ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

Bachelor Thesis Economics and Business Economics

From overstress to under-sleep: an analysis of the effects of stress and desire for me-time on bedtime procrastination.

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Date final version: 25-08-2021

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Abstract

Revenge bedtime procrastination – sacrificing sleep for more me-time because of a busy life that lacks free time – has become a very relatable and popular concept in the everyday life of most people. The current research aims to find out whether higher stress and more desire for me-time make people more likely to engage in bedtime procrastination. With an online survey among the Dutch population (N = 138), data were retrieved on the levels of bedtime procrastination, self-control, stress and desire for me-time of participants. Using multiple hierarchal regressions and a bootstrapping procedure, the relationships between bedtime procrastination and self-control, stress and desire for me-time were examined. Results show a positive association between bedtime procrastination and both stress and desire for me-time. However, no significant effect of either variable was found. Self-control did prove to significantly negatively influence bedtime procrastination, even when controlling for stress and desire for me-time. Furthermore, self-control is proven to mediate the effect of stress on bedtime procrastination. These results stress the importance of improving self-control, as insufficient sleep can lead to serious health problems. Finally, there is no reason to believe self-control is the only factor explaining bedtime procrastination. Further research should focus on finding more potential causes for the phenomenon.

1. Introduction

In June 2020, the phenomenon of *revenge bedtime procrastination* gathered popularity on social media, after a Twitter-message explaining the term gained nearly 65,000 retweets and almost 250,000 likes in just two days' time [1](Lee, June 28 2020). The term is described as "*the decision to sacrifice sleep for leisure time that is driven by a daily schedule lacking in free time*" (Sleep Foundation, 2021), and was found to be relatable for hundreds of thousands of social media users. Revenge bedtime procrastination is a way to find some more hours of free time or me-time for people in high-stress and/or time-consuming jobs, even though it leads to insufficient sleep. The aim of the current research is to investigate whether higher stress levels and desire for me-time influence *bedtime procrastination* and thus if revenge bedtime procrastination actually exists, answering the following research question:

How is bedtime procrastination influenced by stress levels and desire for me-time?

In scientific literature, research into the general area of bedtime procrastination is limited, as the first research on the topic was done by Kroese, De Ridder, Evers & Adriaanse (2014) just seven years ago. They explain bedtime procrastination as a concept that occurs when someone does not succeed in going to sleep at the time they intended to, without external factors being responsible for this. Another research by Kroese, Evers, Adriaanse & De Ridder (2016) shows low self-regulatory skills as a cause for bedtime procrastination. Kamphorst, Nauts, De Ridder & Anderson (2018) add to this by finding that people who resist more desires during the day and have less self-control in the evening, which is the moment that bedtime procrastination can take place, are more likely to procrastinate their bedtime. Furthermore, Nauts, Kamphorst, Sutu, Poortvliet & Anderson (2016) find a second cause of bedtime procrastination: people with a higher aversiveness to their bedtime routine are more likely to engage in bedtime procrastination. Chung, An & Suh (2020) find no significant differences in stress levels between young adults in a "high bedtime procrastination group" and participants in a "low bedtime procrastination group". However, this research took a different approach than the current research, used a sample consisting of only adolescents and did not necessarily aim to show the relationship between stress and bedtime procrastination. In addition to this, Chung et

[1] The Twitter statistics for June 30 2020 were checked using WayBackMachine (https://web.archive.org/web/20210423042231/https://twitter.com/daphnekylee/status/1277101831693275136).

al. (2020) do not provide any reasoning for this finding. Furthermore, research into the relationship between stress and general procrastination shows a positive relationship between procrastination and stress in the long-term (Baumeister & Tice, 1997). Although research into desire for me-time is scarce, motivation for the theory that people desire more me-time because of busy work- or study schedules can be found in research by Roberts (2008). This study into the concept of work-life balance shows that many participants consider me-time as an important factor in designing their work schedule. As Roberts writes: "*an improved 'work–life balance' is more about a mind-set that refuses to be dominated by a work temporality and is determined to create 'me time'*" (Roberts, 2008). It can be reasoned that people who are not able to design their own working patterns and are stuck to the general "clock time work schedule" lack this me-time if they fit their bedtimes to achieve sufficient sleep. Therefore, it can be reasoned that increased desire for me-time can motivate people to try to enjoy more me-time in the hours past their bedtime, at the expense of sufficient sleep. As existing literature can reason motivation for stress and desire for me-time to influence bedtime procrastination, research into these relationships can provide new insights into the potential causes of bedtime procrastination.

Furthermore, despite the limited research, bedtime procrastination is a socially relevant topic. As Kroese et al. (2014) mention, bedtime procrastination leads to sleep insufficiency. A lack of sleep is generally known to negatively influence physical and mental health. Kroese et al. (2014) name problems with concentration and memory (Ram, Seirawan, Kumar & Clark, 2010) and obesity and cardiovascular diseases (Buxton & Marcelli, 2010) as examples of specific health problems caused by insufficient sleep. Gaining more knowledge on the topic of bedtime procrastination is useful for solving this problem of sleep insufficiency and therefore relevant for the health of society. Specifically, proving whether stress and desire for me-time directly influence bedtime procrastination (and not through self-control as a mediator), opens new possibilities for solving the behavioural health issue of bedtime procrastination. Instead of only focusing on ways to increase self-control, policy makers then can also look into ways to reduce stress and desire for me-time throughout the day.

As bedtime procrastination is a relatively novel concept in scientific literature, the current research will continue to sum up the most important findings about the phenomenon and other important terms from existing literature in the next section. Next, the paper will go into detail on the procedure and measures of the data in Section 3, as the data of the current research were

collected by the author himself. After all data are explained, this paper will continue with Section 4, describing the relevant methodology that will be used to answer the hypotheses and research questions posed in this paper. Then, descriptive statistics of all question scales and baseline characteristics and the results from the multiple regression, Cronbach's Alpha tests and bootstrapping procedures will be shown in Section 5. Next, Section 6 will try to answer the research question, as well as draw relevant conclusions based on the findings of this research. Finally, Sections 7 and 8 will discuss the validity and limitations regarding the set-up and results of this research and will make recommendations for both future scientific research and governments and healthcare companies.

2. Theoretical framework

Information on general procrastination

Klingsieck (2013) defines procrastination as *"the voluntary delay of an intended and necessary and/or [personally] important activity, despite expecting potential negative consequences that outweigh the positive consequences of the delay".* This is in line with Steel (2007), who describes procrastination as a situation in which someone voluntarily delays their intentions even though they know they will likely be worse off doing so. Procrastination can be seen as an example of the "intention-behaviour gap". In general, this occurs when people fail to live up to their intentions. It can be reasoned that bedtime procrastination can be seen as an example of this intention-behaviour gap as well, as people intend to go to bed earlier than they end up going to bed. Furthermore, general procrastination has been found to have an effect on many different factors. For instance, in the area of health, Tice & Baumeister (1997) found that people who procrastinate more reported more health symptoms and reported higher levels of stress in the long-term. In addition to this, they found that in the area of education, people who procrastinate score significantly lower than non-procrastinators (Tice & Baumeister, 1997).

The foundation of bedtime procrastination

Research on bedtime procrastination is scarce and has been published only recently, as the first paper on the phenomenon was presented in 2014. This first research tried to prove whether general procrastination is present in the domain of sleeping behaviour, as most existing literature on procrastination at that time focused on other domains (Kroese et al., 2014). Furthermore, the study aimed to find an association between procrastination and a specific health behaviour problem, namely insufficient sleep resulting from going to bed later than intended, that cannot be explained by underlying factors. For this study, the researchers collected data using an online survey among a community sample and designed their own question scale to measure the degree of bedtime procrastination. First, the study showed that the majority of the participants experienced insufficient sleep. As insufficient sleep leads to increased likelihood of health problems, this once again stresses the importance of studying bedtime procrastination. Furthermore, the majority of the participants also experienced what the researchers describe as bedtime procrastination. Secondly, the researchers used hierarchal multiple regressions to investigate the effects of self-control and bedtime procrastination on sleep and found that insufficient sleep is strongly associated with self-regulatory skills and bedtime procrastination. Finally, the research shows that bedtime procrastination is related to

reports of insufficient sleep, even when controlling for demographics and self-regulatory skills. This means that low self-control is not the only reason participants experienced insufficient sleep and that bedtime procrastination really does influence the amount of sleep.

As it is essential to know what causes bedtime procrastination to take place, as it directly affects the amount of sleep a person gets, further research was done two years later. This study focused more on testing whether bedtime procrastination still affected insufficient sleep when controlling for more possible causes of insufficient sleep (Kroese et al., 2016). Once again, data was collected from a representative group of Dutch individuals using an online survey and hierarchal multiple regressions were used to get the results. Testing a variety of potential factors, such as being a student, household composition, external reasons for going to bed later and age, the researchers found that bedtime procrastination was still the strongest predictor of insufficient sleep, followed by self-control. Furthermore, using a bootstrapping procedure, they found that the effect of self-control on insufficient sleep was partially mediated through bedtime procrastination.

Stress

Tice & Baumeister (1997) aimed to find a relationship between trait procrastination and stress among students, as the majority of students consider themselves procrastinators. The researchers assigned health psychology students a writing exercise with a deadline of a few weeks, while having these students fill in daily symptom checklists and weekly questionnaires on their levels of stress and work requirements. Using this data, Tice & Baumeister (1997) found that procrastinators experience higher stress levels and worse health in the long-term, implying that procrastination could lead to more stress. Though, it could be reasoned that there is a reverse effect as well: increased stress could lead to more procrastination. However, in a literature review prior to her own experiment, Sirois (2014) reasons that it is unlikely that procrastination as a trait is an outcome of increased stressed. However, bedtime procrastination differs from general procrastination, for instance because it can only take place around bedtime and because it is directly linked to the amount of sleep a person gets. Furthermore, no scientific literature says that bedtime procrastination is an actual trait. Therefore, it can be possible that this reverse effect does exist for bedtime procrastination and it is interesting to investigate whether this is the case. This reverse relationship will be tested using hypothesis 1:

Hypothesis 1: "*Stress throughout the day is positively associated with bedtime procrastination.*"

Bedtime routine aversiveness

Knowing that self-control was a factor that could cause bedtime procrastination and thus insufficient sleep, more research was done on potential causes for bedtime procrastination in the following years. Nauts et al. (2016) performed two studies into the relationship between bedtime routine aversiveness and bedtime procrastination. Both studies used an online survey to collect data. In the first study, participants were shown a list of bedtime routine activities and had to indicate how frequently they performed these activities. After that, participants had to answer ten questions about bedtime routine aversiveness, followed by the bedtime procrastination scale by Kroese et al. (2014). The second study was similar to the first, though the researchers did not ask participants about their avoidance of bedtime routine tasks this time. Nauts et al. (2016) found that an aversiveness to the bedtime routine increased the likelihood of participants to engage in bedtime procrastination. However, no single exact reason for why participants found their routine aversive was found. The researchers do come up with a few potential explanations. Their main explanation is that people who come home from work or school can finally relax after having done their basic household chores during the evening. When it is time to go to bed, however, this me-time has to come to an end and another set of chores has to be done (i.e. making the bed, setting an alarm, brushing teeth). The aversiveness to their routine could then arise from them not wanting to end the leisure time they finally have. Note that this reasoning is also in line with the concept of revenge bedtime procrastination.

Desire for me-time

In addition to the research mentioned in the previous paragraph, Nauts, Kamphorst, Stut, De Ridder & Anderson (2019) find that one of the reasons of their survey's respondents to engage in bedtime procrastination is that they felt like they deserved some time for themselves. This reason was given by multiple participants and can be connected to the concept of revenge bedtime procrastination mentioned in the introduction. The study by Nauts et al. (2019) does not look further into desire for me-time as a potential cause of bedtime procrastination, as this was not the aim of their research. The current study will however investigate this potential relationship between desire for me-time and bedtime procrastination, by testing hypothesis 2:

Hypothesis 2: "*Desire for me-time throughout the day is positively associated with bedtime procrastination.*"

Self-regulatory resources

The current research will use the definition of self-regulation or self-control used by Baumeister & Vohs (2004): "*the exercise of control over oneself, especially with regard to bringing the self into line with preferred (thus, regular) standards*". This section will not go into detail on all aspects of self-regulation, as this is a very broad and widely studied topic. However, some insights and progresses that are relevant for bedtime procrastination will be mentioned. First, self-regulation has been found to be highly influenced by emotions (Baumeister & Vohs, 2004). It can be reasoned that, throughout the day, people experience a number of different emotions all possibly influencing their self-control. As people with a normal sleeping pattern are only able to engage in bedtime procrastination at the end of the day, it is likely that their self-control is partially exhausted by emotions during the day. Secondly, Baumeister & Vohs (2004) name that people are often dealing with several goals at the same time, while not being able to achieve all of these simultaneously. As these goals require self-control, their self-regulatory resources are decreasing throughout the day. Once again it is only at the end of the day, when the self-control resources are used up, that people are able to engage in bedtime procrastination. Furthermore, Kamphorst et al. (2018) did more research into the effect of depleted self-regulatory resources on bedtime procrastination. They found that people who had resisted more desires during the day and thus had depleted self-regulatory resources, were more likely to engage in bedtime procrastination. This once again confirms the strong influence of self-control on bedtime procrastination and thus on insufficient sleep. Following from this existing literature on bedtime procrastination and self-control, as well as research by Kroese et al. (2014, 2016), it is expected that self-control will mediate the effect of stress and desire for me-time on bedtime procrastination. A graphic display of these relationships using the hypotheses is presented in Figure 1. The third and final hypothesis concludes:

Hypothesis 3: "*Self-control functions as a mediator for stress and me-time in influencing bedtime procrastination.*"

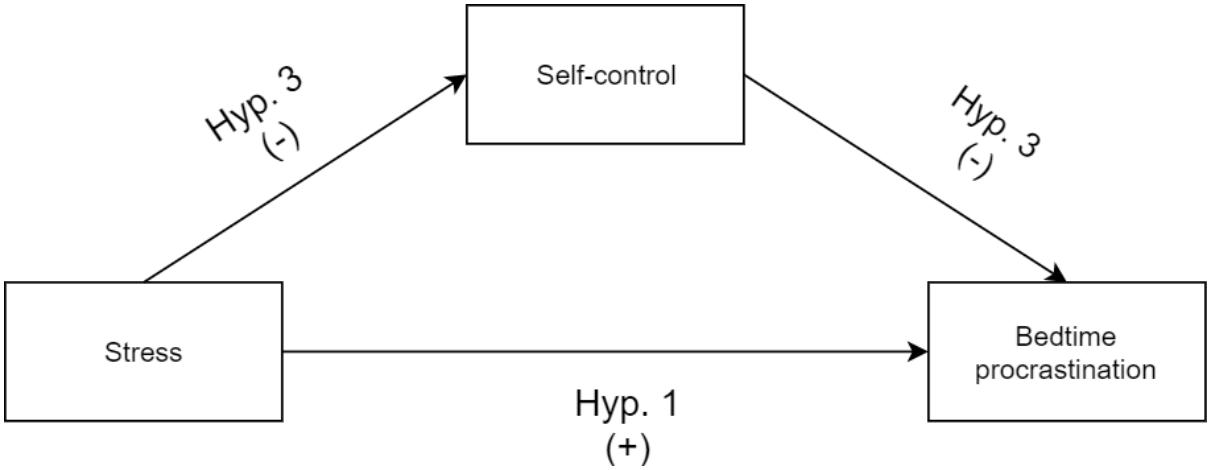

Figure 2 Graphic overview of expected mediation of self-control based off hypotheses

3. Data

Participants

Similar to the existing literature on bedtime procrastination mentioned in the introduction (Kroese et al., 2014, 2016; Nauts et al., 2016; Kamphorst et al., 2018), the data for the current research were collected via an online survey. This survey was spread in the social network of the author and was aimed at people who live in The Netherlands and do not suffer from sleeping problems or work night shifts. In a little over one week time, 152 people completed the survey. Observations that had missing values for any of the questions or answered the control question incorrect were deleted, leading to 138 observations in the final dataset.

Procedure

The survey consisted of three general parts and was conducted in Dutch for practical reasons. The first part of the survey included a consent form and checked if the respondent either worked night shifts or had diagnosed sleeping problems. The latter was done, because this research focusses on people with a generally normal sleeping pattern (i.e. people who do not frequently go to bed after midnight during workdays). Any diagnosed sleeping problems and night shifts could explain irregular bedtimes and sketch an incorrect image of bedtime procrastination. The survey then ended for respondents who did not give consent or answered the second or third question with "Yes". The second part of the survey consisted of four question-scales to measure the variables of interest for this research. A English translation of all question scales used can be found in Appendix A. A more detailed description of each of the variables and respective scales can be found in the Measures section. All questions were randomized within the scales and one of the scales included a simple control question ("*Pick answer two.*") to make sure participants were paying attention to the questions. The data from participants that failed to pick the right answer for this control questions were removed from the dataset. The third and final part of the survey consisted of three question about the baseline characteristics of the respondents. The first question was a categorical question about age, with answer options *0-17*, *18-25*, *26-40*, *41-60* and *60+*. After the data were collected, the latter two groups were combined due to a low number of observations. The second question asked about the everyday occupation and had the following answer options: *student*, *employed*, *unemployed* and *other*. Once again, after the data were collected, the last two groups were combined due to a low number of observations. The third and final question regarded the gender of the respondent and had answer options *male*, *female* and *other*. For the variable of gender, all observations that

answered this question with “other” were removed. This was done purely because of the low number of respondents who stated that their gender was neither male or female. Furthermore, it is impossible and unethical to combine this group of respondents with either the male or female gender, therefore deletion was the best option.

Measures

Bedtime procrastination

The bedtime procrastination variable is computed using an adaptation of the bedtime procrastination scale (BPS). The general version of this scale was used in the original bedtime procrastination research by Kroese et al. (2014) and by Nauts et al. (2016) in their research into bedtime routine aversiveness. However, the current research will use the state version bedtime procrastination scale created by Kamphorst et al. (2018). The scale was translated to Dutch by the author of the current research. This scale consists of nine questions about bedtime behaviour of which four were reverse scored, as can be seen in Appendix A. The questions in this scale had to be answered on a 7-point Likert scale from 1 (*completely false*) to 7 (*completely true*). An example question from this scale is *“Yesterday, I went to bed later than I had intended.”*.

Self-control

The variable for self-control will be measured using a translation by Verweijen (2012) of the brief self-control scale (BSCS) by Tangney (2004). This scale is well known in scientific literature and has been used in a number of researches to measure the degree of self-control. Duckworth & Seligman (2005) use Tangney’s BSCS to measure the effect of self-control on academic performances in the United States. Furthermore, the BSCS was used in research into the effect of trait grit on success outcomes by Duckworth, Peterson, Matthews & Kelly (2007). Both researches are positive about the use of the BSCS to measure self-control among participants. The scale consists of thirteen questions that have to be answered on a 5-point-scale from 1 (*not at all like me*) to 5 (*just like me*). Four questions were reverse scored, as can be seen in Appendix A. An example of a question from this scale is *“I am good at resisting temptations.”*.

Stress

The variable for stress is measured using a customized version of the Perceived Stress Scale (PSS) (Cohen, Kamarck & Mermelstein, 1983). This is scale is one of the most popular scales to measure stress and is used in many existing researches. These researches vary both in topic as well as in the target-country or language of the scale: Reis, Hino & Añez (2010) checked the reliability of the scale in Brazil using a Portugese translation. The PSS was also used by Aspinwall & Taylor (1992) to measure the degree of stress of college students in their research into adjustment to college of freshman students. Furthermore, Otto et al. (1997) used the PSS to measure the association between stress and depression. Because of this popularity, this scale has been chosen to measure the variable for stress in the current research. Furthermore, a Dutch translation of this original scale will be used, as the participants will make the survey in Dutch. This translation was made by Van Eck, Berkhof, Nicolson & Sulon (1996). Secondly, the time periods in the questions will be changed from "month" to "week". The scale consists of ten questions that had to be answered on a 5-point Likert scale ranging from 1 (*never*) to 5 (*very often*). Once again, four questions were reverse scored, as can be seen in Appendix A. An example question from this scale is *"In the last week, how often have you been upset because of something that happened unexpectedly?"*.

Desire for me-time

Because there is no existing scale that measures desire for me-time, a custom scale for this variable was designed by the author of the current research. This desire for me-time scale consisted of nine questions, which had to be answered on a 5-point Likert scale ranging from 1 (*totally disagree*) to 5 (*totally agree*). In this customized scale two questions were reverse scored, as can be seen in Appendix A. Furthermore, notes on the design of the scale can also be found in Appendix A. An example question from this scale is *"At the end of a (work)day, I desire more me-time than there is still available that day."*.

Time variable

In addition to all explained variables, a variable keeping track of the part of the day a participant filled in the survey was created. The online tool that was used to design and distribute the survey kept track of the time a participant filled out the survey. This time of day variable is a categorical variable that takes value 0 for *morning* (06:00 – 12:00), 1 for *afternoon* (12:00 – 18:00), 2 for *evening* (18:00 – 00:00) and 3 for *night* (00:00 – 06:00).

4. Methodology

Analysis techniques

The statistical software program *Stata* will be used to analyse all collected survey-data. First, the correlations between stress and bedtime procrastination and between desire for me-time and bedtime procrastination will be computed. These correlations will be used to confirm whether there is reason to believe that stress and/or desire for me-time increase bedtime procrastination. In computing the correlations, a first insight will be given into both hypothesis 1 and hypothesis 2. For both hypotheses to hold, both correlations need to be positive.

Next, a number of multiple regression models will be performed, with bedtime procrastination as the dependent variable and baseline characteristics (age, gender and occupation) and the time of day variable as independent categorical variables in all models. Model 1, Model 2 and Model 3 will additionally include respectively self-control, desire for me-time and stress as an independent variable. Previous research on bedtime procrastination suggest that higher self-control should lead to lower bedtime procrastination. Therefore, Model 1 is expected to show a significantly negative effect of self-control on bedtime procrastination. Furthermore, the regression results are expected to confirm the previously computed correlations by showing positive coefficients for desire for me-time and stress in respectively Model 2 and Model 3.

Model 4 will once again have bedtime procrastination as the dependent variable and will have stress and desire for me-time as independent variables. The model is expected to show positive coefficients for both stress and desire for me-time. As the description of revenge bedtime procrastination states that one experiences both a desire for more me-time as well as a high level of stress, both factors are expected to work as complements. In a separate table and model, an interaction term between stress and desire for me-time will be added to Model 4 to once again test the concept of revenge bedtime procrastination. If revenge bedtime procrastination does depend on both high stress and a desire for more me-time, this interaction term should prove to be significant.

Finally, Model 5 will add self-control to Model 4. This most extensive model, however, is expected to show less significant coefficients for stress and desire for me-time due to the mediation of self-control. This is in line with hypothesis 3. Self-control is expected to (partially) mediate the influence of stress and desire for me-time and to be significantly

negative in Model 5. If self-control indeed decreases the effects of both stress and desire for me-time, a bootstrapping procedure (Preacher & Hayes, 2008) will be employed to check whether self-control is a mediator for those factors. The results of the bootstrapping procedure are expected to prove that the effects of stress and desire for me-time on bedtime procrastination are indeed, at least partially, mediated through self-control.

5. Results

Descriptive statistics

First, looking at the baseline characteristics, it can be seen that the majority of participants was female (58.70%). Furthermore, most participants (51.45%) were aged 18-25 and most of the people who filled in the survey were either studying (51.45%) or employed (43.48%). More details on the frequencies of the baseline characteristics can be found in Table 1.

Table 1 Frequencies of baseline characteristics

Variable	**Category**	**Frequency**
Time of day	Morning	11 (7.97%)
	Afternoon	50 (36.23%)
	Evening	73 (52.90%)
	Night	4 (2.90%)
Age	0-17	10 (7.25%)
	18-25	71 (51.45%)
	26-40	19 (13.77%)
	40+	38 (27.54%)
Gender	Female	81 (58.70%)
	Male	57 (41.30%)
Occupancy	Student	71 (51.45%)
	Employed	60 (43.48%)
	Other	7 (5.07%)

Notes: Percentages of frequency are given in brackets.

Second, Table 2 shows the descriptive statistics for all variables of interest. It can be seen that the mean score on the BPS is 4.357 out of a maximum score of 7. Furthermore, over 60 percent

of participants had an average score of 4 or higher on the BPS. This shows that the act of bedtime procrastination was very common under the participants.

Table 2 Descriptive statistics of all variables of interest

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Bedtime procrastination	4.357	1.329	1.111	7	138
Stress	2.462	.700	1	4.100	138
Desire for me-time	2.103	.679	.667	3.667	138
Self-control	2.920	.580	1.538	4.846	138

Looking at the variables' mean per age group, all variables of interest except self-control tend to decrease with age. If self-control negatively influences bedtime procrastination, it is likely that both variables move in the opposite direction when looking at age groups. As expected, the mean self-control score increases with age. Results from ANOVA analyses presented in Table B1 in Appendix B show significant differences between categories of the age variable for all variables of interest. To get a more detailed look on which exact age groups differ significantly, a Tukey post hoc test was performed. As can be seen in Table B2 in Appendix B, for all variables interest, participants aged 0-17 and 18-25 differed significantly from participants aged 41 and up. It is not unsurprising that children and adolescents differ in general behaviour compared to older participants. Because the variables of interest in the regression models may vary depending on the categories of baseline characteristics, there will be checked for potential significant interaction effects in the "Main regression results" paragraph.

Cronbach's alpha

As mentioned in the introduction, all four questions scales were tested for reliability using Cronbach's alpha. This statistic measures how closely the questions within a scale are related as a group. Although many researchers name different alpha values for a reliable scale, it is generally assumed that an alpha higher than 0.7 is acceptable (Cortina, 1993). The BPS, PSS, SCS and desire for me-time scale all showed good reliability with alphas even higher than 0.8, as can be seen in Table 3. Because of this high internal consistency, the scores for these scales can be assigned to their respective variables by computing the mean score for each scale.

Table 3 Cronbach's Alpha for all question scales.

Question scale	**Cronbach's alpha**	**Number of questions**
Bedtime procrastination scale	0.884	9
Perceived stress scale	0.892	10
Self-control scale	0.826	13
Desire for me-time scale	0.823	9

Main regression results

As mentioned before, correlations are computed between both stress and desire for me-time and bedtime procrastination, to check if either of the variables is associated with bedtime procrastination. The correlation between stress and bedtime procrastination is 0.317 ($p = 0.0002$) and the correlation between desire for me-time and bedtime procrastination is 0.259 ($p = 0.002$). As expected, both correlations are positive and significant and now further regressions will be executed to test the first two hypotheses.

Table 4 Regression results of relationship between bedtime procrastination and variables of interest and baseline characteristics

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
1. Self-control	-0.732***				-0.695***
	(0.184)				(0.190)
2. Desire for me-time		0.328*		0.168	0.272
		(0.167)		(0.185)	(0.179)
3. Stress			0.428**	0.353*	0.158
			(0.164)	(0.184)	(0.183)
4. Age (base = 18-25 years old)					
0-17 years old	0.117	0.0352	0.142	0.0760	-0.00876
	(0.397)	(0.421)	(0.410)	(0.417)	(0.398)
26-40 years old	-0.314	-0.319	-0.147	-0.176	-0.246
	(0.413)	(0.432)	(0.432)	(0.434)	(0.414)
40+ years old	-0.628	-0.689*	-0.537	-0.513	-0.404
	(0.394)	(0.415)	(0.419)	(0.420)	(0.402)
5. Female	0.227	0.0648	0.0551	0.0215	0.0951
	(0.200)	(0.215)	(0.211)	(0.214)	(0.205)
6. Occupation (base = student)					
Employed	-0.392	-0.501	-0.516	-0.514	-0.404
	(0.363)	(0.378)	(0.374)	(0.374)	(0.358)
Other	-0.483	-0.548	-0.586	-0.553	-0.412
	(0.553)	(0.578)	(0.570)	(0.571)	(0.547)
7. Time of day (base = afternoon)					
Morning	0.360	0.397	0.491	0.459	0.345
	(0.391)	(0.409)	(0.404)	(0.406)	(0.389)
Evening	-0.359	-0.237	-0.221	-0.225	-0.351
	(0.223)	(0.230)	(0.228)	(0.228)	(0.220)
Night	1.820***	1.855***	1.973***	1.967***	1.915***
	(0.605)	(0.632)	(0.628)	(0.628)	(0.600)
(Constant)	6.873***	4.145***	3.703***	3.558***	5.814***
	(0.568)	(0.413)	(0.484)	(0.510)	(0.785)
Observations	138	138	138	138	138
F-statistic	5.88	4.32	4.71	4.35	5.50
Model significance	0.000	0.000	0.000	0.000	0.000
Adjusted R-squared	0.263	0.195	0.213	0.212	0.283

Notes: Standard errors can be found in parentheses. Furthermore, *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table 4 shows the results of all performed multiple regressions. As mentioned in the analysis plan, the first three models contain only the dependent variable, baseline characteristics and one of the variables of interest (self-control, stress or desire for me-time). Model 1 and 3 both show significant effects of respectively self-control ($p = 0.000$) and stress ($p = 0.010$). However, Model 2 shows that the variable for desire for me-time is only marginally significant ($p = 0.052$). Furthermore, the effect of self-control on bedtime procrastination is noticeably more significant than that of stress of desire for me-time. It can be seen that, when they are the only variables of interest in the model, higher stress and desire for me-time increase bedtime procrastination, whereas higher self-control decreases bedtime procrastination. This confirms hypotheses 1 and 2, because it shows a positive association of both stress and desire for me-time and bedtime procrastination.

However, Model 4 shows that the effect of desire for me-time on bedtime procrastination becomes insignificant ($p = 0.365$) when the variable for stress gets added to the model. Additionally, the effect of stress on bedtime procrastination becomes less significant in this model ($p = 0.057$). This hints at omitted variable bias in Model 2, eliminating desire for me-time as a serious potential cause for bedtime procrastination. To further test how strong stress and desire for me-time depend on each other, an interaction-term of stress and desire for me-time was added to Model 4. As mentioned before, the description of revenge bedtime procrastination predicts that this interaction-effect is significantly positive. The results from this interaction model can be found in Table B3 in Appendix B. As can be seen, the coefficient of the interaction-term is nearly zero and is insignificant ($p = 0.758$). Therefore, there is no significant interaction effect of stress and desire for me-time on bedtime procrastination.
Next, if the variable for self-control is added to Model 4, both stress and desire for me-time become insignificant. The effect of self-control on bedtime procrastination, however, is still significantly negative, as can be seen in Model 5 in Table 4. A one-point increase in the self-control score decreases the bedtime procrastination score with 0.695 points *ceteris paribus*. Thus, even when controlling for stress, desire for me-time and demographics, a lower self-control leads to more bedtime procrastination. Unsurprisingly, Model 5 has the highest explanatory power of all models, with an adjusted R^2 of 0.283. Furthermore, this model shows motivation for looking into the variable of self-control acting as a (partial) mediator, as stated in hypothesis 3. In the final paragraph of this section, this potential mediation will be analysed further by performing a bootstrapping procedure.

Next, throughout all models, the dummy variable for night is significantly positive. A good explanation for this, is that people who stay up till after midnight are most likely in the act of bedtime procrastination at that exact moment. Filling in the survey could have been an excuse for not having to go to bed at that moment. However, due to the low number of participants filling out the survey at night (n = 3), this effect is likely to be biased. Furthermore, though the effect of both variables are insignificant in all models, it is worth noting the difference between participants filling out the survey in the morning and those who filled out the survey in the evening. The dummy variable for morning shows a positive effect, meaning that, if the coefficient had been significant, morning-participants are more likely to engage in bedtime procrastination. The variable for evening, however, is negative implying that participants making the survey in the evening are less likely to engage in bedtime procrastination if the effect had been significant. This is more difficult to explain, but a possible explanation could be that participants experienced more cognitive dissonance in the morning than in the evening. Cognitive dissonance has been described as the situation of a person trying to make psychological inconsistencies more consistent (Festinger, 1962). Furthermore, Rabin (1994) says that the concept occurs when someone is being inconsistent with their beliefs and tries to convince themselves that their immoral behaviour is truly moral. In this case, people who engage in bedtime procrastination most likely know that it is bad for them to stay up past their bedtime, but still deliberately choose to do so. This results in psychological inconsistencies. As three of the questions on the BPS regarded the previous night, participants are reminded about a concrete situation in which they could have procrastinated. However, it should be harder for morning participants to deny that they procrastinated than it would be for evening participants, as they can vividly remember themselves procrastinating the previous night. Evening participants can deceive themselves more easily, because they are not confronted with their procrastination behaviour almost immediately after it happened.

Finally, as mentioned in the descriptive statistics section, potential interaction effects between age and variables of interest tested. The results from this regression model can be seen in Table B4 in Appendix B. The only interaction effect that was found to be significant regarded the variable for self-control. As Table B4 shows, there is a significantly positive interaction effect of 1.717 ($p = 0.023$) between self-control and the age group 18-25.

Self-control as mediator

As mentioned before, there are reasons to believe that self-control serves as a potential mediator for the effect of stress on bedtime procrastination. In other words, it is likely that the effect of stress on bedtime procrastination goes through the self-control of respondents. By performing a bootstrapping analysis, it can be further measured whether there are strong direct effects of stress on bedtime procrastination, or whether these effects mainly flow through self-control. If self-control indeed acts as a mediator for the effect of stress on bedtime procrastination, the direct effect of stress on bedtime procrastination is expected to be insignificant. Figure 1 shows the results of this bootstrapping analysis in Stata. Furthermore, all baseline characteristics as well as the variable for desire for me-time were added to the model as control variables. As expected, even though with a value of -0.266 the direct effect of stress on self-control is significantly negative (p = 0.001), the direct effect of stress on bedtime procrastination is not significant (p = 0.513). The negative effect of self-control on bedtime procrastination of -0.653, however, is highly significant (p = 0.001). This confirms that self-control, at least partially, mediates the effect of stress on bedtime procrastination, further confirming hypothesis 3. The meaning and implications of this important finding will be discussed in the next section. Full results of the mediation analysis can be found in Table B5 in Appendix B.

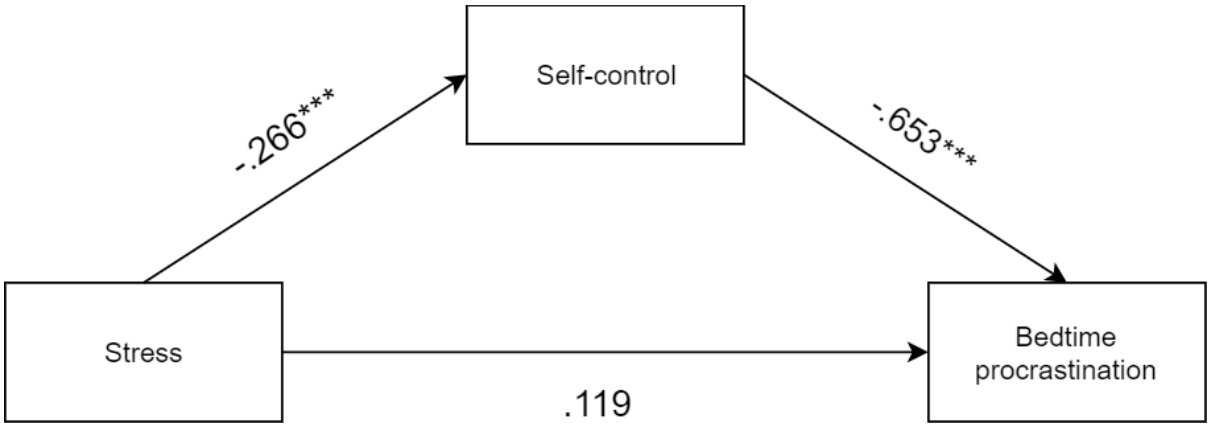

Figure 2 Direct and indirect effects of stress on bedtime procrastination.

6. Conclusion

This paper aimed to gain more knowledge on potential causes of bedtime procrastination, by trying to answer the question: *"How is bedtime procrastination influenced by stress levels and desire for me-time?"*. An online survey was conducted among the Dutch population, measuring the degrees of bedtime procrastination, self-control, stress and desire for me-time of participants and multiple regression analyses were performed with these data.

Results from multiple regression models show that there are significant influences of both stress and desire for me-time on bedtime procrastination, but solely when they are the only variables of interest in the model. A one-point increase on the PSS increases the BPS score with 0.428 points ($p = 0.010$), confirming hypothesis 1. Furthermore, a one-point increase on the desire for me-time scale increases the BPS score with 0.328 ($p = 0.052$), which confirms hypothesis 2. Therefore, people who are high in stress or have a high desire for me-time are more likely to engage in bedtime procrastination.

Next, to answer hypothesis 3, the current research looked at the role of self-control in the process of bedtime procrastination. Results show a significantly negative effect of self-control on bedtime procrastination. This effect retains its significance even when adding stress and desire for me-time to the model. The effects of both stress and desire for me-time lose their significance in this model, however, motivating the role of mediator for self-control. A bootstrapping analysis was performed to find out whether self-control mediates the effect of stress on bedtime procrastination. Results show a significant direct effect of self-control on bedtime procrastination with a coefficient of -0.769 ($p = 0.000$), while the direct effect of stress on bedtime procrastination was merely 0.213 and was insignificant ($p = 0.240$). This proves that self-control acts as a mediator for the effect of stress on bedtime procrastination.

In summary, the current research has found that bedtime procrastination is positively associated with stress levels and desire for me-time. However, no significant direct influence of either stress or desire for me-time on bedtime procrastination has been found. Furthermore, results showed that self-control significantly negatively influences bedtime procrastination, even when controlling for stress, desire for me-time, time of day and baseline characteristics. Finally, self-control has been proven to be a mediator for the effect of stress on bedtime procrastination.

7. Discussion and limitations

Discussion

By using question scales that are widely accepted as valid in scientific literature, the variables of interest in the current study measure what they are supposed to measure. The only exception to this, is the variable for desire for me-time. As no existing literature has designed a question scale for measuring desire for me-time, the current research has made a custom scale. Although the questions within this scale, as has been shown by the Cronbach's alpha, have been proven to have a high internal consistency, this does not necessarily mean that the variable measures what it is supposed to measure. More researchers using this same scale will have to prove its validity in the future, as nothing can be said about this now. Furthermore, as questions were randomised within the scales when conducting the online survey, there is no reason to believe that, with exception of the variable for desire for me-time, the current research does not have a high internal validity.

Next, most baseline characteristics show similarities with the average Dutch population and no significant differences in variables of interest between the baseline characteristics were found. However, descriptive statistics of the variable for age show that the older age groups, namely ages 41 and up, are underrepresented in the used dataset. Because the survey was spread in the network of the author, it was expected that the sample would not be fully representative of the Dutch population. The results of the current research can therefore not be generalised for the whole of The Netherlands, which can threaten its external validity. However, when looking at the main variables of interest in this study, no significant differences in variables of interest between categorical groups of the baseline characteristics variables were found. The only exception to this is the significant differences between different times of day for the bedtime procrastination variable. The next section will go more in depth on this. Finally, the survey was spread online and was therefore accessible to the majority of the population. Of course some people in The Netherlands are unable to work with modern day technology and thus unable fill out the survey. However, it is unlikely that large specific groups of the population were excluded because of this data collection method.

Looking at the main results of the current research, the expectations were met for the most part. As expected and in line with existing literature (Kroese et al., 2014, 2016; Nauts et al., 2016; Kamphorst et al., 2018) bedtime procrastination was a common habit among participants. Some participants even reached out to me after finishing the survey to tell how much they could relate

to the questions in the BPS specifically. Furthermore, stress and desire for me-time were positively associated with bedtime procrastination and self-control was negatively associated with bedtime procrastination, which is all in line with the expectations. As mentioned in the theoretical framework, there is some discussion in scientific literature about the direction of the relationship between stress and procrastination. The current research reasoned that there could be a reverse effect of stress on procrastination in the domain of sleeping. The results of this study show how stress influenced bedtime procrastination, motivating this reverse relationship in the domain of sleeping behaviour. Therefore, not only does general procrastination increase stress, stress can in turn also increase bedtime procrastination. Furthermore, upon adding self-control to the model of bedtime procrastination, stress and desire for me-time, the effect of the latter two variables decreased. This was a reason to test for self-control as a mediator for the effect of stress on bedtime procrastination. As expected, self-control was proven to partially mediate this effect. Finally, the size of the effect of self-control in this study needs to be noted, as it dominates the findings of the current research. Not only is self-control the only significant variable of interest, its' coefficient is more than double the size of all other variables of interest in the most extensive model.

However, there are some findings that are not fully in line with the expectations of the current research. First, the effect of desire for me-time on bedtime procrastination was weaker than expected and lost its significance when added to a model with stress. As the phenomenon of revenge bedtime procrastination describes both stress and desire for me-time to lead to bedtime procrastination, it was expected that the two factors would have a significantly positive effect on bedtime procrastination even when added to the same model. Even when adding a variable for the interaction between stress and desire for me-time, this does not yield a significant effect (see Table B3 in Appendix B). Though, this could potentially be due to the customised scale that was used for measuring desire for me-time. Secondly, the finding that participants filling out the survey at night were more likely to engage in bedtime procrastination was not expected at the start of the current research. This was mainly due to the fact that time of day was not intended to be a variable in the original theoretical framework. However, two causes for this effect of making the survey at night can be reasoned. The first explanation is that people who fill out the survey at night-time are already actively procrastinating their bedtime and are therefore more likely to answer that they suffer from bedtime procrastination. The second explanation is more related to data that was collected. As only four participants ended up filling out the survey at night, this low number of observations is potentially biasing the actual effect

of night-time on bedtime procrastination. It is therefore hard to say whether the effect of filling the survey out at night is actually due to it being night-time.

Overall, the current research does not succeed in finding a novel cause for bedtime procrastination. However, it does stress the importance of more research into potential causes for bedtime procrastination in two ways. This paper will go more in depth on this in Section 8. Finally, the current research debunks the phenomenon of revenge bedtime procrastination, as stress and desire for me-time do not seem to have a significant effect on bedtime procrastination among participants when controlling for other factors.

Limitations

Similar to previous research (Kroese et al., 2014, 2016; Nauts et al., 2016; Kamphorst et al., 2018), self-control has been proven to mediate the effect of other factors on bedtime procrastination. The current research has therefore not fully succeeded in finding more potential causes for bedtime procrastination, but does find evidence against stress and desire for me-time as potential causes.

Next, as mentioned before, a potential limitation could have been the number of observations and the time of day that respondents filled out the survey. The current situation around the Covid-19 virus did not allow nor made it easy to reach a big number of respondents, though the data proved to contain enough observations to provide useful results. However, a larger dataset most likely would have been able to show even more of a true effect. Furthermore, the current data collection procedure could not make sure that participants filled out the survey at a certain time, as participants were free to choose at what time they wanted to fill out the survey. As can be seen in the results however, time of day did influence the answer of participants. A small potential explanation has been given on why different times of day lead to different answers, but more extensive thinking needs to be done before retrieving data in future research. However, it is a fact that gathering data from participants at the same time of day makes sure there are no differences in effects due to time of day, therefore leading to more pure results and a more reliable conclusion.

Next, the current research has provided a question scale designed for measuring desire for me-time in both English and Dutch. Although the Cronbach's alpha test showed positive results, nothing can be said about the internal validity of this scale. The current research fails to prove

whether the scale actually measures what it aims to measure. Therefore, the results about the variable for desire for me-time could be misleading.

8. Recommendations

Future research

The data of the current research show that the majority of participants procrastinates their bedtime, most likely leading to insufficient sleep. Existing literature mentioned in the introduction shows the serious health implications that insufficient sleep can have. Future research should focus on finding more causes for bedtime procrastination, as nothing so far points in the direction that low self-control is the only cause. Secondly, similar to previous research, self-control has been proven to be a mediator for the effect of certain factors on bedtime procrastination. However, it is still hard to tell how big the effect of self-control on bedtime procrastination is. Further research is necessary to measure the strength of this effect.

Governmental policy and healthcare

In addition to scientific research, the current research can also provide recommendations for healthcare companies and governments. Not only has the significant negative effect of self-control on bedtime procrastination been reproduced, the current research also confirms that self-control acts as a mediator for another factor (namely stress). By showing more negative consequences of low self-control, the current research increases the importance of looking into ways to improve self-regulatory skills by health companies. Healthcare providers could for example look more into providing coaching and training to support people with low self-regulatory skills. It has been proven that a small amount of practice of self-control activities can already increase the self-regulatory skills of adults (Muraven, 2010). Furthermore, governments should consider spending more time on developing self-regulatory skills for children in school. Meichenbaum & Goodman (1971) show that self-control skills of children in kindergarten and elementary school can be increased by simple training. This can prevent children from experiencing behavioural health issues such as bedtime procrastination at a later age.

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10. Appendix

Appendix A: Question scales survey

Bedtime procrastination scale

1. Yesterday, I went to bed later than I had intended.
2. I go to bed early if I have to get up early in the morning. (reverse coded)
3. If it is time to turn off the lights at night I do it immediately. (reverse coded)
4. Yesterday, I was still doing other things when it was time to go to bed.
5. I easily get distracted by things when I actually would like to go to bed.
6. I did not go to bed on time yesterday.
7. I have a regular bedtime which I keep to. (reverse coded)
8. I want to go to bed on time but I just do not.
9. I can easily stop with my activities when it is time to go to bed. (reverse coded)

Note that questions 2, 3, 7 and 9 are reverse scored.

Perceived stress scale

1. In the last week, how often have you been upset because of something that happened unexpectedly?
2. In the last week, how often have you felt that you were unable to control the important things in your life?
3. In the last week, how often have you felt nervous and "stressed"?
4. In the last week, how often have you felt confident about your ability to handle your personal problems?
5. In the last week, how often have you felt that things were going your way?
6. In the last week, how often have you found that you could not cope with all the things that you had to do?
7. In the last week, how often have you been able to control irritations in your life?
8. In the last week, how often have you felt that you were on top of things?
9. In the last week, how often have you been angered because of things that were outside of your control?
10. In the last week, how often have you felt difficulties were piling up so high that you could not overcome them?

Note that questions 4, 5, 7 and 8 are reverse scored.

Brief self-control scale

1. I am good at resisting temptation
2. I have a hard time breaking bad habits
3. I am lazy
4. I say inappropriate things
5. I do certain things that are bad for me, if they are fun
6. I refuse things that are bad for me
7. I wish I had more self-discipline
8. People would say that I have iron self- discipline
9. Pleasure and fun sometimes keep me from getting work done
10. I have trouble concentrating
11. I am able to work effectively toward long-term goals
12. Sometimes I can't stop myself from doing something, even if I know it is wrong
13. I often act without thinking through all the alternatives

Note that questions 1, 6, 8 and 11 are reverse scored. Additionally, the variable for self-control was created by reversing the whole scale after reverse scoring the aforementioned questions, meaning that a higher value of this variable means that a person has more self-control.

Desire for me-time scale

1. In the past week I needed more leisure time.
2. Today I took enough (small) breaks to keep myself happy.
3. I find it important to take time off for myself.
4. Besides my job and/or study, I have enough time for activities that I like doing.
5. In the past week I felt like I needed more leisure time.
6. During my work and/or study I often desire a break.
7. Only in the weekends I can fully live up to my desire for free time.
8. I find my life too busy.

9. At the end of the day, I desire for more me-time than there is still available that day.

Note that questions 2 and 4 are reverse scored.

Author's notes on designing the desire for me-time scale:

To make it less obvious to respondents what the aim of the scale is, the word "me-time" is substituted for "leisure time" or "free time" in some of the questions. Furthermore, by relating some questions (specifically questions 2, 4, 6 and 8) to work and study, the scale emphasizes the difference between work/study time and actual free time. As people can really enjoy their study or work, it may feel as if the time spent doing these activities is actual leisure time. However, it can be reasoned that even if work or study gives joy and happiness, time spent on it does not provide actual relaxation or rest to a person. Furthermore, during work hours most people are still surrounded by co-workers or classmates, preventing them from experiencing actual alone time.

Appendix B: Additional results from performed analyses

Table B1 ANOVA analysis results for variables of interest and categorical variable age

Variable	**F-statistic**	**P-value**	**Degrees of freedom**
Bedtime procrastination	7.32	0.0001	137
Stress	10.02	0.000	137
Desire for me-time	6.69	0.0003	137
Self-control	7.22	0.0002	137

Table B2 Significant Tukey post hoc test results for all variables of interest and categorical variable age

Variable	**Contrast**	**Std. Err.**	**P-value**
Bedtime procrastination			
41+ vs 0-17	-1.291	0.443	0.021
41+ vs 18-25	-1.059	0.250	0.000
Stress			
41+ vs 0-17	-0.719	0.227	0.010
41+ vs 18-25	-0.673	0.129	0.000
Desire for me-time			
41+ vs 0-17	-0.882	0.228	0.001
41+ vs 18-25	-0.446	0.129	0.004
Self-control			
41+ vs 0-17	0.626	0.193	0.008
41+ vs 18-25	0.470	0.109	0.000

Table B3 Regression results of interaction effect of stress and desire for me-time on bedtime procrastination

Variable	Model 4a	
1. Desire for me-time	-0.185	(0.605)
2. Stress	0.0432	(0.537)
3. Stress x Desire for me-time	0.147	(0.240)
4. Age (base = 18-25 years old)		
0-17 years old	0.0585	(0.419)
26-40 years old	-0.168	(0.435)
40+ years old	-0.508	(0.421)
5. Female	0.013	(0.215)
6. Occupation (base = student)		
Employed	-0.515	(0.375)
Other	-0.601	(0.578)
7. Time of day (base = afternoon)		
Morning	0.445	(0.408)
Evening	-0.232	(0.229)
Night	1.805***	(0.683)
(Constant)	4.281***	(1.286)
Observations	138	
Adjusted R-squared	0.277	

Notes: Standard errors can be found in parentheses. Furthermore, *** for p<0.01, ** for p<0.05 and * for p<0.1.

Table B4 Regression results of interaction effect of self-control and age variable on bedtime procrastination

Variable	Coefficient	Std. Error
1. Desire for me-time	0.146	(0.177)
2. Stress	0.224	(0.178)
3. Self-control	-2.002***	(0.705)
4. Self-control x Age (base = 0-17 years old)		
18-25 years old	1.717**	(0.744)
26-40 years old	0.318	(0.818)
40+ years old	1.469	(0.828)
(Constant)	9.293***	(1.991)
Observations	138	
Adjusted R-squared	0.330	

Notes: Standard errors can be found in parentheses. Furthermore, *** for p<0.01, ** for p<0.05 and * for p<0.1. Furthermore, due to practical reasons only the variables of interest and the interaction-terms are displayed. The computed model also included all other baseline variables and can be derived using the data and do-file.

Table B5 Results from mediation analysis

Variables	(1) Direct effect on self-control	(2) Direct effect on bedtime procrastination
Self-control		-0.653***
		(0.191)
Stress	-0.266***	0.119
	(0.0781)	(0.182)
Desire for me-time	0.127	0.239
	(0.0786)	(0.178)
Age	0.125*	-0.143
	(0.0730)	(0.165)
Gender	0.104	0.0651
	(0.0927)	(0.209)
Occupancy	0.0743	-0.293
	(0.112)	(0.252)
Time of day	-0.0597	-0.0997
	(0.0643)	(0.145)
Observations	138	138

Notes: Standard errors can be found in parentheses. Furthermore, *** for p<0.01, ** for p<0.05 and * for p<0.1.