-mail addresses were deleted, therefore the data was anonymous in the end. The aim of the separate surveys was to collect data on the time inconsistency associated with sleep behavior. There was no treatment or experiment in the survey. For a reliable answer for the actual bedtime in the second survey, it was important that the second survey had to be sent and completed the next day. The surveys were conducted by an online survey software, Qualtrics. A function in this software program, ensured that all participants got the second survey the day after.

3.2.1 First survey

The first survey asked the participants to write down their preferred time to go to sleep (ideal time) and what they think at what time they will go to sleep (predicted time). After that, they get a list of choices to detect a monetary present-bias. This data was not appropriate to measure the monetary present bias, thus in the end this data was not used. Then qualitative questions were asked to look whether the individuals were presently biased generally and in sleeping behavior. For this, a 7-point Likert-scale is used that detects this present-bias. This

scale consists of several combined statements, where participant have to fill in to what extent they agree to the statements, to detect a present-bias. First, one simple statement is asked to detect a general present-bias: 'I live for today and do not think about tomorrow'. This survey measure was tested by Ringer (2017) whether it is a valid statement to detect the present bias. Her result was that it significantly relates to other present-bias measures and that it is a valid method to detect the present bias. Besides this statement, I also came up with two statements that fit a present-bias for sleep. Lastly, questions were asked about characteristics that fit to persons that are present-biased (Gottfredson & Hirschi, 1990). These characteristics were being procrastinating, impulsive, adventurous, liking physical activities more than cognitive activities and being insensitive to others suffering. The combined scale is used to detect whether there is a general and sleep related present-bias. Both, the actual score and a dummy are used as present-bias variables. The actual score is the average number of points of the scale, which is calculated by the total amount of points (between 1 and 56) divided by the number of statements (8). The dummy variable takes value 1 if the actual score equals a score of five or higher, and zero otherwise. Then a couple of sleep related questions are asked, as social jetlag, average hours of sleep, temptations before going to bed, and causes for bad sleeping behavior. The causes for bad sleeping behavior that were asked are being tired, stress, social pressure, Fear-Of-Missing-Out (Henceforth FOMO), blue screen before sleep. FOMO is the fear of missing out or feeling of being ignorant of information, events, experiences, or life decisions. This information can be used to look at correlations between occurrence of time inconsistency and these sleep related questions. This data can also be used as control variables. The first survey can be found in Appendix 1.

3.2.2 Second survey

The second survey was administered on the day after. As already stated above, this was done by a function in the survey software. This survey started with questioning the actual time the respondent went to bed. Together with the data of the first survey, the time-inconsistency can then be measured in relative terms. The relative time-inconsistent preferences are calculated using Equation 2. The relative time-inconsistent behavior is calculated using Equation 3. The two equations for relative time-inconsistency are used for the one-sample t-test to look whether there exists time-inconsistency. The absolute time-inconsistent preferences are calculated using Equation 4. The absolute time-inconsistent preferences are calculated using Equation 5. The two equations for absolute time-inconsistency are used for

the quantile regressions. Furthermore, dummy variables were made with the absolute time-inconsistency measures for the logit models. Since this paper focusses on under sleeping, the dummies are 1 when the absolute time-inconsistency is lower than zero, and zero otherwise. The calculations were based on the method of Ameriks et al (2007). These formulas are already showed before in Equation 2, 3, 4 and 5.

On top of that, the reason was asked for when this was a different time than they planned. Again, there were some sleep-related questions about the quality for sleep, as the wake-up time, whether they snooze, whether they fall in sleep easily and their self-reported sleep quality. Snoozing seemed like a very interesting question, as it could also be a form of time-inconsistency. Individuals set an alarm clock, because they plan to get up at a certain time. Snoozing actually means that at the moment the alarm goes off, people postpone getting up. Then there were asked demographic questions, that can be used as controls. Lastly, there was asked whether they use a commitment device, to go to bed at the planned time. Also, there was asked whether they would use a commitment device that blocks their phone after a preset time. The second survey can be found in Appendix 2.

3.2.3 Third survey

In the first survey, the data was not appropriate to detect a monetary present bias. Only one choice list was sent out, while two choice lists were needed. That is why a third survey was sent out. The drop-out rate was expected to be high, since a lot of people expected to only answer two surveys.

The present-bias is measured by the DI-index that was introduced by Kirsten Rohde (2018), which is already explained in the theoretical framework section. The DI-index formula is shown before by Equation 1. Two monetary choice lists were used, where participants had to choose between €100,- or €150,- at increasing time delays. The time delays increase in both choice lists with one week every time. However, the difference between choice lists is that the first choice list represents choices between €100,- today and €150,- in one week, which continues to 52 weeks. The second choice list represents choices between €100,- in two weeks and €150,- in three weeks, which continues to 54 weeks. Both choice lists show 12 choices, where the difference stays equal (compared to the other choice list). The switching point, where the participant chooses first €150,- and then €100,- (or the other way around), is used as the key point to determine present bias. For example, when the respondent has his switching point in choice list 1 after 6 weeks, then the indifference point (t) is 6.5. When the

respondent has his switching point in choice list 2 after week 9, then the indifference point $(t + \tau)$ is 9.5, which means that τ is 3 (9.5-6.5). s is the timing of the first choice in list a1(0), and $s + \sigma$ is the sooner amount in choice list 2. This means that σ is 2. Then it is possible to calculate the DI index, which is 0.08. This is larger than zero, which means that there is decreasing impatience and present bias. Participants that have more than one switching point, are left out the data for the present bias. For participants that have no switching point, is assumed that they have their switching point one day and one week later (only one day later than the maximum delay in the choice list). If the DI-index is larger than zero, the respondent is present-biased. If the DI-index is zero, the respondent is stationary discounting. If the DI-index is smaller than zero, the respondent is future-biased. With this data, a dummy was made for present-biased individuals.

3.3 Analysis methods

3.3.1 One Sample T-test

After collecting the data, it is possible to do the analysis. Then, it is possible to look whether there occurs time-inconsistency in sleeping habits among young adults. To answer the first research question, this will be tested by looking at whether the means of relative time-inconsistent preferences and behavior significantly differ from zero. Equation 2 and 3 are used to calculate relative time-inconsistency. This will be done by a one sample t-test, by testing if the averages of all the values of the time-inconsistency variables are different from 0. It is important that this t-test uses the absolute values to look at whether the values significantly differ from zero. This is necessary, since otherwise it may occur that positive and negative values cancel each other out and still show an average close to zero. In that case the t-test will not show a statistical difference from zero, while the most values are not time-inconsistent. The null hypothesis and alternative hypothesis are shown below. TI can be relative time-inconsistent preferences and relative time-inconsistent behavior. If the null hypothesis can be rejected, this means that there occurs time-inconsistency in sleeping preferences or behavior. The null hypothesis and alternative hypothesis are shown below.

$$H_0: TI = 0$$
$$H_a: TI \neq 0$$

3.3.2 Paired T-test

If the results for time-inconsistent preferences and time-inconsistent behavior give different results, the respondents may already know that the ideal time cannot be met. This can be due to the planning with exercise, school, study. However, another reason could be that they already know they that their preferences differ between now and tonight. In that case, a significant difference between ideal and predicted time can indicate that a large part of the respondents is sophisticated. A paired t-test is used to test whether the ideal time significantly differs from the predicted time. If the null hypothesis can be rejected, it might mean that on average the respondents are sophisticated. The null hypothesis and alternative hypothesis are shown below.

$$H_0: Ideal\ time = Predicted\ time$$
$$H_a: Ideal\ time \neq Predicted\ time$$

3.3.3 Logistic Regression model

To answer the second research question, the data about present-bias is used. A logistic regression (henceforth logit model) is used to look whether the present bias has a predictive power on time-inconsistent sleeping preferences and behavior among young adults. Equation 6 and 7 show the regression models, where time-inconsistent preferences and time-inconsistent behavior are the dependent variables. Time-inconsistency is in this regression a binary variable, which is necessary for a logit model. First, the relative time-inconsistency is measured by Equation 2 and 3. Then the binary variable is created, which is 1 when the outcome of the time-inconsistency calculation is below zero and 0 otherwise. Since sleep deprivation is a bad health behavior, the study focusses on under sleepers. The logit model estimates the probability of being time-inconsistent or not. The beta parameter is measured by a maximum likelihood estimation (from now MLE). By estimating a logit model, it is only possible to interpret the sign and significance and not the magnitude of the beta. In our sample, this means that it is only possible to say whether it significantly (or not) decreases or increases the probability of being time-inconsistent. To get meaningful estimates the marginal effects will be calculated. With the marginal effects it is possible to estimate magnitude of the effect.

This study investigates both time-inconsistent preferences and behavior and two different types of present biases. Equations 6 and 7 show these equations. The dependent variable time-inconsistency can be either time-inconsistent preferences as time-inconsistent behavior. β_1 shows the correlation between facing time-inconsistency and suffering from monetary present bias. β_2 shows the correlation between facing time-inconsistency and suffering from the sleep present bias. With these Betas it is possible to answer the second research question, whether present bias has a predictive power on time-inconsistency in sleeping habits. $\sum \beta_i$ stands for the correlations of the sleep related variables and time-inconsistency for both equations. With these estimates, it is possible to also look at other sleep related or sleep quality measures and the correlations with time-inconsistency. $\sum \beta_j$ shows the correlations between the control variables and time-inconsistency for both equations. These control variables are primarily demographics. α is the constant and ϵ is the error term.

The controls and sleep related questions should only be added to the regression if they do not bias the results. This means that colliders should not be included and variables that otherwise cause an omitted variable bias, should be included. "A collider bias occurs when an exposure and outcome (or factors causing these) each influence a common third variable and that variable or collider is controlled for by design or analysis." (Holmberg, 2022, p.1282) While a collider bias is adding a wrong variable to the regression, omitted variable is the opposite. An omitted variable bias occurs when a relevant variable was left out of the regression. This causes that the zero conditional mean assumption is violated and that the error term is correlated with the independent variable. This can cause either an upward or downward bias (Wooldridge, 2021). However, since this study is only looking at the predicting factor of the present bias it is not necessary to include them. Nevertheless, by curiosity the variables are still added in the regression, to see what association some sleep related- and control variables have with time-inconsistency. Thereby, it may give more precise estimates of the association in this sample.

(6) $$Time\ inconsistency = \alpha + \beta_1 * PresentBias_{Monetary} + \sum \beta_i * SleeprelatedVariables + \sum \beta_j * ControlVariables + \epsilon$$

(7) $$Time\ inconsistency = \alpha + \beta_2 * PresentBias_{Sleep} + \sum \beta_i * SleeprelatedVariables + \sum \beta_j * ControlVariables + \epsilon$$

3.3.4 Quantile Regression model

In addition to the logit model, a quantile regression will also be performed. The quantile regression model was first described by Koenker and Basset (1978). The quantile regression is an analysis that estimates the dependent variable conditional on independent variables, for every quantile, q. An advantage of the quantile regression model is that is possible to focus on specific parts of the distribution. This makes it possible to look specifically to the lower and the higher part of the distribution for time-consistency. Another advantage compared to Ordinary Least Squares (OLS) is that estimates of a quantile regression is more robust against outliers.

Equation 8 and 9 show the equations for the quantile regressions for present bias sleep and monetary present bias, respectively. The dependent variable time-inconsistency can either be time-inconsistent preferences as time-inconsistent behavior. Time-inconsistency is measured by Equation 2, 3, 4 and 5. q represents the choice of quantile. This analysis uses deciles as quantiles $\in \{1, 2, \dots, 8, 9\}$. Since sleep deprivation is a bad health behavior, the study is specifically interested in the first deciles, where time-inconsistency is below zero. $\beta_3(q)$ shows the correlation between time-inconsistent preferences or behavior and the monetary present bias for decile q. $\beta_4(q)$ shows the correlation between time-inconsistent preferences or behavior and the present bias for sleep. $\sum \beta_i$ stands for the correlations between sleep related variables and time-inconsistency for both equations. $\sum \beta_j$ shows the correlations between the control variables and time-inconsistency for both equations. These control variables are primarily demographics. ϵ is the error term. α represents the constant.

(8) $$\xi_q(Time\ inconconsistency) = \alpha + \beta_3(q) * PresentBias_{Monetary} + \sum \beta_i(q) * SleeprelatedVariables + \sum \beta_j(q) * ControlVariables + \epsilon$$

(9) $$\xi_q(Time\ inconconsistency) = \alpha + \beta_4(q) * PresentBias_{Sleep} + \sum \beta_i(q) * SleeprelatedVariables + \sum \beta_j(q) * ControlVariables + \epsilon$$

4. Results

This part explains the results of this paper. It starts with the one sample t-test to determine whether sleeping preferences and sleeping behavior are time-inconsistent. This will reject or accept Hypothesis 1 and Hypothesis 2. Then, it is tested whether the monetary present bias is a strong predictor for time-inconsistency in sleeping habits. This is done by a logistic and quantile regression. This will reject of accept Hypothesis 3. The last part will test whether the sleep present bias is a strong predictor for time-inconsistency in sleeping habits. Then Hypothesis 4 can be rejected or accepted.

4.1 Results time-inconsistency

To look at the existence of time-inconsistency in sleeping preferences and behavior among young adults, a one sample t-test is executed with the absolute values of relative time-inconsistency. First, time-inconsistent sleep preferences are discussed and thereafter time-inconsistent sleep behavior is discussed. For this analysis, the relative time-inconsistent preferences and behavior are used, calculated by Equation 2 and 3.

Table 4.1 gives an overview of the under-, over- and time-consistent sleepers for behavior and preferences. It is interesting to look at this before looking at the results of the t-test, to get a view how many participants face sleep deprivation. The table shows that 90 percent of the participants have time-inconsistent preferences and 75.72 percent shows time-inconsistent behavior. However, only 42.86 percent shows under sleeping behavior. There are also some participants that show over sleeping behavior (32.86 percent).

Table 4.1: Overview of the number of under-sleepers, over-sleepers and time-consistent sleepers.

	Under-sleepers	**Time-consistent sleepers**	**Over-sleepers**
Time-Inconsistent Preferences			
Number of participants	56	7	7
Percentage	80%	10%	10%
Time-Inconsistent Behavior			
Number of participants	30	17	23
Percentage	42.86%	24.28%	32.86%

Note: Overview of the under-, over-, and time-consistent sleepers. In the first column shows the type of time-inconsistency. The second column shows the number and percentage of under-sleepers. The third column shows the number and percentage of time-consistent sleepers. The fourth column shows the number and percentage of over-sleepers.

Table 4.2 shows the results of the one-sample t-test for time-inconsistent preferences and behavior for sleep. Time-inconsistent-preferences indicate that the ideal time to go to bed is not equal to the actual time that they went to bed. The mean of the time-inconsistent preferences is above zero (*M=0.05, SD=0.04*). The results of the one-sample t-test show that there is a statistically significant difference on a 1% level, between the mean of the time-inconsistent preferences and zero (t(69)=8.61, p=0.0000). In this sample of you adults, time-inconsistent sleep preferences exist.

Time-inconsistent behavior indicates that the preferred time to go to bed is not equal to the actual time that they went to bed. The mean of the time-inconsistent behavior is above zero (*M=0.03, SD=0.02*). The results from the one-sample t-test show that there is a statistically significant difference on a 1% level, between the mean of time-inconsistent behavior and zero (t(69)=9.10, p=0.0000). In this sample of young adults, time-inconsistent sleep behavior exists.

This part looked at the first research question, to test whether there occurs time-inconsistency in sleeping habits among young adults. The first hypothesis is that there exist time-inconsistent preferences in sleeping habits among young adults. The results show that it is possible to confirm this hypothesis. This means that on average, the ideal bedtime for the respondents is a different time, compared to the actual bedtime. Furthermore, it is also possible to confirm the second hypothesis. It is possible to state that there exists time-inconsistent behavior in sleeping habits among young adults. This means that on average there is a significant difference between the predicted bedtime and the actual bedtime.

The survey also asked what the reasons were for going to bed another time as planned. Because this was an open question, this is checked manually. The most responses are about using their telephones, watching television, streaming services and social restrictions. The social restrictions were mostly about going out longer than planned. A large group of respondents mentioned that they were using their telephone, watching television or streaming services longer than they had planned.

Table 4.2: T-test time-inconsistent preferences and time-inconsistent behavior

Variable	N	Mean	Standard Deviation
Time-Inconsistent Preferences	70	0.05	0.04
Degrees of freedom = 69 t = 8.6081	p-value = 0.0000***		
Time-Inconsistent Behavior	70	0.03	0.02
Degrees of freedom = 69 t = 9.1038	p-value = 0.0000***		

Note: T-test to test whether the means significantly differ from zero. In the first column the variables Time-Inconsistent Preferences and Time-Inconsistent Behavior are shown. In the second column the sample size is shown. The third column shows the means and the last column shows the standard deviations. Also, the degrees of freedom, the t-statistics and p-values are shown. Significance levels: * p < .10, ** p < .05, *** p < .01

4.2 Results sophistication and commitment devices

Thereby, it is also interesting to look at how sophisticated or naïve this sample of young adults is. This can be done by looking at the difference between the ideal and predicted bedtime. A difference between these two may indicate the presence of a sophisticated sample. When there is a difference between the ideal and predicted bedtime, the respondents already know that unfortunately they will not go to bed at the ideal bedtime. In that case, the respondents would be sophisticated. This is tested by a paired t-test. The results are shown in Table 4.3. The difference between ideal time and predicted time is below zero *(M=-0.85, SD=0.90),* which means that on average people predicted that they would go to bed later than their ideal time. This difference is statistically significant on the 1% level (t(69)=-7.85, p=0000). This can be due to a large fraction of sophisticated people in this sample of young adults.

Table 4.3: Paired t-test for the ideal and predicted bedtime

Variable	N	Mean	Standard Deviation
Ideal Time	70	22.75	0.60
Predicted Time	70	23.60	1.07
Difference	70	-0.85	0.90
Degrees of freedom = 69 t = -7.85	p-value = 0.0000***		

Note: Paired t-test to test whether the means of ideal and predicted time significantly differ from zero. In the first column the variables Ideal Time and Predicted Time are shown. In the second column the sample size is shown. The third column shows the mean, and the last column shows the standard deviations. Also, the degrees of freedom, the t-statistics and p-values are shown. Significance levels: * p < .10, ** p < .05, *** p < .01

Thereby it was interesting to know how much respondents were already using commitment devices and whether they would otherwise like to use commitment devices. There were 7 individuals reporting that they already use commitment devices. Still 6 persons showed time-inconsistent preferences, but only 3 showed time-inconsistent behavior. Furthermore, 56 individuals reported time-inconsistent preferences, but only 10 of them

wanted to make use of commitment devices when they would be able to. Only 30 individuals showed time-inconsistent behavior, but only 5 of them would like to use commitment devices if they have the possibility.

To conclude, this sample may exist of a lot of sophisticated individuals. However, almost half of the participants still show time-inconsistent behavior, only around 17 percent is interested in decreasing it with use of commitment devices.

4.3 Results predictive power of the monetary present-bias

This part looks at the second research question, that is about whether the Present Bias is a strong predictor for time-inconsistent preferences and behavior in sleeping habits of young adults. This part looks at the predicting power of the monetary present-bias. This is done by the logit model with Equation 6 and by a quantile regression with Equation 8. First the predicting power on time-inconsistent preferences is discussed, and thereafter time-inconsistent behavior is discussed. Unfortunately, this sample only consists of 45 participants, which makes it hard to find any significant results. The reason for this small sample size is that the participants had to fill in three surveys in total, which makes the drop-out rate high.

Table 4.4 shows the results of the logit model and the marginal effects, for the effect of the monetary present-bias on time-inconsistent preferences. It was impossible to use the dummy variable for the monetary present bias, since only 9 respondents of the sample were present biased and time-inconsistent. Therefore, the DI-index is used. Respondents are present biased, if the DI-index is above zero. This indicates that a higher DI-index means a higher probability of being present biased. The results in the table show that there is no significant effect of the DI-index on time-inconsistent preferences. Nevertheless, the sign of the coefficient is positive. This means that when the DI-index increases, people are more present biased and the probability of having time-inconsistent preferences increases. Thereby, looking at the marginal effects in Table 4.4, on average a 1% increase in the DI-index results in an increase in the probability of having time-inconsistent preferences by 88 percentage points. This is a very large increase. However, this coefficient is not significantly different from zero, which means that it provides no support for Hypothesis 3. This may be caused by the small sample size.

Besides the DI-index, it is interesting to look at some control variables. The results show a negative significant coefficient on the 10% level for feeling social pressure. Feeling social

pressure to go to bed on other times than they want, compared to feeling no social pressure, decreases on average the probability of being time inconsistent by 67 percentage points. This looks like a strange result, since feeling social pressure to go to bed at a different time than the ideal time, would be the other way around. Another interesting variable is the difficulty of falling in sleep. The coefficient is positive and significant on the 10% level. When the difficulty (on a scale of 1-3) increases by one point, the probability of having time-inconsistent preferences increases by 0.24 percentage point. This result makes sense, since when people find it hard to fall asleep this occurs that they often go to bed at different times than they preferred.

Table 4.4: Logistic Regression of DI-index on time-inconsistent preferences.

Dependent Variable:	**Time-Inconsistent Preferences**	
Variables:	**Coefficient**	**Marginal Effect**
DI-index	10.00	0.88
	(7.00)	(0.56)
Social Pressure	-7.58	-0.67*
	(4.78)	(0.38)
Use of bluescreen devices	0.00	0.00
	(1.99)	(0.18)
Suffer from FOMO	-1.91	-0.17
	(1.50)	(0.12)
Snoozer	6.46	0.57
	(4.36)	(0.35)
Having children	-5.42	-0.48
	(4.66)	(0.38)
Association member	-0.08	-0.01
	(1.59)	(0.14)
Difficulty falling in sleep	2.70	0.24*
	(1.82)	(0.14)
Age	0.59	0.05
	(0.54)	(0.05)
Female	3.40	0.30
	(2.63)	(0.21)
Alcohol user	-0.59	-0.05
	(1.61)	(0.14)
Works overtime	-0.26	-0.02
	(2.43)	(0.21)
Constant	-17.98	-
	(14.34)	
Pseudo R^2	0.4070	
N	45	
Observations with TIP = 0	8	
Observations with TIP = 1	37	

Note: Logistic Regression of DI-index on Time-Inconsistent Preferences. The first column shows the independent variables: DI-index; Social Pressure; Use of bluescreen devices; Suffering from FOMO; Snoozer; Having children; Association member; Difficulty falling in sleep; Age; Female; Alcohol user; Works overtime. In the second column estimates are shown from the logit model. The third column shows the Beta coefficients, estimated due to marginal effects. The standard errors are given in parentheses. The Pseudo R^2 and sample size are shown. Significance levels: * p < .10, ** p < .05, *** p < .01.

Table 4.5 shows the results of the quantile regression of monetary present bias on time-inconsistent preferences for decile 2 and decile 3. The reason to choose for these deciles is that all the observations in this decile are negative, which makes it possible to only look at the effect of the present bias on how time-inconsistent the respondents are. The other results of the monetary present bias on time-inconsistent preferences are shown in Appendix 4, Table 4.12.

The dependent variable is the continuous variable of the absolute time-inconsistent preferences, calculated by Equation 4. The coefficient of monetary present bias decile 2 is negative, while the coefficient for decile 3 is positive. The coefficients for the monetary present bias for both deciles are not statistically significant. It is not possible to say that the monetary present bias is a strong predictor for time-inconsistent preferences in sleeping habits among young adults. Moreover, the results contradict each other. While the coefficient of decile 2 says that the time-inconsistent preference become more negative for people that are present biased, the coefficient of decile 3 says that time-inconsistent preferences become less negative. Furthermore, only one control variable shows a statistically significant effect on the 10% level. Being a snoozer shows negative correlation with time-inconsistent preferences. Since all the observations are negative, this means that snoozers have more negative time-inconsistencies. This means that being a snoozer increases the difference between the ideal and actual time with 1.53 hours (around 90 minutes), which is a large difference.

According to these results, Hypothesis 3 cannot be accepted. Both models of for the effect of the monetary present bias on time-inconsistent preferences do not show a statistically significant effect. It is not possible to say that the monetary present bias is a strong predictor for time-inconsistent preferences in sleeping habits among young adults.

Table 4.5: Quantile Regression of monetary present bias on time-inconsistent preferences.

Dependent Variable:	**Absolute Time-Inconsistent Preferences**	
Variables:	**q=0.20**	**q=0.30**
Monetary Present Bias	-0.03	0.27
	(0.90)	(0.76)
Social Pressure	0.41	0.15
	(1.88)	(1.92)
Use of bluescreen devices	0.29	-0.13
	(1.08)	(0.97)
Suffer from FOMO	1.42	0.53
	(0.97)	(0.89)
Snoozer	-1.53*	-0.82
	(0.84)	(0.95)
Having children	2.95	1.27
	(2.27)	(2.27)
Association member	-1.39	-0.35
	(1.00)	(0.89)
Difficulty falling in sleep	-0.19	-0.29
	(1.23)	(1.04)
Age	-0.20	-0.05
	(0.22)	(0.22)
Female	-1.32	0.06
	(1.19)	(1.04)
Alcohol user	-0.17	-0.31
	(0.78)	(0.92)
Works overtime	1.50	0.58
	(0.93)	(0.87)
Constant	3.62	0.61
	(6.62)	(6.26)
Pseudo R^2	0.2530	0.1447
N	45	45

Note: Quantile Regression of the Monetary Present Bias on Absolute Time-Inconsistent Preferences. The first column shows the independent variables: Monetary Present Bias; Social Pressure; Use of bluescreen devices; Suffering from FOMO; Snoozer; Having children; Association member; Difficulty falling in sleep; Age; Female; Alcohol user; Works overtime. In the second and third column estimates are shown for deciles 2 and 3. The standard errors are given in parentheses. The Pseudo R^2 and sample size are shown. Significance levels: * p < .10, ** p < .05, *** p < .01.

Table 4.6 shows the results of the logit model and the marginal effects for the effect of the monetary present-bias on time-inconsistent behavior. In this sample there were enough people presently biased and time-inconsistent, which made it possible to use the dummy variable for the monetary present bias. Contrary to the results of the DI-index on time-inconsistent preference, this sign of the monetary present bias on time-inconsistent behavior is negative. This means that when respondents are presently biased, the probability on time-inconsistent behavior decreases. Looking at the marginal effects in Table 4.6, being presently biased, compared to being not, decreases the probability on time-inconsistent behavior by 16 percentage points. However, this coefficient is not significant. Contrary to the expectation,

this result provides no support for Hypothesis 3. This can also be caused by the small sample size of 45 respondents.

It is still interesting to look at some sleep related and control variables. The coefficient for the use of bluescreen devices before sleep, shows significantly negative on the 1% level. Marginal effects show, that the using bluescreen devices, compared to not using them, decreases the probability of behaving time-inconsistent on average by 91 percentage points. This result is very large and contradicts the literature (Hersenstichting, 2021), which says that this worsens sleep. According to these results, it is negatively associated with time-inconsistent behavior. Suffering from FOMO shows a negative significant correlation with time-inconsistent behavior on the 5% level. For respondents that suffer from FOMO, compared to respondents that do not, the probability of behaving time-inconsistent decreases by 34 percentage points. Being an association member, compared to being not, increases on average the probability of being time inconsistent by 34 percentage points. This effect is significant on the 1% level. The respondents that have more difficulty falling in sleep are also more likely to behave time-inconsistent. When the difficulty (on a scale of 1-3) increases by one point, the probability of having time-inconsistent preferences increases on average by 31 percentage points. The coefficient for female was negative and statistically significant on the 5% significance level. Being a female, compared to being a male, decreases on average the probability of being time-inconsistent by 53 percentage points. One interesting result, which is related to health, was the positive statistically significant (on a 5% significance level) coefficient for using alcohol. Respondents that were using alcohol, increases the probability of behaving time-inconsistent on average by 42 percentage points.

Table 4.6: Logistic Regression of monetary present bias on time-inconsistent behavior.

Dependent Variable:	**Time-Inconsistent Behavior**	
Variables:	**Coefficient**	**Marginal Effect**
Monetary Present Bias	-1.24	-0.16
	(1.63)	(0.21)
Social Pressure	1.86	0.24
	(1.89)	(0.24)
Use of bluescreen devices	-6.88***	-0.91***
	(2.42)	(0.18)
Suffer from FOMO	-2.59**	-0.34**
	(1.26)	(0.13)
Snoozer	-1.44	-0.19
	(1.19)	(0.15)
Having children	-1.40	-0.18
	(4.30)	(0.56)
Association member	2.57*	0.34**
	(1.34)	(0.15)
Difficulty falling in sleep	2.39**	0.31***
	(1.07)	(0.11)
Age	-0.15	-0.02
	(0.28)	(0.04)
Female	-4.06**	-0.53**
	(2.03)	(0.22)
Alcohol User	3.24**	0.42**
	(1.61)	(0.17)
Works Overtime	1.50	0.20
	(1.44)	(0.18)
Constant	5.72	-
	(7.61)	
Pseudo R^2	0.4250	
N	45	
Observations with TIB = 0	24	
Observations with TIB = 1	21	

Note: Logistic Regression of the Monetary Present Bias on Time-Inconsistent Preferences. The first column shows the independent variables: Monetary Present Bias; Social Pressure; Use of bluescreen devices; Suffering from FOMO; Snoozer; Having children; Association member; Difficulty falling in sleep; Age; Female; Alcohol user; Works overtime. In the second column estimates are shown from the logit model. The third column shows the Beta coefficients, estimated due to marginal effects. The standard errors are given in parentheses. The Pseudo R^2 and sample size are shown. Significance levels: * p < .10, ** p < .05, *** p < .01

Table 4.7 shows the results of the quantile regression of the monetary present bias on time-inconsistent behavior for the 2nd and 3rd decile. The other results of the monetary present bias on time-inconsistent behavior are shown in Appendix 4, Table 4.12. The time-inconsistent behavior is calculated by Equation 5. Again, the coefficient for decile 2 is negative and the coefficient for decile 3 is positive. They contradict each other, just like the results of the monetary present bias on time-inconsistent preferences. The coefficients for both deciles are not statistically significant. This means that, contrary to the expectations, the results of the quantile regression do not provide support for Hypothesis 3.

However, there are some interesting control variables to look at. The coefficient for the use of bluescreen devices before sleep in the 2nd decile, is significantly negative effect on the 10% level. It means that respondents that use their devices before sleep, have on average a higher value on absolute time-inconsistent behavior. Since all the observations in this decile are negative, this indicates that the difference is 1.32 hours smaller (around 80 minutes). The coefficient for suffering from FOMO is positive and statistically significant on the 5% level. This means that respondents that suffer from FOMO, compared to respondents that do not, have on average a 0.99 higher value of absolute time-inconsistent behavior. In this scale, that means that the difference is 0.99 hours smaller. The difference is almost one hour less (0.99 * 1 hour). People that have children have also a smaller difference in hours, compared to people that do not have children, since the coefficient is positive and statistically significant on the 5% level. The difference is 2.73 hours smaller, which is around 164 minutes.

According to these results, Hypothesis 3 cannot be accepted. The logit model and the quantile regression of the monetary present bias on time-inconsistent behavior do not show a statistically significant effect. It is not possible to say that the monetary present bias is a strong predictor for time-inconsistent behavior in sleeping habits among young adults.

Table 4.7: Quantile Regression of monetary present bias on time-inconsistent behavior.

Dependent Variable:	**Absolute Time-Inconsistent Behavior**	
Variables:	**q=0.20**	**q=0.30**
Monetary Present Bias	-0.12	0.04
	(0.58)	(0.53)
Social Pressure	0.64	0.98
	(0.90)	(0.98)
Use of bluescreen devices	1.32*	1.23
	(0.77)	(0.74)
Suffer from FOMO	0.99**	0.63
	(0.47)	(0.49)
Snoozer	-0.49	-0.22
	(0.74)	(0.51)
Having children	2.73**	1.54
	(1.10)	(1.30)
Association member	-0.21	-0.18
	(0.49)	(0.36)
Difficulty falling in sleep	-0.57	-0.61
	(0.48)	(0.55)
Age	-0.19	-0.09
	(0.11)	(0.14)
Female	-0.43	0.07
	(0.68)	(0.64)
Alcohol user	-0.99	-0.72
	(0.87)	(0.67)
Works overtime	0.26	0.12
	(0.54)	(0.51)
Constant	4.08	1.70
	(3.64)	(3.96)
Pseudo R^2	0.2743	0.3424
N	45	45

Note: Quantile Regression of the Monetary Present Bias on Absolute Time-Inconsistent Preferences. The first column shows the independent variables: Monetary Present Bias; Social Pressure; Use of bluescreen devices; Suffering from FOMO; Snoozer; Having children; Association member; Difficulty falling in sleep; Age; Female; Alcohol user; Works overtime. In the second and third column estimates are shown for deciles 2 and 3. The standard errors are given in parentheses. The Pseudo R^2 and sample size are shown. Significance levels: * p < .10, ** p < .05, *** p < .01

4.4 Results predictive power of sleep present-bias

After looking at the predicting power of the monetary present bias, this part looks at the explaining power of the sleep present bias on time-inconsistency. This is done by the logit model with Equation 7 and by a quantile regression with Equation 9. First the predicting power of the sleep present bias on time-inconsistent preferences are discussed, thereafter the explaining power on time-inconsistent behavior is discussed.

Table 4.8 shows the results of the logit model and the marginal effects, for the effect of the sleep present bias on time-inconsistent preferences. For this logistic regression there were enough respondents presently biased and time-inconsistent, which made it possible to use a dummy for sleep present bias as explanatory variable. The results in the table show that

there is no significant effect of the sleep present bias on time-inconsistent preferences. Besides, that sign of the coefficient is negative. This would mean that presently biased people have on average a lower probability of being time-inconsistent. However, again the coefficient is not statistically significant. Contrary to the expectation, this provides no support for Hypothesis 4. This may be caused by the small sample size. The control variables do also not show a significant correlation with time-inconsistent preferences. This is strange, since social pressure and difficulty in falling in sleep had an association with time-inconsistent preferences in the logit model from Section 4.3. This is a similar analysis, but these results do not show that.

Table 4.8: Logistic Regression of Sleep Present Bias on time-inconsistent preferences.

Dependent Variable:	**Time-Inconsistent Preferences**	
Variables:	**Coefficient**	**Marginal Effect**
Sleep Present Bias	-0.05	-0.01
	(0.80)	(0.12)
Social Pressure	0.03	0.00
	(1.28)	(0.19)
Use of bluescreen devices	0.91	0.14
	(0.85)	(0.12)
Suffer from FOMO	0.21	0.03
	(0.67)	(0.10)
Snoozer	0.68	0.10
	(0.79)	(0.12)
Having children	1.01	0.15
	(1.65)	(0.24)
Association member	0.94	0.14
	(0.86)	(0.13)
Difficulty falling in sleep	0.40	0.06
	(0.52)	(0.08)
Age	0.05	0.01
	(0.15)	(0.02)
Female	-0.11	-0.02
	(0.78)	(0.12)
Alcohol user	-0.72	-0.11
	(1.27)	(0.19)
Works overtime	0.63	0.09
	(0.90)	(0.13)
Constant	-1.22	-
	(4.08)	
Pseudo R^2	0.0744	
N	70	
Observations with TIP = 0	14	
Observations with TIP = 1	56	

Note: Logistic Regression of the Sleep Present Bias on Time-Inconsistent Preferences. The first column shows the independent variables: Sleep Present Bias; Social Pressure; FOMO; Use of bluescreen; Difficulty falling in sleep; Age; Education; Smoking; Alcohol; Sport; Female; Job Hours and Association. In the second column estimates are shown from the logit model. The third column shows the Beta coefficients, estimated due to marginal effects. The standard errors are given in parentheses. The Pseudo R^2 and sample size are shown. Significance levels: * p < .10, ** p < .05, *** p < .01.

Table 4.9 shows the results for the quantile regression of the sleep present bias on time-inconsistent preferences for the 2nd and 3rd decile. These deciles were chosen, since all the observations are under sleepers. This gives a better view of the association between the sleep present bias and time-inconsistency. The coefficients of sleep present bias for the other deciles and the corresponding R-squared are shown in Appendix 4, Table 4.12.

The dependent variable is the continuous variable of the absolute time-inconsistent preferences, calculated by Equation 4. The estimates of the coefficient for both deciles are negative. The coefficient of sleep present bias for the 2nd decile is negative. This means that respondents that are present biased have on average an absolute time-inconsistency score, that is 0.79 hours lower than respondents that are not presently biased, which is around 48 minutes. However, this coefficient is not statistically significant. The coefficient of sleep present bias for the 3rd decile is negative and statistically significant on the 10% level. This means that people that are present biased have on average an absolute time-inconsistency score, that is 0.84 hours lower than respondents that are not presently biased (around 50 minutes). This is in line with the expectation and provides support for Hypothesis 4. According to these results, the sleep present bias has a strong predictive power on time-inconsistent preferences.

The results of the sleep present bias on time-inconsistent preferences are mixed. The logit model provides no support for Hypothesis 4, but the quantile regression does. It shows that the time-inconsistency becomes larger when respondents face the sleep present bias. It is also a large statistical difference, since present biased people have almost an hour larger difference with their preferred bedtime. Even though the logit model says there is no effect, the quantile regression does. This is arguably the better model since it explicitly looks at a certain group and does not lump all time-inconsistent and time-consistent people together in one category. This means that it is possible to say that the sleep present bias has a strong predictive power on time-inconsistent preferences in sleeping habits among young adults.

Table 4.9: Quantile Regression of sleep present bias on time-inconsistent preferences.

Dependent Variable:	**Absolute Time-Inconsistent Preferences**	
Variables:	**q=0.20**	**q=0.30**
Sleep Present Bias	-0.79	-0.84*
	(0.49)	(0.44)
Social Pressure	-0.05	-0.47
	(0.92)	(0.63)
Use of bluescreen devices	-0.12	-0.02
	(0.93)	(0.88)
Suffer from FOMO	-0.54	-0.25
	(0.73)	(0.55)
Snoozer	0.50	0.40
	(0.86)	(0.74)
Having children	-0.41	-0.34
	(1.20)	(1.01)
Association member	-0.27	0.02
	(0.92)	(0.90)
Difficulty falling in sleep	0.14	0.19
	(0.27)	(0.24)
Age	-0.08	-0.02
	(0.09)	(0.09)
Female	-0.42	0.08
	(0.49)	(0.50)
Alcohol user	-0.12	0.30
	(0.86)	(1.05)
Works overtime	0.38	0.03
	(0.58)	(0.59)
Constant	0.78	-1.31
	(2.86)	(2.74)
Pseudo R^2	0.1225	0.1024
N	70	70

Note: Quantile Regression of the Sleep Present Bias on Absolute Time-Inconsistent Preferences. The first column shows the independent variables: Sleep Present Bias; Social Pressure; Use of bluescreen devices; Suffering from FOMO; Snoozer; Having children; Association member; Difficulty falling in sleep; Age; Female; Alcohol user; Works overtime. In the second and third column estimates are shown for deciles 2 and 3. The standard errors are given in parentheses. The Pseudo R^2 and sample size are shown. Significance levels: * p < .10, ** p < .05, *** p < .01.

Table 4.10 shows the results of the logit model and the marginal effects for the effect of the monetary present-bias on time-inconsistent behavior. In this sample there were enough people presently biased and time-inconsistent, which made it possible to use the dummy variable for the monetary present bias. This logistic regression shows no statistically significant effect of the sleep present bias on time-inconsistent behavior. The coefficient is positive, which means that the respondents that are presently biased, compared to respondents that are not, have on average a higher probability for having time-inconsistent behavior. Contrary to the expectation, this provides no support to Hypothesis 4, since there is no significant effect. This also may be caused by the small sample size of 70 respondents.

Only one control variable has a statistically significant effect on time-inconsistent behavior on the 5% level. People that use their bluescreen devices before sleep, have on average lower probability of having time-inconsistent behavior. The probability of having time-inconsistent behavior decreases on average by 37 percentage points if people use their bluescreen devices before going to sleep. This is in contrast with the literature (Hersenstichting, 2021), but in line with findings from the logit model of monetary present bias on time-inconsistent behavior from Section 4.3.

Table 4.10: Logistic Regression of Sleep Present Bias on time-inconsistent behavior.

Dependent Variable:	**Time-Inconsistent Behavior**	
Variables:	**Coefficient**	**Marginal Effect**
Sleep Present Bias	0.29	0.06
	(0.65)	(0.13)
Social Pressure	0.72	0.15
	(0.97)	(0.20)
Use of bluescreen devices	-1.80**	-0.37**
	(0.85)	(0.15)
Suffer from FOMO	0.27	0.05
	(0.57)	(0.12)
Snoozer	-0.27	-0.06
	(0.65)	(0.13)
Having children	1.23	0.25
	(1.50)	(0.30)
Association member	0.53	0.11
	(0.65)	(0.13)
Difficulty falling in sleep	-0.07	-0.01
	(0.42)	(0.09)
Age	-0.13	-0.03
	(0.14)	(0.03)
Female	-0.43	-0.09
	(0.65)	(0.13)
Alcohol user	0.67	0.14
	(1.11)	(0.23)
Works overtime	-0.36	-0.08
	(0.65)	(0.13)
Constant	3.52	-
	(3.63)	
Pseudo R^2	0.1230	
N	70	
Observations with TIB = 0	30	
Observations with TIB = 1	40	

Note: Logistic Regression of the Sleep Present Bias on Time-Inconsistent Preferences. The first column shows the independent variables: Sleep Present Bias; Social Pressure; Use of bluescreen devices; Suffering from FOMO; Snoozer; Having children; Association member; Difficulty falling in sleep; Age; Female; Alcohol user; Works overtime. In the second column estimates are shown from the logit model. The third column shows the Beta coefficients, estimated due to marginal effects. The standard errors are given in parentheses. The Pseudo R^2 and sample size are shown. Significance levels: * p < .10, ** p < .05, *** p < .01.

Table 4.11 shows the results of the quantile regression of sleep present bias on time-inconsistent behavior for the 2nd and 3rd decile. These deciles were chosen, since all the

observations around this decile are under sleepers. This gives a better view of the association between the sleep present bias and time-inconsistency. The coefficients of sleep present bias for the other deciles and the corresponding R-squared are shown in Appendix 4, Table 4.12.

The continuous, dependent variable is absolute time-inconsistent behavior, calculated by Equation 5. The coefficients for both deciles are negative. The observations in both deciles are negative, which means that a negative coefficient means a more negative value of the dependent variable. This indicates that presently biased respondents are more time-inconsistent than respondents that are not. However, the coefficients are both not statistically significant. Thereby, the coefficients are smaller, compared to the coefficients on time-inconsistent preferences. This is a normal result, since section 4.2 showed that there might be sophistication in this sample. To conclude, these results do not provide support for Hypothesis 4, contrary to the expectations. The control variables also do not have a statistically significant effect on the dependent variable.

According to the results of this section, Hypothesis 4 can partly be accepted. The quantile regression of the sleep present bias on time-inconsistent preferences does show that the sleep present bias is a strong predictor for time-inconsistent preferences. However, the logit model and quantile regression of the sleep present bias on time-inconsistent behavior does not show a statistically significant effect.

Table 4.11: Quantile Regression of sleep present bias on time-inconsistent behavior.

Dependent Variable:	**Absolute Time-Inconsistent Behavior**	
Variables:	**q=0.20**	**q=0.30**
Sleep Present Bias	-0.20	-0.18
	(0.52)	(0.43)
Social Pressure	-0.14	-0.42
	(0.58)	(0.56)
Use of bluescreen devices	0.40	0.58
	(0.67)	(0.71)
Suffer from FOMO	-0.26	-0.12
	(0.34)	(0.29)
Snoozer	0.24	0.26
	(0.51)	(0.32)
Having children	0.57	0.13
	(1.33)	(0.84)
Association member	-0.07	-0.22
	(0.66)	(0.73)
Difficulty falling in sleep	0.11	0.04
	(0.24)	(0.24)
Age	-0.03	0.01
	(0.10)	(0.08)
Female	0.08	0.25
	(0.37)	(0.37)
Alcohol user	-0.31	-0.06
	(0.53)	(0.62)
Works overtime	0.11	0.19
	(0.29)	(0.26)
Constant	-0.15	-1.43
	(2.12)	(2.04)
Pseudo R^2	0.1051	0.0859
N	70	70

Note: Quantile Regression of the Sleep Present Bias on Absolute Time-Inconsistent Behavior. The first column shows the independent variables: Sleep Present Bias; Social Pressure; Use of bluescreen devices; Suffering from FOMO; Snoozer; Having children; Association member; Difficulty falling in sleep; Age; Female; Alcohol user; Works overtime. In the second and third column estimates are shown for deciles 2 and 3. The standard errors are given in parentheses. The Pseudo R^2 and sample size are shown. Significance levels: * p < .10, ** p < .05, *** p < .01.

5. Conclusion and Discussion

This part examines the results of the paper and gives the conclusion. After that, some limitations of the paper and improvements that can be done for further research are discussed in the discussion.

5.1 Conclusion

The aim of this paper was to investigate whether there exists time-inconsistency in sleeping habits among young adults. The study also looked at whether the monetary present bias and the sleep present bias have a strong predictive power for time-inconsistency. The data is collected by sending out three separate surveys. The analysis for the monetary present biased used a sample of 45 respondents. The analysis for detecting time-inconsistency and the sleep present bias used a sample of 70 respondents.

The existence of time-inconsistent preferences and behavior in sleeping habits of young adults, was tested by a one-sample t-test. The first hypothesis is that there exist time-inconsistent preferences in sleeping habits among young adults. The results showed that it was possible to confirm this hypothesis. On average, there exist time-inconsistent preferences in sleeping habits among young adults. The results also showed support for the second hypothesis, which states that there exists time-inconsistent behavior in sleeping habits among young adults. This indicates that it is possible to say that young adults behave time-consistent with respect to sleeping habits. Thereafter, the paper looked at sophistication and commitment devices. Results showed that the sample may exist of a lot of sophisticated individuals, since there is a statistically significant difference between the ideal and predicted time. This indicates that people already know before that they will be not able to make the ideal bedtime. Furthermore, a large fraction of the respondents reports time-inconsistency, but only 17 percent are interested in using commitment devices to improve the sleep duration.

The next step was to look at the predicting power of the monetary present bias on time-inconsistency. Hypothesis 3 states that the monetary present bias has a predictive power on time-inconsistent preferences and behavior in sleeping habits among young adults. This analysis was done by a logit model and a quantile regression. First, the effect on time-inconsistent preferences was investigated. Both models did not show significant effects of the

monetary present bias on time-inconsistent preferences. Thereafter, the effect on time-inconsistent behavior was investigated. Again, both models showed no significant effects on time-inconsistent behavior. According to these results it is not possible to say that the monetary present bias is a strong predictor for time-inconsistency. There is insufficient evidence to accept Hypothesis 3.

The last part looked at the predicting power of the sleep present bias on time-inconsistency. This was done by a logit model and a quantile regression. Hypothesis 4 states that the sleep present bias has a predictive power on time-inconsistent preferences and behavior in sleeping habits among young adults. This part also discussed time-inconsistent preferences first. The results were mixed. Where the logit model did not show significant effects of the sleep present bias on time-inconsistent preferences, the results of the quantile regression actually did. Respondents that face a sleep present bias, have larger time-inconsistent preferences (more negative) than respondents that do not face a sleep present bias. Since the quantile regression specifically looks at under sleepers, it provides enough support for Hypothesis 4. Thereafter, the effect on time-inconsistent behavior was investigated. The results for both models did not show significant effect of the sleep present bias on time-inconsistent behavior. Hypothesis 4 can partly be accepted. While the sleep present bias has a predictive power on time-inconsistent sleeping preferences among young adults, it has no predictive power on time-inconsistent sleep behavior among young adults.

The first research question was asking whether time-inconsistent preference and behaviors exist in sleeping habits of young adults. Hypothesis 1 can be confirmed, while Hypothesis 2 cannot. In this sample only time-inconsistent preferences exist, which means that the ideal bedtime differs from the actual bedtime. The second research question was asking whether two different present biases have a predictive power on time-inconsistency. For the monetary present bias, there was no supportive evidence to confirm Hypothesis 3. The results for the sleep present bias, did show supportive evidence for Hypothesis 4 with respect to time-inconsistent preferences. For time-inconsistent behavior, there was no sufficient evidence to accept the other part of Hypothesis 4.

5.2 Discussion

In this paper, evidence was found for time-inconsistent preferences in sleeping habits among young adults. However, no evidence was found for the existence of time-inconsistent behavior. Therewithal, the analyses of the monetary present bias on time-inconsistency gave no significant results. There is found some evidence for the predicting power of the sleep present bias on time-inconsistent preferences in this sample. There are some limitations that may have caused the low rate of significant results. The first explanation may be the small sample size. Only 70 respondents filled in the first two surveys. There was a high drop-out rate after the first survey, that was filled in by 128 respondents. The third survey was filled in by only 45 respondents. Reasons for the high drop-out rate may be that it takes too much time or that there was lack of interest. It is important to look in that case at measurement errors, which was also done by the quantile regression. This paper only looked at deciles that were not the outer deciles. This indicates that the outliers do not have an effect on these deciles. In the case of a high drop-out rate, there could occur a self-selection bias. A self-selection bias indicates that participants are able to decide by themselves, to participate in the survey or not (Heckman, 1990). This may result in a bad external validity, since the sample of respondents is not representative for the target population. The (for example) lazy respondents that do not want to participate, can also be lazy in going to bed on time. The respondents that do participate, can be less busy and better able to go to bed on time.

In the questions for the present bias, there were only simple questions. Especially for the monetary present bias this may be a problem, since there were no real incentives. The individuals had to fill in what they would do in the specific situation, but did not get money in real life. For further research this could be improved by asking what they think other people would do, due to the false consensus bias. This is an egocentric bias. When individuals have to fill in what they think others will do, it will reflect what they would do themselves. Another option would be to really pay out the respondents, to make sure they fill in their actual preferences.

Another limitation can be that the participants did not fill in the actual bedtime honestly. Then, the hypothetical bias will occur. In that case, the numbers for time-inconsistency are not right. A solution for this problem for further research may be gathering information in an artificial environment, a lab experiment. In that case, it is possible to monitor people and get detailed information about bedtimes, quality of sleep and what people do

before sleep. This will help to better look at threats for sleep quality and quantity in the future. Thereby, in this research there was no distinction made between filling in the survey in the weekends or during the workweek. This could cause the lack of significant results, because in the weekend it is less necessary to go to bed on time. For future research this will be an interesting difference to look at.

For further research it would thus be necessary to be aware of the limitations that were described. It is important to have a larger sample size, with more real incentives to detect present biases. Thereby, actually monitoring sleep behavior will also help to get more detailed information about bedtimes, quality and threats. It is then also possible to detect behavior before sleep to get more insight information about what improves and what worsens sleep quality. Another interesting direction would be to look at differences between bedtimes in the weekend or during the workweek. In the workweek it is important to go to bed on time, since people are otherwise not fit, bright and awake enough to work or learn. However, in the weekends this is not so important, since there are less deadlines to meet. This makes it interesting for further research to look at whether people know that they will go to bed later or that they think that also in the weekend they go to bed early. This can then explain whether people are more sophisticated in the weekends, compared to the workweek.

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Appendix

Appendix 1

Survey 1:

The survey was distributed with Qualtrics and conducted in Dutch.

Introductie:

Ik nodig u uit om deel te nemen aan een onderzoek. Uw deelname is vrijwillig. Als u wilt deelnemen, moet u uw toestemming geven. Neem de tijd om de volgende informatie aandachtig door te lezen.

Voor mijn master Health Economics aan de Erasmus Universiteit doe ik onderzoek naar het slaapgedrag van jongvolwassenen (tussen 16 en 30 jaar). Het verzamelen van de gegevens zal middels twee enquêtes gebeuren. Als u deze enquête start is het dus belangrijk dat u ook bereid bent om de volgende enquête in te vullen. Het is belangrijk dat u zowel in de eerste enquête als in de tweede enquête hetzelfde e-mailadres invoert, want deze wordt gebruikt om de twee enquêtes aan elkaar te koppelen. Aan het einde van de tweede enquête kunt u meedoen aan een loting voor een bol.com bon ter waarde van €20,-.

Uw deelname is vrijwillig en anoniem. Ik zal in beide enquêtes vragen om uw e-mailadres in te voeren. Deze wordt uitsluitend gebruikt om de tweede enquête naar u toe te sturen en wordt na koppeling van de enquêtes direct verwijderd. Dit betekent dat de gegevens anoniem zullen zijn en niet naar u te herleiden zijn. U kunt uw deelname en toestemming op elk moment tijdens deze enquête intrekken, zonder een reden hiervoor op te geven.

Deze enquête duurt ongeveer 5 minuten. Mocht er iets niet duidelijk zijn, dan kunt u contact met mij opnemen via mijn e-mail 482242me@student.eur.nl

Consent:

Geeft u toestemming voor deelname aan het onderzoek?

- Ja, ik geef toestemming voor deelname aan dit onderzoek
- Nee, ik geef geen toestemming en zal niet meedoen aan dit onderzoek.

Vul hieronder uw e-mail in, zodat ik de twee enquêtes aan elkaar kan koppelen.

Preferred and predicted time to go to sleep:

Hieronder kunt u de tijden aangeven wat voor u vanavond de ideale tijd zou zijn om te gaan slapen en hoe laat u denkt dat u vanavond daadwerkelijk gaat slapen. Hiermee wordt bedoeld de daadwerkelijke tijd dat u probeert te slapen. Hiermee wordt dus niet de tijd dat u naar bed gaat en nog televisie gaat kijken bedoeld. Het is belangrijk dat u voor de ideale bedtijd alle voorzienbare restricties meeneemt. Een voorbeeld hiervan is dat uw ideale tijd misschien 21.30 is, maar als u sport tot 22.00 is dit niet haalbaar. Uw ideale tijd moet dus wel mogelijk zijn.

Vult u alstublieft de tijd als volgt in: half 9 als 20.30 of 10 uur als 22.00.

Ideal time:

Wat is voor u de ideale tijd om te gaan slapen?

Predicted time:

Hoe laat denkt u dat u vanavond gaat slapen?

Present bias questions:

Monetary Present Bias

De volgende vraag gaat over welke van de twee opties in de volgende scenario's uw voorkeur heeft. U kunt elke keer kiezen tussen nu €100,- krijgen of €150,- op een later moment. Kies hieronder welke van de twee opties uw voorkeur heeft.

	Optie A	Optie B
Optie A: €100,- nu, of Optie B: €150,- over 1 dag		
Optie A: €100,- nu, of Optie B: €150,- over 2 dagen		
Optie A: €100,- nu, of Optie B: €150,- over 3 dagen		
Optie A: €100,- nu, of Optie B: €150,- over 4 dagen		
Optie A: €100,- nu, of Optie B: €150,- over 5 dagen		

Optie A: €100,- nu, of Optie B: €150,- over 6 dagen
Optie A: €100,- nu, of Optie B: €150,- over 7 dagen

Sleep Present Bias

Hieronder staan 8 stellingen. Geef aan in hoeverre u het hiermee eens bent.

	Helemaal niet mee eens (1)	Niet mee eens (2)	Enigszins mee oneens (3)	Noch eens noch oneens (4)	Enigszins mee eens (5)	Mee eens (6)	Helemaal mee eens (7)
Ik ga vaak later naar bed dan ik had willen gaan en heb dan de volgende dag spijt							
Ik ben vaak moe, omdat ik vaak later naar bed ga dan goed voor mij is.							
Ik leef voor vandaag en denk niet aan morgen.							
Als er lastige of moeilijke							

dingen op de planning staan stel ik deze vaak uit.							
Ik ben impulsief in het maken van beslissingen.							
Ik ben eerder avontuurlijk, dan voorzichtig.							
Ik vind fysieke activiteiten leuker dan cognitieve activiteiten (bijvoorbeeld sportspellen in plaats van denkspellen)							
Ik vind het erg als ik mensen zie lijden.							

Sleep related questions:

Er zit meer dan een uur verschil tussen de tijd dat ik doordeweeks naar bed ga en de tijd dat ik in het weekend naar bed ga.

- Eens
- Niet eens

Hoeveel uur slaap krijgt u gemiddeld per nacht (in uren)?

Welke verleidingen zijn bij u van toepassing, waardoor u later gaat slapen dan gepland?

- Telefoon
- Televisie
- Streaming platforms, zoals Netflix of Videoland
- Boeken lezen
- Werk
- Gamen
- Studeren

Hieronder staan 5 stellingen, geef aan in hoeverre u het hiermee eens bent.

	Helemaal niet mee eens (1)	Niet mee eens (2)	Enigszins mee oneens (3)	Noch eens noch oneens (4)	Enigszins mee eens (5)	Mee eens (6)	Helemaal mee eens (7)
Ik heb last van moeheid.							
Ik heb last van stress.							
Ik voel sociale druk om op andere tijden naar bed te gaan dan ik eigenlijk zou willen.							
Ik heb last van Fear-Of-Missing-Out. Dit is de angst om iets te missen en het gevoel van vrees dat men niet op de hoogte is van informatie, gebeurtenissen,							

ervaringen of levensbeslissingen.							
Voor ik ga slapen zit ik nog lang achter een scherm of op mijn telefoon.							

Afsluiten:

Ontzettend bedankt voor het invullen van deze eerste enquête. U zult morgen de tweede enquête ontvangen. Om de enquête op te slaan, klikt u op het pijltje rechts onderin.

Appendix 2

Survey 2:

The survey was distributed with Qualtrics and conducted in Dutch.

Bedankt dat u ook mee wilt werken aan het tweede onderdeel van dit onderzoek. De enquête zal zo starten met de tijd dat u gister naar bed bent gegaan en daarna volgen er nog een paar algemene vragen. Als laatste kunt u aangeven of u mee wilt doen aan de loting voor de bol.com bom van €20,-.

Voordat u de enquête begint is het belangrijk dat u weer hetzelfde e-mailadres hieronder invult zodat ik uw twee enquêtes aan elkaar kan linken. Na koppeling zal uw e-mailadres direct verwijderd worden, tenzij u aan het einde aangeeft mee te willen doen aan de loting voor de bol.com bon.

Actual time to go to bed:

Net als in de vorige enquête is het belangrijk dat u de tijden weer als volgt invoert: half 9 als 20.30 of 10 uur als 22.00.

Hoe laat bent u gister naar bed gegaan (de avond nadat u de eerste enquête had ingevuld)?

Indien u gister later naar bed bent gegaan dan gepland wat was hiervoor de reden?

Sleep related questions:

Hoe laat staat u op een doordeweekse dag op? (Vul de tijd weer als volgt in: 7 uur als 7.00 en 9.00)

“Snoozet” u vaak wanneer u de wekker zet? Hiermee bedoel ik dat u de wekker nog even uitstelt, zodat die later alsnog afgaat.

- Nooit
- Zelden
- Regelmatig
- Vaak
- Altijd

Valt u makkelijk in slaap? Hiermee bedoel ik of u snel in slaap valt, of dat u vaak nog een uur wakker ligt.

- Ik val makkelijk in slaap
- Dit verschilt heel erg
- Ik val moeilijk in slaap

Als u de kwaliteit van slaap een cijfer zou moeten geven, welk cijfer zou dat dan zijn?

(Tussen 0 en 10)

Demographic Questions:

Wat is uw leeftijd?

Wat is uw geslacht?

- Vrouw
- Man
- Anders/dat wil ik niet zeggen

Wat is het hoogste opleidingsniveau waar u mee bezig bent of dat u hebt voltooid?

- Geen diploma
- Mbo-opleiding of vergelijkbaar
- Hbo-bachelor
- Universitaire bachelor
- Master degree
- Kandidaats/PhD

Heb je op dit moment een baan? Dit kan ook een bijbaan zijn.

- Ja
- Nee

Hoeveel uur werkt u gemiddeld per week?

Werkt u vaak naast uw eigenlijke werktijden?

- Ja
- Nee

Hoe zou u, uw huishouden beschrijven?

- Ik woon op mezelf en alleen
- Ik woon op mezelf, maar met huisgenoten
- Ik woon nog thuis bij mijn ouders
- Ik woon met mijn partner samen
- Ik woon met mijn partner en (jonge) kinderen

Bent u lid van een student- en/of studievereniging?

- Ja
- Nee

Rookt u? En zo ja, hoe zou u dit gedrag omschrijven?

- Nee

- Ja, maar ik rook alleen op feestjes
- Ja, maar ik ben van plan te stoppen op korte termijn
- Ja, en ik wil niet stoppen op korte termijn

Drinkt u alcohol?

- Ja
- Nee

Hoeveel uur sport u in de week?

- 0 uur
- 0-3 uur
- 3-6 uur
- 7 uur of meer

Commitment device:

Maakt u gebruik van een app of apparaat die u eraan helpt herinneren om op tijd te gaan slapen?

- Ja
- Nee

Indien er een app zou bestaan die uw telefoon of tablet blokkeert op de vooraf ingestelde, ideale bedtijd, zodat u op tijd naar bed kunt gaan. Zou u deze app dan willen gebruiken?

- Ja
- Nee

Afsluiten:

Zou u mee willen doen voor de loting van de bol.com bon ter waarde van €20,-?

- Ja, graag!
- Nee, dat wil ik niet.

Ontzetten bedankt voor het invullen van de vragen. Dit zal het onderzoek ontzettend helpen! Om de enquête op te slaan, klikt u op het pijltje rechts onderin.

Appendix 3

Survey 3:

Allereerst bedankt dat u mij weer wilt helpen! Voor mijn onderzoek miste ik nog een paar laatste dingen, die de kwaliteit van mijn onderzoek verbeteren. Uiteraard zal ik degene die ook meewerken aan mijn laatste enquête twee keer laten meedoen in de loting voor de bol.com bon. Dit keer zal de enquête nog korter zijn, dus u bent binnen 3 minuten klaar. Om de data te koppelen, heb ik weer uw e-mailadres nodig. Deze zal ik daarna verwijderen.
Vul hieronder uw e-mail in:

Wilt u nog steeds meedoen met de bol.com bon?

- Ja
- Nee

De volgende vraag gaat over welke van de twee opties in de volgende scenario's uw voorkeur heeft. U kunt elke keer kiezen tussen nu €100,- krijgen of €150,- op een later moment. Kies hieronder welke van de twee opties u voorkeur heeft.

	Optie A	Optie B
Optie A: €100,- vandaag, of Optie B: €150,- vandaag.		
Optie A: €100,- vandaag, of Optie B: €150,- over 1 week.		
Optie A: €100,- vandaag, of Optie B: €150,- over 2 weken.		
Optie A: €100,- vandaag, of Optie B: €150,- over 3 weken.		
Optie A: €100,- vandaag, of Optie B: €150,- over 4 weken.		
Optie A: €100,- vandaag, of Optie B: €150,- over 5 weken.		
Optie A: €100,- vandaag, of Optie B: €150,- over 6 weken.		
Optie A: €100,- vandaag, of Optie B: €150,- over 7 weken.		
Optie A: €100,- vandaag, of Optie B: €150,- over 8 weken.		

Optie A: €100,- vandaag, of Optie B:
€150,- over 12 weken.
Optie A: €100,- vandaag, of Optie B:
€150,- over 26 weken.
Optie A: €100,- vandaag, of Optie B:
€150,- over 52 weken.

Optie A	Optie B
Optie A: €100,- 2 weken, of Optie B:	
€150,- 2 weken.	
Optie A: €100,- 2 weken, of Optie B:	
€150,- over 3 weken.	
Optie A: €100,- 2 weken, of Optie B:	
€150,- over 4 weken.	
Optie A: €100,- 2 weken, of Optie B:	
€150,- over 5 weken.	
Optie A: €100,- 2 weken, of Optie B:	
€150,- over 6 weken.	
Optie A: €100,- 2 weken, of Optie B:	
€150,- over 7 weken.	
Optie A: €100,- 2 weken, of Optie B:	
€150,- over 8 weken.	
Optie A: €100,- 2 weken, of Optie B:	
€150,- over 9 weken.	
Optie A: €100,- 2 weken, of Optie B:	
€150,- over 10 weken.	
Optie A: €100,- 2 weken, of Optie B:	
€150,- over 14 weken.	
Optie A: €100,- 2 weken, of Optie B:	
€150,- over 28 weken.	
Optie A: €100,- 2 weken of Optie B:	
€150,- over 54 weken.	

Ik wil jullie graag ontzettend bedanken, dat jullie ok deze enquête hebben ingevuld. Dit gaat mij enorm helpen. Degene die de bol.com cadeaubon heeft gewonnen krijgt dit binnenkort te horen! Druk op het pijltje rechts onderin om de antwoorden op te slaan. Groetjes, Myrthe

Appendix 4

Table 4.12. Quantile Regression of different present biases on time-inconsistency for all deciles.

Decile:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Monetary present bias									
Coefficient for PB on TIP	0.11 (0.60)	-0.03 (0.90)	0.27 (0.76)	-0.01 (0.64)	-0.27 (0.52)	-0.26 (0.50)	-0.43 (0.53)	-0.48 (0.46)	-0.27 (0.49)
R-squared	0.5180	0.2530	0.1447	0.1304	0.0988	0.1081	0.1734	0.2340	0.3362
Coefficient for PB on TIB	-0.05 (0.63)	-0.12 (0.58)	0.04 (0.53)	0.13 (0.41)	-0.06 (0.46)	-0.16 (0.63)	-0.17 (0.57)	-0.25 (0.53)	-0.92 (0.50)*
R-squared	0.4192	0.2743	0.2046	0.1851	0.1536	0.1723	0.2699	0.3424	0.3918
Sleep present bias									
Coefficient for PB on TIP	-0.85 (0.63)	-0.79 (0.49)	-0.84 (0.44)*	-0.75 (0.43)*	-0.75 (0.40)*	-0.20 (0.37)	-0.07 (0.34)	-0.12 (0.39)	-0.25 (0.48)
R-squared	0.2817	0.1225	0.1024	0.884	0.0454	0.0169	0.0544	0.0636	0.1844
Coefficient for PB on TIB	0.32 (0.56)	-0.20 (0.52)	-0.18 (0.43)	-0.27 (0.34)	-0.13 (0.35)	0.00 (0.46)	0.56 (0.50)	0.37 (0.43)	0.14 (0.57)
R-squared	0.0576	0.1051	0.0859	0.1007	0.0728	0.0911	0.1380	0.1468	0.0953

Note: Quantile Regression of the Monetary Present Bias and Sleep Present Bias on Absolute Time-Inconsistent Preferences (TIP) and Behavior (TIB). The first column shows the different present biases (monetary and sleep), the coefficients and R-squared. The second to the tenth column shows the results for deciles 1 to 9. The standard errors are given in parentheses. Significance levels: * p < .10, ** p < .05, *** p < .01.