

Experience Method Sampling and Self-Control: Measurement or Intervention Tool?

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M12: BSc Thesis PSY

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January 10, 2025

ABSTRACT

Self-control is one of the most investigated concepts in psychological research. It fulfils an important role in goal-oriented behavior and its significance for increasing the quality of life is undisputed. As self-control already has a well-established theoretical framework and dimensionality, this research paper examined whether the concept is susceptible to being influenced solely by the mere measurement effect. Subsequently, the two-factor self-control model, dividing the concept into inhibitory self-control and initiatory self-control, was assessed by the experience sampling method (ESM). The study consisted of three major parts. Starting with the pre-test, participants were asked to fill out a Multidimensional Self-Control Scale (MSCS). The questionnaire includes 29 questions measuring the general self-control score and dimensions of the concept. Afterwards, participants were asked to continue with the 'm-Path' mobile application for 14 days where the ESM part was carried out. Lastly, participants answered the MSCS once more. The pre-test and the post-test results were analyzed between the group taking part in the ESM assessments and the control group. The total sample consisted of 42 women and 14 men. The group comparison was achieved by implementing the repeated measures ANOVA model. Additionally, thematic analysis was performed to analyze feedback obtained from participants in the experimental group. For the quantitative analysis, results provided an insignificant interaction effect between group and time for the general score of self-control, $F(1,54) = 3.119, p = .083$. While the interaction for the inhibitory dimension was insignificant as well, $F(1,54) = 1.881, p = .176$, the interaction effect for initiatory self-control was significant, $F(1,54) = 4.106, p = .048$. Thematic analysis indicated six themes: *Increased Awareness, Reflection and Insight, Repetition, Longevity, Positive Impact and Negative Impact*. Findings suggested that while the general score of self-control and its inhibitory dimension remained stable throughout the study, initiatory self-control significantly and positively changed due to ESM. While accounting for certain limitations highlighted in this paper, for instance regarding the sample size, it could be stated that ESM is more than just a measurement tool. When it comes to the proactive and reflective dimension of self-control, ESM could potentially be implemented as an intervention.

Keywords: self-control, inhibitory self-control, initiatory self-control, experience sampling method, repeated measures ANOVA model, thematic analysis

1. Introduction

Self-control can be described as one of the most ubiquitous psychological concepts present in modern research (Boekaerts et al., 2000). The concept was scientifically recognized in 1970 by Walter Mischel who conducted a well-known experiment in the psychological field called the marshmallow test (Mischel, 2014). In the experiment, after receiving a marshmallow, young children faced a choice of eating the marshmallow immediately or waiting for 15 minutes to get an additional second marshmallow. The test allowed to identify the variety of cognitive, behavioral or emotional tactics employed by children to resist temptation which served as a basis to conceptualize self-control. Moreover, as the study continued and implications of it were assessed, participants who could and could not wait were compared (Brooks, 2024). It turned out that children willing to obtain a delayed reward were prone to achieving success in different life domains. However, replications of Mischel's original study mostly concluded with insignificant correlations (Sperber et al., 2024). Despite the debate on the interplay of confounding variables like socio-economic status or unrepresentative sample, recent research papers showed that the hypotheses regarding of Walter Mischel, regarding the impact of self-control, can be considered partly truthful (Watts et al., 2018).

Modern research proved that a high level of self-control influences and predicts general well-being (Peng et al., 2021), academic and professional success (Stork et al., 2016), quality of interpersonal relationships (Himanen & Gunst, 2023) and health (Conner et al., 2022). On the other hand, the negative connotations of lowered levels of self-control can be responsible for a range of maladaptive behaviors such as engaging in damaging eating patterns (Chuang & Wang, 2021), procrastination (Zhao et al., 2019) or struggling with financial stability (Dali et al., 2023). Moreover, self-control has an undisputed presence in a clinical setting (Kim et al., 2022). Unusual levels of self-control often facilitate the development of various mental disorders (Yang et al., 2019). For instance, deficient levels of self-control were determined to play a major role in shaping disorders such as substance addictions or impulse control and excessive self-control like eating disorders or OCD (He et al., 2023). Self-control has an indisputable presence in psychology, and further enhancement in understanding the concept may become imperative to understand different aspects of human nature.

Due to the concept being covered in a variety of psychological fields, terminology relating to self-control became scattered, and the general coherence suffered from it (Groß, 2021). Gillebaart (2018) pointed out that the terms self-control, self-regulation or self-discipline are often used interchangeably. As researchers from diverse domains conceptualize self-control differently, the definition of the concept may vary. Usually, self-control is viewed as a state or trait responsible for adjusting one's behavior to achieve long-term goals (Groß, 2021; Nęcka et al., 2019). Self-control includes processes such as stress and attention management, unwanted stimuli control or planning and adhering to set objectives (Nęcka et al., 2019). For some time, as presented in the marshmallow experiment, the research focus was set on the inhibitory side of self-control (Tornquist & Miles, 2019). Inhibitory self-control is mainly associated with restraining oneself from bothering and tempting stimuli (Tangney et al., 2004). According to the TOTE (Test-Operate-Test-Exit) model of self-regulation, inhibition is aligned to the "operate" phase in which specific actions of an individual to eliminate discrepancies between long-term goals and unwanted behavior are being undertaken (Carver & Scheier, 1981). In general, the TOTE model represents the ability to adapt behavior to be in line with long-term goals through feedback loops. However, according to the strength model of self-control, constant inhibition is rather impossible and ineffective (Gillebaart, 2018). The model emphasizes the ego depletion phenomenon which identifies the problem of limited mental resources individuals have to deal with immediate desires (Muraven & Baumeister, 1998). In other words, the more an individual resists unwanted stimuli, the harder it becomes to resist consecutive stimuli. Recent theories, however, emphasize the role of initiatory self-control as an indicator of an individual's self-control capabilities (Gillebaart & De Ridder, 2015).

As it turns out, people with higher levels of self-control are not necessarily better at restraining oneself from a short-term desire (Ent et al., 2014). Rather than that, high self-controllers do not allow those desires to bother them in the first place. Initiatory self-control refers to active engagement in controlling the environment to make achieving long-term goals more accessible (De Ridder et al., 2011; Sklar et al., 2017). In contrast to inhibitory self-control, initiatory self-control stands for proactivity. For example, an individual with a goal of reducing unhealthy snacks consumption to improve their health may decide to get rid of any unhealthy snack from their home, rather than rely on effortful and constant inhibition. Several studies have successfully identified the necessity of presenting self-control as a two-factor concept (Lindner et al., 2015). For instance,

upon closer examination of the Brief Self-Control Scale which is one of the most used self-assessment tools for self-control, it turned out that the set of two factors are significantly correlating negatively (Heller et al., 2017). Although a couple of multidimensional sets of factors were proposed in self-control research, a model based on inhibition and initiation provided the best explanation (Lindner et al., 2015). The nature of the interplay between the inhibitory and initiatory dimensions of self-control can be already assessed by numerous validated questionnaires. What remains, however, is to explore how those dimensions may be subject to change over time.

One of the methods allowing to grasp the possible change within self-control over time is experience sampling method (ESM). ESM is an assessment tool that can be considered as a successor of the daily diary method (Csikszentmihalyi & Larson, 1987). Both methods collect the data based on answers to self-reported questions multiple times a day in a span of a certain time period (J. Palmier-Claus et al., 2019). However, ESM allows the researchers to control when participants respond to questions by utilizing prompts, making the measurement more ‘at the moment’. The appearance of prompts may be dependent on the study design where a prompt is triggered by preplanned timeslots, location or physical state of the participant. Moreover, it acquires data in natural environments. By systematically collecting the data, the factors that may have impaired the results by using traditional diary methods can be tackled (Palmier-Claus et al., 2012). In contrast to the daily diary method, ESM does not require participants to retrieve memories from the long-term memory, which could lead to biased reconstructions. Because of the systematic and intense nature of ESM, it has been applied to studies to determine the effectiveness of various tools on specific phenomena over time (Trull & Ebner-Priemer, 2012). For instance, the effect of various medications on patients can be reliably assessed using ESM (Jamison, 2024). The ESM method is starting to become more influential in medical fields, as it overthrows the structured interview scales to collect more valid data (Miller & DiBello, 2024). As an example, detection of psychotic symptoms using ESM turned out to be a feasible way of assessment (Palmier-Claus et al., 2012). ESM has also been applied to more psychological-oriented domains like personality psychology to assess the importance of individual differences in the context of behavior or well-being (Van Halem et al., 2024). Moreover, the ESM research focused on the interaction between personological and situational factors to determine traits such as aggression, stress responding and controllability or worthwhileness (Ringwald et al., 2024; Kersten & Greitemeyer, 2024; Schneider et al., 2024).

In the context of ESM, self-control has been implemented in a variety of studies as a moderating factor (De Ridder et al., 2018). Multiple studies present measurements done by ESM in the context of substance and phone usage or physical activity (Schöndube et al., 2016; Murray et al., 2023; George et al., 2017). However, measuring self-control specifically with ESM has not been exhaustively studied in prior research (Dohle & Hofmann, 2017). It is unknown whether frequently asking questions about self-control may change the outcomes of previous studies. This may raise a question if repeated measurement could influence participants' perception or behavior concerning self-control. Therefore, it might be interesting to investigate the idea of self-control potentially being influenced and strengthened by frequent measurement of the concept. In this type of research, it is to be noted that the phenomenon of mere measurement effect may occur (Morwitz & Fitzsimons, 2004). Research in social and behavioral sciences indicated that mere acts of measuring certain concepts or intents have a profound effect on behavior (Chapman, 2001). For instance, measuring intent to exercise increases the likelihood to exercise (Rodrigues et al., 2014). The effect originates from heightened self-awareness about the topic that is being measured. Moreover, the cognitive activation process may promote active reflection about one's orientation toward the phenomenon being measured (Sheeran et al., 2022). In other words, by constant exposure to the concept of self-control, individuals can be prone to think and reflect about measured constructs, thus partially explaining the role of ESM as an intervention tool.

The mere measurement effect is often responsible for influencing certain characteristics when they are being measured. However, in combination with other theories explaining the adaptive and variable nature of self-control, the mere measurement effect could be significantly facilitated. According to the TOTE model of self-regulation, participants may evaluate trends in their response patterns because of the feedback loops (Carver & Scheier, 1981). In other words, potential engagement in self-reflection may beneficially influence evaluations of their behavior, which can result in changes within initiatory self-control. Similarly, because of the mere measurement process of cognitive activation, the design of ESM exposes participants to actively control their responses (MacKenzie & Baumeister, 2015; Sheeran et al., 2022). Overall, the frequent prompts, in combination with the reflective nature of ESM, might stimulate participants to adopt proactive strategies, such as organizing their environment or planning, thus promoting the initiatory side of self-control. On the other hand, the ego depletion phenomenon is an obstacle, making it impossible for individuals to continually rely on their ability to inhibit unwanted desire

(Baumeister et al., 1998). The nature of the ESM study may give valuable insight whether it is possible to strengthen the inhibitory dimension solely by reoccurring measurement. Research conducted by de Ridder and colleagues (2019) suggested that improving self-control is mainly dependent on the time allocated to practice rather than individual self-efficacy or beliefs about the level of self-control. Similarly, it has been proposed that according to the theory of cognitive plasticity, while implementing well-rounded exertion, a human brain can be trained to utilize acquired developments more efficiently (Lövdén et al., 2010). It is to be noted, however, that ESM by itself is a measurement tool that does not directly serve as a practice. As such, because of the lack of a direct challenge, inhibitory self-control may stay relatively stable over the course of the study. In other words, while it may be challenging to affect inhibitory self-control because of its direct and specific behavioral context, the initiatory side may be fostered as multiple mechanisms relating to it are about reflection and intents. It may be easier to influence a person's willingness to change their environment rather than their habits.

The evaluation of existing literature on the ESM and self-control topic resulted in the following explorative research questions:

- Research question 1: How does ESM influence the general level of self-control?
- Research question 2: To what extent does ESM influence self-control dimensions differently? Is there a significant difference between inhibitory and initiatory self-control?

To assess whether ESM has a positive effect on the general level of self-control and to examine if there is a difference between initiatory and inhibitory dimensions, suggesting a positive influence on the initiatory dimension, the following hypotheses were formulated:

- Hypothesis 1: Participants who have their level of self-control assessed through ESM will have a higher level of general self-control than participants in control group who have not participated in the ESM.
- Hypothesis 2: Participants who have their level of self-control assessed through ESM will experience a significant increase of initiatory self-control compared to inhibitory self-control.

2. Methods

2.1. Study Design

This study applied a longitudinal experimental design to investigate the impact of Experience Method Sampling (ESM) on the concept of self-control. During the span of 16 days, participants had to complete pre-test and post-test measuring their self-control level. Moreover, depending on the allocated group, participants had to take part in the ESM measurement. While the experimental group partook in ESM for the span of 14 days, the other group did not and served as a control group. Before the start of the study, an ethical approval was granted by the BMS ethical committee of the University of Twente (request number: 2313310).

2.2. Participants

Although for this study the target population was the general population, participants had to meet some eligibility criteria to proceed with the study. The study was open to adults 18 years old or older, fluent in English and with access to a mobile device with an internet connection. Participants were excluded from this study when suffering from an anxiety disorder of any kind and/or were receiving treatment for any mental disorder. This is because, due to the nature of the study, participants may have become more aware of their levels of self-control, which could make the experience distressing.

For this study, participants were gathered through convenience sampling. The questionnaire has been distributed online through three social media platforms: WhatsApp, Instagram and Facebook. Additionally, the study was published in SONA, offering 2.5 points for participation. Moreover, snowball sampling was deployed as well by asking participants to share the study by invitation.

From 94 responses that have been recorded, a total of 66 participants completed all the required steps. Of these, 42 were women (63.64%) and 24 (36.36%) were men. Participants' age varied from 18 to 57 years old with a median of 22. The most common nationalities present in the study consisted of German (n = 17), Greek (n = 16) and Dutch (n = 10) respectively.

2.3. Materials

2.3.1. *Self-control Questionnaire*

The measurement tool chosen for the pre-test and post-test was the Multidimensional Self-Control Scale (MSCS) (Nilsen et al., 2020). The MSCS questionnaire is a reliable and valid tool (Nilsen et al., 2020). The internal consistency level is satisfactory as Cronbach's alpha value reached 0.70 threshold with values ranging from 0.72 to 0.82 for each dimensions (Nilsen et al., 2020). Validity was assessed through direct comparison with other well-established self-control scales, such as the Self-Control Scale and the Brief Self-Control Scale. For this study, applying MSCS over other scales was motivated by its' clear division between dimensions. The concept of self-control is divided into two dimensions: inhibitory (INHIB) and initiatory (INIT). Moreover, each dimension is followed by three subdimensions where procrastination (PRO), attentional control (AC) and impulse control (IC) are part of the INHIB dimension and emotional control (EC), goal orientation (GO) and self-control strategies (SCS) are part of INIT dimension (Nilsen et al., 2020). MSCS consists of 29 questions with each dimension being measured by 4 to 6 items. For instance, one of the exemplary questions from the INHIB dimension was '*It is hard for me to concentrate.*' (Appendix A). Each question must be scored on a Likert Scale from 1 to 5, where 1 indicates strongly disagree and 5 strongly agree. The score for general self-control or for the dimensions was calculated by summing results from all related Likert Scales. Qualtrics website was used to implement the questionnaire for pre-test and post-test. Qualtrics is a platform for inputting surveys and easy extraction of data to other programs (Barnhoorn et al., 2014).

2.3.2. *ESM Questions*

The ESM part was conducted in a mobile device application called "m-Path". "m-Path" is a digital platform allowing for simple implementation of ESM into the study (Mestdagh et al., 2023). It is specifically designed to collect real-time data from participants in their natural environment, making it a perfect tool for researchers to gather insight about fluctuations in a variety of concepts. The notification system operates similarly to other mobile phone notifications, therefore allowing for receiving notifications is mandatory. The daily questionnaires within m-Path consisted of 6 questions about self-control. Each item represents one of the subdimensions from MSCS, and the questions were moderated to align more with ESM standards measuring feeling at a specific moment or designated timeframe. For instance, the question from the INHIB

dimension *'I postpone things.'* was converted to *'Since the last questionnaire, I have postponed things.'* (Appendix B). Moreover, the decision on which questions should be put into "m-Path" was determined by the factor loading of items from each of the six dimensions. Questions with the highest factor loading were prioritized. As those questions are derived from MSCS, each question was measured with a Likert Scale ranging from 1 to 5, where 1 indicated strongly disagree and 5 strongly agree.

2.4. Procedure

After accessing the study through the provided link to Qualtrics, participants were asked to read the informed consent form. In it, the overview of the study was provided with inclusion criteria and potential benefits and detriments were outlined. After agreeing to the informed consent form, participants were asked to fill out information about their age, gender and nationality. Afterwards, participants were asked to fill out the MSCS questionnaire measuring their level of self-control. Lastly, the instruction on how to access the study in "m-Path" was provided, and participants were asked to generate a code which could identify them so they could be connected to their pre-test and post-test results. Every day at 23:00, all new participants that joined the study were randomly assigned to experimental or control groups. Participants were randomly assigned to one of the groups using the alternating assignment method. In other words, the first participant was placed in the experimental group, the second in the control group, and so on.

In the "m-Path" application, participants from the experiment group were asked to complete daily surveys (approx. 3 minutes each) three times a day for 14 days. The surveys were scheduled to be completed every day at 12:00, 16:00 and 20:00. At those specific hours, participants had a 2-hour window to complete the survey. If one did not manage to complete it during that time period, access to it was lost. Each survey was reminded by a notification that was going to be received both at the scheduled time and after an hour. Participants from the control group received a message that they would receive a notification to fill out a post-questionnaire after 14 days.

After 14 days, participants from both the experiment and the control group received a notification with an access link to the post-test questionnaire. The post-test, similarly to the pre-test, was conducted in Qualtrics, where after inserting previously established code generated in the pre-test, participants were able to answer questions from MSCS. At the end of the post-test,

participants from the experimental group were asked to share their perspectives on how they perceive the ESM impacted their level of self-control, and what they think about the study in general. The question stated was: *'How did you experience measuring stress, interoceptive awareness and self-control using the ESM (triggers, levels, awareness)? How do you think it affected your view on those constructs?'* At the end, the purpose of the study was debriefed, and the option to contact researchers to gain access to the paper was provided. The process of collecting the data lasted one month throughout November 2024.

2.5. Data Analysis

Before the analysis could be conducted, the data was adequately cleaned and prepared, meaning that the dataset was transformed into a numeric format. Next to removing missing or incomplete entries from the dataset, the response rate cutoff of 60% for ESM surveys was applied (Weermeijer et al., 2023). However, to consider the shorter than recommended duration of ESM measurement, the determined rate of 55% was raised to 60%. Participants from the experimental group had to meet the indicated threshold to be included in the analysis. With the invalid entries excluded, general descriptive statistics were obtained, and the data was analysed for potential outliers. Because of the small sample size and participants being assessed for the general self-control score and its' dimensions over two time points, wisnorizing method was adopted (Chambers et al., 2000; Liao et al., 2016). Considering that each participant had six measures total, it was preferable to adjust the outliers instead of erasing participants from the dataset. To conduct it, for each measurement, outliers were established. Subsequently, each measurement below or above determined outliers was corrected to the outlier score.

The quantitative data analysis plan was based on the repeated measures ANOVA model. It was conducted to analyse the overall effect of ESM on self-control over time. This examination included a factor of time as a within-subjects factor and a factor of the group as a between-subjects factor. After accounting for assumptions common for this type of analysis, the repeated measures model ANOVA allowed to assess whether self-control changed significantly between the experimental and control groups. The analysis was implemented three times to not only assess the general level of self-control, but also inhibitory and initiatory self-control.

Additionally, the qualitative feedback obtained from the total sample of the experimental group was analysed to gather additional insight into the processes (Appendix C). The feedback

was segregated into two groups depending on whether participants reached the 60% response rate threshold or not. Although reaching the required response rate was essential for the quantitative analysis to keep the idea of ESM as an intervention valid, extending the analysis may have provided a deeper understanding of the processes behind the measurements. After the comments had been gathered in a single document, they were reviewed and underwent through grammatical and orthographical corrections. The document containing all the feedback was imported into ATLAS.ti programme where the thematic analysis could be performed (Braun & Clarke, 2006). Based on the variety of codes that covered similar patterns, multiple themes were indicated. Afterwards, themes were assigned to specific parts of the feedback and counted.

3. Results

3.1. Quantitative Research

3.1.1. Descriptive Statistics

A total of 56 participants successfully met the criteria necessary to be involved in the study. For the experimental group specifically, participants who were discarded did not reach the threshold of 60% response rate (Weermeijer et al., 2023). In total, 10 participants from the experimental group did not manage to sufficiently meet the criteria. The experimental group consisted of 23 participants, and the control group consisted of 33 participants.

Descriptive statistics were obtained based on the results of the pre-test and post-test for the variable of self-control. For the experimental group, mean self-control seemingly changed from the pre-test ($M = 90.48$, $SD = 10.51$) to the post-test ($M = 94.87$, $SD = 11.47$). For the control group, mean self-control remained relatively the same between the pre-test ($M = 89.48$, $SD = 13.93$) and the post-test ($M = 89.39$, $SD = 14.72$).

When it comes to the dimension of the inhibitory self-control, in the experimental group the mean changed from the pre-test ($M = 43.13$, $SD = 7.15$) to the post-test ($M = 44.91$, $SD = 7.92$). For the control group, mean inhibitory self-control remained relatively the same between the pre-test ($M = 44.21$, $SD = 9.04$) and the post-test ($M = 43.91$, $SD = 9.39$).

Lastly, for the initiatory self-control levels, in the experimental group mean changed from pre-test ($M = 47.35$, $SD = 7.00$) to post-test ($M = 50.48$, $SD = 7.04$). For the control group, mean

initiatory self-control remained relatively the same between pre-test ($M = 45.58$, $SD = 7.01$) and post-test ($M = 45.12$, $SD = 8.03$).

3.1.2. Assumptions Testing

To continue the analysis using repeated measures ANOVA with one between-subjects factor (group) and one within-subjects factor (time), certain assumptions had to be assessed. The assumptions for ANOVA analysis are: the dependent variable is metric, the independent variable is fixed, the error term is normally distributed with a constant variance across groups (homogeneity of variance) and the sphericity of equal variance across time (Muhammad, 2023).

First of all, the assumption regarding the dependent variable being metric was met because results from MSCS are ratio scaled. Moreover, the categories of independent variables are predefined, thus are assumed to be fixed (Muhammad, 2023). The third assumption requires the error term to be normally distributed, which equals the normal distribution of the dependent variable. This can be checked via a Q-Q plot, where it can be observed that the normality assumption is met (Figure 1). Furthermore, the assumption of constant variance is assessed with Levene's Test that has to be insignificant as it checks for heterogeneity. Initially, the assumption was not met for the level of general self-control in the pre-test, therefore the wisnorizing outlier correction had to be conducted as outliers affect the assumption significantly (Chambers et al., 2020; Liao et al., 2016). 13 outliers were identified across 5 participants. The correction resulted in obtaining insignificant Levene's Test (Table 1). For both dimensions of self-control, Levene's Test was insignificant as well. When it comes to the sphericity tests, because there are only two levels of the repeated measures factors, the test was not necessary (Dimitrov & Rumrill, 2003). As such, there is only one set of difference scores and nothing to compare those difference scores against to indicate a violation of sphericity.

Figure 1

Q-Q Plot

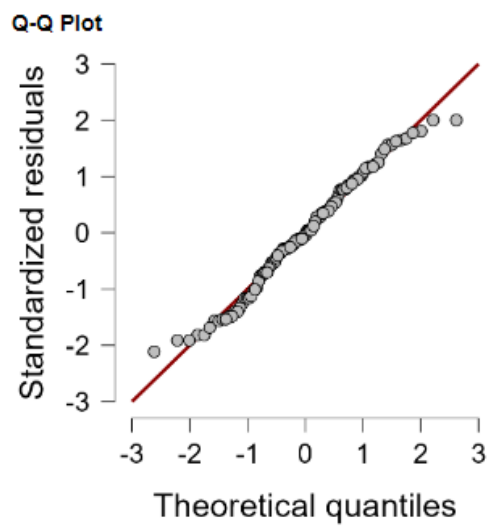


Table 1

Levene's Test for Equality of Variances of Self-Control

	F	df1	df2	p-value
PRE-Self-Control	3.856	1	54	.055
POST-Self-Control	1.806	1	54	.185

Note. $p < .05$ (two-tailed).

3.1.3. Main Effects

As the assumptions for the ANOVA method are not violated, the analysis can advance. Main effects analysis in ANOVA reports two main effects, the effects of the within-subjects factor (time) and between-subjects factor (group). For the general level of self-control, analysis revealed

that the main effect of time did not reach a significant level, $F(1,54) = 2.871$, $p = .096$ (Table 2). Similarly, the main effect of the group remained insignificant, $F(1,54) = .950$, $p = .334$ (Table 3).

Table 2

Within-Subjects Effects of Self-control

Cases	Sum of Squares	df	Mean Square	F	P	η_p^2
Time	125.326	1	125.326	2.871	.096	.050
Time x Group	136.147	1	136.147	3.119	.083	.055
Residuals	2357.103	54	43.650			

Note. Type III Sum of Squares

Table 3

Between-Subjects Effects of Self-control

Cases	Sum of Squares	df	Mean Square	F	P	η_p^2
Group	283.598	1	283.598	.950	.334	.017
Residuals	16117.366	54	298.470			

Note. Type III Sum of Squares

For inhibitory self-control, the analysis revealed a non-significant main effect of time, $F(1,54) = .946$, $p = .176$, and non-significant effect of the group on the variable $F(1,54) = 3.117 \times 10^{-4}$, $p = .986$ (Table 4 and Table 5).

Table 4*Within-Subjects Effects of Inhibitory Self-control*

Cases	Sum of Squares	df	Mean Square	F	P	η_p^2
Time	14.835	1	14.835	.946	.335	.017
Time x Group	29.478	1	29.478	1.881	.176	.034
Residuals	846.441	54	15.675			

*Note. Type III Sum of Squares***Table 5***Between-Subjects Effects of Inhibitory Self-control*

Cases	Sum of Squares	df	Mean Square	F	P	η_p^2
Group	.041	1	.041	3.117×10^{-4}	.986	5.772×10^{-6}
Residuals	7094.236	54	131.375			

Note. Type III Sum of Squares

Lastly, for initiatory self-control, the analysis revealed a non-significant main effect of time on the level of the variable, $F(1,54) = 2.288$, $p = .136$, and non-significant effect of the group on the variable, $F(1,54) = 3.990$, $p = .051$ (Table 6 and Table 7).

Table 6*Within-Subjects Effects of Initiatory Self-control*

Cases	Sum of Squares	df	Mean Square	F	P	η_p^2
Time	48.524	1	48.524	2.288	.136	.041
Time x Group	87.096	1	87.096	4.106	.048	.071
Residuals	1145.395	54	21.211			

Note. Type III Sum of Squares

Table 7*Between-Subjects Effects of Initiatory Self-control*

Cases	Sum of Squares	df	Mean Square	F	P	η_p^2
Group	344.425	1	344.425	3.990	.051	.069
Residuals	4661.137	54	86.317			

Note. Type III Sum of Squares

3.1.4. Interaction Effects

A trend-level interaction effect between time and group was observed for the general level of self-control, $F(1,54) = 3.119$, $p = .083$ (Table 2). This suggests a potential difference in the change in general self-control scores over time between the study and control groups, as the effect did not reach the conventional level of significance. For inhibitory self-control, the interaction effect between time and group did not result in significant association, $F(1,54) = 1.881$, $p = .176$ (Table 4). However, for initiatory self-control, a positive and significant interaction effect was observed, $F(1,54) = 4.106$, $p = .048$ (Table 6). Moreover, the proportion of variance explained indicated a medium effect size ($\eta_p^2 = 0.071$), approximately explaining 7.1% of the variance (Richardson, 2011). To conclude, while the first hypothesis of ESM affecting the general level of

self-control had to be rejected, the second hypothesis could be accepted, indicating that initiatory self-control can be positively influenced by ESM.

3.2. Qualitative Research

Feedback was collected from the total sample of the experimental group. Out of 33 participants who reached and did not reach the threshold of 60% response rate, 17 and 6 shared their experiences about the study respectively. However, due to one response being in German, it was not taken into consideration as unprofessional translation could impact the delivery of the feedback, thus lowering the number from 17 to 16 (Van Nes et al., 2010). After conducting the thematic analysis, 6 themes were identified: *Increased Awareness, Reflection and Insight, Repetition, Longevity, Positive Impact and Negative Impact* (Table 8).

Table 8

Thematic Analysis of the Experimental Group Feedback

Theme	Instances		Participants	
	>60% RR	<60% RR	>60% RR	<60% RR
Increased Awareness	13	3	12	3
Reflection and Insight	9	2	9	1
Repetition	4	2	4	2
Longevity	3	0	3	0
Positive Impact	7	2	7	2
Negative Impact	1	1	1	1

The theme that was identified the most was *Increased Awareness*. The theme concerned all the fragments related to participants becoming more aware of their physical and emotional states, their environment or their self-control capabilities. For instance, a participant shared, “It made me a bit more comfortable and made me aware of when and why I feel discomfort” or “I

caught myself focusing more on sensing rather than thinking”. Others described the process as a source of continuous reminder on the importance of mindfulness techniques, with comments such as, “The notifications helped me regain focus on my body and stress levels”.

The second most common theme in the gathered feedback was *Reflection and Insight*. As one participant commented, “It changed my views slightly”, the theme connected all the responses where participants stated possibly learning new ideas from the experiment. For some, the measurements enabled new perspectives on themselves and possibly created new goals. For instance, “[...] I will try to be more mindful about my body and emotional states” or “It gave me another perspective on the importance of body awareness and how it relates to self-control”.

The *Repetition* theme concerned all the comments regarding the repetitive nature of the study and the repercussions of it. Some participants viewed the study as an underwhelming responsibility with comments like, “The repetitive nature of the questions sometimes put me off and I didn’t really pay as much attention to the questions themselves which made it feel more like a chore” or “I didn’t participate in every questionnaire due to work and hobbies”. On the other hand, some participants emphasized the positive effect of repetitiveness, attributing it to be the cause of the change. For instance, “I think after answering all these questions for multiple days, I feel more aware of my body sensations and how it affects me”.

The *Longevity* theme concerns all the deliberately stated hopes or uncertainty for the future impact ESM may have outside of short-term benefits. For instance, participants stated, “I am not sure yet if this will affect me sustainably [...]” or “I will try to be more mindful about my body and emotional state in the future”.

Lastly, the dichotomy of positive and negative effects was captured in either *Positive Impact* or *Negative Impact*. The first theme concerned all the comments indicative of positive outcomes gained from increased awareness or through changes in behavioral patterns. As an example, one participant stated, “It kind of reminded me to think about situations from another perspective”. Other participants indicated the positive value of increased mindfulness ability through comments such as, “It made me more aware of some techniques to make me feel more at ease” or “It made me a bit more conscious about observing my body and regain relaxation”. On the other hand, heightened awareness was sometimes attributed to negative outcomes. As one participant expressed, “[...] but there were times when I had to answer it during working or

studying when it made me realize how much in a hurry and anxiety I am most of the time during my day, which made me sad”.

4. Discussion

4.1. Main Findings

The goal of the study was to examine whether the experience sampling method has an influence on self-control levels through mere measurement effect. Moreover, the study put into question if dimensions of self-control may be affected in a different manner and whether initiatory self-control change is observed to be more positive and significant than the change in inhibitory self-control. Results provided support for the last hypothesis: ‘Participants who have their level of self-control assessed through ESM will experience a significant increase of initiatory self-control compared to inhibitory self-control.’ revealing a significant interaction effect between group and time for initiatory self-control where inhibitory self-control turned out to be insignificant. This finding entails that participants taking part in the ESM had their level of initiatory self-control significantly increased when comparing scores obtained from MSCS in the pre-test and post-test. On the other hand, comparing pre-test and post-test scores for the inhibitory side of self-control did not result in a meaningful change.

It can be stated that reoccurring measurements may influence the ability or willingness to control the environment more than simply strengthening one’s willpower. As in contrast to inhibitory self-control which emphasizes restraining oneself from unwanted impulses through the ego depletion phenomenon, initiatory self-control refers to more advanced reflective processes allowing to adapt one’s environment to align it with short-term or long-term goals (Baumeister et al., 2007; De Ridder et al., 2017). This finding is also in line with the qualitative part of the study. Two of the most reoccurring themes that emerged through the thematic analysis were ‘Increased Awareness’ and ‘Reflection and Insight’. While not directly mentioning how their level of self-control was affected by ESM, feedback obtained from participants in the experimental group may suggest that participants reflected on the experience and became more aware of both the environment and internal processes that guide them. According to previous literature, reoccurring feedback on one’s self-awareness can lead to positive and meaningful behavioral changes (Sheeran et al., 2022; MacKenzie & Baumeister, 2015). This possibly entails that the reflection caused by ESM was sufficiently impactful to influence the initiatory self-control.

On the other hand, inhibitory self-control might require more to be influenced than asking questions which primary focus is to facilitate the mere measurement effect and the reflection process. As inhibitory self-control requires an intervention focused on challenging the concept directly, ESM was not sufficient to observe a significant influence of the measurements (De Ridder et al., 2019). Moreover, some participants from the experimental group found it difficult to fully commit to the experiment. In some cases, it possibly resulted in the engagement being sporadic and less reliable, thus negatively affecting response rates. The theme of ‘Repetition’, in some cases, provided insight into how the repetitiveness of the design facilitated a negative attitude towards the study, thus potentially explaining lowered willingness and barriers to engagement.

Somewhat surprisingly, however, findings regarding the general level of self-control turned out to be insignificant. Subsequently, the first hypothesis: ‘Participants who have their level of self-control assessed through ESM will have a higher level of general self-control than participants who have not’ could not be confirmed. Although upon closer examination of the descriptive statistics, the mean was observed to increase, high standard deviation indicated a broad spread of data points. In other words, the difference in means is less indicative of increasing the level of self-control because of the potentially overlapping groups. However, it is imperative to address that as self-control is operationalized as a combination of initiatory and inhibitory dimensions, the stability of the second dimension may have caused the interaction effect to be insignificant for the general score. The theoretical division of the self-control concept resulting from two set of factors from Brief Self-Control Scale being negatively correlated signifies the fact that one dimension increasing does not necessarily correspond to changing the overall score of self-control (Heller et al., 2017).

4.2. Strengths and Limitations

4.2.1. Strengths

As the study was set to uncover limitedly explored interaction between ESM and self-control, it provides a new perspective on self-control and on its relation to being exposed to mere measurement effect. Application of the Multidimensional Self-Control Scale allowed to grasp the dimensionality of the construct and potentially highlighted the value of the two-factor model of self-control. As the results differ considerably, the differences between inhibitory and initiatory dimensions should not be neglected.

Validation of the theoretical distinction between the dimensions was partly highlighted by the design of the study. In particular, applying ESM with the ‘m-Path’ application allowed participants to answer the surveys in a real-world setting, ensuring ecological validity and limiting the researcher's impact. This approach minimized the bias, possibly allowing the assessment to be more accurate. It would be in line with feedback provided by participants where the ‘Repetition’ theme suggested that participants did not put much cognitive effort into answering the questions. Conversely, it highlights that through applying ‘m-Path’, the self-assessment bias was reduced, as well as the importance of implementing qualitative research into this study. Additionally, theme analysis allowed to include more participants that were ineligible for the quantitative analysis due to the low response rate.

4.2.2. Limitations

While qualitative research allowed to incorporate participants from the total sample of experimental group, the sample size, in general, stayed relatively small. Subsequently limiting the statistical power and potential for generalizing results. The required response rate of 60% interfered with the equal distribution of participants from the study and control group as it may led to potential bias in group composition. Moreover, possibly because of the intense and relatively time-consuming nature of the study, a high dropout rate was observed. Considering the complexity and requirements of the study, it is possible that some technical difficulties sometimes discouraged participants from continuing. Moreover, sampling methods introduced, namely snowballing sampling and convenience sampling, may have impacted the sample as participants consisted mostly of young adults. Lastly, the ESM part of the study lasted for 14 days, making it quite short and possibly reducing the capability of self-control to be impacted.

Despite the duration of the study being relatively short, this research did not study ESM data. Therefore, it is not known how self-control may have fluctuated over the span of one day and what other factors could have influenced it. It is worth noting that the study was conducted in cooperation with other researchers, thus constructs of stress and interoceptive awareness were studied simultaneously. Following the same study design, participants were not only exposed to self-control but to the aforementioned constructs as well. While measuring interoceptive awareness and stress might contributed to participants being more aware of their states, making individuals prone to reflect easier, it might have led to replenishing mental resources quicker

(Hisler et al., 2018). In other words, measuring those constructs could affect both dimensions of self-control.

4.3. Implications for Future Research

In regard to the aforementioned limitations, future research could build upon the identified shortcomings. Namely, introducing more participants and possibly reducing the dropout rate. To collect a larger sample size, it would be advised to extend the time for sample collection or adopt other ways to reach more people (Anderson et al., 2017). To tackle the dropout rate issue, one could implement an incentive system to motivate potential participants to continue with the study. While a raffle seemingly may even lower the response rate, a fixed reward tends to significantly increase the tendency of participants to finish an experiment (Weermeijer et al., 2023).

Other than simply reducing the intervention to assess self-control, a comparison between other dimensions or theoretical models of the construct are of high interest. As the study utilized MSCS which conceptualize self-control as a trait, for different purposes the state self-control may be measured. In general, state self-control is more reactive to external factors such as sleep quality or emotion intensity (Hisler et al., 2018; Simons et al., 2015). In the context of ESM, it may be intriguing to get insight into how state self-control could be affected by the proposed intervention, as the method utilizes ecological validity. Different conceptualization and operationalization methods of self-control could be implemented. Moreover, one could design a study where another intervention next to ESM assessments was to be implemented. It could provide a better understanding of self-control and mechanisms behind it, as purposeful exertion is seemingly required to affect the inhibitory dimension (Lövdén et al., 2010).

4.4. Conclusion

The purpose of this research was to determine whether ESM can significantly influence self-control. As it became apparent, the study demonstrated that ESM can potentially affect the initiatory dimension of self-control tied to proactiveness and reflective behavior. To conclude, the main research question cannot be fully answered. This paper, however, provides deeper understanding of the concept and its' relation to mere measurement effect. Subsequently, by addressing the limitations, future research can unlock the full potential of ESM as a possible intervention.

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Appendices

Appendix A

Trait Questionnaire

The Multidimensional Self-Control Scale (Nilsen et al., 2020)

1. I postpone things.
2. If there is something I should do, I get to it before attending to lesser tasks.
3. I put things off for so long that my well-being or efficiency suffers unnecessarily.
4. I spend my time wisely.
5. I have a hard time to get started.
6. It is hard for me to concentrate.
7. I have a good ability to concentrate.
8. I can concentrate, even with many disturbances.
9. I can regulate my focus during a task.
10. I have problems to stay focused on what is said during a talk.
11. Bodily impulses do sometimes have too much control over me.
12. I am easily disturbed by my impulses.
13. Sometimes, it is hard to restrain myself.
14. When I am confronted with an unwanted impulse, I have problems to stop thinking about it.
15. I often act without thinking though other alternatives.
16. I try to think about something else when an unpleasant thought is bothering me.
17. When I feel sad, I try to think about something positive.
18. When I feel down, I try to do something I like.
19. If I get angry, I try to focus on something else.

20. When I set a goal, I make concrete plans of how to reach it.
21. I make plans for when, where, and how to reach my goals.
22. I focus daily on my long-term goals.
23. I know what I have to do to reach my goals.
24. I try anything to get me started when I am uncertain of how to solve a task.
25. When I feel stuck, I try to look at the situation from another perspective.
26. I try to conquer the fear if I do something scary.
27. When it is hard to get started on a task, I try to find something to get me going.
28. When it is hard for me to concentrate on what I read, I try different ways of increasing my concentration.
29. I often look for new solutions by redefining the situation.

Appendix B

ESM Questions

1. Since the last questionnaire, I have postponed things.
2. Right now, it is hard for me to concentrate.
3. At this moment, I am easily disturbed by my impulses.
4. Since the last questionnaire, whenever I felt sad or down, I tried to think of something positive or did something I like.
5. Right now, I know what I have to do to reach my goals.
6. Since the last questionnaire, whenever I felt stuck, I tried to look at the situation from another perspective.

Appendix C

Feedback

Above 60% response rate

- It made me more aware of some techniques to make me feel more at ease
- I think after answering all these questions for multiple days I feel more aware of my body sensation and how it affects me.
- It made me a bit more conscious about observing my body and regain relaxation
- It made me realize that I need to pay more attention to my body's reaction during the day. Most of the time, the fact that I had to read the questions and think about the answers in order to be able to answer, made me calmer, but there were times when I had to answer it during working or studying when it made me realize how much in a hurry and anxiety I am most of the time during my day, which made me sad.
- I feel like the regular reminder of the topic of awareness and mindfulness has made me more receptive to those aspects, making it more prevalent in the last two weeks. I am not yet sure if this will affect me sustainably, but I enjoyed diving into the topic a lot.
- I realized that I personally find it rather hard to focus on my breathing in order to relax myself. I had one panic attack during the 14 days, and it was the only occasion where I could really use my breathing to calm myself down. I found it quite easy to describe where in my body I feel changes when my mood changes (for example when very hungry or stressed my hands sometimes feel a bit numb) but I also realized that I could find it hard to focus on sensing my body when I don't not feel comfortable. When I feel comfortable (which I do most of the time, there haven't been many occasions where I felt extremely bad) I do think a lot about sensing my body because usually my body feels as good as then. But when I do feel nervous/hungry/sad, I notice' changes and that I don't feel entirely good anymore.
- I definitely noticed changes in my awareness. Towards the end, I was able to implement some of the content of the question. For instance, I caught myself focusing more on sensing rather than thinking. It was a good experience to track my moods throughout the day, because I was able to compare them. This way I noticed kinda what influences me to feel happy and what not (same thing with having motivation to work)
- Durch die t ogliche Befragung wurde ich immer wieder daran erinnert, mich auf meine Empfindungen zu konzentrieren, was ich in verschiedenen Situationen sehr hilfreich fand. Die Fragen haben sich mit der Zeit "eingebrannt" und gingen mir auch zwischendurch immer wieder durch den Kopf,. Ich bin sehr gespannt auf die Ergebnisse!

- I do not think the constant questionnaires helped a lot in getting me to be more aware of my body and concentrate on my body. I felt like I forgot the contents of the survey almost immediately after filling it in.
- It made me a bit more comfortable and made me aware of when and why I feel discomfort
- I would say it helped to make me be more aware although sometimes I was so focused on the tasks I was doing during the day like lectures and studying that the questioners didn't really hit me that deep. Also, the repetitive nature of the questions sometimes put me off and I didn't really pay as much attention to the questions themselves which made it feel more like a chore.
- It was a small boost in my awareness of those things. It worked as a daily reminder. It didn't change my life, but I think it had a positive impact.
- The notifications helped me regain focus on my body and my stress levels. Oftentimes, I didn't notice how I was feeling until filling in the questionnaire, which then helped me to regain focus (for example, if I filled in I was postponing something, it made me realize I should get to work), which was really useful in my everyday life. I think it was a very good experience and I will try to be more mindful about my body and emotional state in the future!
- I believe that my awareness of the daily questionnaire had a slight (3.5/10) influence on how I answered the questions. Although, it helped me more frequently reflect on how I felt every day, but of course it wasn't the core reason. In the beginning I was only slightly worried how my awareness of this questionnaire would affect my daily awareness of my mental health, but soon after I felt at ease with it.
- It made me more aware, especially when filling in the questionnaire, how I (have) felt and how it was in past experiences. It made me realize how and where I felt tension and that I should pay attention to it, to use breathing to relax a bit more.
- It changes my views slightly
- Made me more aware of the connection between the way I feel and how it affects my body, the changes in moods that I might experience within a day

Below 60% response rate

- Mildly
- It made me slightly more aware of my body and breathing
- It kind of reminded me to think about situations from another perspective but at the same time made me continuously more aware about me having deadlines & thus kind of stressed me whenever the question was if I postpone things, or if I am worried etc.

- The questions were very similar to one another, so it felt like not all experiences of stress could be identified
- It gave me another perspective on the importance of body awareness and how it relates to self-control. It helped me with emotional self-regulation and with being more aware of my body responses. I understood that to self-control you do not need to try avoiding paying attention to discomfort, but on the other hand be more aware of it without overthinking too much. Some of the notifications were really helpful in the moment, especially when there is a lot going on.
- I can't see effects, but I didn't participate in every questionnaire, due to work and hobbies