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A randomized experiment to test the effect of a soft commitment device on time-inconsistency and expectation in screen time

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Abstract

Various research show excessive screen time has negative effects on one's health. I investigated whether a soft commitment device to reduce screen time and time-inconsistency, could also affect one's expectation with regards to their predicted screen time in a week. Participants who were given the soft commitment device turned out to have a decreased expectation, one closer to their ideal screen time and are considered more confident in reaching their goal. However, this soft commitment device made them less likely to reach their ideal screen time and even appeared to be more time-inconsistent. Results of this research, unfortunately, all show to be statistically insignificant and there needs to be more research to effective soft commitment devices in the battle against screen time. Furthermore, a clearer answer needs to be found to the question whether a soft commitment device indeed changes one's expectations.

Introduction

Problems of screen time

Social media addiction has become a worldwide problem in harming students' well-being and performance (Pekpazar et al., 2021). Montagni et al. (2016) found an association between migraine in young adults with high levels of screen time. Allcott et al. (2021) formalised an economic model of digital addiction that later is used to see whether self-control problems and habit formation affect smartphone use. The model of digital addiction, when calibrated with data from a randomized experiment, suggests self-control problems are responsible for 31 per cent of social media use (Allcott et al., 2021). Furthermore, Allcott et al. (2021) noticed plenty of their participants – who have an inside of their self-control problems – are aware of screen time limiting functions (and are willing to pay for it). However, they wonder why there is yet to be a demand for commercial digital devices to limit self-control issues since only 5 per cent of their sample used any application in restricting smartphone use at baseline. The lack of demand could be due to too high expenses or the ineffectiveness since penalties are too easily avoided (Allcott et al., 2021).

Pekpazar et al. (2021) investigated the relationships between Instagram addiction, procrastination, and academic performances among students in Turkey. They found a significant effect of Instagram addiction on procrastination. Furthermore, they found that Instagram addiction acts as a mediator in the effect of procrastination on academic performances (Pekpazar et al., 2021). People who have a tendency to procrastinate find time management and task prioritisation difficult (Pekpazar et al., 2021). Meier (2021) looked at the effect of smartphone and social media use on procrastination and well-being using a "technology habits approach" instead of using a screen time approach. In his research, the smartphone checking habit was used. Results show a strong connection between a high checking habit and procrastination. Furthermore, people with a high mobile checking habit experience more interruptions from their notifications and a stronger urge to check their messages (Meier, 2021).

LeBlanc et al. (2017) give an overview of the risks and benefits of screen time in the context of seated behaviour. Screen time can have a negative effect on children's and youths' healthy growth and development (LeBlanc et al., 2017). On the other side, LeBlanc et al. (2017) emphasize the importance of acknowledging screen time as a new "fixture in daily life" and has led to "opportunities never thought possible". Research has shown that one should not just compensate for their sedentary screen time behaviour by having more physical activity but that limiting one's screen time (especially in the context of seated behaviour) is necessary for a healthy lifestyle (LeBlanc et al., 2017). There have been some commitment devices to reduce screen time (e.g., screen time limitation applications),

like Alcott (2021) (discussed above) and Hoong (2021) (discussed below). It is of great importance to investigate whether these devices show to be effective in the battle against excessive screen time.

Time-(in)consistency

In making the following section clearer to explain time-(in)consistency, there is a need to describe the terms actual, ideal, and predicted. These terms can be used in various areas of interest (gym time, weight, study time, etc.). Let us take the example of gym time to clarify them. One spends a particular time in the gym – this is one's *actual* time spent in the gym. There is also one's ex-ante preference, what time one would like to spend in the gym – their *ideal*. Time-inconsistent preferences are when a person fails to follow on her ex-ante preferences (Strotz, 1995; Halevy, 2015; Ericson & Laibson, 2019). In questionnaires, the time frame must be specified, which could be in a day, a week, a month, or a year. Time-inconsistent preferences are measured as the difference between the ideal and actual. If these are equal, one is time-consistent. If not, one is time-inconsistent. Some studies that have used this approach are Cobb-Clark et al. (2021) in the context of weight, Wong (2008) in the context of study hours for an exam, and Hoong (2021) with regards to screen time. These three are discussed of below.

There is a distinction in time-inconsistency: one can be naïve or sophisticated – differing in their awareness of future time-inconsistency in preferences. To investigate whether one is naïve or sophisticated, their *expected* (ex-ante) preference of time spent in the gym – in one week – could be asked. Meaning, what does one think, predict or expect, their time spent in the gym to be in one week. One's prediction and expectation are presumed to be the same in this research. Research by Cobb-Clark et al. (2021) measured people's time-(in)consistency through self-control limitations in Germany. Participants were asked about their current weight, their ideal weight, the expectation of their weight in a year – and a year later, their actual weight. They were inspired by Wong (2008) who did the same for students in Singapore identifying time-(in)consistency studying for an exam: what would their ideal study time be, expectation, and actual (a month later). If one is time-consistent, their ideal and actual choice will be the same in the future (Cobb-Clark et al., 2021). If one is time-inconsistent, their ideal and actual will be different, in which one can be naïve or sophisticated. A naïve person believes he is time-consistent and is not aware of their self-control limitations: their ideal and prediction will be the same, however, their actual will not be (O'Donoghue & Rabin, 1999). A sophisticated person is aware of their lack of self-control and will, therefore, have a different ideal and expectation of oneself (O'Donoghue & Rabin, 1999).

Wong (2008) found that time-consistent people perform better in exams than time-inconsistent people. According to Cobb-Clark et al. (2021), sophistication fully compensates for

disadvantages created because of one's low self-control regarding choices about immediate costs and future benefits. For example, the immediate costs of going to the gym is the membership one pays for or having less time spend on more fun activities. The future benefits are, for example, controlled weight, improved mental health, reduced risks of certain deceases. If one has low self-control, one prefers the immediate benefits of having time spent on something different than going to the gym and the future benefits it brings. However, when one is sophisticated and therefore aware of their limited self-control, they know they need to use commitment devices to force their future-self to go to the gym (e.g., signing up for a gym class), and therefore hope to overcome their time-inconsistency. Self-control problems are associated with procrastination (Cobb-Clark et al.,2021). O'Donoghue and Rabin (1999) also conclude sophistication can help – but only if the knowledge of one's future limited self-control increases the consequences one currently experiences of current "misbehaving" (having limited self-control). For example, if one wants to get up early the next morning and is aware (sophisticated) he will have trouble getting out of bed, one will already feel bad before he goes to bed. This mindset would then a serve as some sort of psychological soft commitment device, helping them overcome their time-inconsistency. One could be thinking about what would happen if he does not get up early the next morning, e.g. "I have much to do", "I cannot miss this important meeting". According to O'Donoghue & Rabin (1999) sophistication decreases the chance of repeated procrastination. Meaning, when sophisticated, one realises that if they do not go to the gym now, they probably procrastinate again tomorrow (and the day after, and the day after that), and eventually never end up going to the gym. This therefore increases the cost of not going to the gym more. When naïve, one probably thinks they can skip going to the gym today but believe they will indeed go tomorrow instead. However, it increases the chance of "preproperating", meaning one does an immediate pleasant activity, "gratification", too quickly (O'Donoghue & Rabin, 1999). Screen time could be seen as such an immediate (beneficial) activity.

Sophisticated people are more likely to (want to) use commitment devices to act against their limited self-control (Cobb-Clark et al., 2021). There are two distinctions when considering a commitment device: hard or soft. A hard commitment device limits one's choices by providing tangible punishment for misbehaviour and/or rewards for achievements, a soft commitment device only provides psychological penance (Bryan, Karlan & Nelson, 2010). These two are not completely distinct and could have aspects of one another.

Research by Hoong (2021) in the US, used a similar approach as Wong (2008) and Cobb-Clark et al. (2021) but used screen time instead of study hours or weight. She found that people use their phones more than they expected and what their ideal time would be. People still tend to know very little about their behaviour online, even though they state the opposite (Hoong, 2021). Furthermore,

Hoong (2021) encouraged its participants to use a soft commitment device: an application to limit phone usage (or certain applications, e.g., Instagram, Facebook). In this, she found such a device significantly helps people reduce their screen time if they suffer from overconsumption. However, self-control issues still exist – even when encouraged to do different (Hoong, 2021).

The soft commitment device and expectations in this research

This paper will use a different soft commitment device than Hoong (2021), to find more ways to limit self-control issues regarding smartphone use, and therefore smartphone screen time, which will from now on be referred to as just "screen time". This is important, since awareness (sophistication) on its own does not seem to be enough. Sophisticated people know they have limited self-control, yet still cannot bring themselves to their ideal use. So, sophisticated people need to be offered a commitment device. In this research, participants will be asked to write down on a piece of paper what they would want to do (school, work, exercising, etc.) instead of spending time looking at their screen. The effectiveness of this commitment device is based on O'Donoghue and Rabin (1999) take on when sophistication is helpful: people will (presently) be reminded, and therefore experience the consequences of what they would rather have done – creating psychological penance: encouraging them to behave. One could think, for example, "If I were to spend less time on my phone, I would have already finished this important assignment and, therefore, not experience as much stress.".

Furthermore, this research will be carried out in a different country, namely the Netherlands. The world is digitally changing – this also applies to the Netherlands. The following information regarding the Netherlands has been collected from an annual report of the Central Bureau of Statistics (CBS) (2019) concerning the National Youth Monitor. A great majority of people aged between 12 and 25 uses internet every day – this has not changed since 2012. However, what device is used to access internet has changed. Online communication is the most common activity of young people in the Netherlands. Wherein 2012 84 per cent used a PC, in 2018 this was only 63 per cent. Meanwhile, wherein 2012 86 per cent of youth used the internet on a smartphone, this was 99 per cent in 2018. Moreover, in 2012 67 per cent used social networks to communicate (e.g., WhatsApp) which has risen to 94 per cent in 2018. Screen time has increased by over 30 per cent in two years (RTL Nieuws, January 12, 2022). This makes it important to investigate screen time among young people in the Netherlands.

Moreover, this research will examine the effect a commitment device on one's expectations. To the best of my knowledge, this has not been research in any context yet. It has been known that a commitment device can help people in being less time-inconsistent. However, does it change one's expectation? On one hand, if one expects the commitment device to work for them, one could move

their expectation to their ideal – showing more confidence in reaching their goal. On the other hand, if one expects the commitment device to not work for them, one could move their expectation further from their ideal – showing less confidence in reaching their goal. For example, one could have been made more aware of their own flaws and therefore feel their target is more difficult to achieve. It is important to examine such a possible effect since it can influence the results of people's time-inconsistency, and therefore also the effectiveness of the commitment device regarding time-inconsistency. If such a device changes one's expectation it should be taken into consideration when looking at time-inconsistency.

All considered, leads to the following research question: *"What is the effect of a soft commitment device on time-inconsistency and expectations concerning screen time of Dutch young people?"***.**

To collect data, two questionnaires are conducted using Qualtrics. In the first questionnaire, participants are asked about their ideal and expected screen time for the upcoming week. Exactly one week later, in the second questionnaire, participants are asked about their actual screen time. To find an answer to the research question, two hypotheses are formed.

Hypothesis (1): testing time-(in)consistency.

H1: People who receive a soft commitment device are less time-inconsistent.

First, there is a need to check whether the soft commitment device has worked in lowering people's time-inconsistency. One is time-consistent when the answers for their ideal and actual screen time are equal. As discussed, there are different forms of time-inconsistency: sophisticated and naïve. Naïve people believe themselves to be time-consistent yet are not. This implies their answers to the question about their ideal and expected screen time will be equal, however, their actual screen time in one week will be different. One is sophisticated when their expected value differs from their ideal: one is aware of their own time-inconsistency. There is, however, another variation that should be considered: reversed time-inconsistency (Sayman & Öncüller, 2009). Sayman and Oncüller (2009) mention this concept is mostly observed in situations where the timing is up to one week – just as in this research. It means one initially prefers the small outcome that is relatively soon over a larger outcome that is further in the future. Yet, when the small benefit is presented right away, one switches to the larger outcome that is further away in the future. In the context of screen time and the soft commitment device, one has an actual lower than his ideal. In testing this first hypothesis, one's time-inconsistency is measured as the difference of their actual (second questionnaire) and ideal screen time.

Hypothesis (2): testing expectations.

H2: The soft commitment device changes screen time expectations.

Second, the effect of the soft commitment device on one's expectations is examined. In the first questionnaire, participants are asked twice about their expected screen time: before and after treatment. They could be made more aware of their own limitations, changing their expectation further from their ideal than their initial, and therefore making them less confident. Or one could feel as if this commitment device could truly help them in reaching their target, the expectation would decrease closer to their ideal, making them more confident. The control group will at the same time be provided with simple questions about their phone, functioning as a neutral time-filler between the two questions on expectations.

Structure research

The rest of the paper is structured as follows. First, the methodology of this research is given where the implementation of the treatment, the soft commitment device to reduce screen time, is described. The methodology section also provides the data collection as well as the data analysis. Next, the results are given. A summary and conclusion of the research are provided next. Lastly, a discussion is given – including the limitations and recommendations of this research.

Methodology

Experimental design

The experimental design is inspired by the research by Hoong (2021). This experiment consists of three parts: one recruitment and two questionnaires. Two weeks before spreading the first questionnaire, a message was spread (the recruitment) using the same (social) networks that were used for spreading the questionnaires (e.g., *WhatsApp*, *Instagram*, and *Gmail*). Here, people were asked if their smartphone had an application that keeps track of their screen time. They were also noticed an iOS-system has that already. If they did not have any, they were requested to download such an application. This was done two weeks before to give people enough time to download an application and get an average daily screen time of a week. Two weeks later, the first questionnaire was sent out. People who fill in the survey were asked to have an application on their smartphone measuring their screentime. If they did not, they were unable to make the questionnaire. This is because the application should have measured the daily average screen time of the past few days. If they would download it at that very moment, the participant would not have a daily average. Furthermore, they were asked to have a pen and paper.

Demographics and psychological characteristics

Next, the participants' level of self-control and procrastination are measured. The level self-control was tested using the short version of the Brief Self-Control Scale (BSCS) by Morean et al. (2014) which consisted of 7 questions and was measured on a 5-point Likert scale (1=Not at all like me, 5=Very much like me). The procrastination level was tested using the Pure Procrastination Scale (PPS) by Tangney et al. (2004), which consisted of 12 questions and was measured on a 7-point Likert scale (1=Strongly disagree, 7=Strongly agree). These scales were then followed by other questions containing the demographics age, gender, and education. For the latter, since the target group is from the Netherlands, the levels of educations were Dutch levels: primary school; high school; intermediate vocational education; higher vocational education; university; master; PhD.

Screen time

After these demographics, participants reported their average daily screen time over the last few days. Participants were asked to check this in their application. The main reason for asking the actual screen time was to give participants some sort of indication or *anchor* in how their actual average daily screen time was of the past few days. In doing so, the participants' responses for their ideal and expectations are more realistic. If this anchor of their actual screen time over the last few days was not provided, it would be very difficult for participants to give a realistic ideal and expectation for the upcoming week. The follow-up questions asked participants about their *ideal* average daily screen time (what time they would like to spend on their phone daily over the next

week) and their *expected* average daily screen time – over the next week, at the time of the second questionnaire. The average daily screen time must be reported in minutes for all questions, which was clearly stated in both questionnaires.

Treatment

Next, participants were randomly assigned to the control and treatment group. The treatment group received the soft commitment device. At the same time, the control group received fill-up questions that took approximately the same time as the soft commitment device in the treatment group. These questions for the control group were smartphone-related (e.g., what brand is your smartphone? how old is your smartphone? what are your activities on your smartphone?). The treatment group were asked what they would like to spend more time on if they were to spend less time looking at their screen. The question included boxes with answers which could be ticked when it applied to the participants, options were (in the same order): school; work; exercising; cleaning; chores; family and friends; something else. Furthermore, they were asked to write the things down on a piece of paper: their own soft commitment device. After both groups completed their questions, they continued the questionnaire.

Change in expectations

At the end of the first questionnaire, after the treatment and the fill-up questions, the participants from both the control and treatment group were again asked about their expected screen time in one week. Could their second expectation, after being provided with the commitment device (post-treatment), be different? One could be influenced by a commitment device: they could be made more aware of their own flaws due to the way how the soft commitment device was presented. For the commitment device, participants needed to write down what they would like to spend more time on if they were to spend less time on their screen. However, if they truly want to do this, they could think, “why did I not do that before?”, making people aware of their own flaws in time-management. If they were made aware of this, they could therefore have an increased expectation – one further away from their ideal than their initial expectation, assuming the first expectation was greater than or equal to their ideal. Yet, it could also go the other way. One could feel like this commitment device will help them in spending less time on their screen, giving one more confidence in why one wants and will spend less time on their screen. Which would therefore, resulting in a decreased expectation – one closer to their ideal than their expectation pre-treatment, assuming the first expectation was greater than or equal to their ideal. The expectations for the control group are expected to be the same pre- and post-treatment.

Second questionnaire

The time gap between the two questionnaires is one week for the soft commitment device to be most effective since it is likely to wears of over time. After one week, the second questionnaire is sent out and people are asked to fill in their true actual daily average screen time (in minutes) of the last few days. This daily average screen time in minutes can be received from the application used by the participant. It shows the average daily screen time in minutes of the current week. If one fills in the questionnaire on Friday, the application shows the average daily screen time of Monday, Tuesday, Wednesday, Thursday, and the part of the day that has passed on that current Friday. In the first questionnaire, participants first received a random id number. They were asked to remember this id number which could be done by using the pen and paper required for the questionnaire. The pen and paper were needed for the treatment but was also asked to use here to remember, to have a question where the control group needed it as well. They could use this tool, the pen and paper, as a remembrance. This number is necessary to couple respondents from the first to the second questionnaire, in which they must state their id number. An extra question was put in the first questionnaire, which asked participants about their favourite dish. This is done to couple the respondents to the second questionnaire in case they forgot their id number.

Data collection and sample

The data is collected through questionnaires conducted in Qualtrics in a period of 10 days. The questionnaires were distributed through social platforms (e.g., *WhatsApp*, *Instagram* and *Gmail*) using snowball sampling. Meaning, it was spread among acquaintances who could then spread it among their acquaintances. The first questionnaire was sent out on the 13th of May 2022 at 10:00 which was opened for three days, until 15th of May 2022 at 23:59. The second questionnaire was sent out exactly one week later, on the 20th of May 2022, which was again opened for three days and closed the 22nd of May 2022 at 23:59. The application provided to participants showed the actual daily average screen time for this week (i.e., since Monday). The reason the days Friday to Sunday were chosen was due to the time gap between the two questionnaires which is one week. Participants had to fill in the second questionnaire exactly one week after they had filled in the first questionnaire. One week was chosen since the effectiveness of this soft commitment device is likely best in the short run. If the questionnaires were filled in on a Monday or Tuesday, a clearer vision would be seen as how participants' past week's average daily screen time. However, the soft commitment device would have little time to be effective since this week would have already started. Furthermore, initially, the plan of spreading the first questionnaire was one week before the 13th of May – however, a week later was chosen to avoid holidays, as did Hoong (2021).

Sample

The target group of this research are young people in the Netherlands. The first questionnaire was finished by 59 people from which only 42 finished the second questionnaire. These final people were then coupled using the id numbers given in the first questionnaire. One of the observations in this final sample was unplausible since some numbers seem unfeasible. For the ideal number of minutes spent on a screen the participant answered 650 minutes – this is over 10 hours – and his expectations was exactly 1379 minutes, leaving only 61 minutes left in a day not looking at a screen. Therefore, this observation is dropped. Table 1 shows the summary statistics of the sample of remaining 41 observations. In the first questionnaire, 48.8% of the participants were randomly assigned to the treatment group. The total sample has an average age of 23.2 years, consists of 58.5% women, and 41.4% has a bachelor's degree or higher as their highest education attained. Most people in the sample have (or are currently pursuing) a bachelor's degree. The short version of the BSCS has a minimum of 7 points and a maximum of 35 points. The higher the score, the higher one's level of self-control. The PPS has a minimum of 12 points and a maximum of 84 points. The higher the number of points, the greater one's tendency to procrastinate. The sample has an average score of 21.098 for the level of self-control and the scale for procrastination has an average score of 44.805.

Table 1

Descriptive statistics final sample

		M	*SD*	*Min*	*Max*
Variable		(1)	(2)	(3)	(4)
Treatment		0.488	0.506	0.000	1.000
Gender		0.585	0.499	0.000	1.000
Age		23.244	3.434	19.000	34.000
Education	High school graduate	0.122	0.331	0.000	1.000
	Intermediate Vocational Education	0.220	0.419	0.000	1.000
	Higher Vocational Education	0.244	0.435	0.000	1.000
	Bachelor's degree	0.341	0.480	0.000	1.000
	Master's degree	0.073	0.264	0.000	1.000
Trait self-control (BSCS)		21.098	5.594	7.000	32.000
Procrastination (PPS)		44.805	15.936	12.000	74.000
Number of observations		*41*			

Notes. Gender is equal to zero for males and one for females. The categorical variable education has been divided into five different dummy variables. Education is the highest level of education attained. The higher the score for the BSCS, the higher one's level of self-control. The higher the score for the PPS, the greater one's tendency to procrastinate. Columns (1) to (4) indicate the mean, standard deviation, minimum and maximum of the sample. $n = 41$.

Data analysis

The data collected from the questionnaires is analysed using *Stata*. To measure the questions of the Brief Self-Control Scale (BSCS) and the Pure Procrastination Scale (PPS) on their degree of coherence, the Cronbach's alpha will be computed. This alpha shows how closely related these separate questions are within each scale. To be clear, it does not show how closely related the PPS and BSCS are to each other, but it shows how close all question related to one of the two scales (7 for the BSCS and 12 for the PPS) are related to each other. The higher the score, the higher the scale reliability. An alpha of 0.8442 was found for the shortened BSCS by Morean et al. (2014) and an alpha of 0.9240 for the PSS. Both these scales are found to be acceptable, since an alpha of at least 0.70 is wished for both scales to be perceived acceptable. Meaning, the seven questions related to the BSCS have a high degree of coherence which shows these questions are related and could indeed measure what one wants to measure. This also applies to the twelve questions for the PPS, that also show a high degree of coherence, and therefore also has a high scale reliability.

Next, the scores for the BSCS and PPS were computed. This was done by summing up the point received for each question. Furthermore, a balance test is performed to check whether the differences in characteristics between the control and treatment group are significant. This will be done using the demographic variables as well as the scores of the BSCS and the PPS.

Hypothesis (1): time-(in)consistency

One's time-inconsistency (equation (1)) is measured as the difference of their actual (second questionnaire) and ideal screen time (first questionnaire) in minutes.

$$Timeinconsistent\ preferences_i = actual_i - ideal_i \quad (1)$$

Where $actual_i$ stands for participant i's response to their actual screen time in the second questionnaire, and $ideal_i$ stands for participant i's response to their ideal screen time in the first questionnaire. The greater the difference between one's ideal and actual, the more time-inconsistent one is since one is further away from their ideal. First, there will be checked what proportion of time-consistent and time-inconsistent people are in the treatment and control group. As explained, time-inconsistency can differ in one being reversed time-inconsistency, naïve, or sophisticated (fully and partially). The proportions of different time-inconsistent preferences will be provided as well. Furthermore, the means of ideal and actual screen time for both the control and treatment group will be given. This is done since there could be different targets of ideal screen times between both groups. Time-inconsistency could be higher for one group due to a lower ideal screen time rather than a higher actual screen time. For example, if one group has on average a lower ideal screen time (more difficult to reach), this group has a bigger chance of higher time-inconsistency.

This research expects the soft commitment device to be effective and therefore have people in the treatment group appear to be less time-inconsistent. An Ordinary Least Squares (OLS) regression is run with time-inconsistency (Y_i) as the dependent variable for participant i against the treatment (T_i) as the independent variable for participant i – whether the participant was provided with the soft commitment device or not. The coefficient is expected to be negative, being less time-inconsistent, for the commitment device to be effective since it should be smaller. The demographics and the scores from the BSCS and PPS will be added to the regression as control variables, resulting in equation (2).

$$Y_i = \beta_0 + \beta_1 * T_i + \beta_2 * female_i + \beta_3 * age_i + \beta_4 * education_i + \beta_5 * BSCS_i + \beta_6 * PPS_i + \varepsilon_i \quad (2)$$

Furthermore, another regression is run with actual screen time (in minutes) as dependent variable against treatment as the independent variable. This results in the same regression (equation (2), where only the dependent variable changed. There is a need to check this, since there could be a difference in the ideal and actual screen times between the control and treatment group. If both groups have on average the same actual screen time one group, and one group has a lower ideal, the last group has a higher chance of being more time-inconsistent. The regression of time-inconsistency should be put into perspective which can be done by another regression of actual screen time. For the soft commitment device to be effective, the coefficient of treatment should be negative since it should give them a smaller value between their actual and ideal (and reduce time-inconsistency). It should also reduce their actual screen time.

Hypothesis (2): testing expectations

To test the second hypothesis, the differences in expectations (equation (3)) of participants were examined.

$$difference\ in\ expectations_i = expectation\_2_i - expectation\_1_i \quad (3)$$

Where $expectation\_1_i$ is participant i's response to the first expectation question in the first questionnaire, and $expectation\_2_i$ is participant i's response to the second expectation question at the end of the first questionnaire. If the difference is positive, it shows one has an increased expectation, one larger than their initial expectation. Meaning, their second expectation is further away from their ideal (assuming their initial expectation is greater or equal to their ideal). They could feel the soft commitment device will not help them in reaching their goal and could even be made more aware of their own limitations, therefore making them less confident. If the difference is negative, it shows one has a decreased expectation, one smaller than their initial expectation. Meaning, the second expectation is closer to their ideal (again, assuming their initial expectation is

greater or equal to their ideal). One could feel as if this commitment device could truly help them in reaching their target, and could therefore be made more confident, resulting in an expectation closer to their ideal. This difference in expectations (Y_i) is used as the dependent variable in an OLS regression and the treatment as independent variable, using the same regression specified in equation (2).

Control variables

All regressions – for both hypotheses – are controlled for self-control, procrastination, age, gender, and education. As many discussed papers already suggest self-control if a very important aspect to control for. Self-control is measured using a short version of the Brief Self-Control Scale (BSCS) by Morean et al. (2014). The regressions are also controlled for procrastination using the Pure Procrastination Scale by Steel (2010), since self-control problems are associated with procrastination (Cobb-Clark et al.,2021). Age is important to control for since there are differences in generations concerning screen time: young people use their smartphone more often. Gender will be controlled for since females in the Netherlands are more likely to search information online, purchase more online, and tend to use social networks more often (Central Bureau for Statistics, 2019). Education will also be controlled for since sophisticates have on average higher IQs and better educated parents, compared to naïfs (Cobb-Clark et al., 2021). Age is treated as a continue variable, and gender as a dummy variable (0=Male; 1=Female). Education is treated as a categorical variable and is split into five dummy variables of all educational levels.

Results

Balance test

First, a randomisation check is necessary to see if the treatment and control group are balanced for them to be comparable. A balance test is performed using the baseline characteristics to see whether they appear to be similar on average pre-treatment. This is done by performing two-sided two-sample t-tests for each of these characteristics. Table 2 shows the results of the balance test. For the groups to be similar on average, the differences (column (3)) should not be significant. Table 2 shows the baseline characteristics gender, age, and the PPS do not differ significantly for the control and treatment group. The differences of the dummy variables – of the categorical education variable – high school graduate, intermediate vocational education, higher vocational education, and bachelor's degree do not differ significantly.

However, the control and treatment group appear to be unbalanced for the dummy variable master's degree (of the categorical education variable) since the difference of 0.15 is statistically significant on a significance level of 10%. Meaning, all three participants who reported a master's degree as their highest education were all in the treatment group. Unfortunately, the control and treatment group also appear to be unbalanced for the BSCS since the difference of 4.59 is statistically significant on a 1%-significance level. The control group has an average score of 18.86 and the treatment group an average score of 24.34. Meaning, the treatment groups on average has a higher level of self-control than the control group, when compared on this scale.

The main regression (regression 4) performed to test the hypotheses has the treatment as independent variable, and is controlled for everything (self-control, education, gender, age, and procrastination). Additional regressions were run that control for variables where a significant difference was found. Since the differences of the randomization check lie in the master's degree and the level of self-control, two additional regressions were performed with just these two as control variables (regression 3). Due to the bigger difference in looking at the level of self-control and its influence on time-inconsistency, this variable is run separately as a control variable (regression 2). Furthermore, an additional regression with just the treatment was run as well (regression 1).

Table 2

Balance table

Variables		Control (1)	Treatment (2)	Difference (3)
Gender		0.524 (0.512)	0.650 (0.489)	0.126 (0.157)
Age		23.190 (3.544)	23.300 (3.404)	0.110 (1.086)
Education	High school graduate	0.095 (0.301)	0.150 (0.366)	0.055 (0.104)
	Intermediate Vocational Education	0.286 (0.463)	0.150 (0.366)	-0.136 (0.131)
	Higher Vocational Education	0.333 (0.483)	0.158 (0.375)	-0.175 (0.138)
	Bachelor's degree	0.286 (0.463)	0.368 (0.496)	0.083 (0.152)
	Master's degree	0.000 (0.000)	0.150 (0.366)	0.150* (0.080)
Trait self-control (BSCS)		18.857 (5.642)	23.450 (4.582)	4.593*** (1.610)
Procrastination (PPS)		46.048 (16.250)	43.500 (15.913)	-2.548 (5.026)
Observations		*21*	*20*	*41*

Notes. Results of a balance test by performing two-sides two-sample t-tests for each variable. Columns (1)-(2) present the means of the variable and numbers in parentheses present the standard deviations. Differences in column (3) present the differences of the mean of the treatment group minus the mean of the control group and the associated standard errors in parentheses. The treatment represents the group that received the soft commitment device. $*** p < 0.01,\ ** p < 0.05,\ * p < 0.1.$

Before analysing the data, it is useful to know the average screen times for the ideal and actual of both the control and treatment group. This information is noted in Table 3. The average ideal screen time for the control group is 181.7 minutes and for the treatment group 154.5 minutes. The means of the actual screen times of both the control and treatment group, Table 3, are 230.1 minutes and 235.1 minutes. In the control group ideal number of minutes spent on their screen range from 44 to 360 minutes and the actual screen time range from 44 to 587 minutes. In the treatment group minutes for the ideal range from 60 to 300 minutes and for the actual from 95 to 420 minutes. Even though the control group has a lower minimum for their ideal, the mean is on average more than the treatment group. As for the actual screen time, the control group has a higher maximum, the actual mean screen time is less. There is a larger difference for the ideal between both groups (which was asked prior to the treatment), than the difference between the actuals. Moreover, the treatment group wants to spend (ideally) less time on their screen than the control group. However, they have spent more time on average on their screen than the control group has. This means that for the treatment group, time-inconsistency is on average higher due to a lower ideal rather than a higher actual. The latter is confirmed by the averages of time-inconsistency in Table 3. Time-inconsistency for the treatment group is on average 32.2 minutes higher (80.6-48.4).

Table 3

Means of ideal and actual screen time in minutes for both the control and treatment group

	Full sample			Control group			Treatment group		
	M	*Min*	*Max*	*M*	*Min*	*Max*	*M*	*Min*	*Max*
Ideal	168.4	44	360	181.7	44	360	154.5	60	300
Actual	232.5	44	587	230.1	44	587	235.1	95	420
Time-inconsistency	64.1	-113	347	48.4	-113	347	80.6	-42	278
Observations		*41*			*21*			*20*	

Notes. The ideal and actual show the number of minutes of screen time. Time-inconsistency is equal to actual minus ideal.

Hypothesis (1): testing time-(in)consistency

People who receive a soft commitment device are less time-inconsistent.

One is time-consistent when their actual and ideal are equal. One is reverse time-inconsistent when their actual is lower than their ideal screen time. When the actual is higher than the ideal screen time, one is considered time-inconsistent from which one can be sophisticated or naïve. A naïve person is unaware and has an expected screen time equal to their ideal. Sophisticated means that one is aware of their time-inconsistency and has an expected screen time that is different from their ideal. There are two variations of sophistication: fully and partially. One is fully sophisticated if one expects their actual precisely and one is partially sophisticated if one does not (expects less than actual, but more than ideal). The proportion of sophisticated and naïve people could change due to the change in expectations.

Proportion time-(in)consistency

Table 4.1 shows the proportions of the different time-(in)consistencies for the full sample, the control group, and the treatment group. In the full sample, time-inconsistent people have the lowest proportion (9.8%), followed by reversed time-inconsistent people (14.6%), and the greatest proportion is that of time-inconsistent people (75.6%). The control group has a higher proportion of time-consistent people (19.0%) than the treatment group which has none. The control group also has a higher proportion of reversed time-inconsistent people than the treatment group (19.0% vs 10.0%). Time-inconsistent people have a lower proportion in the control group compared to the treatment group (62.0% vs 90.0%) For the control group, 9.5% of sophisticated participants have switched to naïve after the second expectation was asked (a change in expectations affects whether an individual is sophisticated, partially sophisticated or naïve, but does not affect whether they are time inconsistent, reverse time inconsistent, or time consistent). The change in expectation could be due to a second time asking. One could possibly be given a reminder to think of their actions again, which could make one more aware. Participants could therefore consider if their ideal screen time is truly reachable, and whether they should lower or up their standards. In the treatment group there were also participants who switched from sophisticated to naïve but a bigger proportion of 25.0%. When looking closely to the change in sophistication it shows the fully sophisticated people rose for the control group (4.7%) and stayed the same for the treatment group.

Table 4.1

Proportion of time-(in)consistencies (first and second expectation)

	Full sample		Control group		Treatment group	
	First	*Second*	*First*	*Second*	*First*	*Second*
Time-consistent	9.8%	9.8%	19.0%	19.0%	0.0%	0.0%
Reversed	14.6%	14.6%	19.0%	19.0%	10.0%	10.0%
Time-inconsistent	75.6%	75.6%	62.0%	62.0%	90.0%	90.0%
Sophisticated	73.2%	56.1%	57.1%	47.6%	90.0%	65.0%
Fully sophisticated	9.8%	12.2%	14.3%	19.0%	5.0%	5.0%
Partially sophisticated	63.4%	43.9%	42.9%	28.6%	85.0%	60.0%
Naïve	2.4%	19.5%	4.8%	14.3%	0.0%	25.0%
Observations	*41*		*21*		*20*	

Notes. This table shows the proportion of different time-(in)consistencies. First and second represent the first and second expectation asked, the second expectation was asked after the treatment. One is time-consistent if the participants had the same number of minutes for their ideal and actual screen time (actual=ideal). One is reversed time-inconsistent if actual<ideal. One is time-inconsistent if actual>ideal. One is naïve if expectation=ideal, sophisticated if expectation≠ideal. One if fully sophisticated if expectation=actual and partially if expectation≠actual. A change in expectations affects whether an individual is sophisticated, partially sophisticated or naïve, but does not affect whether they are time-inconsistent, reverse time-inconsistent, or time-consistent. $n = 41$.[1]

Table 4.2

Proportion of time-inconsistencies for restricted sample of time-inconsistent participants

	Full sample		Control group		Treatment group	
	First	*Second*	*First*	*Second*	*First*	*Second*
Fully sophisticated	12.9%	16.1%	23.1%	30.8%	5.6%	5.6%
Partially sophisticated	83.9%	58.1%	69.2%	46.2%	94.4%	66.7%
Naïve	3.2%	25.8%	7.7%	23.1%	0.0%	27.8%
Time-inconsistent observations	*31*		*13*		*18*	

Notes. First and second represent the first and second expectation asked, the second expectation was asked after the treatment. One is time-inconsistent if actual>deal. One is naïve if expectation=ideal, sophisticated if expectation≠ideal. One is fully sophisticated if expectation=actual and partially if expectation≠actual.

[1] One of the observations in the treatment group that changed from partially sophisticated to naïve can be seen as extra naïve. His first expectation was above his ideal, but his second expectation was under. Otherwise said: the treatment made this participant overconfident, making him extra naïve while first being aware of his time-inconsistency.

Table 4.2 provides more information on the subsample of time-inconsistent people and shows the proportion of the variation of time-inconsistency in the sample. In the full sample, fully sophistication increased by 3.2% between the first and second expectation, partially sophistication decreased by 25.8%, and naïveté increased by 22.6%. In the control group, fully sophistication increased by 7.7% between the first and second expectation, naïveté increased by 15.4%, and partially sophistication decreased by 23.0%. In the treatment group, the proportion of fully sophistication did not change between the first and second expectation, naïveté increased by 27.8%, and partially sophistication decreased by 26.7%. It shows, when the expectation is asked again, sophistication decreased, and naïveté increased – even more for the participants provided with the soft commitment device.

Regression time-inconsistency

Table 5.1 shows the four regressions of treatment on time-inconsistency. When all control variables are involved (gender; age; every level of education; self-control; procrastination), the main regression (column (4)), only two coefficients appear to be statistically significant ($p < 0.05$): higher vocational education and bachelor's degree. Participants who have higher vocational education as highest level of education attained are on average approximately 130 minutes less time-inconsistent than participants who have attained a maximum of high school. For participants who have attained a bachelor's degree as their highest level of education are on average approximately 124 minutes less time-inconsistent than participants who have attained high school. The coefficient for gender, age, and procrastination are not statistically significant and are very small. **I**n the main regression, treatment increases time-inconsistency on average by 30.826 minutes – although not statistically significant (possibly due to a small sample size). When controlled only for the level of self-control and/or master's degree, the coefficient for treatment is statistically significant on a 5%-significance level. When only controlled for self-control (column (2)), the treatment group increases the time-inconsistency on average by 52.356 minutes. The treatment increases time-inconsistency on average by 47.678 minutes when controlled for both.

Regression actual screen time

Table 5.2 shows multiple regressions with the actual screen time as dependent variable. All coefficient estimates of the treatment are statistically unsignificant. Yet, they are all positive and thus show to increase the actual screen time. In the main regression, education seems to have a large effect on the actual screen time. The coefficients of the variables whether someone attained higher vocational education or a bachelor's degree are significant on a 10%-significance level. When someone attained higher vocational education, their actual screen time decreased on average by 136.048 minutes. When someone attained a bachelor's degree, their actual screen time decreased on average

by 117.763 minutes. Self-control shows to decrease the number of minutes actually spent on their screen. It decreases on average by 8.747 minutes when not controlled for master's degree and by 9.570 minutes when controlled, both on a 10%-significance level. However, it did not have a significant effect in the full regression (column (4)).

Hypothesis (1) results – discussion

For the soft commitment device to be effective, the coefficient estimates of treatment in regressions with time-inconsistency and actual screen time should be negative since it should give them a smaller value between their actual and ideal (and therefore reduce time-inconsistency). However, the coefficient estimate of treatment in the main regression of time-inconsistency is positive (Table 5.1) – meaning, the soft commitment device shows to make them on average more time-inconsistent, although not significant. A possible reason for this effect – in the opposite direction of what was expected – could be the imbalance in groups, since the control group has a higher ideal but almost the same actual (Table 3). The average of time-inconsistency (Table 3) is on average higher for the treatment group. The treatment group would, ceteris paribus, therefore have a higher chance of being time-inconsistent. However, looking at actual screen time (Table 5.2), the treatment had a positive coefficient estimate – meaning their actual screen time is on average higher than that of the control group, although insignificant. In other regressions than the main regression, when only controlled for self-control and/or master's degree in the regression of time-inconsistency, the coefficient of the treatment gives a positive value and is statistically significant on a 5%-significance level.

A possible reason for the positive effect of treatment on actual screen time could be the ineffectiveness of the soft commitment device. It shows the device indeed makes them more time-inconsistent due to a rise of actual screen time and not just because of the difficult endeavour they had given themselves with a very low ideal screen time. They could have felt overly confident in reaching their ideal and therefore pay less attention than they normally would have – resulting in a higher actual screen time and more time-inconsistency. The insignificance of treatment in the main regressions of both time-inconsistency and actual screen time could be due to lack of statistical power, the small sample size, and imbalance in groups on level of self-control and master's degree variables. Yet, the coefficient estimates at least suggest the treatment did not work as hoped. The commitment device is therefore possibly not effective, and perhaps could even be seen as the opposite.

Table 5.1

Results of Ordinary Least Squares regression with time-inconsistency as dependent variable.

	(1)	(2)	(3)	(4)
Treatment	32.219 (24.257)	52.356** (20.011)	47.678** (20.354)	30.826 (25.011)
Trait self-control (BSCS)		-4.385 (3.525)	-5.637 (3.954)	-3.033 (3.141)
Education				
Intermediate V. Education				-96.044 (61.151)
Higher V. Education				-130.335** (54.084)
Bachelor's degree				-123.512** (51.883)
Master's degree			69.541 (50.301)	-64.643 (76.909)
Gender				3.345 (22.418)
Age				-0.070 (4.356)
Procrastination (PPS)				-0.703 (1.011)
(Constant)	48.381** (18.691)	131.060 (79.895)	154.678* (87.609)	244.001 (156.576)
Observations	*41*	*41*	*41*	*41*

Notes. The table shows the estimates obtained from an Ordinary Least Square regression. The dependent variable is time-inconsistency which is equal to the actual screen time minus the ideal screen time (measured in minutes). Treatment denotes zero for the control group and one for participants who received the soft commitment device. Gender denotes zero for males and one for females. Education is the highest level of education attained. High school graduate is the reference value for sub-variables of education. The higher the score for one's trait of self-control, the higher one's self-control. The higher the score for procrastination, the greater one's tendency to procrastinate. Standard errors are noted in parentheses. $*** p < 0.01$, $** p < 0.05$, $* p < 0.1$.

Table 5.2

Results of Ordinary Least Squares regression with actual screen time as dependent variable.

	(1)	(2)	(3)	(4)
Treatment	5.052 (35.540)	45.209 (36.187)	42.116 (36.441)	17.613 (50.343)
Trait self-control (BSCS)		-8.743* (4.487)	-9.570* (5.113)	-4.606 (6.257)
Education				
Intermediate V. Education				-88.920 (76.337)
Higher V. Education				-136.048* (74.100)
Bachelor's degree				-117.763* (65.159)
Master's degree			45.960 (53.924)	-84.766 (100.954)
Gender				-11.651 (42.770)
Age				-4.351 (6.536)
Procrastination (PPS)				0.115 (1.399)
(Constant)	230.048*** (30.020)	394.919*** (93.917)	410.528*** (104.890)	522.988** (206.004)
Observations	*41*	*41*	*41*	*41*

Notes. The table shows the estimates obtained from an Ordinary Least Square regression. The dependent variable is actual screen time (measured in minutes). Treatment denotes zero for the control group and one for participants who received the soft commitment device. Gender denotes zero for males and one for females. Education is the highest level of education attained. High school graduate is the baseline for sub-variables of education. The higher the score for one's trait of self-control, the higher one's self-control. The higher the score for procrastination, the greater one's tendency to procrastinate. Standard errors are noted in parentheses. $*** p < 0.01$, $** p < 0.05$, $* p < 0.1$.

Hypothesis (2): testing expectations

The soft commitment device changes screen time expectations.

Table 6.1 shows the results of the regression with the difference in expectations as the dependent variable. Table 6.2 shows the results of the same regression but restricted to time-inconsistent (actual>ideal) participants (31 observations). If the coefficient is negative, there is a decreased expectation which means the second expectation is closer to the ideal than the first expectation (assuming expectations are greater or equal to the ideal) – showing one has more confidence in reaching their ideal screen time. If the coefficient is positive, there is an increased expectation which means the second expectation is further away from the ideal than the first expectation (assuming expectations are greater or equal to the ideal) – showing one feels less confident in reaching their ideal screen time in the upcoming week.

Column 4 shows the main regression. Even though no coefficient of treatment in the regressions of the entire sample (Table 6.1) are significant, all coefficients are negative. This could suggest the soft commitment device indeed changes one's expectation. Furthermore, it changes negatively, which should be interpreted as their second expectation moving closer to their ideal – meaning, leading to more confidence in reaching their ideal screen time. The coefficient estimate of treatment for the entire sample decreases the difference between the first and second expectation by 72.813 minutes on average. Table 6.2 shows the coefficient of treatment restricted to time-inconsistent participants in the main regression (column (4)) decreases the difference between the first and second expectation by 26.655 minutes on average. It also shows, when controlled only for the level of self-control and/or master's degree, the coefficient for treatment is statistically significant on a 10%-significance level. When controlled only for the level of self-control, the soft commitment device decreases the difference in expectation by 29.974 minutes. When controlled for the level of self-control and master's degree the difference decreases by 29.419 minutes. When restricted to time-inconsistent participants in the sample, it still decreases but on average on a lesser extent.

Table 6.1 shows the level of self-control has statistically significant coefficients in the second and third regression on a 5%- (column (2)) and 10%-significance level (column (3)). When only controlled for treatment and self-control, self-control increases the difference in expectations on average by 10.094 minutes. When also controlled for master's degree, it increases the difference in expectations on average by 11.076 minutes. Table 6.2 shows the coefficient estimates of the level of self-control to be statistically significant on a 5%-significance level in column (2) and column (3). When only controlled for treatment and self-control, self-control increases the difference in expectations on average by 4.889 minutes. When also controlled for master's degree the level of self-control increases the difference in expectations on average by 5.108. Meaning, a higher level of self-control gives one

less confidence. However, for the sample that is restricted to time-inconsistent participants, to a lesser extent.

The coefficient estimates of age, gender, and procrastination are statistically insignificant. The estimates of age and procrastination show to have little effect on differences in expectation (as with time-inconsistency). The small effects could be the reason for the insignificant estimates. Gender, although also statistically insignificant, does show to have a big effect on the difference in expectation. Compared to males, females decrease their expectation on average by -59.793 minutes – getting closer to their ideal and appearing more confident. However, when the regression is restricted to time-inconsistent people (Table 6.2), this decrease changed to a small increase of 1.302 – eliminating the previous effect, although, again, insignificant.

Hypothesis (2) results – discussion

The second hypothesis stated that participants' expectations of their future screen time who received the soft commitment device would change more than the participants who did not receive this device. Table 4.2 showed the proportions of time-inconsistent people in the control and treatment group. More people in the treatment group changed to being naïve, and there are more fully sophisticated people in the control than in the treatment group. Furthermore, the soft commitment device led to a larger decrease of partially sophistication. Also, there was already a change in proportions of time-inconsistent participants in the control group (9.5% changed from sophisticated to naïve (Table 4.1)). These results show there is already a change in expectations without treatment – although more with. The change in expectations without treatment raises the question why expectations change when it is asked a second time. It could possibly make one think more of their actions and therefore create more awareness of the feasibility of their ideal screen time – whether they under- or overestimated themselves in reaching their goal. If they would think they underestimated themselves in their first expectation, they would appear more confident in the second expectation. The opposite is true for awareness of overestimating oneself: resulting in less confidence in the second expectation.

Table 6.1 shows a negative coefficient estimate of the treatment on the difference between expectation one and two, meaning the second expectation is closer to the ideal than the initial one. Table 6.2, the same regression of difference in expectation that is restricted to time-inconsistent people, show similar results and shows a negative coefficient estimate of the treatment on differences in expectations – although smaller – as well. Otherwise said: participants that were offered the soft commitment device in this sample, feel more confident in reaching their ideal screen time.

Table 6.1

Results of Ordinary Least Squares regression with difference in expectations as dependent variable

	(1)	(2)	(3)	(4)
Treatment	-35.452 (37.613)	-81.812 (52.913)	-78.143 (51.120)	-72.813 (57.448)
Trait self-control (BSCS)		10.094** (4.780)	11.076* (5.490)	7.588 (5.443)
Education				
Intermediate V. Education				-37.665 (57.863)
Higher V. Education				-10.518 (52.605)
Bachelor's degree				40.096 (45.735)
Master's degree			-54.536 (44.139)	-28.553 (62.695)
Gender				-59.793 (53.599)
Age				-4.392 (6.511)
Procrastination (PPS)				-1.254 (1.145)
(Constant)	12.952 (36.250)	-177.388** (68.377)	-195.910** (80.598)	63.605 (196.085)
Observations	*41*	*41*	*41*	*41*

Notes. The table shows the estimates obtained from an Ordinary Least Square regression. The dependent variable is the difference in expectation (second expectation minus first expectation). Treatment denotes zero for the control group and one for participants who received the soft commitment device. Gender denotes zero for males and one for females. Education is the highest level of education attained. High school graduate is the baseline for sub-variables of education. The higher the score for one's trait of self-control, the higher one's self-control. The higher the score for procrastination, the greater one's tendency to procrastinate. Standard errors are noted in parentheses. $*** p < 0.01,\ ** p < 0.05,\ * p < 0.1.$

Table 6.2

OLS regression of difference in expectations as dependent variable with only time-inconsistents

	(1)	(2)	(3)	(4)
Treatment	-7.077 (17.827)	-29.974* (16.206)	-29.419* (16.852)	-26.655 (23.282)
Trait self-control (BSCS)		4.889** (2.090)	5.108** (2.443)	3.110 (2.839)
Education				
Intermediate V. Education				10.164 (42.209)
Higher V. Education				25.072 (39.194)
Bachelor's degree				38.330 (41.488)
Master's degree			-9.503* (21.000)	36.647 (51.411)
Gender				1.302 (23.891)
Age				3.542 (2.975)
Procrastination (PPS)				0.112 (0.831)
(Constant)	-17.923 (13.626)	-108.548** (46.288)	-112.621** (52.987)	-183.253 (130.861)
Observations	*31*	*31*	*31*	*31*

Notes. The table shows the estimates obtained from an Ordinary Least Square regression. This is a subsample of only time-inconsistent participants. One is time-inconsistent when actual>ideal. The dependent variable is the difference in expectation (second expectation minus first expectation). Treatment denotes zero for the control group and one for participants who received the soft commitment device. Gender denotes zero for males and one for females. Education is the highest level of education attained. High school graduate is the baseline for sub-variables of education. The higher the score for one's trait of self-control, the higher one's self-control. The higher the score for procrastination, the greater one's tendency to procrastinate. Standard errors are noted in parentheses. $*** p < 0.01,\ ** p < 0.05,\ * p < 0.1.$

Conclusion and recommendations

Summary

This research aimed to find an answer to whether the soft commitment device in this research could reduce time-inconsistency and what effect a soft commitment device has on one's expectations, in a context of screen time of Dutch young people. It is of great importance to investigate whether these devices show to be effective in the battle against screen time. Various research show excessive screen time has negative effects on one's health. An association with migraine was found, and it can also have negative effect on children's and youth's grow and development. Furthermore, the addiction of social media has become a problem in harming students' well-being and performance. However, prohibiting is not an option due to the present digital world in which it cannot be omitted.

For the commitment device, participants needed to write down what they would like to spend more time on if they were to spend less time on their screen. People would be reminded, and therefore experience the consequences of what could have been done – creating psychological penance: encouraging them to behave. A commitment device could change one's expectation: making them more, or less confident. Two questionnaires with a time frame of one week were conducted in which participants were asked their ideal daily screen time and their expectations in one week (twice), and, a week later, their actual daily screen time.

In trying to find an answer to the main question, two hypotheses were formed. First, there was a need to test the effectiveness of the soft-commitment device to reduce time-inconsistency. Second, the change of expectations due to soft commitment device was examined. Time-inconsistency was measured as the actual minus ideal screen time in minutes and change in expectation was measured as the second minus the first expectation of screen time in minutes.

Hypothesis (1): testing time-(in)consistency

The coefficient estimates of treatment in the main regressions of both time-inconsistency and actual screen time show to be positive, although statistically insignificant. The insignificance could be due to lack of statistical power, the small sample size, and imbalance in groups on level of self-control and master's degree variables. The commitment device is therefore possibly not effective, and perhaps could even be seen as the opposite – making one more time-inconsistent.

Hypothesis (2): testing expectations

The main regressions of difference in expectations give negative coefficient estimates of the treatment variable, although statistically insignificant (due to same reasons as with the first hypothesis). Meaning, participants who were given the soft commitment device show a decreased expectation, a second expectation closer to their ideal screen time in the upcoming week than their initial expectation. Results show, however, already a decreased expectation without treatment –

although more with. Concluding, participants who were given the soft commitment device in this sample, are considered more confident in reaching their ideal screen time in the upcoming week compared to participants that were not offered the device.

Conclusion

In this sample, participants in the treatment group are on average more time-inconsistent after being given the soft commitment device. These participants also changed their expectations more negatively, making them more confident in reaching their ideal screen time. All considered, participants who were given the soft commitment device were made more confident, yet they showed to be more time-inconsistent in reaching their ideal screen time. Concluding, the effect of this soft commitment device has a confident-making effect on participants in this sample of Dutch young people. However, this soft commitment device makes them less likely to reach their ideal screen time and even appear to be more time-inconsistent. Unfortunately, the results of this research all appear to be insignificant and there needs to be more research to find a clearer answer to the question whether a soft commitment device indeed changes one's expectations.

Implications

As Hoong (2021) suggested, soft commitment devices may help sophisticated people to reduce screen time (and their time-inconsistency) and should therefore be considered by governments to use in policies. Unfortunately, as with this research, the device could be ineffective. Therefore, there should be more research in finding the right commitment device to reduce screen time. If a short-time effective commitment device is found, it could be used in the work field. In the Netherlands, over 64 per cent use their phone during working hours (Emerce, April 22, 2022). Prohibition is not an option due to the present digital world in which it cannot be omitted. However, people still could set personal targets, on what they should spend their time to finish their work – instead of spending time on their phone. This could be done by the employee themselves or the employer could offer such commitment devices. Even though the treatment showed to be ineffective, the people in this group appeared to be more confident in reaching their ideal screen time. This could suggest overconfidence, resulting in opposite wanted results, and should be considered when designing another commitment device.

Limitations and recommendations for future research

This research has multiple limitations which should be solved in future research. First, the experimental groups were unbalanced. The treatment group had a higher level of self-control and more people who attained a master's degree compared to the control group. Nowadays, most people

use their phone for work. It would therefore also be beneficial to ask a control question whether they use their phone for work or not since this could affect screen time significantly. These should then be balanced in future research as well. Moreover, the questionnaire was spread among acquaintances who were mostly students which makes it less comparable for other socioeconomic groups in the Netherlands. Future research should be spread more widely among Dutch young people, collecting a larger and more diverse sample.

Furthermore, the sample size was small. This could have caused lack of statistical power. This sample size also decreased because people who filled in the first questionnaire, did not fill in the second one. I found out some participants forgot their id number and therefore did not fill in the second one – even though the possibility was given to send an e-mail to find their id number using the food-related question (unrelated to the research). So, there is a need be of a better way in coupling both questionnaires, so that participants are more likely to fill in the second questionnaire which would also result in a larger sample. For example, personal links could be sent out for each questionnaire generated. However, this is quite complicated in the programme used (Qualtrics), and the questionnaire should therefore perhaps be made using a different programme.

Moreover, this research is limited due to self-reports. Participants were asked to self-report their actual, ideal, and expected screen time in minutes. There could be errors of the participants, resulting in impossible screen times. For example, one participant answered 1379 minutes for both his daily expected screen times, leaving only 61 minutes left in a day not looking at their screen (this observation was dropped). Future research could solve this by following participants on a (perhaps self-developed) screen time-measuring application or let participants make screenshots of their own application as Hoong (2021) did. Participants could have also reported untruthfully – giving screen time minutes lower than they actually have or expect to have (possibly due to the experimenter demand effect – which was tried to mitigate through anonymity). A suggestion for future research would be to use choice-matching by Cvitanić et al. (2019). In here, there would be incentives to answer truthfully. An honest answer could then be linked to receiving different kind of benefits.

Another limitation to this research is the ineffectiveness of the soft commitment device. This research gave unsignificant results of the treatment in making one less time-inconsistent. Furthermore, the coefficient estimates for treatment were negative, making one more time-inconsistent. For the soft commitment device to be effective, it should have made people on average less time-inconsistent (not just more confident). Participants could have noted their preferred time-spending (instead of spending time on their screen) on their phone, instead of the piece of paper. If they wanted to be reminded, they had to enlarge their screen time. They could have also lost the piece of paper, not given it a second look since the world is very digital now. Participants could have also

just not undergone the treatment and not written down anything (or did not put in their phone). Differentiating between these could have yield different outcomes. The device could be improved by providing participants with reminders – even if it is on their phone – to reach their time-spending targets. Moreover, the boxes ticked in the first questionnaire could be put as a control question in the second questionnaire. The existence of the control question should be provided at the same time, hopefully leading participants to at least remind the things they would have want to have done, and therefore note them somewhere. In the end, future research should develop a soft commitment device effective to reduce screen-time and make people less time-inconsistent.

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Appendix

First questionnaire

Note. The questionnaires in the Appendix are translated, the original questionnaires were in Dutch.

Section 1: consent form

Welcome and thank you for participating in this survey!

To complete this survey, you must have an application on your phone that tracks your daily (average) screen time. If you do not have such an application, you cannot finish this survey. You will also need pen and paper.

By completing this survey, you contribute to a survey into awareness of smartphone use. Your data will be treated with the necessary caution with regard to the General Data Protection Regulation (GDPR). All responses are processed completely anonymously and used for research purposes only. All data collected will be deleted after five weeks. Your participation in this study is voluntary. If you do not feel comfortable, you can choose to not participate. You can also change your mind and stop participating later, even if you have previously consented. You have the right to withdraw your consent to the use of the data you provide at any time.

When you complete this first survey, you will be required to complete a second survey in approximately one week. The second survey will take significantly less time than the first.

It takes approximately 12 minutes to complete this survey. Don't forget to have a pen and piece of paper handy. If you have any questions, comments or complaints about this research, please contact 540565nh@student.eur.nl.

If you need a copy of this consent form, you can print this page. If you understand the statements above and agree voluntarily to participate in this study, please click the button below to continue.

> Q1. I hereby declare that I voluntarily participate in this survey and agree that my answers will be processed anonymously for research purposes only. If you do not agree, please end the survey.

Section 2: id number

Your personal ID number: ${e://Field/Random%20ID}

Please note your personal ID number. Keep it safe, you will need it to fill in the second survey. You can use the necessary writing tools for this.

As soon as you have noted your personal ID number, you can continue the survey.

> Q2. Please note your personal ID number.

Section 3: short versioned Brief Self-Control Scale (BSCS)

Note. The following seven questions of the short version of the BSCS by Morean et al. (2014), were answered on a 5-points Likert scale (1=Not at all like me, 2=Not like me, 3=Neutral, 4=Like me, 5= Very much like me). Questions Q4, Q6, Q7, and Q8 are reversed. The Dutch translation was provided by D. T. Ó Ceallaigh.

Q3. I am good at resisting temptation.
Q4. I do certain things that are bad for me, if they are fun.
Q5. People would say that I have iron self-discipline.
Q6. Pleasure and fun sometimes keep me from getting work done.
Q7. I am able to work effectively toward long-term goals.
Q8. Sometimes I can't stop myself from doing something, even if I know it is wrong.
Q9. I often act without thinking through all the alternatives.

Section 4: Pure Procrastination Scale (PPS) of Tangney et al. (2004)

Note. The following twelve questions were answered on a 7-points Likert scale (1=Completely disagree; 2=Disagree; 3=Slightly disagree; 4=Neutral; 5=Somewhat agree; 6=Agree; 7=Totally agree).

Q10. I delay making decisions until it's too late.
Q11. Even after I make a decision I delay acting upon it.
Q12. I waste a lot of time on trivial matters before getting to the final decisions.
Q13. In preparation for some deadlines, I often waste time by doing other things.
Q14. Even jobs that require little else except sitting down and doing them, I find that they seldom get done for days.
Q15. I often find myself performing tasks that I had intended to do days before.
Q16. I am continually saying "I'll do it tomorrow."
Q17. I generally delay before starting on work I have to do.
Q18. I find myself running out of time.
Q19. I don't get things done on time.
Q20. I am not very good at meeting deadlines.
Q21. Putting things off till the last minute has cost me money in the past.

Section 5: demographics

Q22. What is your gender?
- Female
- Male
- Non-binary
- Prefer not to say

Q23. What is your age?

Q24. What is the highest level of education you have attained?
- Primary school,
- High school
- Intermediate vocational education
- Higher vocational education
- Bachelor's degree university
- Master's degree
- PhD

Q25. What is your favourite dish?[2]

[2] This question was asked for if one forgot their id number for the second questionnaire.

Section 6: anchor, ideal, and first expectation

You can use the following tool to answer the following questions: 1 hour = 60 minutes; 2 hours = 120 minutes; 3 hours = 180 minutes; 4 hours = 240 minutes; 5 hours = 300 minutes; 6 hours = 360 minutes; 7 hours = 420 minutes; 8 hours = 480 minutes; 9 hours = 540 minutes; 10 hours = 600 minutes.

Q26. Last week, what was your average daily screen time (in minutes), as indicated in the application on your smartphone?
On an iPhone you can find this application by going to 'Screen time' via 'Settings'.
To illustrate: if your phone says "6 hours and 24 minutes" you should answer 384 (360+24).

Q27. What is your ideal daily screen time (in minutes) in a week from now, at the time of the second survey?

Q28. What do you **expect** your daily screen time (in minutes) to be in a week, at the time of the next survey?

Note. For section 7, one was either assigned to the treatment or control group. Section 7a shows the questions of the treatment group, the one that were given the soft commitment device. Section 7b shows the questions, given to the control group, that would take approximately the same amount of time to finish.

Section 7a: treatment

Q29a. If you would spend less time on your screen, what would you like to spend this saved time on? Check what applies to you.

- ☐ School
- ☐ Work
- ☐ Working out
- ☐ Cleaning
- ☐ Chores
- ☐ Family and friends
- ☐ Other

Q29b. Use the necessary writing tools for this question. Please write down the things you checked in the previous question. You have indicated that you would like to spend more time on these things (if you would spend less time on your screen). You can write this information on the same piece of paper as your personal ID number. Please keep this information safe.

☐ I have written it down and will keep this information safe.

Section 7b: control

Q30a. What brand of smartphone do you have?

- Apple
- Fairphone
- Huawei
- Motorola
- OPPO
- Samsung
- Sony
- Xiaomi
- Other

Q30b. How old is your smartphone (in years)?

Q30c. What do you use your phone for? Check what applies to you.

- ☐ Applications
- ☐ Banking
- ☐ Calling
- ☐ Taking pictures
- ☐ Finding Hot Spots
- ☐ Looking up information
- ☐ Mail
- ☐ Listening to music
- ☐ Navigation
- ☐ Reading news
- ☐ Shopping
- ☐ Social media
- ☐ Checking travel information
- ☐ Other

Section 8: second expectation

Q31. What do you **expect** your daily screen time (in minutes) to be in a week, at the time of the next survey?

Second questionnaire

Section 1: consent form

Welcome back and thank you for participating in this survey!

To complete this survey, you must have an application on your phone that tracks your daily (average) screen time. In addition, you are expected to have completed the first survey.

It takes approximately 2 minutes to complete this survey. If you have any questions, comments or complaints about this research, please contact 540565nh@student.eur.nl.

By completing this survey, you contribute to a survey into awareness of smartphone use. Your data will be treated with the necessary caution with regard to the General Data Protection Regulation (GDPR). All responses are processed completely anonymously and used for research purposes only. All data collected will be deleted after five weeks. Your participation in this study is voluntary. If you do not feel comfortable, you can choose to not participate. You can also change your mind and stop participating later, even if you have previously consented. You have the right to withdraw your consent to the use of the data you provide at any time.

If you need a copy of this consent form, you can print this page. If you understand the statements above and agree voluntarily to participate in this study, please click the button below to continue.

> Q1. I hereby declare that I voluntarily participate in this survey and agree that my answers will be processed anonymously for research purposes only. If you do not agree, please end the survey.

Section 2: id number

> Q2. Last week you received a personal ID number, please write down your personal ID number. If you do not remember this information, you can contact me via 540565nh@student.eur.nl.

Section 3: actual screen time

You can use the following tool to answer the following questions: 1 hour = 60 minutes; 2 hours = 120 minutes; 3 hours = 180 minutes; 4 hours = 240 minutes; 5 hours = 300 minutes; 6 hours = 360 minutes; 7 hours = 420 minutes; 8 hours = 480 minutes; 9 hours = 540 minutes; 10 hours = 600 minutes.

> Q3. What is your current daily screen time (in minutes) over the past week as indicated in the application on your smartphone?
> To illustrate: if your application indicates "6 hours and 24 minutes" you should answer 384 (360+24).
