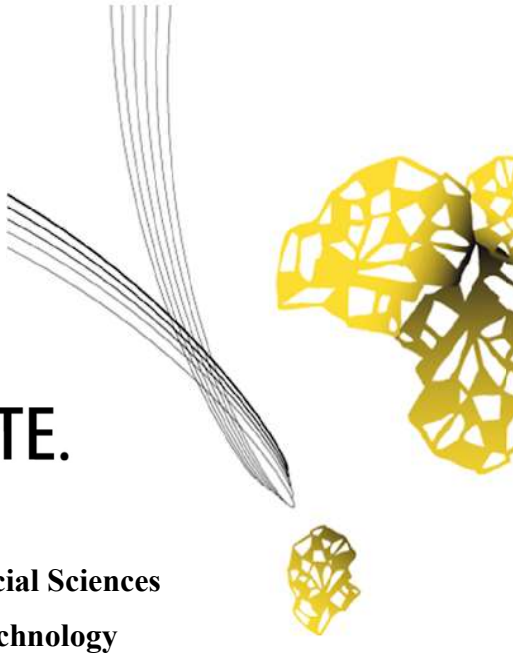

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Control yourself!
How is state self-control related to anxiety and trait self-control in students?

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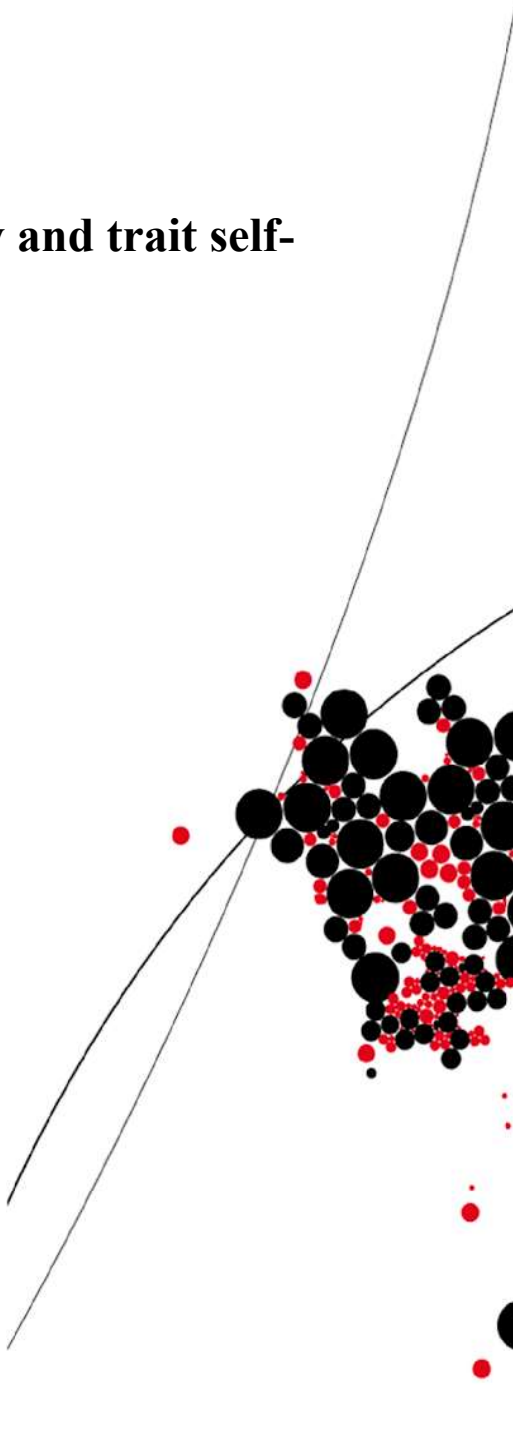


Abstract

Background: Low self-control can lead to adverse outcomes, such as higher risk for depression or loneliness. This is especially predominant in students. Another common problem among students is anxiety, as 50% - 70% experience it. Recent literature found an association between anxiety and self-control, yet not all facets of this relation have been explored. Specifically, both anxiety as well as self-control, can be divided into trait and state concepts and research has widely focussed solely on trait self-control, resulting in a gap in research about state self-control. **Objective:** The goal of this study is to understand the association between state control and anxiety. The association between state self-control and state anxiety was investigated, as well as the relation between state self-control and trait self-control. Further, the study aimed at answering how trait anxiety is related to state self-control, compared to state anxiety. **Methods:** The study was conducted in a sample of 35 university and college students with different nationalities, who were between 18 and 25 years old. To examine longitudinal data, the experience sampling method was used, administered via mobile devices. Over 15 days, the participants answered three short questionnaires per day to assess their state levels of anxiety and self-control. For measuring trait levels of both constructs, participants filled out questionnaires three times in total, namely, the Brief Self-Control Scale and the Hospital Anxiety and Depression Scale. **Results:** The results indicated a significant positive association between state self-control and trait self-control and a significant negative correlation between state self-control and state anxiety. Results further show that state anxiety is associated both with differences in anxiety between participants (between-person effect) and day to day differences in anxiety within one single individual (within-person effect), yet the correlation between trait anxiety and state self-control is stronger. **Discussion:** Besides the results, data show high levels of anxiety in the sample, as well as stronger fluctuations of state self-control in people low on trait self-control, than in people high on trait self-control. Self-control can be separated into multiple subtypes, which were not considered in this study, but should be included in future research. Further, after the Covid-19 pandemic ended, comparative studies should be conducted to investigate differences and impacts.

Keywords: state self-control, trait self-control, state anxiety, trait anxiety, ESM, experience sampling method

Introduction

"Just one more episode", "Just one beer and then I'll leave", "I'll just wake up early tomorrow and do it then", and the list with similar sentences could probably be extended on and on. However, those are just some exemplary statements that most people recognize but still catch themselves to watch at least the next episode as well, get too many drinks or sleep in the next day. Nonetheless, these patterns of behaviour are familiar to most people, at least to a certain extent (Guan & He, 2018). As a matter of fact, these are examples of what happens when self-control fails; we do not stick to our goals and intentions (Muraven et al., 2005). Generally, self-control can be understood as "the process of controlling and altering predominant responses in order to bring them in line with social or individual norms" (Englert et al. 2011, p. 1), meaning to suppress one's immediate impulses to reach a higher-end goal. Exhibiting high levels of self-control is especially essential for university and college students, as they often experience a vast workload, which they must coordinate and integrate into their schedule (Rubio-Valdehita et al.). Further, the amount of guidance on their learning process has decreased, compared to high school, meaning that not only the amount of work has increased, but also, the demand to work more independently, which is straining for self-control as well (Honken & Ralston, 2013). Having low self-control can bear multiple problems, such as procrastinating, overeating, or binge drinking, which in turn might result in physical and psychological problems, ranging from obesity to higher risk for depression and isolation (Moreno & Rajiv, 2011; Newcomb & Locke, 2005). Another frequent problem among students is anxiety and in fact, literature indicates an association between self-control and anxiety (Bertrams et al., 2010; Englert et al., 2011; Eisenberg et al., 2010). Indeed, between 50% and 70% of college students experience anxiety to a certain extent at some point during their studies (Regehr et al., 2013). The consequences of the heightened anxiety can reach any area of their lives, whether it is social, academic, or internal. Even though low self-control as well as high anxiety appear to be common in students, not much research has been conducted about all facets of this relationship. Therefore, the focus of this investigation lies in the interaction between self-control and anxiety in students.

First, it is important to fully understand the concepts of self-control and anxiety. Self-control can be divided into trait self-control and state self-control (Schmeichel & Zell, 2007). Trait self-control is the more commonly studied type, which is viewed as relatively stable throughout life and often viewed as part of the personality (Guan & He, 2018). State self-control can fluctuate to a great extent throughout the day, meaning that state self-control can

easily be influenced by a range of determinants, regardless of whether they are environmental, interpersonal, or internal, such as emotions like anxiety (Guan & He, 2018). As state self-control is reactive towards emotions such as anxiety, trait self-control is rather stable and therefore cannot be evoked or declined by emotions, which makes the distinction between the two types of self-control necessary, in order to analyse any interaction with anxiety.

Generally spoken, anxiety is an emotion, which is activated when under stress. It is often displayed by symptoms that resemble mild panic attacks, like tension, an irritating feeling, increased heart rate, irrational thoughts which can be difficult to control, and sometimes shaking, to name just a few (Craske et al., 2011). To a certain extent, everybody experiences this feeling at some point in their lives. Whether it is before an important presentation, when heading to a job interview, or when they are on the last try of an important exam. The distinction between a trait and state construct is also applicable for anxiety. Like self-control, also for anxiety, it can be differentiated between trait anxiety and state anxiety. Trait anxiety describes the general tendency of a person to be anxious or to respond in anxious ways, such as experiencing fear which is above average in a situation (Endler & Kocovski, 2001). On the contrary, even though trait anxiety is a predisposition of state anxiety, state anxiety is an immediate emotion, which is evoked by environmental, social, or internal stimuli (Endler & Kocovski, 2001). To understand the differences between trait and state concepts is crucial to fully understand the relationship between self-control and anxiety in all facets. To be more precise, investigating whether e.g., only the state concept is associated but not the trait concept, or if trait and state anxiety and self-control are all related equally, can bring insight about whether trait and state concepts measure the same. It could lead to misleading results if this distinction is ignored. In brief, both anxiety and self-control can be divided into trait and state concepts, whereby trait anxiety/self-control describes the general tendency to react in a certain way and state anxiety/self-control can fluctuate throughout the day and is easily influenced.

So far, many studies about self-control focus solely on trait self-control, whereas state self-control is not much known about yet, nor about the association between the two types of self-control. The relations between trait self-control and numerous different constructs and behaviours, such as anxiety, have been in the focus of researchers for decades. So far, mainly the consequences of losing self-control were analysed instead of identifying determinants that contribute to the temporary but rapid loss of self-control (Baumeister et al., 2007). This is caused by the fact that state self-control is a relatively new discovered aspect of self-control, where respectively few is known about yet (de Ridder et al., 2018). In a meta-analysis by de

Ridder and colleagues (2018) about integrating findings of trait self-control onto state self-control, they argued that trait and state self-control show clear congruences, yet discrepancies are evident as well, which are not well-researched nor fully understood yet. They argue that trait self-control is often viewed under the focus of underlying mechanisms, whereas studies about state self-control mainly aim at analysing consequences of self-control failure. Based on this discrepancy, the direct connection between the two constructs has rarely been investigated (de Ridder and colleagues, 2018). Nevertheless, some studies have been preoccupied with the topic to what extent trait and state self-control are related. Guan and He (2018) indicate that there is a strong positive correlation between the two constructs, whereas Schmeichel and Zell (2007) argue for only moderate correlation. Showing that literature generally indicates a positive relation between trait and state self-control. Divergent findings of de Ridder and others (2018), Guan and He (2018), and Schmeichel and Zell (2007), support the notion of studying both state and trait self-control, which is intended to be tackled by this study. Thus, next to analysing self-control and anxiety, also the relationship between trait self-control and state self-control will be examined.

As implied in the beginning, literature suggests an association between self-control and anxiety, but not all facets have been studied. Multiple studies indicate that trait anxiety is associated with the loss of state self-control, whereas the focus on state anxiety was omitted (Englert et al., 2011; Bandura, 2007). State self-control can be reactive to spontaneous triggers, but trait anxiety is rather stable and can hardly serve as a trigger, whereas state anxiety is fluctuating as well, and therefore might trigger changes in state self-control. An inclusion of it might have led to different results or solely would have enrich the findings by stating that trait and state anxiety behave similarly in that context. Nevertheless, a study by Bertrams and colleagues (2010) argued for a different association between anxiety and self-control. To be more precise, they found evidence that state self-control mediates the relationship between trait and state anxiety, meaning that trait and state anxiety are related, only if state self-control is low, but not when state self-control was high. Their study supports the existence of an association between self-control and anxiety, whereas other facets of the constructs were focussed on than in this current investigation. To be more precise, state self-control is included but not explicitly focussed on, as the main construct is anxiety, showing again the need for further investigation about state self-control. Further, they found that trait anxiety and state anxiety are not necessarily related (in test situations) (Bertrams et al., 2010). This underlines that trait and state anxiety might indeed measure separate concepts, suggesting that studies about anxiety in general, such as of Bandura (2007) could have missed

important aspects about the impact of anxiety on self-control. This is caused by the fact that anxiety was not separated into the different subtypes, and it cannot be ensured which type was measured. To fully grasp state self-control and anxiety in relation, it is therefore crucial to examine the subtypes, trait, and state anxiety, separately.

Current Research

This study aims at investigating state self-control, by assessing the association between state self-control and trait self-control, as well as understanding the relation between state self-control and anxiety, both on state and trait level. Both trait concepts will be measured via established questionnaires. State self-control and state anxiety will be examined via an experience sampling method (ESM), where participants indicate their current mood multiple times per day over two weeks. Based on literature, three research questions were established. Furthermore, single individuals will be under additional observation to see how state self-control behaves among people high on trait self-control and in people who are low on trait self-control. The first research question concerns solely the subtypes of self-control, and it is hypothesized that people high on trait self-control also exhibit high levels of state self-control. The second research question includes anxiety as well, and here it is expected that a person that shows low state self-control, simultaneously shows high state anxiety levels. For the last research question, it is hypothesized that state anxiety can better predict state self-control, than trait anxiety.

Research question 1

To what extent trait self-control and state self-control related?

Research question 1.2

How does state self-control fluctuate over time in single individuals?

Research question 2

To what extent are state self-control and state anxiety related?

Research question 3

To what extent does trait anxiety predict state self-control compared to state anxiety?

Methods

Design

This overall investigation was a collaborative study where multiple constructs, in relation to self-control, were tested simultaneously, namely anxiety, fatigue, perfectionism, and pro-social behaviour. In this paper, however, the focus lies solely on anxiety in relation to self-control, meaning that only material relevant for anxiety and self-control will be discussed in the following. To measure trait self-control the Brief Self-Control Scale by Tangney, and colleagues (2004) was used. For measuring trait anxiety, the Hospital Anxiety and Depression Scale by Zigmond and Snaith (1983) was included. To analyse the state data, the experience sampling method (in the following referred to as ESM) was worked with.

ESM is a method to measure behaviour, thoughts, and states while they are occurring through the usage of systematic self-reports (Myin-Germeyes et al., 2018). As data was collected during daily life experiences in the participant's natural environment, it provides a more accurate representation of the participants' natural behaviour, in comparison to the artificial laboratory environment (Van Berkel et al., 2017). Further, ESM generally allows for investigating internal states and the intensity or frequency of those (Csikszentmihalyi & Larson, 2014). As the focus in this research lies on self-control and anxiety, solely internal events were measured. Meaning the amount of self-control that participants had at a given moment of time, was analysed, as well as the intensity of the experienced anxiety in the same moment.

In this study a time-contingent design was used through the utilization of state questionnaires for both, self-control, and anxiety, which were administered daily. This duration was chosen based on recent findings that advocate a period of two weeks for ESM on mobile devices (Van Berkel et al., 2017). Van Berkel and colleagues (2017) argued that in this time span, the average person undergoes a sufficient variety of states, which results in valid measurements. Further, they advocate that the frequency of questionnaires should be between three and five times per day, to get sufficient data yet to not unnecessarily burden the participants. In case of a 100% response rate, this would result in a total number of 45 data points for state measurements and an additional 3 measurements for each trait. This study was approved by the Behavioural, Management and Social Sciences' ethics committee of the University of Twente with the request number 210672.

Participants

The target group in this study were university and college students. All participants were within the researcher's social contacts and were therefore approached through the usage of convenience sampling and snowball sampling. Therefore, criteria for inclusion were being between 18 and 25 years old, being officially registered as a student at a higher-educational institution and participants had to indicate that they have a sufficient understanding of the English language. Moreover, data were only included when a response rate of 50% or higher was given, as this is the common threshold for ESM studies (Conner & Lehman, 2012).

The study was conducted by a sample of 61 students. Out of these 61 participants, 26 participants needed to be excluded, meaning the final sample size consisted of 35 individuals. Most excluded participants (n=21) were removed due to incomplete or missing answers to the demographic questions, including the informed consent. Additionally, other participants (n=4) got excluded because they did not meet the inclusion criterion of being registered as a student. The age range of the participants was between 18 and 25 (M_{age} = 22) and 25 identified as female, 11 stated to be male. Furthermore, 3 of the participants were Dutch, 32 were German, and 1 had another nationality, namely Lithuania. Out of these 36 participants, 32 indicated to have finished high school with VWO or Abitur as highest educational graduation, and 4 participants stated to have completed their Bachelors.

Measurements and Materials

Experience Sampling Method (ESM)

This study was conducted via the online application *Ethica,* which was administered through the participant's mobile phones. *Ethica* is an online platform which is designed for researchers to create, modify, and distribute their surveys (ethicadata.com). Once a study is set-up, participants can complete the surveys using any form of digital devices (e.g., smartphones, tablets, etc). *Ethica* is especially convenient for the usage of ESM, as it allows for iterative exposure to surveys. Generally, ESM is used for measuring state data by gathering data multiple times throughout the day for a longer period (Larson & Csikszentmihalyi, 2014). As for the time of response, *Ethica* makes use of a variety of triggering logics. With these triggering logics, a fixed time or time-period can be set on which the participants need to answer the given surveys. Additionally, pop-up notifications can be used to give participants a reminder on when a specific activity (e.g., survey) needs to be completed. This was done to increase functionality of the study and encouragement to fill out the provided surveys, by erasing participants' burden to remember the surveys themself (Consolvo & Walker 2003). Functions of *Ethica* like clarity of user interface, notifications,

functionality of surveys and response functionality were repeatedly tested and adapted by the researchers before the studies' deployment. Regarding the psychometric properties of ESM, it holds good reliability as well as validity (Csikszentmihalyi & Larson, 2014). The ESM was used to investigate state self-control and state anxiety. Therefore, nine items were stated, seven regarding self-control and two aimed at measuring anxiety, which are elaborated on and explained below. See table 1 for a shortened overview or see Appendix A for a full report of the items.

Self-Control. State self-control was measured daily using seven items (see Table 1). Generally, self-control can be separated into multiple sub-categories, namely ego depletion, goal directedness and inhibitory self-control (Baumeister et al., 2019; Tornquist et al., 2019; Simons et al., 2016). However, this distinction was not relevant for this research about self-control and anxiety thus the distinction is not considered in this study. Nevertheless, the first three questions were formulated by Baumeister and colleagues (2019) as to measure the ego-depletion process an individual can experience. The questions could be answered on a 5-point Likert-Scale, ranging from 0 (*Not at all*) to 4 (*Very much so*). Question four to seven measured the concepts of goal-directedness and inhibitory self-control. These questions were newly created, based on work by Tornquist and Miles (2019) and Simons and colleagues (2016). Questions four and five concern self-control goal-directness and question six and seven the inhibitory aspect of self-control. These questions could be given answers to, based on a 5-point Likert-Scale, ranging from 0 (*Not at all*) to 4 (*Very much so*).

Anxiety. To measure state anxiety, two items were used. These items were based on a combination out of different commonly used questionnaires, which were the State-Trait Anxiety Inventory for Adults by Spielberger and the HADS-A, whereas the questions were rephrased to fit the state measurements (Spielberger, 2010). The question could be answered via a 5-point Likert scale, ranging from 0 (*Not at all*) to 4 (*Very much*).

Table 1

Daily questions for state measurements

Self-Control: Ego depletion	Self-Control: Goal-directedness	Self-Control: Inhibition	Anxiety
1. In the past couple of hours, have you felt that it is hard to	4. In the past couple of hours, how easy was it for you to do	6. In the past hour, how easy was it for you to	1. Right now, I feel worried about something.

make up your mind about even simple things?	something "good" that you did not really want to do?	refrain from doing something "bad" you really wanted to do?	
2. In the past couple of hours, have you felt that things are bothering you more than they usually would?	5. In the past couple of hours, I was able to stick to my goals.	7. In the past few hours, I was able to resist temptations.	2. Right now, I feel comfortable. (Inverted)
3. In the past couple of hours, have you felt that you have less mental and emotional energy than you normally have?			

Brief Self-Control Scale

Trait self-control was measured via the Brief Self-Control Scale (BSCS) by Tangney, Baumeister and Boone (2004). This scale is a questionnaire that assesses one's degree of trait self-control based on thirteen different items (see Appendix B) on a 5-point Likert-Scale scaling from 0 *(Not at all)* to 4 (*Very much*) (Tangney et al., 2004). The 13-Item Brief Self-Control Scale questionnaire covers multiple aspects of self-control, including task performance, impulse control, psychological adjustment & self-esteem, interpersonal relationships, personality features and moral emotions. The 13-Item Brief Self-Control Scale was used because it is one of the most common and effective instruments for measuring self-control and by now, the longer version has become almost obsolete (Manapat et al., 2021). Furthermore, its length was appealing, since participants must fill in multiple questionnaires per day in this research and an excessive number of questions would have resulted in a lowered participant engagement (Cairns, 2013). As for the internal consistency of this survey, it was proven to be adequate ($\alpha = .87$) (Tangney, Baumeister & Boone, 2004). As for the test-

retest reliability the 13-Item Brief Self-Control Scale scored high as well (r = .87) (Tangney, Baumeister & Boone, 2004). Based on our findings, the internal validity was concluded to be good.

Hospital Anxiety and Depression Scale

Trait anxiety was investigated via the Hospital Anxiety and Depression Scale (HADS) by Zigmond and Snaith (1983). It is a 14 -item scale, based on a 4-point Likert-Scale ranging from 0 (*Not at all)* to 3 (*Most of the time)* (see Appendix C). The HADS can be divided into two subscales, with 7 items each, the HADS-D for depression, and the HADS-A for anxiety. In this study, only the HADS-A was used as the focus is on anxiety. Its short length was expected to increase the participants willingness to engage in the study (Cairns, 2013). Furthermore, literature indicated that the HADS-A is commonly used as a stand-alone measurement in research studies (Julian, 2011). The HADS-A also has excellent psychometric properties. To be more precise, the HADS-A has a Cronbach's alpha with a mean of .84 and an excellent balance between specificity and sensitivity, resulting in an accurate measurement of anxiety, without missing or including false cases. The questionnaire indicated good internal consistency. Correlations between the HADS and comparable questionnaires are adequate (Bjelland et al., 2001). Therefore, the HADS-A indicated an adequate fit to measure trait anxiety in this context.

Procedure

Before launching the study

Participants were asked to download the *Ethica* application on their smartphone using their email address and a study code which was provided by the researchers in advance. In *Ethica,* participants received a Welcome message with a description of the study (see Appendix D). Additionally, they were asked to give *Ethica* permission to use the notification function on their smartphone (iOS/ Android). Finally, the subjects were informed to contact the researchers regarding any problems with the *Ethica* application or the study itself.

Day 1

An overview of the 15 days study is provided in Table 2. The study officially started on April 27th, 2021. First, participants were asked to fill out a demographic survey, followed by the informed consent (see Appendix F). Generally, after the participants completed a survey, they were provided with a positive message in which the researchers continuously

thanked them for their participation, both after trait and state questionnaires. This was aimed at increasing and maintaining high response rates and a positive attitude towards the study in general. This was also done more extensively at the completion of the whole study.

Day 3-7 & 9-14

Throughout the study, participants were asked to fill out state questionnaires three times a day during time intervals in the morning, afternoon, and evening (9 a.m. – 12 a.m.; 1 p.m. – 4 p.m.; 8 p.m. – 11 p.m.). During these time slots, participants were notified to answer the questionnaire in variable randomized timeframes via the received notifications. When the app requested the completion of said questions, it sent a notification every half hour to ensure that participants fill in their responses. The order in which the question blocks of each survey were displayed was randomized too, to prevent biases with data collection. This ensured that all question blocks receive on average the same amount of attention. Participants were only able to answer the questionnaire during the corresponding timeslot, after which the questionnaire expired. This prevented participants from filling out all surveys at the end of the day. Thereby, it is ensured that all data reflects participants' experience at that moment of data collection rather than participants' (potentially biased) memory of events.

Day 2, 8 & 15

On the second day, after one week of the study, as well as at the very end, the participants were asked to fill in the trait questionnaires. Still, the daily questions were asked as well. Therefore, on these three days there was a larger workload, as the trait and state questions were asked simultaneously. They were asked to fill out the trait questionnaires of self-control (BSCS) and anxiety (HADS-A). This procedure was repeated at the first, the eighth and the fifteenth day since the starting point of the study for each participant. The trigger for the trait measurements were set between 12 a.m. and 1 p.m. After the last questionnaire is filled out on day 15, the participants receive a more extensive thank-you message from the researchers. The study terminated on May 12th, 2021.

Table 2

Overview of study activities

Day 0	Day 1	Day 3-7 Day 9-14	Day 2, 8, and 15

Morning 9 a.m. – 12 a.m.	1. Instalment of *Ethica* 2. Registration in *Ethica* with e-mail and study code	1. Demographic questions and confirming the informed consent	State measurements: 1. ESM items about state self-control and state anxiety	State measurements: 1. ESM items about state self-control and state anxiety
Afternoon 1 p.m. - 4 p.m.	3. Welcome message		State measurements: 2. ESM items about state self-control and state anxiety	State measurements: 2. ESM items about state self-control and state anxiety Trait measurements: 2. Brief Self-Control Scale 3. Hospital Anxiety and Depression Scale: subscale anxiety
Evening 8 p.m. – 11 p.m.			State measurements: 5. ESM items about state self-control and state anxiety	State measurements: 8. ESM items about state self-control and state anxiety

Data Analysis

The results were analysed by means of the software program *IBM SPSS Statistics* (Version 26). Before starting the analysis, the data were imported from *Ethica* into *SPSS*. The design of this investigation resulted in numerous measurements from multiple participants each, therefore, means scores were calculated to sort the data in order to analyse them. For the trait score, first, the same items out of the three trait measurements were combined into one mean score per item per participant. Second, these item-means were combined into one mean score as well, resulting in one mean for trait anxiety and one mean for trait self-control per person. To analyse the state scores, for each time point (n= 45: three per day for 15 days) one mean score for state anxiety and one score for state self-control was calculated, based on all items, resulting in 45 different mean scores for state anxiety and state self-control per participant.

From this, the person mean (PM) was calculated, to investigate the between-person effect. By this, a comparison between the different constructs and the different participants was possible (Wang & Maxwell, 2015). Since in this study, within-person analysis was of interest as well, the person mean-centred (PMC) was also calculated for the state scores, by subtracting the state scores from their person mean. The PMC describes how much a certain score differs from the average score of that person, or how high/weak that specific score is for the participant. Hereby, individuals could be compared to their own scores, allowing for analysis of e.g., fluctuations over time. Additionally, standardized scores (Z-scores) were calculated, which are necessary for answering the third research question. Z-scores describe how much certain data deviates from the norm, regardless of its scaling, and thus making data comparable. For assessing the reliability of the measurements, Cronbach's alpha was calculated.

First, descriptive statistics were analysed to get an understanding of the distribution patterns within the data. To answer the research questions, two Linear Mixed Models (LMM) were conducted. As this research includes longitudinal data, the LMMs made use of a first-order autoregressive (AR1) structure to calculate how much a value is dependent on a given time point. For investigating the association between trait self-control and state self-control, the first LMM was run. In this model, the average trait score per participant was considered as well as the raw mean score per day per participant. This is justified, as both measurements have the same scaling and are therefore comparable. Here, trait self-control was put as the independent variable and state self-control the dependent variable. To get a more profound

understanding of the association, single individuals, who scored highest or lowest on trait self-control were examined into greater depth, by means of visual representations. This allowed also for investigating any fluctuations throughout the duration of the study. Visualizations were made through the program *IBM SPSS Statistics.*

The second LMM was intended to analyse research question 2 and 3 simultaneously. In this LMM, standardized scores of state self-control were put as dependent variable, and standardized trait anxiety scores (PM) and standardized state anxiety scores (PMC) were inserted as independent variables. By solely inspecting the PMC score, it could be retrieved to what extent state self-control and state anxiety are related. By examining both, PMC, and PM it could be answered if state anxiety or trait anxiety is more predictive of state self-control.

Results

Descriptive statistics

See Table 3 for an overview of the mean, minimum, maximum, and standard deviation. For trait self-control, the sample scores a mean of 1.82, which indicates low levels of self-control, compared to literature (Malouf et al., 2013). Based on the evaluation scale of the HADS-A, for trait anxiety, a mean below 1 is regarded as normal, a value between 1 and 1.43 is viewed as borderline abnormal and a value between 1.44 and 3 is classified as abnormal. Meaning that the sample displayed a respectively high level of trait anxiety. Among the participants, 24% showed a normal degree of anxiety, 17% displayed borderline abnormal cases, and 55% scored into the category of abnormal anxiety, which supports the notion that the sample exhibits high levels of trait anxiety.

Table 3

Descriptive statistics for state and trait measurements of anxiety and self-control

	Mean	Minimum (Scale Minimum)	Maximum (Scale Maximum)	Std. deviation
Trait self-control	1.82	.17 (0)	3.64 (4)	.74
Trait anxiety	1.44	.22 (0)	2.29 (3)	.58
State self-control	2.43	1.53 (0)	3.56 (4)	.83
State anxiety	1.54	.26 (0)	2.99 (4)	1.05

Trait Self-Control and State Self-Control

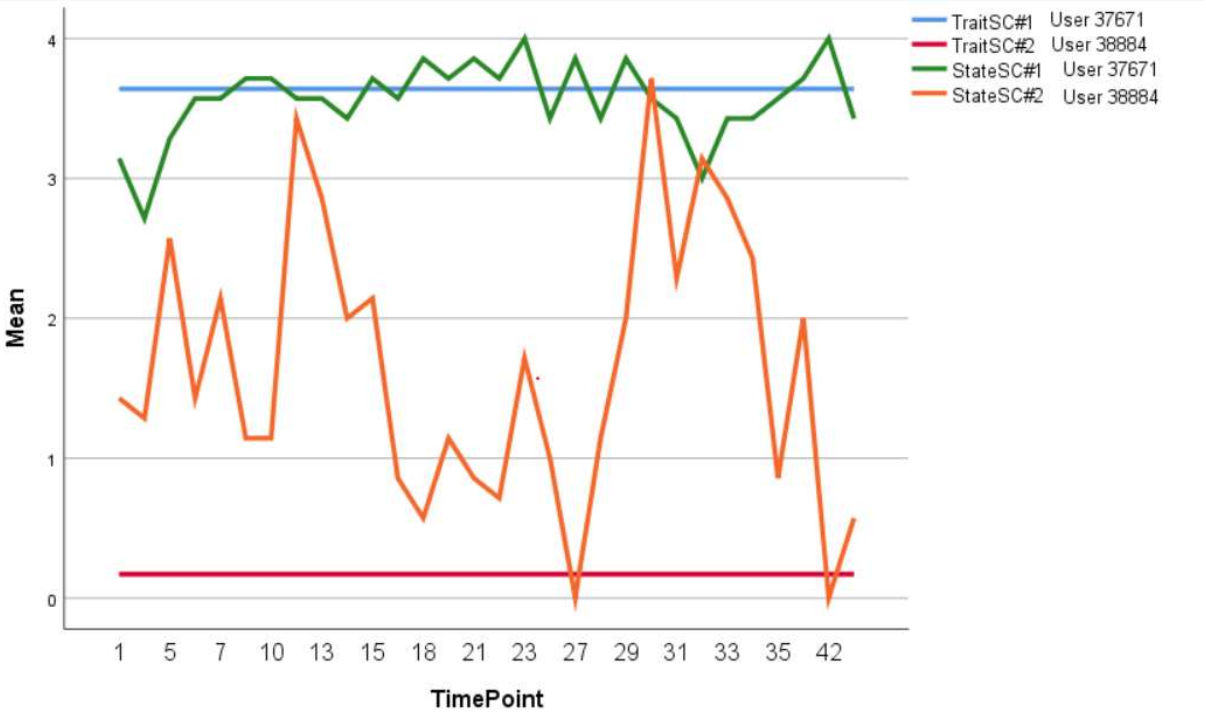
In order to understand the relationship between trait and state self-control, a LMM was run. The results show a moderate positive association between the two constructs, B= .48, p <.001, 95% CI [.39, .57]. This indicates that participants who score high on trait self-control generally score high on state self-control as well.

. Figure 1 displays the visual analysis with an overview of the trait and state values of the two participants. The blue line indicates the trait level of self-control of participant 37671 and the green line the corresponding state score. The red line displays the trait measurement of participant 38884, and the orange-coloured line shows the corresponding state values of this participant. These participants were selected, because, among all participants, participant 37671 exhibited the highest score on trait self-control and participant 38884 scored the lowest on trait self-control. The visual analysis showed a considerable discrepancy about the extent to which state self-control fluctuates. Participant 37671 showed corresponding high levels of state self-control and a narrow variance of 1.43. Whereas participant 38884, showed a comparatively wide variance in the state self-control scores of 3.71.

The interaction pattern of the participants who scored second and third highest, as well as lowest on trait self-control, confirmed these findings. First, the second highest participant (participant 38895) and second lowest participant (participant 38857) were compared. Results showed a larger variance in the state self-control scores of participant 38895 (var.= 1.71), than of participant 38857 (var. = 2.86), even though it is less distinct than the previous described example. Second, the scores of the third highest participant (participant 37950) and the third lowest participant (33527) again support the notion of a discrepancy in variance of state self-control scores, as participant 37950 had a variance of 1.71 and participant 33527 had a variance of 3.14. These data indicate higher and more stable levels of state self-control in people who also display higher levels of trait self-control.

Figure 1

State self-control and trait self-control levels of User 37671 and User 38884 (highest and lowest levels of trait self-control)



State Self-Control in relation to State Anxiety and Trait Anxiety

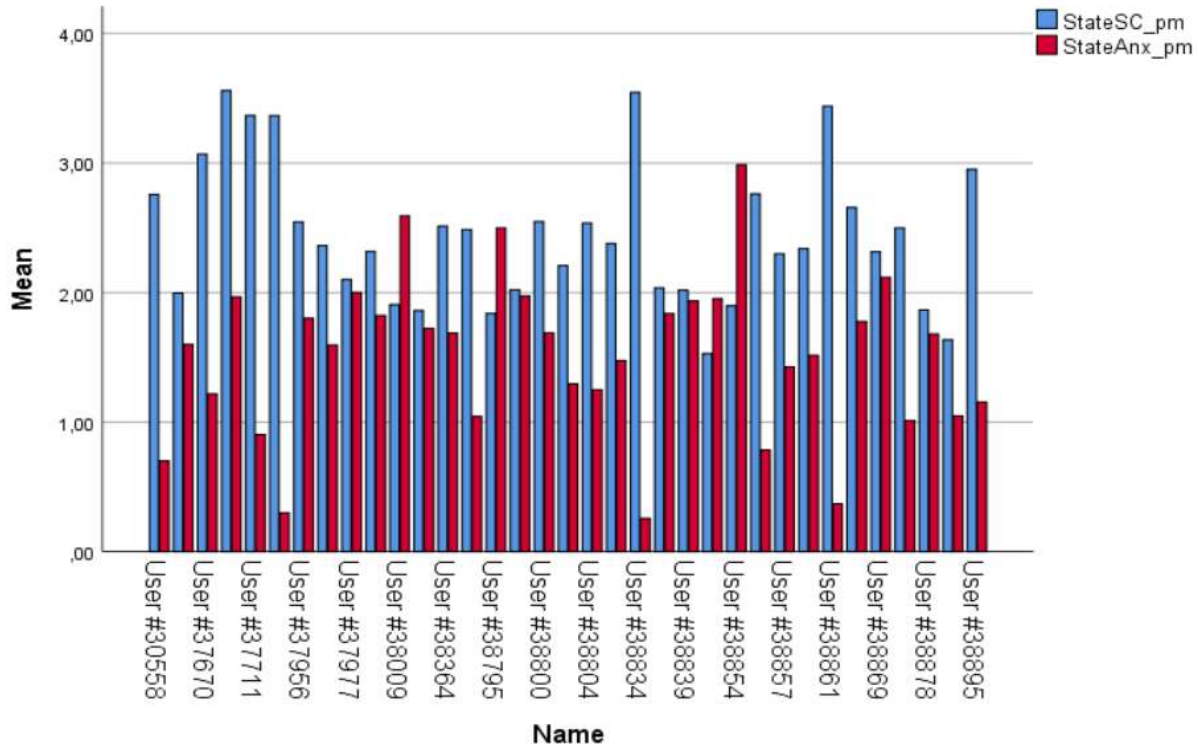
A second LMM was conducted for inspecting potential associations between state self-control and state anxiety or trait anxiety. For this LMM, the person-mean scores as well as the person-mean centred scores were used. By this, a comparison of the between-person effect and within-person effect was possible. State-like anxiety (PMC) has a significant, weak negative association, as ß= -.29, p<.001, CI= 95% [-.33, -.25]. Trait-like anxiety (PM) has a significant, moderate negative association with state self-control, ß= -0.40, p<.001, CI= 95% [-.48, -.33]. This means that state self-control is associated both with differences between participants in anxiety (between-person effect, PM) and day to day differences in anxiety within one single individual (within-person effect, PMC). Given the fact that the confidence intervals of both PM and PMC are not overlapping and all fall below 0, the relationship between the constructs is most likely negative, meaning that if state self-control increases, trait and state anxiety decrease, and vice versa. Furthermore, the confidence intervals support the notion that the association between state anxiety and state self-control is indeed weaker than the association between trait anxiety and state self-control.

Regarding the research question about the extent to which state self-control and state anxiety are related, the results indicate that generally when the state self-control level is high, the state anxiety level is low. Figure 2 pictures this association per participant, whereas state self-control is displayed by blue bars and state anxiety is pictured by red bars. Participant

38854 and participant 38834 are examples for the negative association between the two constructs. Participant 38854 scored high on state anxiety, but low on state self-control, whereas participant 38834 scored low on state anxiety, but high on state self-control. Generally, a negative relation is visible. Both, the LMM as well as the visual analysis support the assumption of a negative association between state self-control and state anxiety. To be more precise, people who exhibit high levels of self-control at a given moment, generally show low levels of anxiety in the exact same moment.

Figure 2

Association between State Self-Control and State Anxiety



In context of the second research question that ought to be answered by this LMM, the results indicate that being high or low on state self-control can better be predicted by someone's trait anxiety than their state anxiety.

Discussion

Interpretation of results

This study aimed to investigate the relationship between state and trait self-control and state and trait anxiety using a 15-days experience sampling study. Three research questions were stated, which were 1. *To what extent are trait self-control and state self-control*

related?, 1.2 How does state self-control fluctuate over time in single individuals?, 2. *To what extent are state self-control and state anxiety related?,* and 3. *To what extent does trait anxiety predict state self-control compared to state anxiety?*. The first question can be answered in terms, that they are moderately related, meaning that if a person generally scores high on self-control, they also exhibit high levels of self-control throughout the day. Therefore, the hypothesis can be confirmed. Further, the extent to which state self-control fluctuates in individuals, differs depending on their level of trait self-control. Regarding the second research question, results describe a significant but weak relation, meaning that when people are anxious at a specific moment, they are usually not too self-controlled. By this, the second hypothesis can be confirmed as well. Lastly, results for the third research question indicate that whether a person has high or low self-control throughout the day (state self-control) can better be predicted by their level of dispositional anxiety, than their daily state level of anxiety. People are therefore more likely to show high self-control when they are generally less anxious. Whether they feel anxious at a specific moment influences the current self-control only to a smaller extent.

Findings of this study about the interplay of state and trait self-control are partly supported by literature. The answer to the first research question is fully in line with the outcome of Schmeichel and Zell's study (2007), and partly with the findings of Guan and He (2018) as well, as all mentioned researchers found a positive correlation between trait self-control and state self-control, whereas the strength of this association varies. Both studies measured state self-control by conducting tests, as the STROOP test (Guan & He, 2018), or measuring how long a participant can refrain from blinking or endure pain stimuli (Schmeichel & Zell, 2017). As explained in the method section of this paper, self-control has multiple facets, and both studies omitted some aspects of self-control, such as goal-directedness, and rather focussed on ego depletion and inhibitory control. This means, the current study included other aspects of self-control as well to this body of research, namely the inclusion of other subtypes of self-control next to inhibitory control and ego depletion. Furthermore, the current study obtained data not in a laboratory, but in a real-life setting, which has better ecological validity (Csikszentmihalyi & Larson, 2014). Indicating that the current study might have measured self-control more precisely. Hence, future researchers might pursue the addition of all types of self-control and further investigate the role of the distinct types of self-control.

Regarding the second research question, in literature, a disagreement exists about his exact interplay between state anxiety and state self-control. This discrepancy regards the

direction of the association, concerning whether anxiety and self-control behave contradictory or simultaneously, meaning if anxiety is high, is self-control low, or if anxiety is high, is self-control high as well. While this current research found support for the notion that state anxiety and state self-control have a negative relationship, a study by Prem and colleagues (2016), found contradicting results. They argue that state self-control and state anxiety increase simultaneously, whereby they tested state anxiety more as a mediating variable than in direct relation. To be more precise, they found that emotional dissonance (caused by job stressors) evokes state anxiety, which in turn increases the individual's necessity to heighten their state self-control to cope adequately with the stressor. However, they also focussed on ego depletion only, as to measure state self-control, instead of including other types of self-control, such as goal-directedness, as well, as it was done in this current study. Like the previously described implication about the miss of some subtypes of self-control in studies about trait and state self-control, the same holds true for this case, which is the need for incorporating all types of self-control. This is caused by the fact that divergent results emerge, based on which types are used, eventually resulting in different results if all or other types of self-control are integrated. Future research is therefore needed to investigate more into this matter, where other types of self-control are included as well.

Moreover, as Prem and colleagues (2016) found anxiety to be a mediator between state self-control and time pressure, they indicate that assuming a direct association between state self-control and state anxiety might be misleading. However, it depends on whether anxiety itself could function as a mediator between state self-control and another, omitted, third construct, or if there was a mediating variable between self-control and anxiety. Whereby, the latter named option is less likely, as literature indicated a direct relationship between anxiety and self-control. Nevertheless, if anxiety operates as a mediator variable, in this study it eventually mediated the relationship between self-control and academic pressure, or motivation, either intrinsic or extrinsic. Nevertheless, this possible triangular relation was not tested in this study, meaning that it cannot be assured that no such interplay was missed, which could have led to different results. Investigating possible mediating relationships between state self-control and anxiety and potential third parties can thus be a matter of future research.

Besides comparison with literature, two additional findings are noteworthy. The first matter concerns the fluctuation of state self-control levels in relation to their corresponding trait self-control levels. Through the visual analysis of single individuals, who exhibit highest and lowest scores on trait self-control it became also evident that people high on trait self-

control seem to exhibit more stable levels of state self-control, whereas the state levels of individuals who are low on trait self-control are notably more fluctuating. One possible explanation might be that individuals low on trait self-control also score low on conscientiousness and therefore feel less pressured to answer the state questionnaires diligently (Ameriks et al., 2007). This means, participants eventually did not read the questions thoroughly, and answers might not be correct, which could result in such high fluctuations, as they are not necessarily true. However, this cannot be known for sure. Another explanation could be that people are higher on self-control in general because they experience less self-control failures throughout the day. Therefore, future studies should continue this line of research and investigate the fluctuations within state self-control dependent on their trait self-control level.

The second striking finding regards the results from the trait anxiety analysis. Regehr and colleagues (2013) stated that more than every second college student experiences anxiety to a certain extent at some point during their studies. However, in this current study evidence was found that 74% of the participants have anxiety scores that are classified as not normal, based on the HADS, meaning that three out of four participants experience anxiety frequently. Even though examining general anxiety levels was not the focus of this study, these high results might be explained by the current Corona pandemic, but this cannot be stated for sure. For this reason, future research could investigate whether anxiety levels in college students generally increased since 2013, when Regehr and colleagues conducted their research, or what else contributed to these high scores.

Strengths and limitations

This study contained multiple strengths, as well as limitations. The main strength of this study is that trait and state measurements were combined, and state questions were partly self-composed, based on pre-existing literature. This can contribute to the body of research that exists around self-control and its measurements, which aims at better understanding state self-control in relation to trait self-control and anxiety. The used methods can further be validated and used by future researchers. Also, the usage of the ESM contributed to adequate results, as they are highly suitable for longitudinal data collection (Van Berkel et al., 2017). Meaning that using this method was another strength of this study The fact that the results in this study are supported by findings from existing research, supports the notion that the choice of measurements was appropriate and that the results measure the intended constructs.

What influenced the outcome of this specific study as well, might have been the choice of the target group. Students are generally high on anxiety, 50% to 70% of them experience it frequently to some extent (Regehr et al., 2013). On the one hand, this could be regarded as a strength, as this specific population allows for a proper insight into the mechanisms involved in anxiety and targets people who are high on anxiety. On the other hand, it can be seen as a limitation, as students only display a small percentage of the overall population, meaning that the broader population experiences on average lower levels of anxiety. This means that caution needs to be taken when generalizing these conclusions. , Adding to that, all participants stem from higher educational institutions, presumable with similar backgrounds.. Concerning this population, they were convenient for analysing anxiety and self-control, but when the focus of the research should lie solely on the constructs and not on the target group as well, another sample population would have given clearer results. However, for this study, where students are included in the focus, the population was a strength since their data about anxiety was highly insightful. For future research, this type of study could be conducted with a population under different life circumstances, such as working full-time, providing for a family, or being retired, to examine how they would score.

Another point to ponder is that following a study for 15 days and filling it out conscientiously, is a demand for self-control in itself. Even though it was not explicitly measured, the individual analysis revealed that User 37671, who scored highest on trait self-control, also filled in almost all state measurements. Out of 48 state measurements, only 3 measurements have been missed. In contrast, User 38884, who scored lowest on trait self-control, filled out only 31 out of 48 state measurements, meaning 17 measures have been missed. The higher percentage of missed measurements can be another indicator for low self-control, since the discrepancy between those two users is striking, even though they were not selected based on their response rate. Taking the assumption that people lower on self-control might have more difficulties answering a study faithfully, it might be that important time points in their measurements are missing, which could have contributed to a more stable understanding of their state levels. To properly assess this, many factors need to be controlled for, or the sheer answering of questions is viewed as a dimension of self-control as well. This, however, bears ground for future studies about whether people low on self-control influence the outcome of the study directly, by having insufficient self-control to conduct the study conscientiously.

Further implication focuses on the execution and implementation of the study. There was a technical issue, regarding wrongly put settings within *Ethica*, which caused a premature

termination of the study, as well as leading to the omission of demographics for many participants. After the issue got fixed, the study itself got started again, but the time frame was limited in which the participants had to delete and initiate the study again, to participate... Through this event, multiple participants failed to enter the study again, which could have been caused by missing the instructions, or experiencing the process as too straining. It could not be retraced who left the study, as it was anonymously, but if participants quit for interpreting the deleting and initiating as too stressful, can be a sign of low conscientiousness itself, which is known to be closely associated with self-control (Ameriks et al., 2007). If this holds true, the results could be distorted as participants with especially low self-control did not participate, resulting in a heightened self-control level within the sample. However, this caused the most loss of participants. Even though in the end enough individuals fulfilled the whole study, this narrowing of participants was unnecessary and to be remedied in future follow-up studies.

Another main limitation was the omission of the analysing the subtypes of self-control separately. Generally, self-control consists of multiple types, such as ego depletion, goal directedness, and inhibitory control. However, based on first literature search, the need to separate between these was not seen, as it was also not crucial for answering the research question. Whereas in the discussion, it became predominant that, even though it was explicitly necessary, it could have given interesting insights into how self-control operates. Including this distinction in the analysis as well, could have given explanation to the differences in some of the discussed findings, as of Guan and He (2018), Schmeichel and Zell (2007), or Prem and colleagues (2016), who did not include the subtypes as well. Results of the current research are still valid, as the named studies also regarded state self-control as one construct but including the distinction would have given valuable and new information to this body of research, eventually. Investigations into these subtypes are therefore needed in order to understand how these types differ and if they contribute to behaviour differently.

Finally, the last limitation is the global pandemic of Covid-19, which affects everyone at this point to some extent. Due to the circumstances, most universities are closed and solely offer online education. This demands high levels of self-control from the students who must schedule their learning on their own, considering multiple additional factors, such as distraction by eventual fellow lodgers or family members. This could have influenced the self-control abilities or their anxiety level, which might have distorted the results. Further, it might have an impact on the representativeness of the outcome, as it would be only applicable

in times of a global pandemic. Nevertheless, this current study offers valuable data from times of a pandemic, which offers a great base of comparison afterwards.

Future implications

This current research bears ground for multiple new lines of research. First, as the target group of students is especially prone to high anxiety levels, it is of interest how it behaves in other target groups, such as people working full-time, or elderlies. Regarding the students, more research should be conducted about their levels of anxiety in general, as this study revealed overly high levels of anxiety. These might be caused by the Covid-19 pandemic, or if students' anxiety level has indeed increased, but this is not guaranteed. Therefore, future research could investigate this, because if the general anxiety level has become higher, then it might be of interest why, and considering potential alleviations for it, as anxiety entails multiple negative consequences on a person. Further, more research should be conducted about the fluctuation of state self-control and whether a study set-up influences these directly. When a study itself poses an obstacle to a person low on self-control, then research about low self-controlled people is generally difficult, and important information might be dismissed. Therefore, a meta-analysis of methods to assess (low) self-control can be beneficial to better understand it. Another future direction concerns the subtypes of self-control and whether they influence certain behaviour differently. Eventually, recreating existing studies with the notion of focussing on all subtypes can be interesting as well. Finally, after the pandemic, comparative research should be conducted to validate the findings, and to assess how the isolation and self-study have influenced students' self-control abilities as well as anxiety levels.

Conclusion

This study was based on adverse consequences related to low self-control, negative emotions, and a lack of literature about the interaction between these concepts, which were anxiety and self-control, especially with including a focus on their trait and state distinction. In this study, it was found that trait and state self-control are positively correlated, state self-control and state anxiety are negatively correlated, and that state self-control can better be predicted by one's general anxiety, than their current anxiety level. This means that people who exhibit high self-control throughout the day, often display high level of general self-control and low levels of anxiety at the same time. Further, it was found that people with high trait self-control exhibit noteworthy stable levels of state self-control, whereas people with

low self-control show a strong fluctuation in their corresponding state levels. Finally, the sample experienced overly high anxiety levels. The study found need to further investigation into the subtypes of self-control and if a study itself has an impact on the sample as it might influence low self-controlled individuals.

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Appendix

Appendix A: State measurements of self-control and anxiety

State measurement of self-control: (Baumeister, Wright & Carreon, 2019)

Ego Depletion

1. "In the past couple of hours, have you felt that it's hard to make up your mind about even simple things?"
2. "In the past couple of hours, have you felt that things are bothering you more than they usually would?"
3. "In the past couple of hours, have you felt that you have less mental and emotional energy than you normally have?"

Goal-directed self-control

4. "In the past couple of hours, how easy was it for you to do something "good" that you did not really want to do?" *For example, eating healthy food; studying for an exam; telling someone they hurt you; waking up early; going to the gym)*
5. "In the past couple of hours, I was able to stick to my goals."

Inhibitory self-control

6. "In the past hour, how easy was it for you to refrain from doing something "bad" you really wanted to do? *For example, snacking; procrastinating; take out your an ger on someone; take a nap during the day; sit on the couch)."*
7. "In the past few hours, I was able to resist temptations."

State measurements of Anxiety

1. "Right now, I feel worried about something"
2. "Right now, I feel comfortable (Inverted)"

Appendix B: Trait measurement of self-control

13-item Brief Self-Control Scale (Tangney, Baumeister, & Boone, 2004).

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

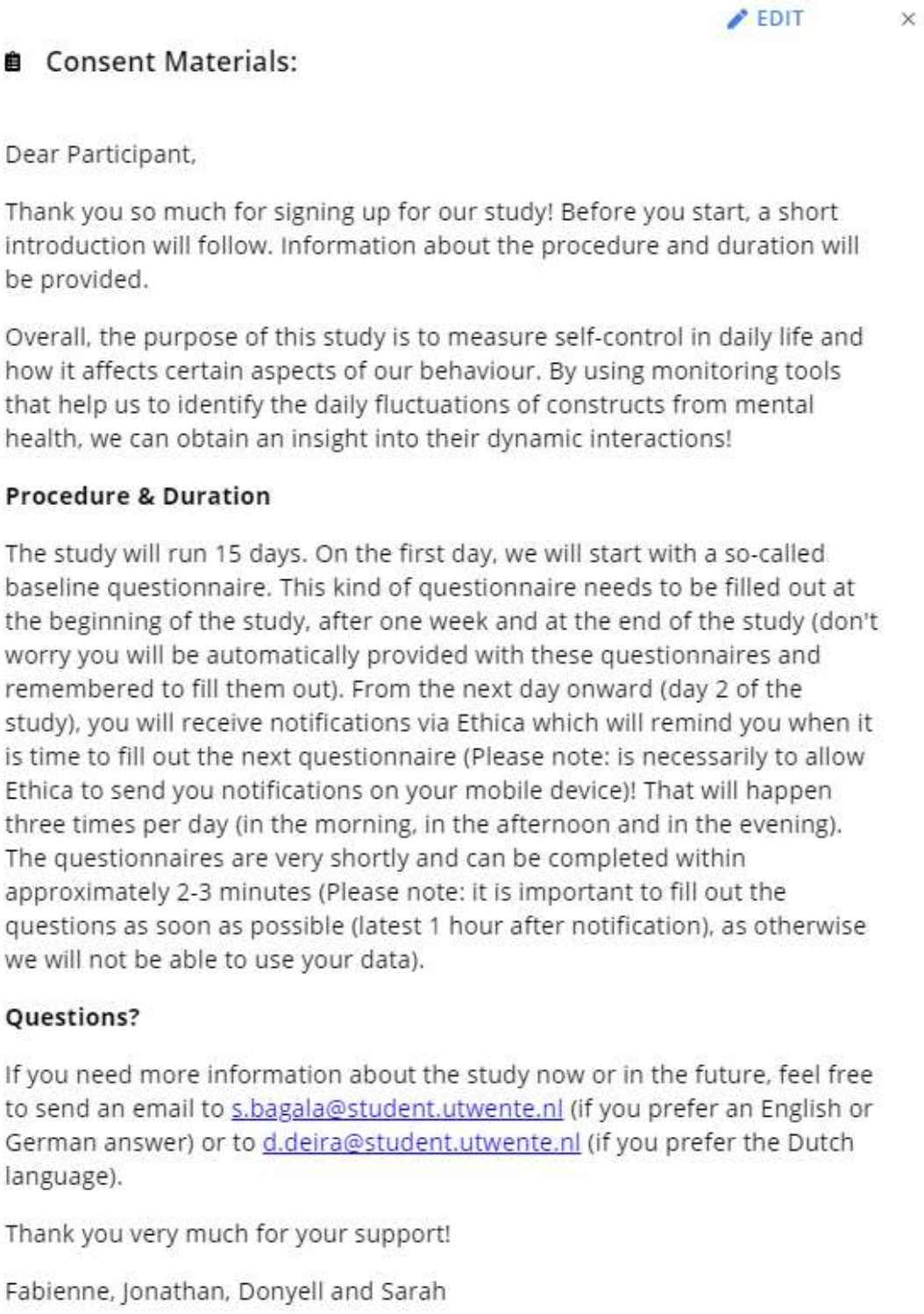
5. I do certain things that are bad for me, if they are fun
6. I refuse things that are bad for me
7. I wish I had more self-discipline
8. People would say that I have iron self- discipline
9. Pleasure and fun sometimes keep me from getting work done
10. I have trouble concentrating
11. I am able to 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

Appendix C: Trait measurement of anxiety

Hospital Anxiety and Depression Scale (HADS); Subscale: HADS-A

1. I feel tense or "wound up"
2. I get a sort of frightened feeling as if something awful is about to happen
3. Worrying thoughts go through my mind
4. I can sit at ease an feel relaxed
5. I get a sort of frightened feeling like "butterflies" in the stomach
6. I feel restless as I have to be on the move
7. I get sudden feelings of panic

Appendix D: Welcome message Ethica



EDIT ×

Consent Materials:

Dear Participant,

Thank you so much for signing up for our study! Before you start, a short introduction will follow. Information about the procedure and duration will be provided.

Overall, the purpose of this study is to measure self-control in daily life and how it affects certain aspects of our behaviour. By using monitoring tools that help us to identify the daily fluctuations of constructs from mental health, we can obtain an insight into their dynamic interactions!

Procedure & Duration

The study will run 15 days. On the first day, we will start with a so-called baseline questionnaire. This kind of questionnaire needs to be filled out at the beginning of the study, after one week and at the end of the study (don't worry you will be automatically provided with these questionnaires and remembered to fill them out). From the next day onward (day 2 of the study), you will receive notifications via Ethica which will remind you when it is time to fill out the next questionnaire (Please note: is necessarily to allow Ethica to send you notifications on your mobile device)! That will happen three times per day (in the morning, in the afternoon and in the evening). The questionnaires are very shortly and can be completed within approximately 2-3 minutes (Please note: it is important to fill out the questions as soon as possible (latest 1 hour after notification), as otherwise we will not be able to use your data).

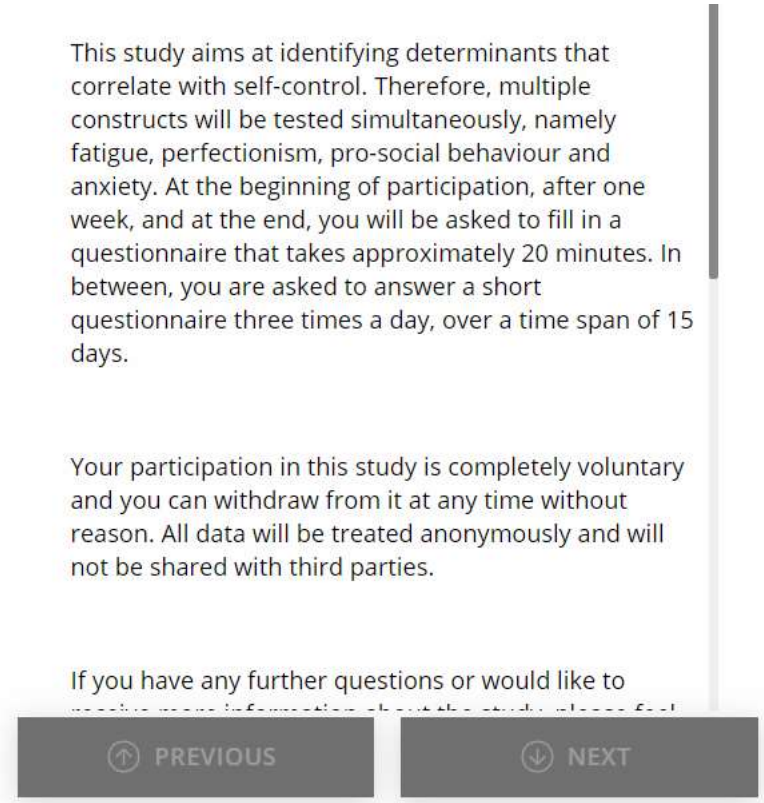
Questions?

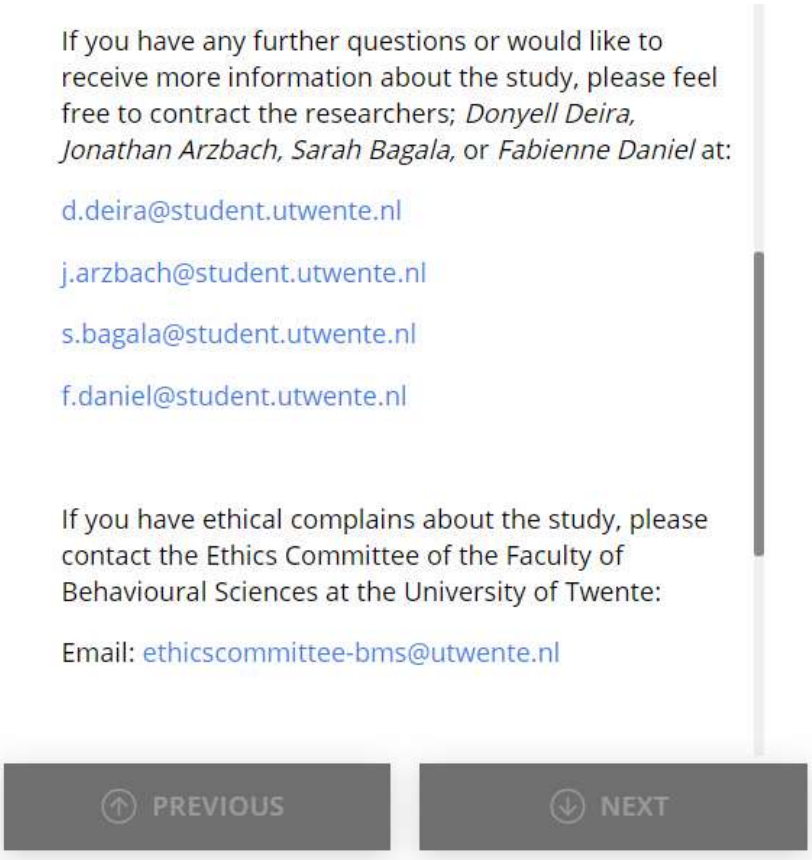
If you need more information about the study now or in the future, feel free to send an email to s.bagala@student.utwente.nl (if you prefer an English or German answer) or to d.deira@student.utwente.nl (if you prefer the Dutch language).

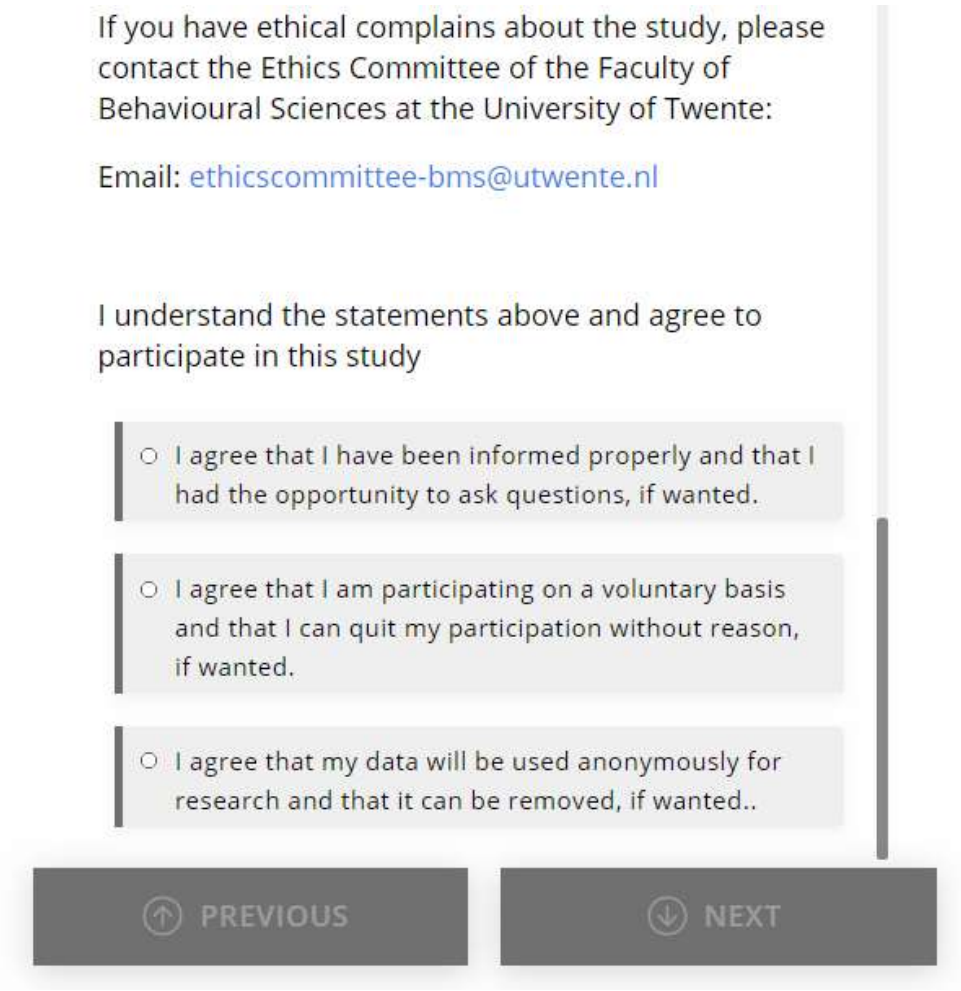
Thank you very much for your support!

Fabienne, Jonathan, Donyell and Sarah

Appendix E: Screenshots of the Informed consent






If you have ethical complains about the study, please contact the Ethics Committee of the Faculty of Behavioural Sciences at the University of Twente:
Email: ethicscommittee-bms@utwente.nl
I understand the statements above and agree to participate in this study
I agree that I have been informed properly and that I had the opportunity to ask questions, if wanted.
I agree that I am participating on a voluntary basis and that I can quit my participation without reason, if wanted.
I agree that my data will be used anonymously for research and that it can be removed, if wanted..
PREVIOUS
NEXT