The relation between field behavior and changes in impatience

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Abstract

Many studies already did research in finding any correlation between impatience and field behavior using hyperbolic discounting functions. However, using these functions can be problematic. Therefore in Rohde (2016), a new measure is introduced for calculating the degree of decreasing impatience. This research focusses on an extension of the experiment by Rohde (2016), searching for correlations between the degree of decreasing impatience and self-reported self-control problems. Two experiments were set up using monetary incentives and health states. For the monetary incentives, two procedures P and T from Rohde (2016) were used. It seems that P gives a more plausible outcome for the degree of decreasing impatience compared to T. For health states, only P was used for theoretical reasons. Using health states instead of monetary incentives leads to people having a stronger degree of decreasing impatience. In both experiments, no correlation was found between the degree of decreasing impatience and self-reported self-control problems, suggesting that self-control problems cannot solely be predicted from changes in impatience.

Contents

1 Introduction

Is it possible to predict individual field behavior by using individual differences in decreasing impatience? In other words, could the degree in which you discount something over the future, tells you something about what kind of person you are? Procrastination is all too familiar to most people (Ariely and Wertenbroch 2002). Maybe you recognize familiar behavior, for example, by declaring that you will start your diet tomorrow or that you keep postpone to stop smoking. Such self-control problems arise when preferences are inconsistent across time or context (Ariely and Wertenbroch 2002; Ainslie 1975). Consider the following adapted example from Ariely and Wertenbroch (2002). Imagine, before going to a party, you might have the intention not drinking too much alcohol that night, because you have to study tomorrow. However, when time comes, you might give in to the temptation and drink too much after all, leaving you with a hangover the next morning. Here, it is not about drinking at a party is right or wrong, but it is the too much drinking which is inconsistent with the decision maker's preference both before and after the party. This inconsistent behavior could in the future possibly lead to costly consequences when one for example becomes an alcoholic. Many other time-inconsistent examples are possible to think of, which in the future can lead to high social costs. If it is possible to predict individual self-control problems by using individual differences in the level of decreasing impatience, such costs could be reduced. Especially, when it could be predicted in a very early stadium of the self-control problem. This study therefore could be interesting for policy makers for example, by using this knowledge for specific target groups. Moreover, large amounts of social costs could be suppressed. For example diseases caused by overweight and smoking costed the Dutch government about 4.5 billion euros in 2010 (in 't Panhuis-Plasmans et al. 2012). Not only in the Netherlands, but world wide, obesity is becoming a major problem, making it more and more interesting to predict which part of the population has a higher chance of becoming obese. Then, it would be possible to take action in a much earlier stage of obesity, leading to a reduction of costs. Furthermore, it could be of interest for banks. If you can predict upfront which people are more likely to have self-control problems with respect to money, it can help banks providing mortgages in different ways.

Many studies already investigated into this subject of time-inconsistent behavior. Already in

1955, Strotz argued that their might be a relation between deviating from constant discounting and self-reported self-control problems. Here, constant discounting is that if you prefer €10 now instead of €15 next month, you always prefer €10 over €15 if both options are shifted into the future with the same amount of time. Self-control problems are for example smoking, use of drugs, but also bad saving behavior. A correlation was already found in studies by for example Sutter et al. (2011), Kirby et al. (1999) and McClure et al. (2004). However, these studies all used hyperbolic discounting as a way to measure the changes of decreasing impatience. The disadvantage of using such a time-inconsistent model is that it assumes linear utility for estimating the parameters. However, as is showed by Rohde (2016), none of the parameters of these discount functions isolate the pure effect of changes of impatience. Moreover, it is not possible to use hyperbolic discounting for people who satisfy increasing impatience or strongly decreasing impatience (Rohde 2016). Nevertheless, these groups exist in significant proportions (Olea and Strzalecki 2014 and Attema et al. 2010). For those reasons, Rohde (2016) developed the Decreasing Impatience (DI) index. This index is able to measure changes in impatience for any degree of decreasing as well as increasing impatience. Note, the index is called "decreasing", because most people tend to satisfy decreasing impatience, instead of increasing or constant impatience (Rohde 2016).

This research focusses on an extension of the experiment by Rohde (2016), using the decreasing impatience (DI)-index to check for any correlation with self-reported self-control problems. For using the DI-index, two indifferences need to be computed. In that paper, two different procedures are proposed for computing these indifferences and one procedure was already tested using monetary incentives. Nevertheless, no correlation was found between the DI-index and the reported control problems. However, an experiment has to point out if the same can be said about the other procedure. Furthermore, a recent study by Bleichrodt et al. (2016) concluded that deviations from constant discounting were more pronounced for health than for money. This could indicate that people might be more vulnerable to self-control problems for health than for money. Moreover, they suggest that findings for monetary values cannot simply be transferred to health. This could imply that despite no correlation was found for the DI-index and monetary incentives, using health states could change this. Therefore, the following question stands central during this research:

Does the degree of decreasing impatience for monetary incentives and health states show any

correlation with self-reported self-control problems?

Two experiments are conducted in this research. In the first part, both procedures are compared to each other, using monetary incentives as was done by Rohde (2016) for only one procedure. Both procedures are considered, making the comparison between the two more reliable. For the second part of this research, health states are used. However, only one procedure is considered here, because the other procedure is inconvenient for using an outcome domain other than real numbers. It seems that one procedure is preferred over the other. Furthermore, the DI-index for health is higher compared to the DI-index for money, implicating a larger degree of decreasing impatience using health states instead of monetary incentives. For both experiments no correlation is found between the DI-index and self-reported self-control problems. This suggests that self-control problems cannot solely be predicted from changes in impatience.

The remainder of this paper is structured as follows. In the next section, a more explicit introduction of the problem is given, including the formulation of the DI-index, an example and some related previous studies. In Section 3, the hypotheses are discussed, which are tested to answer the research question. Section 4 introduces the two procedures to elicit the indifferences needed for calculating the DI-index. The experiment is discussed in detail in Section 5. Finally, the results of the experiment are given in Section 6 and this research is concluded with a discussion in Section 7.

2 Literature

2.1 Definitions

First, recall what actually is a discount function again? A discount function shows what the value of a cash flow today, t_0, is worth at different points of time in the future. For impatient people, there is a decreasing discount function. This means that they value an amount x at time t_0 higher than the same amount x at any point of time in the future; they discount the money. In terms of utility, receiving the amount x now gives a higher utility than receiving it somewhere in the future.

Furthermore, this paper concerns decreasing and increasing impatience. Decreasing impatience actually says that people become less impatient if they have to choose something further away in

the future. Meaning that if a person, satisfying decreasing impatience, prefers €10 today over €12 tomorrow, there will be a point in the future where this person is willing to wait for the better outcome of €12, provided that both outcomes are shifted into the future with the same length. Increasing impatience is exactly the opposite, saying that people people become more and more impatient if they have to choose something further away in the future. Moreover, it is possible that people have a different kind of degree in either increasing or decreasing impatience, i.e. some can have a stronger degree of decreasing impatience than others. To get a better understanding of the degree of decreasing impatience, read the following example in the next subsection, given in Rohde (2016) (p.3-4). During this paper, the same notation is used as in Rohde (2016), where *timed outcomes* $(t : x) \in T \times X$ give *outcome* x *at time* t.

2.2 Example

Consider Ann and Bill, both satisfying decreasing impatience. However, assume that Bill has a larger degree of decreasing impatience than Ann. Ann satisfies $(s : x) \sim (t : y)$ and $(s + \sigma : x) \sim (t + \tau : y)$ for $y \succ x \succ 0$, $s < t$, and $\sigma > 0$. This implies that τ must then be larger than σ. Recall, that decreasing impatience means that an individual is more willing to wait with an additional delay. Then, if Ann is also indifferent for the second choice, it must be that $\tau > \sigma$, otherwise she would prefer waiting for the better outcome y. Now, look at the interval $(t,\ t + \tau - \sigma)$, which is called an *interval of vulnerability for time-inconsistencies* (Attema et al. 2010). It can then be concluded that for every $t' \in (t,\ t + \tau - \sigma)$, Ann satisfies $(s : x) \succ (t' : y)$ and $(s + \sigma : x) \prec (t' + \sigma : y)$. To put this in words, asking Ann to have outcome x at time $s + \sigma$ or outcome y at time $t' + \sigma$, Ann will wait for the better outcome y. However, if we ask the same question after time σ, Ann will behave inconsistent and prefers not to wait for the better outcome and prefers outcome x, assuming that she will behave time-invariant, i.e. that Ann's preference relation does not change over time (Halevy 2015).

For Bill, his willingness to wait for the better outcome is larger than for Ann. Define a * for Bill's outcomes. Assume he satisfies $(s : x^*) \sim^* (t : y^*)$, with $y^* \succeq^* x^*$, then for the second choice where Ann was also indifferent, it now follows that $(s + \sigma : x^*) \preceq^* (t + \tau : y^*)$, because he is more willing

to wait for the better outcome compared to Ann. He will be indifferent between the second choice only if $\tau^* \geq \tau$, therefore, the larger the degree of decreasing impatience, the larger τ. Looking at Bill's *interval of vulnerability*, it is larger than Ann's, equalling $(t,\ t + \tau^* - \sigma)$. Now, it is possible to find an inconsistency for Bill, but not for Ann. That is, considering for every $\theta \in (t + \tau - \sigma,\ t + \tau^* - \sigma)$, then $(s :\ x^*) \succ^* (\theta :\ y^*)$ and $(s + \sigma :\ x^*) \prec^* (\theta + \sigma :\ y^*)$ holds for Bill and $(s :\ x) \succ (\theta :\ y)$ and $(s + \sigma :\ x) \succ (\theta + \sigma :\ y)$ for Ann. Notice that Bill will be more inconsistent compared to Ann, so someone with a larger degree of decreasing impatience shows more inconsistent behavior. This could make Bill more likely than Ann to show signs of self-reported self-control problems like smoking or drug addiction.

2.3 Theory

The main focus of this research lies on the paper by Rohde (2016) and the introduction of the Decreasing Impatience (DI) index. This study introduced a more general way of measuring decreasing impatience. In most studies, it was most likely to make use of the hyperbolic discount functions. For example, the generalized hyperbolic discounting function by Loewenstein and Prelec (1992), which is given as:

$$\phi(t) = (1 + \alpha t)^{-\beta/\alpha} \text{ for } \alpha \geq 0 \text{ and } \beta > 0 \tag{1}$$

and the quasi hyperbolic discounting function, which was introduced by Phelps and Pollak (1968):

$$\phi(t) = \beta\delta^t \text{ for } \beta \leq 1 \text{ and } \delta > 0 \text{ for all } t > 0, \text{ and where } \phi(0) = 1. \tag{2}$$

As for example in a study by Burks et al. (2012), the effectiveness of four different ways of measuring time preferences at predicting real life was tested. It was concluded that overall, the quasi-hyperbolic $(\beta,\ \delta)$ formulation, as given in equation (2), predicts best. According to this model, it assumes decreasing impatience for every situation in which time 0 is involved, but constant impatience if only future periods are involved. The mathematical expression for this formulation is given as follows: if $(0 :\ x) \sim (t :\ y)$ then $(\tau :\ x) \prec (\mathrm{t} + \tau :\ y)$ and if $(s :\ x) \sim (t :\ y)$ then $(s +$

$\tau : x) \sim (t + \tau : y)$ for $s > 0$, respectively. As can be seen from this model, it can only be used for individuals satisfying decreasing impatience. In other words, it is not possible using this model for increasing impatience, defined as $(s : x) \sim (t : y)$, then $(s + \sigma : x) \succeq (t + \sigma : y)$, for all $s < t$, $\sigma > 0$ and $y \succ x \succ 0$. As discussed in Rohde (2016), the assumptions of hyperbolic discount functions can be problematic. Even for individuals satisfying decreasing impatience, it only holds for a certain degree; the model does not satisfy strongly decreasing impatience.

To see this, consider the following: assume that ϕ is continuous and strictly decreasing for both Equations (1) and (2) and assume decreasing impatience such that $(s : x) \sim (t : y)$ and $(s + \sigma : x) \sim (t + \sigma + \tau : y)$ for $y \succ x \succ 0$, $s < t$, and $\sigma > 0$. Then, hyperbolic discounting implies that (Bleichrodt et al. 2009):

$$0 < \tau < \frac{\sigma(t - s)}{s}. \tag{3}$$

Now it is possible to think of an example for which an individual reflects a strong degree of decreasing impatience, where hyperbolic discounting cannot describe this. For example, assume you are indifferent between receiving €40 in 2 weeks or €50 in 4 weeks and €40 in 4 weeks or €50 in 9 weeks. Then, $s = 2$, $t = 4$, $\sigma = 2$ and $\tau = 3$. However, looking at Equation (3), $\tau = 3 > \frac{2(4-2)}{2} = 2$. This shows that hyperbolic discounting cannot be used for people satisfying strongly decreasing impatience. Now, the problem is that research showed that both, the strongly decreasing as well as the increasing impatient people, are significant proportions (Olea and Strzalecki 2014; Attema et al. 2010; Rohde 2016).

Getting back to the DI-index, it was designed in such a way that it can measure the change of impatience for any degree of decreasing *and* increasing impatience. Moreover, it is independent of levels of impatience (Rohde 2016). The index is called *decreasing* impatience, because most literature empirically found that most individuals do deviate from constant impatience as decreasing impatience rather than increasing impatience.

The DI-index can be computed as follows. For x, y, $\nsim 0$, $s < t$, $\sigma > 0$ and τ with

$$(s : x) \sim (t : y) \quad and \tag{4}$$

$$(s + \sigma : x) \sim (t + \tau : y). \tag{5}$$

Then, the DI-index is defined by

$$DI = \frac{\tau - \sigma}{\sigma(t - s)}. \tag{6}$$

The DI-index formula takes the difference between τ and σ relative to σ, and corrects for the level of impatience by dividing by $(t - s)$. Note, that for constant discounting, τ equals σ and, therefore, the DI-index will be zero. Moreover, it follows that for decreasing impatience the DI-index is positive and negative for increasing impatience (Rohde 2016). As can be seen from (4) and (5), two indifferences are needed to use the DI-index. Two procedures to elicit these indifferences are explained in Section 4.

2.4 Previous results

Research on the correlation between self-reported self-control problem and impatience is already broadly studied, using hyperbolic discounting. In 1955, Strotz already argued that people who deviate from constant discounting might have a relation with certain self-reported self-control problems. Indeed, such relationships are found in for example a study conducted by Sutter et al. (2011), where time preferences with children and adolescents was investigated. It was found that experimental measures of impatience are significant predictors of health-related field behavior and saving decisions. Moreover, they found that impatient children and adolescents are more likely to spend money on alcohol and cigarettes, have a higher body mass index and are less likely to save money. Interestingly, no age effect was found between the children and adolescents.

Nevertheless, in a study by Khwaja et al. (2007) about smoking, contradictory results were found. They concluded that the measures impulsive behavior and the length of financial planning horizon indicated that smokers are impatient, but neither of these measures was significantly correlated with measures of time discounting. Their results indicated that time discount rates are not related to

smoking behavior. However, note that these studies were made using hyperbolic discounting models.

Another study, by Kirby et al. (1999), found that discount rates of heroin addicts where almost twice as high compared to non addicts. In other words, for addicts, future money has less value compared to non addicts. It was concluded that for an average heroin addict, 50$ loses half its value if it is delayed 40 days, whereas for the control group this would take 77 days. This finding is also supported by a study done by McClure et al. (2004). They found that heroin is involved in near-term rewards, considering the brain level. Heroin addicts do not only temporally discount heroin, but also money more steeply when they are in a drug-craving state, compared to when they are not. Quickly looking at the neuroscience, McClure et al. (2004) studied the brain using to examine the neural correlates of time discounting, while the participants had to make a number of choices between monetary rewards, which differed in the time of receiving. It was demonstrated that two separate brain systems are involved in such decisions. For choosing immediate rewards, subjects showed stronger engagement of different brain structures (for example limbic and paralimbic cortical structures) compared to subjects who selected the delayed reward. Drug addiction is often involved with the brain structures for immediate rewards. This could possibly indicate that a drug addiction leads to a higher degree of decreasing impatience compared to no drug addiction.

Bleichrodt et al. (2016), studied the differences for money and health with respect to discounting. It is often assumed that the same discounting for money applies to health. However, health is less transferable over time compared to money. Moreover, there is no market for health to observe, therefore they argue that it is unclear whether health and money are discounted similarly. Lots of research has already been done regarding this aspect, but the findings are somewhat contradictory. For example, Cropper et al. (1994) concluded that, on average, money and health are discounted at a similar rate, whereas Cairns (1992) concluded that estimated discount rates were significantly lower for future health as compared to future wealth states. Nevertheless, those studies could not answer whether the degree of decreasing impatience differs for health and money. From Bleichrodt et al. (2016), it was found that most subjects deviate from constant discounting and were decreasingly impatient for both money and health. Furthermore, deviations from constant discounting were more pronounced for health than for money, which indicates that people might be more vulnerable

to self-control problems for health than for money. This finding also suggests that intertemporal preferences are context-dependent and that findings for money cannot simply be transferred to health. Also here, the quasi-hyperbolic discounting model was rejected for both money and health.

Furthermore, some research has been done on correlation of impatience and the performance level of students. In a study by Kirby et al. (2005), a negative association was found between discount rates and academic performance, meaning that the higher the discount rate, the lower the performance and vise versa. This finding is also consistent with previous found literature from Kirby et al. (2002), where including years of education, numeracy, literacy and the participants' fathers' years of education, already led to a negative correlation with discount rates. Again, both studies used hyperbolic discounting functions to estimate the discount rates.

Looking at the emotional state of individuals, research showed that individuals who are in a happy mood tend to overestimate the likelihood of positive, and underestimate the likelihood of negative outcomes and events. The reverse holds for individuals in a sad mood (Johnson and Tversky 1983; Nygren et al. 1996; Schwarz 2000). Moreover, the way individuals adopt a strategy of information processing is influenced by the affective states. It turns out that individuals who are in a happy mood are more likely to adopt a heuristic processing strategy that is characterized by top-down (or active) processing, with high reliance on pre-existing knowledge structures and relatively little attention to the details at hand. In contrast, individuals who are in a sad mood are more likely to adopt a systematic processing strategy that is characterized by bottom-up (or passive) processing, with little reliance on pre-existing knowledge structures and considerable attention to the details at hand(Schwarz 2000). So far, not much research has been done considering mood and intertemporal decision making. However, if your affective state can make you overestimating or underestimating outcomes and influence your strategy of information processing, it could be worthwhile investigating.

Finally, an interesting finding is presented in a study done by O'Brien et al. (2011), concluding that adolescents demonstrated a greater preference for immediate rewards when with their peers, compared to being alone, accomplished by peer pressure. For the purpose of this research, participants are questioned individually. Outcomes can therefore not be transferred to situations involving

peer influences.

Getting back to the main objective of this research, the purpose is to investigate a possible correlation between the degree of decreasing impatience and self-reported self-control problems, where decreasing impatience is determined for monetary incentives and health states. For the experiment, parts of the questions by Rohde (2016) and Bleichrodt et al. (2016) are used. Furthermore, most of the possible correlated factors discussed above are included in the experiment as well.

3 Hypotheses

Reconsidering the research question of this study, "*Does the degree of decreasing impatience for monetary incentives and health states show any correlation with self-reported self-control problems?*", several hypothesis are introduced. This research can be divided into two different parts, where the first part consists of looking at the decreasing impatience levels for monetary incentives and the second one for health states. Considering the first part, the main interest lies in the difference between the two procedures, called *procedure T* and *procedure P*, explained in Section 4. As is also discussed in that section, the major advantage of *procedure T* is that it guarantees that there is an indifference pair. However, this indifference pair cannot be found independently. Moreover, it may be hard for subjects to give answers in both the outcome and time dimension. Therefore, it is expected that *given two homogeneous groups, the distributions of the DI-index for procedure T and P differ from each other.* This difference is assumed to be caused by *procedure T* being more complicated to answer with respect to the true preferences of the subject, leading to probable misunderstandings and, therefore, misleading answers.

According to Rohde (2016), self-reported self-control problems did not correlate with the DI-index. However, as was already found by Kirby et al. (2005), performance tends to have a negative correlation with discount rates, using hyperbolic discounting. This leads to the expectation that this correlation could also be found using the DI-index. Furthermore, as discussed in Section 2, current mood could have a possible influence on the way subject choose their indifferences. Because this is hardly studied with respect to decreasing impatience levels, some small questions regarding

mood are asked in the experiment. Also questions about health and motivation are added. For more details, see Section 5.3. Expanding the experiment of Rohde (2016) using previous results and new variables, it is assumed that *a correlation is expected between the DI-index and the self-reported self-control problems for procedure P, however not for procedure T.* No correlation is expected for T, because this procedure is to difficult to truly reveal the impatience behavior of the subjects, as stated above. Nevertheless, this procedure is tested to support the expectation.

Considering the second part, where health state is used instead of money, Bleichrodt et al. (2016) already found a difference between discounting for money and health. Therefore it is assumed that *the DI-index values for money and health do differ in general and that there exists a correlation between the DI-index for health and self-reported self-control problems.* It might even be that the correlation between health-states and self-control problems is higher than for money.

For both money and health, the same self-control questions are asked. Nevertheless, it might be that the level of decreasing impatience for health states is more related to health-related self-control problems and vice versa. Therefore, as final hypothesis, it is expected that *self-control problems associated to health are more related to the corresponding DI-index, compared to problems who are not associated to health.* A similar hypothesis for money is not included as most questions will not contain monetary aspects.

The hypothesis are tested by the use of two separate experiments, one for the first and one for the second part, using different subjects. But, first two elicitation procedures are explained in the next section, which are needed for the experiment, which is discussed in Section 5.

4 Elicit Procedures

For calculating the DI-index, two different procedures are considered, proposed by Rohde (2016). This is done in order to check for possible differences between the two methods. The first method proposed is from the theoretical perspective, and therefore referred to as *procedure* T (or just T in short), given as follows:

1. Fix two points in time $s < t$;
2. Fix one outcome y and verify that $y \nsim 0$;
3. Elicit x such that $(s : x) \sim (t : y)$;
4. Fix $\tau > 0$ such that $t + \tau \in T$;
5. Elicit σ such that $(s + \sigma : x) \sim (t + \tau : y)$.

Assuming monotonicity and impatience, the biggest advantage of this procedure is that it ensures that one can find an indifference pair. However, there are some practical disadvantages considering this procedure. Therefore, a second, more practical procedure is proposed, called *procedure P* (or just P in short):

1. Fix two outcomes x and y and verify that $y \succ x \succ 0$ or $0 \succ x \succ y$;
2. Fix time s;
3. Elicit time t such that $(s : x) \sim (t : y)$;
4. Fix $\sigma > 0$ such that $s + \sigma \in T$;
5. Elicit τ such that $(s + \sigma : x) \sim (t + \tau : y)$.

For P, the one disadvantage is that there might be no t or no τ which satisfies the mentioned properties. For those situations, it is not possible to compute the DI-index. Nevertheless, P has three big advantages, compared to T. To start, for P the two indifferences that have to be found can be elicited independently, whereas this is not possible for T. So, for T, eliciting the x from the first indifference does influence eliciting σ from the second indifference. Considering real incentives, participants could notice this and try to exploit this, leading to not stating their true indifferences. Secondly, for T, participants are first asked to choose some outcome x in the first indifference and then choose some additional delay time σ, whereas for P, the two indifferences involve only times, making it the same dimension. Having less dimensions minimizes confusion among participants answering such questions (Tversky et al. 1988), which makes P more practical compared to T. Finally, Rohde (2016) stresses the advantage of P by that this procedure elicits indifferences in

the time-dimension. This dimension is often assumed to be easier to describe and to understand, compared to the outcome domain. For this reason, P is also more practical for non-numerical outcome domains. Note that for both procedures, once one DI-index has been computed after observing the two indifferences in (4) and (5), computing an additional DI-index only requires one additional indifference, by using one previous indifference and the new computed one, leading to only $n + 1$ indifferences for computing n DI-index values. For P you can use the last step as a new indifference pair for step 3 for computing a new DI, meaning that you have a different step 3 every time, leaving you with n independent DI-index values. However, for T, you have to reuse the third step completely, choosing only a new τ to calculate a new σ in step 5. Therefore, once one DI-index is computed and you want only to use $n + 1$ indifferences for n different values of the DI-index, you have to use the elicited x every next time. So, if you would like to have n independent DI-index values for T as well, you need $2n$ indifferences.

5 Experiment

For this experiment, first both procedures T and P are used for monetary incentives, using a within-subjects design. This makes it possible to compare the two methods and check for any possible differences. Secondly, only P is used to elicit differences in impatience for health states and investigate if any correlation exists between this and the self-reported self-control problems, using a between-subjects design.

5.1 Part I: Monetary Incentives

First, consider the experiment where monetary incentives are used as a way to find the two indifferences in equations (4) and (5). As mentioned, for this experiment some parts from Rohde (2016) are used. For both procedures, the experiment consists of some *direct asking* questions. For P, this means subjects have to make a choice between receiving €40 at a specific point in time or receiving €60 at a later point in time. Here, three different questions are given to the subjects for computing

2 independent DI-index values, consisting of the following indifferences:

$$\text{€}40 \text{ in } 0 \text{ weeks} + 1 \text{ day} \sim \text{€}60 \text{ in } t_0 \text{ weeks} + 1 \text{ day}$$

$$\text{€}40 \text{ in } 2 \text{ weeks} + 1 \text{ day} \sim \text{€}60 \text{ in } t_2 \text{ weeks} + 1 \text{ day}$$

$$\text{€}40 \text{ in } 4 \text{ weeks} + 1 \text{ day} \sim \text{€}60 \text{ in } t_4 \text{ weeks} + 1 \text{ day},$$

where the subjects have to answer t_0, t_2 and t_4, respectively. For example, in the experiment, the first indifference is stated as follows:

*For which **number of weeks t** do you consider receiving €40 in 0 weeks + 1 day or receiving €60 in t weeks + 1 day to be equivalent to each other? For t is equal to ... weeks*

Note that the word *indifferent* is put differently, because otherwise people might not understand it correctly.

Secondly, for T, four different questions are given, which are needed to calculate two independent DI-index values, consisting of the following indifferences:

$$\text{€}x_0 \text{ in } 0 \text{ weeks} + 1 \text{ day} \sim \text{€}50 \text{ in } 2 \text{ weeks} + 1 \text{ day}$$

$$\text{€}x_0 \text{ in } t_0 \text{ weeks} + 1 \text{ day} \sim \text{€}50 \text{ in } 4 \text{ weeks} + 1 \text{ day}$$

$$\text{€}x_2 \text{ in } 2 \text{ weeks} + 1 \text{ day} \sim \text{€}50 \text{ in } 4 \text{ weeks} + 1 \text{ day}$$

$$\text{€}x_2 \text{ in } t_2 \text{ weeks} + 1 \text{ day} \sim \text{€}50 \text{ in } 6 \text{ weeks} + 1 \text{ day}.$$

Note, that both values x_0 and x_2 are used in the subsequent indifference, i.e. the second and fourth indifference depend on the elicited x of the first and third indifference, respectively. For the experiment, a similar way of asking is used as for P

It is preferred to slightly change the amount of money for both procedures, otherwise it might be that subjects copy their answers they answered for P in order to answer the questions for T. However, slightly, because otherwise the questions differ too much to compare. Furthermore, time gaps are kept the same for both procedures to keep the deviations as small as possible. However, note that for T, time goes up to 6 weeks whereas for P only up to 4. Moreover, a number of

questions is asked after the instructions to check if the subjects did fully understand what they are asked to do. The subjects can only proceed the survey if they correctly answer those questions. Moreover, two versions are made; one first asking questions for P and then for T and a second version the other way around, both using a within-subject design. This controls for the order effect. To make sure it is clear what unit the subjects have to answer (time or money), the unit is presented in **bold** and *italic*, as can be seen in the example question above. Moreover, if the unit changes in the next question, it is mentioned above the question. The questions are presented in Appendix C.

5.2 Part II: Health States

For the second part only P is considered, because for health states using T is not very convenient (see Section 4). For eliciting indifferences regarding health, the idea from Bleichrodt et al. (2016) is used. In the instructions of this experiment, subjects are told to imagine that they suffer from chronic back pain. They described chronic back pain as:

- You have moderate problems in walking about.
- You have moderate problems performing your usual activities, e.g. work, study, housework, family or leisure activities.
- You have moderate pain or discomfort.

Bleichrodt et al. (2016) then give the subjects a choice list between two different treatments (A and B), which can relieve the chronic back pain. However, B was more effective than A, in such a way that both treatments do remove the pain, but B also improves walking and the performance of usual activities. A description of the two treatments is given in Table 1. The effects of the treatments start immediately at the beginning of the treatment and last for exactly one week. After this week, the chronic back pain returns (Bleichrodt et al. 2016).

Using these two treatments, it is assumed that $(t : A) \prec (t : B)$, for any $t > 0$. In words, it is expected that a person always prefer B over A, given that the time for starting both treatments is the same, because B is strictly better than A.In the experiment, the following indifferences are used, keeping time the same as for the monetary part, making the comparison more reliable:

Table 1: The descriptions of the treatments (Bleichrodt et al. 2016)

Treatment A	Treatment B
During one week	*During one week*
• You have **moderate problems** in walking about	• You have **slight problems** in walking about
• You have **moderate problems** with performing your usual activities (e.g. work, study, housework, family or leisure activities).	• You have **no problem** with performing your usual activities (e.g. work, study, housework, family or leisure activities).
• You have **no pain** or **discomfort**	• You have **no pain** or **discomfort**.

$$\text{Treatment A in 0 weeks} + 1 \text{ day} \sim \text{Treatment B in } t_0 \text{ weeks} + 1 \text{ day}$$

$$\text{Treatment A in 2 weeks} + 1 \text{ day} \sim \text{Treatment B in } t_2 \text{ weeks} + 1 \text{ day}$$

$$\text{Treatment A in 4 weeks} + 1 \text{ day} \sim \text{Treatment B in } t_4 \text{ weeks} + 1 \text{ day}$$

Again, subjects have to answer t_0, t_2 and t_4. To make it easier for the subjects to recall the treatments, the same Table 1 is repeated during every question it might be needed. Also here, some questions are added after the instructions to check for complete understanding and units are presented in **bold** and *italic*. You can find the questions in Appendix D.

5.3 General Questions

After these indifference questions, the survey proceeds with questions about measuring the happiness of the subjects. As discussed by Schwarz (2000), it was found that individuals in a positive mood overestimate positive, and underestimate negative outcomes. Moreover, not much research is done considering this mood influence on intertemporal decision making. Therefore, the experiment also consists of a small part where happiness is measured. To do so, questions from Lyubomirsky and Lepper (1999) are used, consisting of 2 statements and 2 questions, using a scale of 1 to 7 and 1 to 5, respectively. The statements and questions are defined as follows:

1. *In general, I consider myself:*
2. *Compared to most of my peers, I consider myself:*
3. *Some people are generally very happy. They enjoy life regardless of what is going on, getting*

the most out of everything. To what extent does this characterization describe you?

4. *Some people are generally not very happy. Although they are not depressed, they never seem as happy as they might be. To what extend does this characterization describe you?*

Here, for the two statements, a 1 stands for *extremely happy* and *an extremely happy person*, respectively and a 7 for *extremely unhappy* and *an extremely unhappy person*, respectively. For the two questions, a 1 correspondents to *describes me extremely well* and a 5 to *does not describe me*. According to Lyubomirsky and Lepper (1999), just taking the average of the four questions gives you the Subjective Happiness Scale. Low averages correspond to very happy people and vice versa. Here, it is not sure what is expected, as not very much research is done considering happiness and degree of impatience. Nevertheless, it does not seem unlikely to expect a difference in degree of decreasing impatience for happy and less happy people.

Next, the average sporting hours per week is asked, which is expected to be negatively correlated, meaning that the more you sport, the lower the DI-index will be. The amount of smoking, glasses of alcohol and body-mass index (bmi, corresponding to weight in kilogram divided by length in meters squared) is more likely to be positively correlated with the DI-index, because this behavior might be associated with more time-inconsistencies, which is expected to be correlated with a larger DI-index. As was already discussed in Section 2, Kirby et al. (2005) found a negative association between discount rates and academic performance. Therefore, a question about the average grade of the last completed study is asked. The expectation is that again a negative association is found; a higher average grade is correlated with a lower DI-index.

The second last part of the survey consists of some questions from Rohde (2016) and some new ones about the self-awareness of the subjects. These questions are rated on a scale from 1 to 7, with 1 referring to *strongly agree* and 7 to *strongly disagree*. They are asked in such a way that they should reveal the discrepancy between the actual and optimal behavior as perceived by the subjects. This correspondents to reflecting the awareness of self-control problems (Rohde 2016). The questions are formulated as the following:

- I wish I would do sports more often than I do currently.

- I should do sports more often than I do currently.
- I study regularly.
- I wish I would study more regularly.
- I should study more regularly.
- I am always well-prepared in class.
- I wish I would be better prepared in class.
- I have a tendency to postpone tasks.
- I consider myself a healthy person.
- I am well motivated
- I buy things spontaneously.

Also the same labels for these questions are used as by Rohde (2016) and some additional ones, corresponding to *sportswish, sportsshould, study, studywish, studyshould, prep, prepwish, postpone, health, motivation and buy, respectively.* Of course, to find any correlation between self-reported self-control problems, subjects must be aware of those problems in the first place. Therefore, these questions give some small indication of the awareness.

Finally, six questions from Tangney et al. (2004) are used, concerning self-control. The questions have a scale from 1 to 5, where a 1 states *strongly agree* and a 5 *strongly disagree.* Taking the average gives an indication of the self-control of the subjects. Then, the maximum score on this scale correspondents to extremely self-controlled (5), and the lowest score on this scale to not at all self-controlled (1) (Tangney et al. 2004). The questions are formulated as follows:

- I get distracted easily.
- I say inappropriate things.
- I am bad at resisting temptation.

- Pleasure and fun keep me from getting work done.
- I do things that feel good in the moment but regret later on.
- I often act without thinking through all the alternatives.

Of course, it is expected that low scores are correlated with high DI-index values and vice versa. Furthermore, there is controlled for age, gender, field of studies and nationality.

Note that the part about the self-control question by Ameriks et al. (2007) is not included in this experiment, because Rohde (2016) found most subjects not to understand those question. Furthermore, it is explicitly stated in the introduction that there is no right or wrong answer and that the only interest lies in the indifferences of the subjects. To see the general questions asked, see Appendix E.

The experiment was carried out using an online survey. This way, the subjects cannot go back to previous questions. The survey was distributed among students using Facebook and student groups. Both the monetary and the health surveys were sent to different people. No payment was involved during this experiment.

6 Results

In total, 90 students responded to the surveys. However, only 66 subjects remain, because 14 subjects did not respond to all questions (most of the people who quit did it quiet early during the experiment); 2 subjects answered $t_0 < t_2$ or $t_2 < t_4$ for the monetary experiment and 4 for health, indirectly violating impatience. Moreover, for procedure T, 4 subjects chose t_0 equal to s, given as *0 weeks + 1 day*, violating monotonicity, which are therefore also deleted from the survey. To be more precise, the remaining 66 subjects are divided as 24 for the monetary experiment with first questions about procedure P and then T, 21 first asking questions about procedure T and then P and 21 for the health experiment. In Table 2, statistics of the total sample are given. In Table 5 in Appendix B, correlations are given between the behavioral variables and the variable $selfcontrol$, calculated from the six questions about self-control.

Table 2: Summary statistics of demographical and behavioral variables for all subjects

Variable	Mean
Gender	57%
Age	22.3
Sports	3.9 hours per week
Smoke	0.64 (0 = no, 1 = every now and then, 2 = every day)
alcohol	6.6 glasses of alcohol per week
Bmi	23.9
Grade	7.2
Happy	$2.7^{\diamond\diamond}$
Sportswish	4.3*
Sportsshould	4.4***
Study	4.6***
Studywish	3.9
Studyshould	4.0
Prep	4.3**
Prepwish	4.1
Postpone	4.3*
Health	4.5***
Motivation	4.9***
Buy	4.1
Self-control	$2.6^{\diamond}$

*** Mean deviates significantly ($p<0.01$) from 4.0 using a wilcoxon signed rank test.
** Mean deviates significantly ($p<0.05$) from 4.0 using a wilcoxon signed rank test.
* Mean deviates significantly ($p<0.10$) from 4.0 using a wilcoxon signed rank test.
$^{\diamond}$ Mean deviates significantly ($p<0.01$) from 3 using a wilcoxon signed rank test.
$^{\diamond\diamond}$ Mean deviates significantly ($p<0.01$) from 3.5 using a wilcoxon signed rank test.

6.1 Money

Before looking at the DI-index values, first consider the values answered for the indifferences, given in Section 5.1. For P, these are t_0 with an average of 5.4 weeks, a standard deviation of 5.0 and answers between 1 and 25 weeks; t_2 with an average and standard deviation of 8.3 and 5.9, respectively and answers between 3 and 30 weeks; and t_4 with an average and standard deviation of 11.7 and 6.7, respectively and answers between 5 and 35 weeks.

For T, x_0 lies between €5 and €50, with a mean of 34.9 and a standard deviation of 11.5. For t_0, it is between 1 and 30 weeks, a mean of 4.3 and a standard deviation of 5.2. x_2 between €15 and €50, mean of 33.8 and standard deviation of 8.9. Finally, for t_2 it is between 3 and 35 weeks, mean of 7.3 and standard deviation of 6.8. Histograms for each of these values are given in Appendix A.

For each subject participating, four DI-index values were computed; two for P, using t_0 and t_2, and t_2 and t_4, and two for T, using x_0 and t_0, and x_2 and t_2. In short, this will be written as PPDI_{02}, PTDI_0, TPDI_{02} and TTDI_0. Here, the first letter stands for either the experiment starting with asking questions about procedure P or T and the second letter refers to the DI-index of the corresponding procedure. So PTDI_{02} means the monetary experiment first asking P and then T with the DI-index corresponding to the procedure T part, using t_0 and t_2. A similar notation is used for t_2 and t_4 for P and x_2 and t_2 for T.

To test for the order effect for both procedures, four Wilcoxon signed rank tests were preformed, comparing PPDI_{02} with TPDI_{02}, PTDI_0 with TTDI_0, PPDI_{24} with TPDI_{24} and PTDI_2 with TTDI_2. According to these test, the null-hypothesis was not rejected four times (p-values: 0.833, 0.250, 0.194, 0.300, respectively). This means that it seems reasonable to assume that the differences between the pairs follow a symmetric distribution around zero. Therefore, from now one, both versions of the monetary experiment are joint with a total of 45 subjects.

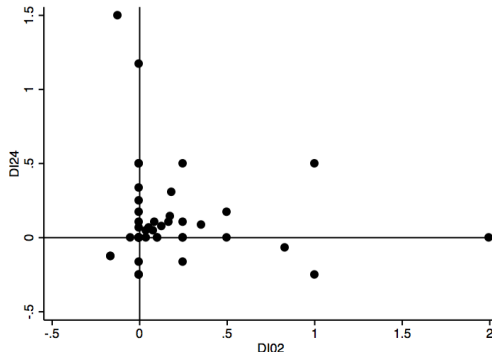

Figure 1: The distributions of DI_{02} and DI_{24} for P

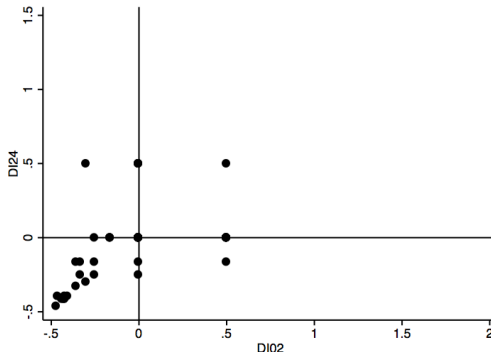

Figure 2: The distributions of DI_0 and DI_2 for T

As can be seen from Figures 1 and 2, it seems that the distributions for the DI-index values for both procedures do differ. The average DI-index for P is 0.12 for and DI_{02} and 0.18 for DI_{24}. For T, this is -0.06 and -0.05 for DI_0 and DI_2, respectively. Note, recall from Section 5.1, there is a small change in time for the indifferences as for P the steps are 0, 2 and 4 weeks and 0, 2, 4 and 6 weeks because the one extra indifference pair needed for T. However, does this small change causes the possible difference between the DI-index values or is it because of the procedures?

Table 3: Deviations from constant discounting for P and T

	P		T	
	DI_{02}	DI_{24}	DI_0	DI_2
Decreasing Impatience (DI>0)	22	23	6	9
Constant Impatience (DI=0)	15	18	21	16
Increasing Impatience (DI<0)	8	4	18	20

As is seen from Table 3, it is somewhat surprising that, using a within-subjects design, there is such a large difference between both procedures in decreasing and increasing impatience. Indeed, a Wilcoxon signed rank test shows that the null-hypothesis is rejected, i.e. the distributions of DI_{02} and DI_{24} for P and DI_0 and DI_2 for T do not follow a symmetric distribution around zero (p=0.0074 for DI_{02} compared to DI_0, and p=0.0018 for DI_{24} compared to DI_2). Furthermore, both DI-index values for P do significantly differ from constant impatience as decreasing impatience (p=0.014 and 0.000 for DI_{02} and DI_{24}, respectively according to a Wilcoxon signed rank test). For T the DI-index values do not significantly differ from 0 (p=0.079 and 0.351 for DI_0 and DI_2, respectively). Therefore, as the means for P are positive and significant, the DI-index values for P give significantly higher results compared to T. Assuming that all subjects did understand the introduction and the small difference in weeks does not play part, it must be that the procedures result in different values for the DI-index for the same subject. Put differently, using T seems to result in subjects ending up more often to be increasing or constant impatient rather then decreasing impatient, compared to P. Getting back to the first hypothesis, stated as: *given two homogeneous groups, the distributions of the DI-index for procedure T and P differ from each other*, there are indeed two homogeneous groups as it is a within-subjects design. Moreover, it is concluded that both distributions of the DI-index for P and T do not follow a symmetric distribution around zero. Therefore, the first hypothesis is not rejected. Furthermore, literature found that people who deviate from constant impatience in most cases deviate to decreasing impatience (Rohde 2016). Moreover, as mentioned in Section 4, subjects have to answer in two outcome domains for T. Tversky et al. (1988) concluded that having less dimensions minimizes confusion among participants answering questions, so this could be the case for T. Therefore, it seems most reasonable to assume that P gives the most plausible results.

For analyzing any possible correlation between the DI-index and the variables, Kendalls τ is used. In total, there are 25 male and 21 female for both DI_{02} and DI_{24}. Considering the DI-index

values for P, no correlation was found between those DI-index values and age and gender (p=0.093 and 0.173 for age and p=0.545 and 0.869 for gender, for DI_{02} and DI_{24}, respectively). Furthermore, checking the behavioral variables, only *sportswish* and *buy* are significant and negatively correlated with DI_{02} and DI_{24}, respectively, according to Kendalls τ (p=0.045 for *sportswish* and DI_{02} and p=0.023 for *buy* and DI_{24}). Nevertheless, these results are very in-robust; leaving one extreme result out makes both variables insignificant as well. Also *happiness* and *self-control* are highly insignificant. Moreover, for each of these variables an OLS, logit or ordered logit regression was preformed, depending on the type of variable. Again, no significant results were found except for *sportswish* and *buy*. However, these results remain very in-robust.

Analyzing the DI-index values for T, also no correlations were found between both DI-index values for age and gender (p=0.683 and 0.669 for age and p=0.763 and 0.385 for gender, respectively). For the behavioral variables, *grade* is significantly positively correlated with DI_0 (p=0.032), however not for DI_2. Furthermore, all other variables do not seem to be correlated at all with the DI-index, including *happiness* and *self-control*. Again, regressions show no significant relation except for *grade* (p=0.012), which is positive again. However, considering T to be a less accurate procedure, it seems that this correlation is more an outcome of luck rather than an interesting finding. Therefore, considering the second hypothesis that *a correlation is expected between the DI-index and the self-reported self-control problems for procedure P, however not for procedure T*, is partly rejected, leaving *grade* as a coincident result. So, for both procedures no clear correlations are found between self-reported self-control variables and the DI-index.

6.2 Health

Again, first consider the values for the indifferences, given as t_0, t_2 and t_4. For t_0, subjects gave answers between 1 and 10 weeks with a mean of 2.9 and a standard deviation of 2.0. For t_2 it is between 3 and 30 with a mean of 8.0 and a standard deviation of 4.8. Finally, for t_3 it is between 5 and 38 with a mean of 12.3 and a standard deviation of 8.3. The histograms can also be found in Appendix 5.

The second thing of interest is if the DI-index values for health and money do differ from each

other. This also correspondents to the first part of the third hypothesis: *the DI-index values for money and health do differ in general.* No large differences were found between the subjects in the monetary and the health experiment. In Figure 3, the distribution of DI_{02} and DI_{24} for health is shown, with averages of 0.75 and 0.60, respectively. Looking at the deviations from constant impatience, which can be seen in Table 4, deviations from constant impatience seem more towards decreasing impatience for health, compared to money using P (see Table 3). Although, decreasing impatience has the largest proportion for both. A Mann-Whitney U test is used to test the DI-index values for health and money, because these groups are unpaired using a between-subjects design. It turns out that the means for DI_{02} and DI_{24} do significantly differ (p=0.059 and 0.000, respectively). Furthermore, both DI-index values do differ from constant impatience as decreasing impatience (p=0.000 and 0.000 for DI_{02} and DI_{24}, respectively). So, assuming the subjects for health and money to be homogeneous, it seems that the average DI-index for health states is higher compared to monetary incentives using P, meaning a larger degree of decreasing impatience for health. This also suggests that the DI-index for money cannot be transferred to health.

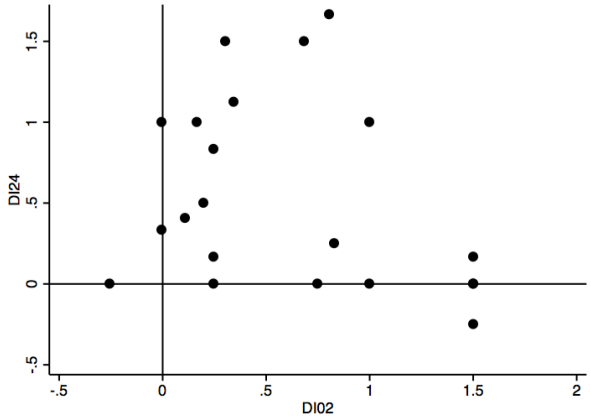

Figure 3: The distributions of DI_{02} and DI_{24} for *health*

Table 4: Deviations from constant discounting for health states

	DI_{02}	DI_{24}
Decreasing Impatience (DI>0)	14	18
Constant Impatience (DI=0)	6	2
Increasing Impatience (DI<0)	1	1

The second part of the third hypothesis is given as *there exists a correlation between the DI-index for health and self-reported self-control problems.* There are 12 males and 9 females. Also

here, no correlation was found between the DI-index values and age and gender, using the Kendalls τ (p=0.753 and 0.417 for age and p=0.160 and 0.642 for gender, for DI_{02} and DI_{24}, respectively). Moreover, there is no significant correlation found at all for all other variables and the same conclusion is made for the regressions. Therefore, this hypothesis is rejected.

Finally, the last hypothesis can be answered very quick now. The hypothesis was given as *self-control problems associated to health are more related to the corresponding DI-index, compared to problems who are not associated to health.* The self-control problems associated to health are the questions about hours of sport per week, smoking, weight (bmi) and whether or not you consider yourself a healthy person. Because no significant correlation was found at all (besides *grade*), health related self-control problems do not associate more with the DI-index for health.

7 Discussion

This paper explored in more depth the use of the DI-index, introduced by Rohde (2016). In that paper, no correlation was found between the DI-index and self-reported self-control problems, using procedure P. In a new experiment, both procedures P and T were used to test for possible differences. It was found that, as expected, the DI-index values for both procedures do differ in distribution. Moreover, in previous literature, deviations from constant impatience is most commonly found to be decreasing impatience, making procedure P most likely to be the better procedure, as T mostly predicted individuals to be increasing impatient. Nevertheless, for both procedures, using monetary incentives, no correlation was found between the DI-index and any self-reported self-control problems, which is in line with the conclusion of Rohde (2016).

Furthermore, health states were used instead of money to calculate the DI-index, because Bleichrodt et al. (2016) argued that in this area, findings for money cannot simply be transferred to health. Indeed, it seems that the DI-index for health follows another distribution than for money and that the average DI-index values for health states are higher than for monetary incentives, using P. However, again no correlation was found between the DI-index for health and any self-control problems.

Getting back at the central question during this paper, defined as follows: *Does the degree of decreasing impatience for monetary incentives and health states show any correlation with self-reported self-control problems?* it looks like the answer is no for both, concluding that self-control problems cannot solely be predicted from changes in impatience. Of course, some limitations were discovered during this paper and one of the most standard ones is the lack of subjects. Although, as this is one of the limitations, the most important one might be that, despite the fact that instructions of Rohde (2016) and Bleichrodt et al. (2016) were used, it turned out that most people (students) did find it hard to truly answer the elicitation questions. Therefore a large number of subjects quitted the experiment before finishing. One possible explanation is that they did not took or had enough time to make the experiment (no incentives were given). However, another one could be that the questions are too difficult to answer truthfully. So, it might be of interest, for example, to ask one indifference question at the beginning of the survey and exactly the same one at the end, measuring the consistency of the subjects. Furthermore, no further questions related to money other than the indifference questions were asked, because the survey already took some time to fill out. It might be that money related questions do have some correlation with the DI-index for money. Moreover, perhaps monetary knowledge plays a significant role in the degree of decreasing impatience. Therefore, measuring this knowledge and searching for possible associations is also advised for further research.

Considering the influence of happiness on the degree of decreasing impatience, it might be that the questions from Lyubomirsky and Lepper (1999) did not actually measured the current state of happiness, but more an overall indication. However, perhaps it is the current mood at the moment that could influence the degree of decreasing impatience more than an overall indication of happiness. Therefore, setting up an experiment where one is able to really measure the current affective state is another aspect for further research.

On the health-side, drugs also could be an interesting aspect. In McClure et al. (2004) drugs and rewards were already investigated with the possible indication that drug addiction leads to a higher degree of decreasing impatience. Therefore, this aspect also seems worth looking into. However, the difficulty here will be that subjects have to reveal their addiction and have to to talk truthfully

about it.

Of course, for a more wide conclusion considering this subject, a more diverse sample must be used; not only students. Also interviewing people could be helpful in a way you can be sure the subjects understand what it is you are asking and, moreover, are willing to take the time to think about it. However, of course, this process is much more time-consuming. Also, instead of a within-subjects design for comparing both P and T, a between-subjects design could be performed, checking for robustness.

So, during this research it is found that procedure P seems more trustworthy compared to T. Moreover, using health states instead of monetary values seems to result in larger degrees of decreasing impatience. However, for both experiments, no correlation was found between the change in impatience and self-reported self-control problems. So, it seems that policy makers are not able to use the individual degree of impatience to reduce high social costs caused by for example obesity and smoking. In contrast, people with a high degree of decreasing impatience should not be treated any different than people with a lower degree with respect to self-control problems.

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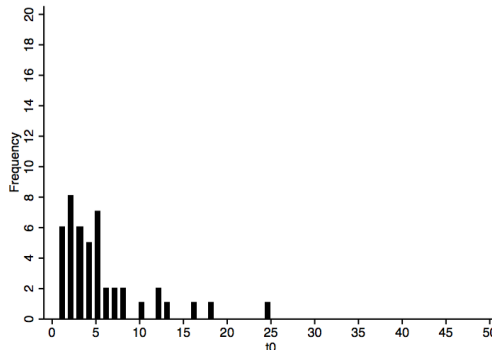
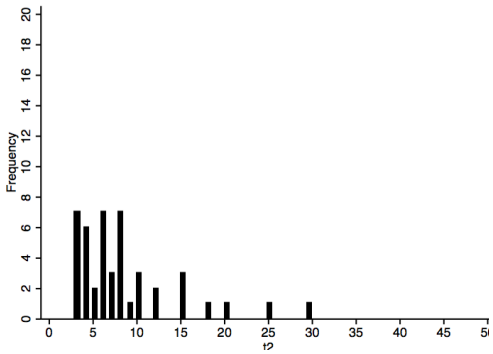
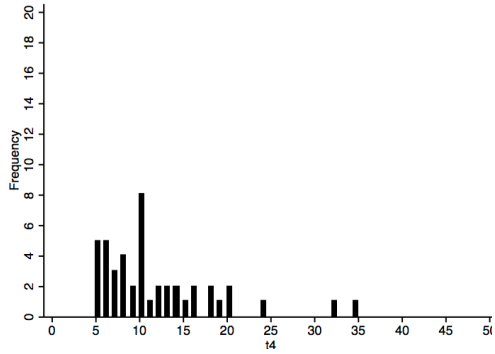
A Indifference values



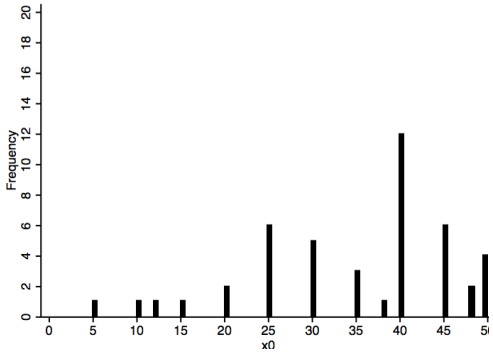
The distributions of t_0 for P



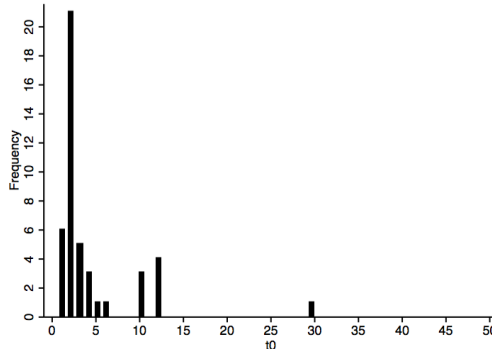
The distributions of t_2 for P



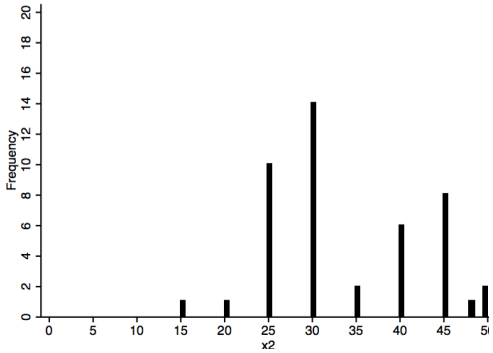
The distributions of t_4 for P



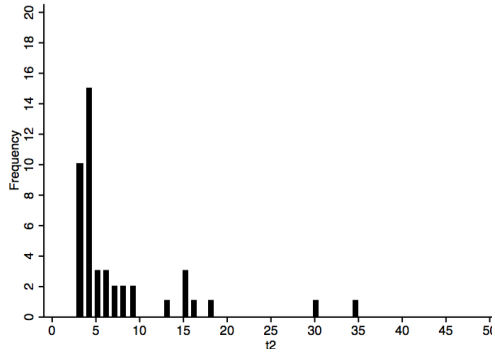
The distributions of x_0 for T



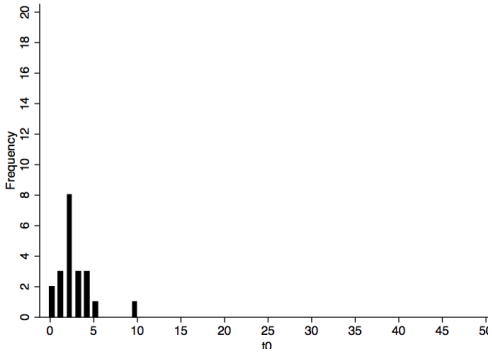
The distributions of t_0 for T



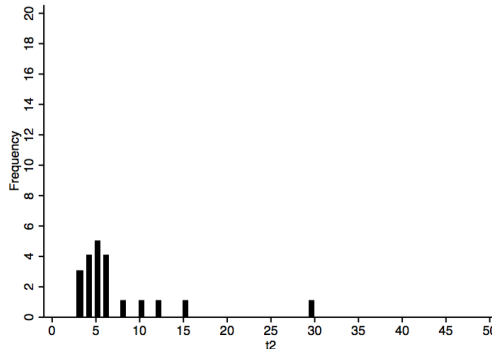
The distributions of x_2 for T



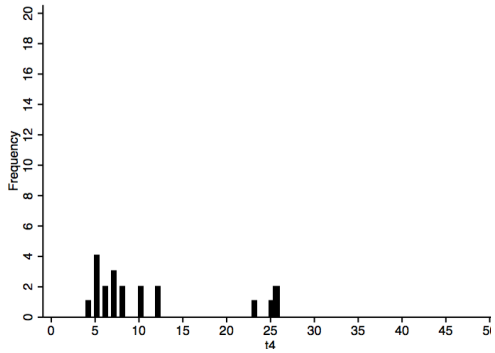
The distributions of t_2 for T



The distributions of t_0 for health



The distributions of t_2 for health



The distributions of t_4 for health

B Correlations

Table 5: Kendalls τ correlation between behavioral viariables with all 66 observations; (p-value)

	sportswish	sportsshould	study	studywish	studyshould	prep	prepwish	postpone	health	motivation	buy	selfcontrol
sportswish		0.452***	0.270**	0.024*	0.184*	0.146	0.152	0.140	-0.001	-0.049	0.037	0.103
		(0.000)	(0,014)	(0.820)	(0.082)	(0.172)	(0.142)	(0.183)	(0.934)	(0.695)	(0.730)	(0.299)
sportsshould			0.305	0.301***	0.095	0.183*	0.010	0.104	-0.029	-0.079	-0.180*	0.081
			(0.640)	(0.005)	(0.382)	(0.094)	(0.928)	(0.336)	(0.795)	(0.488)	(0.092)	(0.428)
study				0.051	-0.018	-0.126	-0.138	0.042	0.165	-0.060	0.059	-0.085
				(0.640)	(0.879)	(0.259)	(0.230)	(0.708)	(0.145)	(0.606)	(0.592)	(0.414)
studywish					0.125	0.111	0.021	-0.077	-0.091	-0.177	-0.127	-0.008
					(0.231)	(0.292)	(0.844)	(0.461)	(0.400)	(0.104)	(0.217)	(0.936)
studyshould						0.002	0.003	-0,156	-0.115	0.130	-0.022	-0.102
						(0.989)	(0.984)	(0.140)	(0.290)	(0.241)	(0.841)	(0.307)
prep							0.306 ***	0.003	-0.080	0.072	-0.100	0.138
							(0.004)	(0.979)	(0.496)	(0.520)	(0.345)	(0.170)
prepwish								0.050	-0.074	0.133	0.082	0.109
								(0.636)	(0.488)	(0.227)	(0.434)	(0.270)
postpone									0.045	-0.059	-0.055	0.211**
									(0.679)	(0.594)	(0.602)	(0.033)
health										0.120	0.111	-0.016
										(0.289)	(0.300)	(0.877)
motivation											-0.118	0.102
											(0.281)	(0.324)
buy												-0.190*
												(0.053)
selfcontrol												

C Money

Money Experiment[1]

Dear participant,

Welcome to this experiment.

Thank you for participating in this experiment.

Please read the instructions carefully.

Instructions:

In this experiment you will be asked for your preferences between amounts of money to be received at specified points in time.

Consider the following example:

Which option would you prefer?

Option 1: Receiving €25 in 0 weeks + 1 day or Option 2: Receiving €30 in 0 weeks + 1 day

Then you would probably choose option 2, as receiving €30 tomorrow is assumed to be better than receiving €25 tomorrow. However, if option 2 would change in receiving €30 in 2 years + 1 day, it becomes more likely that you would switch to option 1. That is, receiving less money tomorrow rather than waiting 2 years + 1 day for the higher amount.

In the questions below you are asked to choose the number of weeks for which you consider the two options to be equivalent. Please, only give whole weeks. Later on, we will also ask you to choose an amount of money instead of weeks for which you consider the two options to be equivalent.
Note, there are no "right" or "wrong" answers, we are only interested in your personal opinion. You can change your choices as often as you like. Once you are satisfied with your choice, click the "confirm" button. Then you can no longer change your choice. All answers will be kept anonymous.

[1] A similar survey was made where first procedure T was asked instead of procedure P.

To check whether you understand the procedure, please answer the following three questions, given:

Option 1: Receiving €25 in 0 weeks + 1 day

Option 2: Receiving €30 in 0 weeks + 1 day

Which option is better if both paid today?

- Option 1
- Option 2

The two options are paid:

- Once per week
- Once
- Not sure

"Receiving €500 in 10 weeks" means:

- Get weekly payment of €500 for 10 weeks
- Get €500 after 10 weeks

For which **number of weeks t** do you consider receiving €40 in 0 weeks + 1 day or receiving €60 in t weeks + 1 day to be equivalent to each other? For t is equal to ... weeks

For which **number of weeks t** do you consider receiving €40 in 2 weeks + 1 day or receiving €60 in t weeks + 1 day to be equivalent to each other? For t is equal to ... weeks

For which **number of weeks t** do you consider receiving €40 in 4 weeks + 1 day or receiving €60 in t weeks + 1 day to be equivalent to each other? For t is equal to ... weeks

Note, here we ask you to choose an **amount of money** instead of number of weeks!
For what **amount of money x** do you consider receiving €x in 0 weeks + 1 day or receiving €50 in 2 weeks + 1 day to be equivalent to each other? For x is equal to €...

For which **number of weeks t** do you consider receiving €*amount of money of previous question* in t weeks + 1 day or receiving €50 in 4 weeks + 1 day to be equivalent to each other? For t is equal to ... weeks

Note, here we ask you to choose an **amount of money** instead of number of weeks!
For what **amount of money x** do you consider receiving €x in 2 weeks + 1 day or receiving €50 in 2 weeks + 1 day to be equivalent to each other? For x is equal to €...

For which **number of weeks t** do you consider receiving €*amount of money of previous question* in t weeks + 1 day or receiving €50 in 6 weeks + 1 day to be equivalent to each other? For t is equal to ... weeks

D Health

Health Experiment

Dear participant,

Welcome to this experiment.

Thank you for participating in this experiment.

Please read the instructions carefully.

Instructions:

Back pain is a common health problem across all age groups. In this experiment we ask you to imagine that you have chronic back pain. This means that:

- You have moderate problems in walking about.
- You have moderate problems performing your usual activities. (e.g. work, study, housework, family or leisure activities)
- You have moderate pain or discomfort.

There is no treatment available that can completely cure you, but there are two treatments that give you a temporary relief of your symptoms. Treatment A completely takes away the pain during one week. It does not improve your walking and usual activity problems. Treatment B also completely takes away the pain during one week. In addition, it allows you to walk with only slight problems and to perform your usual activities with no problems.

Treatment A	Treatment B
During one week	*During one week*
• You have **moderate problems** in walking about	• You have **slight problems** in walking about
• You have **moderate problems** with performing your usual activities	• You have **no problem** with performing your usual activities
• (e.g. work, study, housework, family or leisure activities).	• (e.g. work, study, housework, family or leisure activities).
• You have **no pain** or **discomfort**	• You have **no pain** or **discomfort**.

The descriptions of the effects of the two treatments are repeated on the screen for every question you may need it. The effects of the treatments start immediately at the beginning of the treatment and last for exactly one week. After this you return to your usual health state with chronic back pain.

You will be asked to make several choices between Treatment A and Treatment B. The questions differ in the starting time of the treatments. Usually Treatment B starts at a later date than Treatment A. Usually Treatment B starts at a later date than Treatment A.

Consider the following example:
Would you prefer:

Treatment A in 0 weeks + 1 day or Treatment B in 0 weeks + 1 day.

Then you would probably choose the Treatment B, because B is a better treatment than A. However, if you would receive Treatment B in 2 years + 1 day, it become more likely that you would switch to Treatment A. That is, receiving the worse treatment tomorrow rather than waiting 2 years + 1 day for the better treatment.

In the questions below, you are asked to choose the number of weeks for which you consider the two treatments to be equivalent. Please, only give whole weeks.

Note, there are no "right" or "wrong" answers, we are only interested in your personal opinion. You can change your choices as often as you like. Once you are satisfied with your choice, click the "confirm" button. Then you can no longer change your choice. All answers will be kept anonymous.

To check whether you understand the procedure, please answer the following questions, given:

Treatment A	Treatment B
During one week	*During one week*
• You have **moderate problems** in walking about	• You have **slight problems** in walking about
• You have **moderate problems** with performing your usual activities	• You have **no problem** with performing your usual activities
• (e.g. work, study, housework, family or leisure activities).	• (e.g. work, study, housework, family or leisure activities).
• You have **no pain** or **discomfort**	• You have **no pain** or **discomfort**.

Which treatment is better if they both start today?

- Treatment A
- Treatment B

Treatments A and B make the relief of the symptoms last:

- Forever
- For exactly one week
- Not sure

"Treatment B in 10 weeks" means:

- The relief of symptoms in Treatment B lasts for 10 weeks
- Treatment B starts after 10 weeks, and relief of symptoms lasts for 1 week

One week after starting Treatment A or Treatment B, you:

- Go back to your usual health state with chronic back pain problems
- Are relieved of symptoms
- Not sure

Treatment A	Treatment B
During one week	*During one week*
• You have **moderate problems** in walking about	• You have **slight problems** in walking about
• You have **moderate problems** with performing your usual activities	• You have **no problem** with performing your usual activities
• (e.g. work, study, housework, family or leisure activities).	• (e.g. work, study, housework, family or leisure activities).
• You have **no pain** or **discomfort**	• You have **no pain** or **discomfort**.

For which **number of weeks t** do you consider Treatment A in 0 weeks + 1 day or Treatment B in t weeks + 1 day to be equivalent to each other? For t is equal to ... weeks.

For which **number of weeks t** do you consider Treatment A in 2 weeks + 1 day or Treatment B in t weeks + 1 day to be equivalent to each other? For t is equal to ... weeks.

For which **number of weeks t** do you consider Treatment A in 4 weeks + 1 day or Treatment B in t weeks + 1 day to be equivalent to each other? For t is equal to ... weeks.

E General

Furthermore, we would like to ask you a number of questions about yourself:[2]

In general, I consider myself:

- Extremely happy
- A moderately happy person
- Slightly unhappy
- Neither happy nor unhappy
- Slightly unhappy
- A moderately unhappy person
- Extremely unhappy

Compared to most of my peers, I consider myself:

- An extremely happy person
- A moderately happy person
- A slightly happy person
- A neither happy nor unhappy person
- A slightly unhappy person
- A moderately unhappy person
- An extremely unhappy person

Some people are generally very happy. They enjoy life regardless of what is going on, getting the most out of everything. To what extent does this characterization describe you?

- Describes me extremely well
- Describes me very well
- Describes me moderately well
- Describes me slightly well
- Does not describe me

Some people are generally not very happy. Although they are not depressed, they never seem as happy as they might be. To what extend does this characterization describe you?

- Describes me extremely well
- Describes me very well
- Describes me moderately well

[2]These questions are asked for both the money and the health experiment.

- Describes me slightly well
- Does not describe me

How many hours per week, on average, do you do sports?

Do you smoke any cigarettes?

- Yes, every now and then
- Yes, I smoke every day
- No

How many glasses of alcohol do you drink per week on average?

What is your length? (in cm)

What is your weight?

What is your age?

What is your gender?

- male
- female

What is your field of studies?

What is your nationality?

What is your average grade during your (last) study?

Please read the following statements carefully and indicate to what extent they apply to you.

I wish I would do sports more often than I do currently.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

I should do sports more often than I do currently.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

I study regularly.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

I wish I would study more regularly.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

I should study more regularly.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

I am always well-prepared in class.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

I wish I would be better prepared in class.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

I have a tendency to postpone tasks.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

I consider myself a healthy person.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree

- Strongly disagree

I am well motivated.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

I buy things spontaneously.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

I get distracted easily.

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I say inappropriate things.

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I am good at resisting tempation.

- Strongly agree

- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

Pleasure and fun keep me from getting work done.

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I do things that feel good in the moment but regret later on.

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

I often act without thinking through all the alternatives.

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree