

**How Trait Self Control and State Self Control are Associated with Mindful Eating:  
an Experience Sampling Study**

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### **Abstract**

Non-restrictive diet approaches such as mindful eating are of public health relevance due to rising non-communicable diseases and malnutrition (Schaefer & Magnuson, 2014; World Health Organisation, 2020). The study aimed to investigate possible associations between different types of self-control and mindful eating over time. It was hypothesised that trait and state self-control are positively associated with each other, as well as their subscales initiatory and inhibitory self-control. Additionally, a positive association between initiatory/inhibitory state self-control and mindful eating was hypothesised. The experience sampling method was used to capture between-person effects and within-person variations of self-control. Participants received three questionnaires over 15 days following a semi-random sampling scheme. The total sample consisted of seven young adults. Visual analyses and linear mixed modelling were done to analyse between-person and within-person variations. Trait and state self-control, as well as their subscales, showed positive associations. This study found that inhibitory state self-control correlates positively with mindful eating between- and within-persons. Additionally, the association between initiatory state self-control and mindful eating within-persons is positive. There is no association between persons. Although the study is based on a small sample, the findings suggest that mindful eating is more associated with inhibitory state self-control than initiatory state self-control. This finding may suggest that state self-control and mindful eating (as a non-restrictive approach to food) operate similarly to inhibitory trait self-control and healthy eating (mainly studied using a restrictive approach to food). This research created valuable insights into the fluctuating nature of state self-control and mindful eating. Thus, future research can continue to study self-control and mindful eating using the experience sampling method.

*Keywords:* trait self-control, state self-control, initiatory self-control, inhibitory self-control, mindful eating, experience sampling method

## **How Trait Self Control And State Self Control Are Associated with Mindful Eating: An Experience Sampling Study**

Getting a better understanding of the psychological and behavioural mechanisms behind healthy eating is of public health significance. Over the past decades, the world has experienced a shift in dietary patterns caused by rapid urbanisation, increasing amounts of processed foods, and changing lifestyles (World Health Organization, 2020). As a result, there is a rapid increase in malnutrition and non-communicable diseases such as diabetes, stroke, and cancer, which can be prevented through healthy eating (World Health Organization, 2020). Healthy eating behaviour is a broad term consisting of several facets, such as consuming fruits and vegetables, reducing sugar, salt, and fat intake, eating mindful and following a healthy diet to reduce overweight (Mantzios & Wilson, 2015; World Health Organization, 2020). Therefore, there is a growing body of research on essential determinants to consider in promoting healthy eating.

In addition to national policies developed by governments, consumers are encouraged to eat healthily through tailored fitness and diet programmes. In Western culture, these programmes often focus on restricting dietary intake to induce weight loss (Schaefer & Magnuson, 2014). However, this approach is ineffective for long-term weight loss and increases the risk of unhealthy weight control behaviours like binge eating and other eating disorders (Schaefer & Magnuson, 2014). Therefore, health-centred non-restrictive diet approaches, such as mindful eating, are gaining popularity (Schaefer & Magnuson, 2014). Part of mindful eating is shifting attention back to hunger cues and de-automating eating (Mantzios & Wilson, 2015).

*Self-control* is an important determinant that enhances healthy eating behaviour. One must engage in self-control to withstand everyday temptations and pursue higher-order goals (Hofmann et al., 2012). According to Baumeister et al. (1998), self-control is the regulation of impulses by controlling thoughts, emotions and behaviour. People with high levels of self-control live happier, healthier, and more successful lives, which leads to improved psychological well-being, academic achievement, and interpersonal relationships (De Ridder et al., 2012; Tangney et al., 2018). Hence, the present study is based on a self-control approach to understanding health behaviour patterns.

Researchers agree that self-control is both a stable characteristic, called *trait self-control* and a fluctuating capacity, named *state self-control*. Trait self-control is dispositional and stable over time (Tangney et al., 2004). People that score high on dispositional self-control have better outcomes in achievement and task performance, impulse control, adjustment, and social

relationships (Tangney et al., 2004). On the other hand, state self-control is affected by situational influences, such as working memory capacity (De Ridder et al., 2012). Baumeister et al. (2007) developed the strength model of self-control. This theoretical framework implies that each time one exerts self-control, the self draws upon a limited resource, resulting in a lower capacity for a subsequent action that requires self-control. Individuals are in a state of ego depletion when that resource diminishes. This state makes following acts of self-control more prone to failure (Baumeister et al., 1998; Baumeister et al., 2007; Hofmann & Kotabe, 2012). Self-control can also be seen as a skill, namely exerting self-regulatory strategies. Self-regulation strategies, such as situational strategies (e.g., situation modification) or intrapsychic strategies (e.g., down talking to reduce temptation), can be trained (Duckworth et al., 2016; Ein-Gar et al., 2008). Baumeister et al. (2007) elaborate on that through the strength model of self-control. Regular attempts to self-control increase one's willpower strength to resist ego depletion. Daily regular practice of self-control in one area also extends to other areas, such as using the non-dominant hand for tasks. This led to improved self-control in other areas of life (Baumeister et al., 2007). To summarise, self-control is a construct of being both a stable characteristic and a fluctuating capacity.

Further, scientists differentiate between *inhibitory self-control* and *initiatory self-control*. Self-control is not only the inhibition of undesirable responses (inhibitory self-control) but also the exertion of a desirable response that contributes to pursuing a long-term goal (initiatory self-control) (De Ridder et al., 2011; De Ridder et al., 2012; Hofman & Kotabe, 2012). Concludingly, different types of self-control exist, such as the concept of initiatory and inhibitory self-control.

So far, there has been reliable evidence about an association between trait self-control and healthy eating (Hofman et al., 2014; Lopez et al., 2021; Williamson & Wilkowski, 2020; Wills et al., 2007). Previous research has indicated that dieters high in trait self-control refrain from unhealthy food desires and are more likely to lose weight in the long term (Hofmann et al., 2014). In addition, people high on trait self-control showed more vegetable and fruit intake, sports and less sedentary behaviour (Wills et al., 2007). In contrast, people with low trait self-control consume more saturated fat (Wills et al., 2007). However, it still needs to be determined which aspects of self-control contribute to health-centred non-restrictive diet approaches, such as mindful eating, compared to restrictive eating. Therefore, this study aims to contribute to the area of interest in health behaviour patterns by examining the association between different types of self-control and mindful eating.

These differences are explained by people's different use of self-regulatory strategies. People who are generally self-controlled by character use effortless strategies; they plan ahead—for example, situation modification to avoid temptation (Hofmann et al., 2012). Indeed, people high in trait self-control experience less temptation (De Ridder et al., 2012; Williamson & Wilkowski, 2020). People who experience a temptation that conflicts with their long-term goal exert self-control to attain goal progress (Williamson & Wilkowski, 2020). People who are generally successful at initiating self-control in the moment of a desire that conflicts with their goals are likely to apply several strategies to resist temptation (Lopez et al., 2021). For instance, recent evidence suggests that enacting an initiatory strategy, such as a ritual before eating, enhances the likelihood of choosing healthy food over unhealthy food (Tian et al., 2018). Strategies that involve initiatory self-control are situational selection, mindfulness, and distraction (Lopez et al., 2021). Consequently, initiatory self-control is associated with weaker desires, a lower possibility of following food desires, less food consumed, and higher resistance (Lopez et al., 2021).

Much uncertainty exists on how state self-control is associated with non-restrictive diets, such as mindful eating. Regulating oneself seems to be a key determinant in dieting. A study by Winkens et al. (2018) investigating mindful eating showed a significant correlation between the subscale 'focused eating' with general self-regulation ( $r = 0.13$ ;  $p < 0.001$ ). Nevertheless, the correlation reported by Winkens et al. (2018) is weak. Studies suggest that restrictive diets and their effortful monitoring increase cognitive load and available cognitive resources (Palascha et al., 2021). These changes in cognitive function (e.g., limited working memory capacity and attention) are associated with appetite control and weight gain. Non-restrictive diet approaches, such as mindful eating, use less cognitive capacity and provide more room for state self-control (Palascha et al., 2021). Studies show improvements in state self-control associated with non-restrictive diet approaches (Palascha et al., 2021).

While very few studies have been carried out on state self-control and mindful eating, there is also still limited research investigating initiatory and inhibitory self-control and mindful eating. Lopez et al. (2021) define mindfulness as a strategy of initiatory self-control. Mindfulness is a state of *self-regulating attention* to the present moment in a non-judgmental way (Kabat-Zinn, 2003; Bishop et al., 2004). Since mindful eating involves initiating to regulate the attention back to bodily sensations and the qualities of the food (Mantzios & Wilson, 2015; Palascha et al., 2021), mindful eating may be associated with initiatory self-control. Mindful eating is a non-restrictive diet in

terms of unconditional permission to eat and relying on internal hunger and satiety cues (Schaefer & Magnuson, 2014). However, it also involves inhibiting eating impulsively or mindlessly (Lattimore, 2020; Mantzios & Wilson, 2015). The existing literature does not provide sufficient indications of how initiatory and inhibitory self-control could be associated with mindful eating. Therefore, the present study aims to investigate how initiatory self-control and inhibitory self-control are associated with mindful eating.

### **The Current Study**

Apart from a few studies (among others, Baumeister et al., 2019; Hofmann & Kotabe, 2012; Lopez et al., 2021), there is a general lack of research on self-control studies in everyday life. Most studies used a cross-sectional design, which helps analyse between-person effects (Myin-Germeys, & Kuppens, 2022). For instance, people who score high in trait self-control may also score high in mindful eating. Within-person associations reflect how one individual's experiences fluctuate regarding time and context (Myin-Germeys, & Kuppens, 2022). For example, how state self-control in an individual might be higher in the morning compared to the evening. Since initiatory self-control is susceptible to situational influences such as working memory capacity or previous attempts to self-regulate (Baumeister et al., 1998; De Ridder et al., 2012), it is helpful to study state self-control outside the laboratory. The ESM allows the research of hands-on, real-life experiences of individuals' differences in types of self-control and mindful eating. Therefore, the current research uses the experience sampling method (ESM). The results of this study could pose implications if self-control should be considered when promoting healthy eating, particularly mindful eating.

### ***Association Between Trait Self-Control and State Self-Control***

Drawing upon two strands of research into self-control, this study sheds light on how state self-control fluctuates over time in different real-life contexts. Previous studies indicated a positive relationship between trait self-control and state self-control, meaning that people who are generally highly self-controlled also tend to have more self-control throughout the day (Bagala, 2021; Daniel, 2021; Vos, 2022). Further, people who score high in trait self-control tend to show fewer fluctuations in state self-control (Bagala, 2021). Therefore, this study aims to replicate the relationship between trait self-control and state self-control. Thus, the first research question is, "What is the association between trait self-control and state self-control over time?". The hypothesis will be tested that trait self-control and state self-control are positively associated.

Self-control can be conceptualised into different constructs, such as initiatory and inhibitory self-control. De Ridder et al. (2011) showed that these different aspects of self-control are distinguished but related dimensions of trait self-control. This study uses an experience sampling method and captures momentary experiences of individuals' initiatory and inhibitory self-control over time. Hence, this research aims at investigating the association between these facets as a trait and as a state throughout the day. Thus, the second research question is, "What is the association between inhibitory/ initiatory trait self-control and inhibitory/ initiatory state self-control over time?". As existing literature differentiates between the two concepts (De Ridder et al., 2011; De Ridder et al., 2012; Hofman & Kotabe, 2012), it is expected that initiatory trait self-control and initiatory state self-control are positively associated. Inhibitory trait self-control and inhibitory state self-control are also expected to be positively associated. People who are generally, by character, good at inhibiting themselves or initiating self-control are also on average more likely to exert inhibitory self-control or initiatory self-control at a specific point in time.

### ***Association Between State Self-Control and Mindful Eating***

Given the rising interest in non-restrictive diets, such as mindful eating, this study will investigate the association between mindful eating and different types of self-control, such as initiatory and inhibitory self-control. It still needs to be clarified what type of self-control is stronger associated with mindful eating and what the associations disaggregated between-person effects, and within-person effects look like. Therefore, these research questions are tested: "What is the association between initiatory state self-control and mindful eating over time?" and "What is the association between inhibitory state self-control and mindful eating over time?". It is expected that initiatory state self-control and inhibitory self-control are positively associated with mindful eating. Since people who are generally self-controlled regarding their eating habits (Hofmann et al., 2014) are effectively inhibiting temptation, it could be that people scoring high on inhibitory self-control are also good at inhibiting eating impulsively and mindlessly (Lattimore, 2020; Mantzios & Wilson, 2015). At the same time, initiatory self-control may manifest itself as 'mindfulness', which applies to mindful eating (Lopez et al., 2021). Thus, people who generally score high on initiatory self-control may also score high on mindful eating. Moreover, it is also expected that individuals who become more self-controlled concerning their eating habits also exhibit more mindful eating over time.

## **Methods**

## Participants

A final total sample of participants ( $N= 14$ ) was recruited through snowball sampling in the social networks of the researcher (via WhatsApp). In addition, participants were recruited from the test subject pool University of Twente and earned 2 study credits at the end of the study.

Participation in this study was voluntary and based on informed consent that briefed participants on their right to withdraw at any time, the anonymous nature of the study, and the responsible handling of the data (see Appendix A). All participants owned a smartphone to access “Ethica Data” ([www.ethicadata.com](http://www.ethicadata.com)) and could be contacted via email. Due to a short window of time to answer the informed consent and the demographic questions, not everyone provided explicit informed consent via these questionnaires. The researcher attempted to contact the participants to obtain written consent, but not all participants could be reached. However, due to the continuous commitment of these participants in answering the daily questions, it was assumed that these participants also agreed to the informed consent.

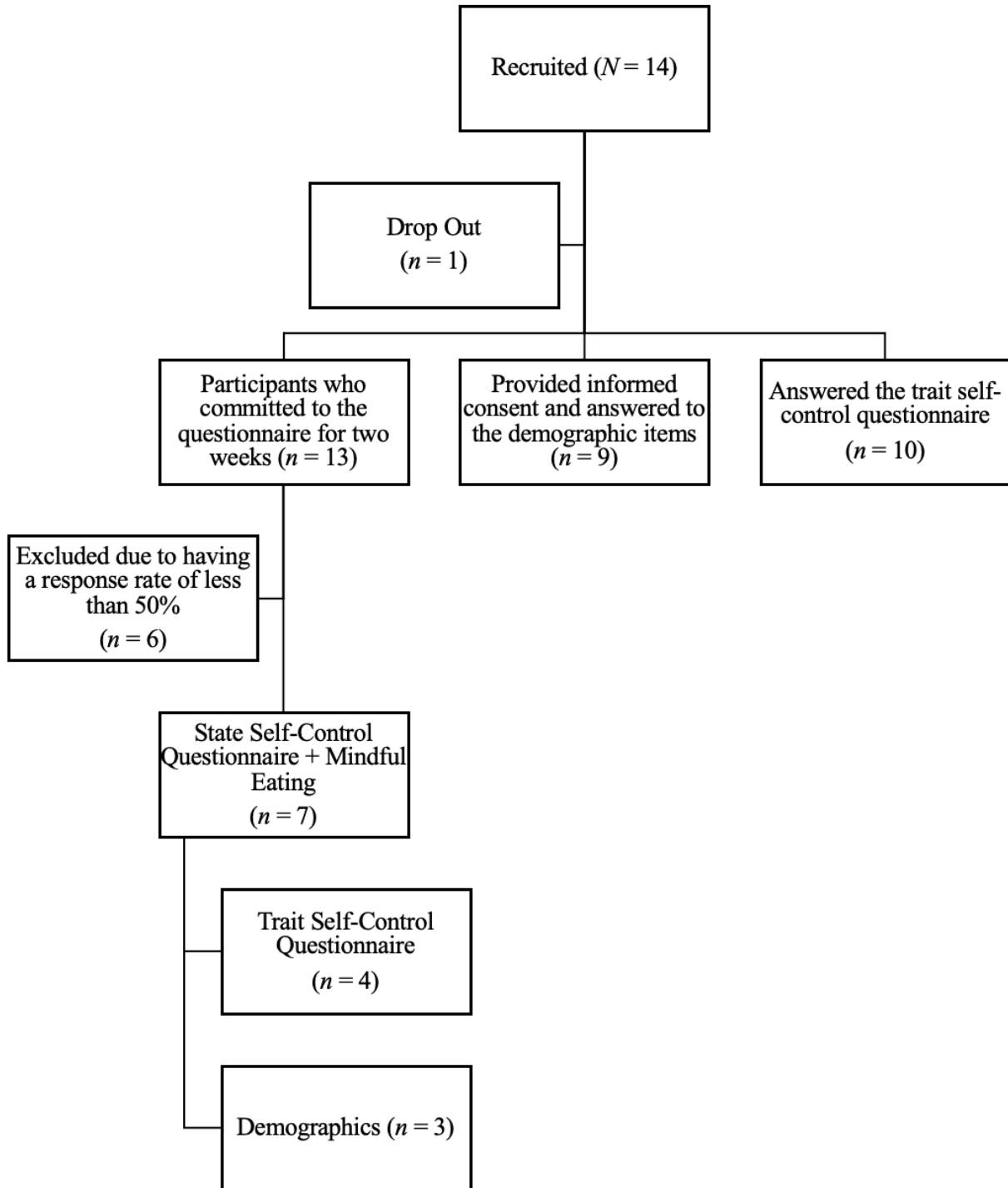
Participants that did not meet the inclusion criteria were excluded from the study, such as minimum age of 18, not being diagnosed with an eating disorder, being fluent in English, and having a response rate above 50%, which is considered sufficient data for ESM (Conner & Lehman, 2012). One participant dropped out of the study immediately after signing up. Six participants were excluded from the study due to having a response rate of less than 50% (Figure 1).

Three participants answered the demographic questions; everyone identified as women, ranging from 19-23 years ( $M = 20.67$ ;  $SD = 2.08$ ). All participants were German; two displayed that their highest education qualification was “VWO/ Gymnasium”, and one indicated that it was a “Bachelor’s degree” (Table 1).



**Figure 1**

*Flow Diagram of Participants Showing The Progression of Participants Throughout The Study*



**Table 1***Descriptive Statistics of Socio-Demographic Data*

Demographic	Frequency	%
Gender		
<i>Woman</i>	3	100
<i>Man</i>	-	-
<i>Non-binary</i>	-	-
<i>Self-disclose</i>	-	-
Nationality		
<i>German</i>	3	100
<i>Dutch</i>	-	-
<i>Other</i>	-	-
Education		
<i>HAVO/ high school</i>	-	-
<i>VWO/ Gymnasium</i>	2	80
<i>HBO</i>	-	-
<i>Bachelor's degree</i>	1	20
<i>Master's degree</i>	-	-
<i>Other</i>	-	-

*Note.*  $n = 3$

**Design**

The current study used the experience sampling method (ESM) to investigate the daily experiences in self-control and mindful eating over 15 days. On the first day, participants gave informed consent and received a baseline questionnaire that captured their socio-demographic data and their trait level of self-control. On each of the following 14 days, participants randomly received three push notifications in the morning, at lunchtime and at dinner to fill in the questionnaire about state self-control and state mindful eating. Csikszentmihalyi and Larson (2014) stated that ESM measures people's experiences in their ecologically valid contexts and relies on repeated measurements at many opportunities. Therefore, ESM provides a more realistic representation of individuals' experiences than laboratory settings (Van Berkel et al., 2017). Hence, this is more beneficial than widely used cross-sectional designs because concepts like self-control and mindful eating fluctuate throughout the day (Bagala, 2021; Palascha, 2021). Further, this study design minimises retrospective cognitive bias through repeated daily measures and push notifications, reducing participants' bias to recall their thoughts and feelings, for example,

compared to interviews at the end of the day (Van Berkel et al., 2017). Thus, it provides high ecological validity (Verhagen et al., 2016).

## **Materials**

### ***Software***

The survey application “Ethica Data” ([www.ethicadata.com](http://www.ethicadata.com)) was used to distribute questionnaires among the participants. Participants used their mobile devices to answer the questionnaires, which is considered a good tool for ESM (Conner & Lehman, 2012; Van Berkel et al., 2017). The software IBM SPSS Statistics 28 and Microsoft Excel were used to prepare, analyse, and visualise the data.

### ***Baseline Questionnaire***

**Demographic Questions.** Five items about socio-demographic data were administered - precisely, age, gender identification, nationality, and educational level (see Appendix B). For example, “Please indicate the gender you currently identify as.”.

**Brief Self-Control Scale.** Thirteen items of the Brief Self-Control Scale (BSCS) by Tangney et al. (2004) measured trait self-control in English (see Appendix C). This scale is a short version of the State Self-Control Scale and measures dispositional self-control, for example, “I am good at resisting temptation”. All items were measured on a 5-point Likert scale ranging from 0 (*not at all like me*) to 4 (*very much like me*) (Tangney et al., 2004). De Ridder et al. (2011) divided the BSCS into items measuring inhibitory and initiatory self-control. Six items measure inhibitory self-control (items 1, 2, 5, 6, 9, and 12), for example, “I refuse things that are bad for me”, and four items measure initiatory self-control (items 3, 10, 11, and 13), for example, “I am able to work effectively toward long-term goals”. Three items are not categorised (items 4, 7, and 8) (De Ridder et al. (2011). Items 2, 3, 4, 5, 7, 9, 10, 12, and 13 were recoded. The total score is the sum score of the items. The minimum total score was zero, and the maximum total score an individual could score was 52. The minimum total sum score of the subscale inhibitory self-control is zero, the maximum score is 24. The minimum total sum score of initiatory self-control is zero, the maximum is 14. Finally, mean scores were calculated.

The BSCS indicated high internal reliability ( $\alpha = .83$  and  $.85$ ), as well as high test-retest reliability ( $\alpha = .87$ ) (Tangney et al., 2004). Furthermore, the convergent validity of the BSCS was high (Manapat et al., 2021). De Ridder et al. (2011) showed adequate internal reliability for the subscales of inhibitory self-control ( $\alpha = .76$  and  $.78$ ) and initiatory self-control ( $\alpha = .65$  and  $.68$ ).

Convergent validity of the subscales is considered moderate ( $r = .68/ .66$ ) (De Ridder et al., 2011; Cohen, 1988). That means that the constructs of inhibitory and initiatory trait self-control conceptualised by De Ridder et al. (2011) are generally moderately related to other measures of the same construct, such as other subscales that measure the same construct used in this research.

### ***Daily Questionnaire***

**State Self-Control Questionnaire.** Seven items of the state self-control questionnaire in English (Bagala, 2021, see Appendix D) measure daily fluctuations in self-control. Three items were derived from the State Self-Control Scale (SSCS) by Baumeister et al. (2019) to measure ego depletion. For example, "In the past couple of hours, have you felt that it is hard to make up your mind about even simple things?". Items four and five measure goal-directed, initiatory self-control (Simons et al., 2016), for example, "In the past couple of hours, how easy was it for you to do something "good" that you did not really want to do (e.g., eating healthy food)?" Items six and seven measure inhibitory self-control (Tornquist & Miles, 2019), for example, "In the past couple of hours, how easy was it for you to refrain from doing something "bad" you really wanted to do (e.g., snacking)?" All items are measured on a 5-point Likert scale (ranging from 0 *not at all* to 4 *very much*). Items 1, 2, and 3 were recoded. The total scale scores are calculated as the mean score of the item scores.

**Mindful Eating Behaviour Scale.** To measure daily fluctuations in mindful eating, the five-item subscale 'eating while focusing on the food' of the Mindful Eating Behaviour Scale (MEBS) (Winkens et al., 2018) is used in English. The MEBS indicated medium to high internal reliability ( $\alpha = .70$  and  $.89$ ) and good convergent validity (Winkens et al., 2018). The subscale "eating while focusing on the food" showed high internal reliability ( $\alpha = .85$ ) and high convergent validity ( $r = .71$  to  $.81$ ) (Winkens et al., 2018). The MEBS was adapted to an ESM format (see Appendix E). The items were introduced with "During the last couple of hours, did you eat a meal (breakfast/ lunch/ dinner)?" along with "Yes" and "No" as answer options. If participants indicated "Yes", they were introduced to the MEBS items. When participants indicated "No", the questionnaire closed. Five items were used, for example, "When I was eating breakfast, I noticed flavors and textures when I was eating my food". All items were measured on a 5-point Likert scale ranging from 0 (*not at all*) to 4 (*very much*) (Winkens et al., 2018). The total scale score is the sum of the five item scores. The mean was calculated.

## Procedure

The Faculty of Behavioural, Management, and Social Sciences ethics committee at the University of Twente approved the design of this research (#221290). The study's design was pilot tested by the researcher and ten participants over three days in November 2022 to ensure the smooth flow of the study and to detect the length of the questionnaires.

Final data were collected over 15 days, beginning November 21, 2022, and ending December 9, 2022 (see Table 2 about the study flow). On day one, participants got a welcome mail sent automatically via Ethica Data when participants joined the study. In addition, they got instructions on verifying their account at Ethica Data and adjusting their push notification settings to receive the time-specific reminders (see Appendix F). On day two, participants got a notification to complete the first survey of the study, for example, "Open the app to fill in the survey! Let's answer the daily questions." (see Appendix G). This intake questionnaire was split into two small questionnaires. The first one was triggered at 11 AM and consisted of information on the duration and procedure of the study, providing informed consent, and questions about demographics. The questionnaire expired after six hours, and participants got two notifications to fill in the survey (immediately and after 30 minutes). The second activity in Ethica Data was triggered at 12 PM and consisted of the trait self-control questionnaire, which was completed once. This questionnaire expired after 6 hours, and participants got three notifications (immediately, after 3 hours and after 6 hours).

From day three to day sixteen, participants received notification three times daily at a randomly selected time point by Ethica Data following a semi-random sampling scheme (Myin-Germeys & Kuppens, 2022). Time intervals were between 10 AM to 12 PM, 2 PM to 4 PM, and 8 PM to 10 PM, which complies with the recommended structure for ESM studies (Van Berkel et al., 2017). Participants answered seven items of the state self-control questionnaire. Then, they were introduced to the question, "Did you eat breakfast/ lunch/ dinner yet?". If they indicated "Yes", they were presented with the five items of the MEBS subscale "eating while focusing on the food". These time frames could have ensured that most participants ate their breakfast, lunch, and dinner to be able to answer the "eating while focusing on the food" questionnaire. Participants were reminded to answer the questionnaire after 30 minutes. If participants did not answer the questionnaire, the push notification expired after one hour. This enhanced reliability in the study since stacking up and answering multiple questionnaires simultaneously affects reliability

negatively (Van Berkel et al., 2017). At the end of the study, a maximum of 42 data points about state self-control and "eating while focusing on the food" was collected from 13 participants (see Figure 1 for the participant flow).

**Table 2**

*Flow of ESM Study*

Time	Day 1	Day 2	Day 3 to 16
Breakfast Timeframe (10 AM - 12 PM)	Welcome Email	Intake Questionnaire with Informed Consent, five items on Demographics, and 13 items of the Questionnaire on Trait Self Control (BSCS)	Seven items of the State Self- Control Questionnaire, "Did you eat breakfast yet?" No: questionnaire stops Yes: five items "eating while focusing on food" (MEBS)
Lunch Timeframe (2 PM – 4PM)			Seven items of the State Self- Control Questionnaire, "Did you eat lunch yet?" No: questionnaire stops Yes: five items "eating while focusing on food" (MEBS)
Dinner Timeframe (8PM-10PM)			Seven items of the State Self- Control Questionnaire, "Did you eat dinner yet?" No: questionnaire stops

Yes: five items  
“eating while  
focusing on food”  
(MEBS)

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## **Data Analysis**

Descriptive statistics, visual analyses and linear mixed modelling were used to examine the relation between self-control and mindful eating over time. First, the data was downloaded from Ethica Data in a long format and integrated into one dataset. A variable was created indicating the time of measurement (one to 42). Six participants who did not match the inclusion criteria of having a response rate above 50% were excluded from the analyses (see Figure 1).

Variables in this research were created, including standardised scores: trait self-control, inhibitory trait self-control, initiatory trait self-control, state self-control, inhibitory state self-control, initiatory state self-control, and mindful eating.

Since self-control is not only a stable trait but also a fluctuating capacity (De Ridder et al., 2012; Tangney et al., 2004), a short-term longitudinal design with repeated measurements was chosen over a cross-sectional design that captures self-control at one point in time. This way, the data represents changes and fluctuations in self-control that would not be visible with one-point measurements. Thus, one can make inferences about relationships across participants (between-person effects) and relationships within an individual (within-person effects) (Curran & Bauer, 2011). Person mean centering disaggregates the inter- and intraindividual differences (Curran & Bauer, 2011; Myin-Germeys & Kuppens, 2022). First, the person mean score was calculated for each individual. That is the overall mean score of a variable (in this case, state self-control, initiatory state self-control, inhibitory state self-control, and mindful eating) across all time points for a specific person. Then, the person mean score of a variable is subtracted from each of that same individuals' time specific variable scores. This results in the person-mean centred score (Curran & Bauer, 2011; Myin-Germeys & Kuppens, 2022).

### ***Descriptive Statistics***

The socio-demographic data were analysed for frequency, means, and standard deviations, including age, gender of identification, education, and nationality. Descriptive statistics were run to examine each participant's level of trait self-control, state self-control (total state self-control

and subscales) and mindful eating. Specifically, mean scores, minimum and maximum scores, and standard deviations were calculated.

### *Visual Analyses*

Graphs were created to explore the data. First, a graph of the average mean scores of initiatory self-control and mindful eating over 42 measurement points (person mean scores) on the y-axis and participants on the x-axis ascending from low to high in person mean of initiatory state self-control.

Next, on an individual level, a participant with a low and high score on the Brief Self Control Scale, namely the trait self-control variable, was selected. Two graphs were created, displaying state self-control and the mindful eating level on the y-axis and measurement points (one to 42, referring to measurement point one as day one in the morning of the study, and day 15, measurement point 42 as evening and the end of the study) on the x-axis.

### *Linear Mixed Models*

A linear mixed model was performed to explore the association between trait self-control and state self-control. A covariance matrix structure, specifically the first-order autoregressive (AR1) structure, was used to model the multiple time-varying measurements and to accommodate the missing data (Brammer, 2003; Clark et al., 2012; Littell et al., 2000). The standardised person mean score of state self-control was set as the dependent variable, and the standardised z-score of trait self-control was set as the independent variable.

A second linear mixed model was used to explore the association between initiatory/inhibitory trait self-control and initiatory/inhibitory state self-control. The standardised person mean score of initiatory/inhibitory state self-control was set as the dependent variable, and the z-score of initiatory/inhibitory trait self-control was set as the independent variable.

A third linear mixed model explored the association between initiatory or inhibitory state self-control and mindful eating. In this model, the standardised variable mindful eating was set as the dependent variable, and the standardised person mean, and person mean centred of initiatory state self-control were set as the independent variables. A similar analysis was done with the standardised person mean and person mean centred variable of inhibitory self-control as the independent variables.

Finally, a fourth linear mixed model was done with standardised mindful eating as being dependent on the fixed, independent factors: standardised person mean score and person mean



centred score of inhibitory self-control and the standardised person mean score and person mean centred score of initiatory self-control. The third LMM on types of state self-control and mindful eating was performed to find out if effects that may be found in the previous single analyses get covered by the other variable when both types of self-control are included in the analysis.

## **Results**

### **Missing Data**

Twenty per cent of mindful eating data was missing since participants had stated that they did not consume breakfast, lunch, or dinner when the measurement was prompted. This missing data could be categorised as data missing not at random (MNAR) (Rubin, 1976). Given the study's exploratory nature, no additional measures (e.g., imputation) were taken to address the missing data.

### **Descriptive Statistics**

The minimum scores, maximum scores, means, and standard deviations of self-control and mindful eating are presented in Table 3. Participants generally reported lower levels of trait self-control than they did for state self-control. On the trait level, respondents indicated higher initiatory self-control than inhibitory self-control. On state levels, participants showed higher average levels of inhibitory self-control than initiatory self-control. There is a slight variation in each of the variables. That means that the sample of this study is very comparable in self-control. People who are generally scoring low in trait self-control, for example, may have failed to fulfil the 50% response rate and were excluded from the study.

**Table 3**

*Descriptive Statistics, including Mean, Standard Deviation, Minimum and Maximum Scores of Trait Self-Control, State Self-Control, and Mindful Eating over Measurement Points*

Variables	Mean ( <i>M</i> )	Standard Deviation ( <i>SD</i> )	Minimum	Maximum
Trait Self-Control	2.11	.56	1.31	2.54
<i>Initiatory Self-Control</i>	2.56	.43	2.00	3.00
<i>Inhibitory Self-Control</i>	1.75	.84	.50	2.33
State Self-Control	2.34	.29	2.00	2.74
<i>Initiatory Self-Control</i>	2.24	.27	1.74	2.56
<i>Inhibitory Self-Control</i>	2.29	.44	1.64	2.84
<i>Ego Depletion</i>	2.42	.51	1.31	2.88
Mindful Eating	2.49	.33	2.08	3.12

*Note.* Trait Self-Control is based on  $n = 4$ ; State Self-Control and Mindful Eating are based on  $n = 7$ ; State Self-Control Scores and Mindful Eating display the calculated person mean scores.

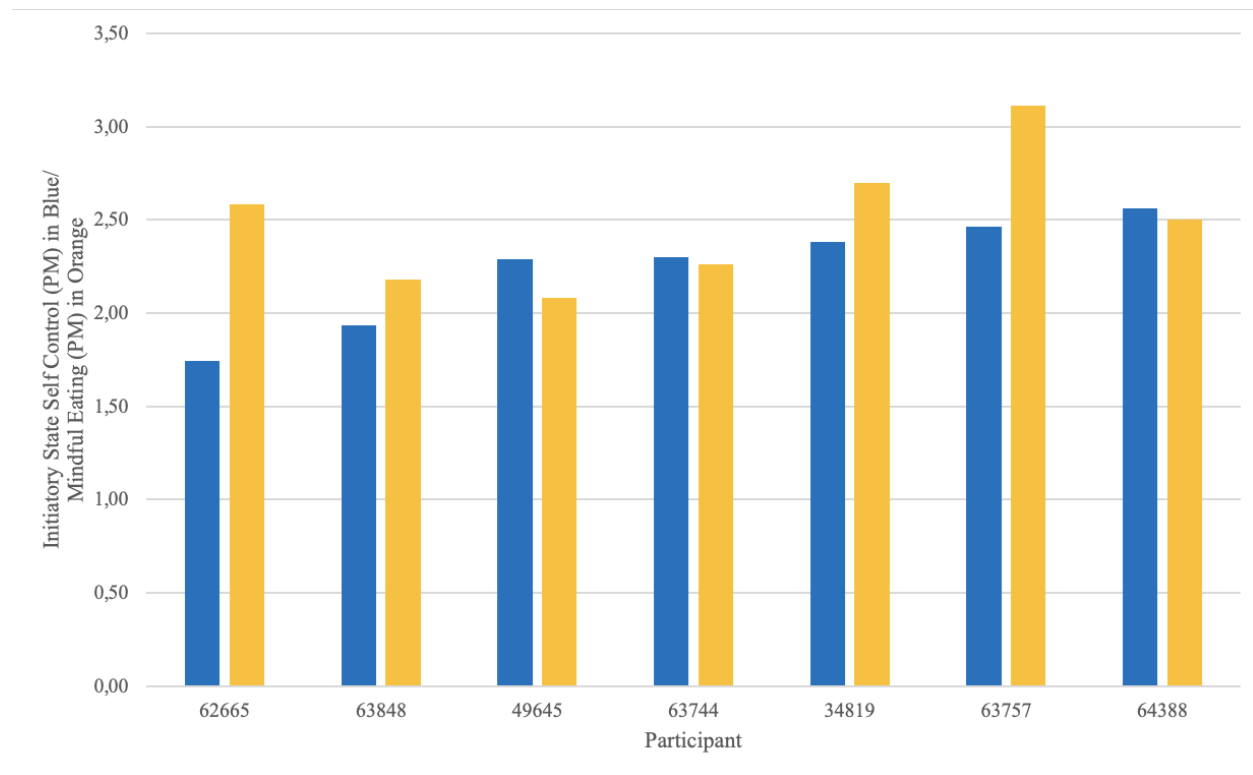
## Visual Analyses

### *Individual Level*

Figure 2 illustrates the person mean of initiatory self-control and mindful eating over 42 measurement points (person means) on the y-axis and participants on the x-axis. Participants were sorted from having the lowest person mean score in state self-control (left on the x-axis) to having the highest person mean score in state self-control (right on the x-axis). This figure displays no visible correlation between initiatory self-control and mindful eating.

**Figure 2**

*Person Mean Scores of Initiatory Self-Control (in Blue) and Person Mean Scores of Mindful Eating (in Orange) per Individual Ascending From Low To High in Person Mean of State Self-Control*

**Individual Case**

The following figures illustrate the person mean centred scores of state self-control and mindful eating over the course of the study for an individual that scored low (Figure 3) and high in trait self-control (Figure 4).

Figure 3 shows the fluctuations in daily self-control and mindful eating in a participant (#62665) with a mean score of 1.31 in trait self-control, which was the lowest value in trait self-control in this sample. Throughout the study, the participant fluctuated during the day in state self-control between -1.22 and 1.22. In mindful eating, the respondent varied between -1.99 and 1.41. The line graph is fragmented, the participant, who generally has low self-control, has omitted many measurement points.

**Figure 3**

*Person Mean Centred Score of State Self-Control (in Blue) and Person Mean Centred Score of Mindful Eating (in Orange) per Measurement Point of Participant (#62665) Low in Trait Self-Control*

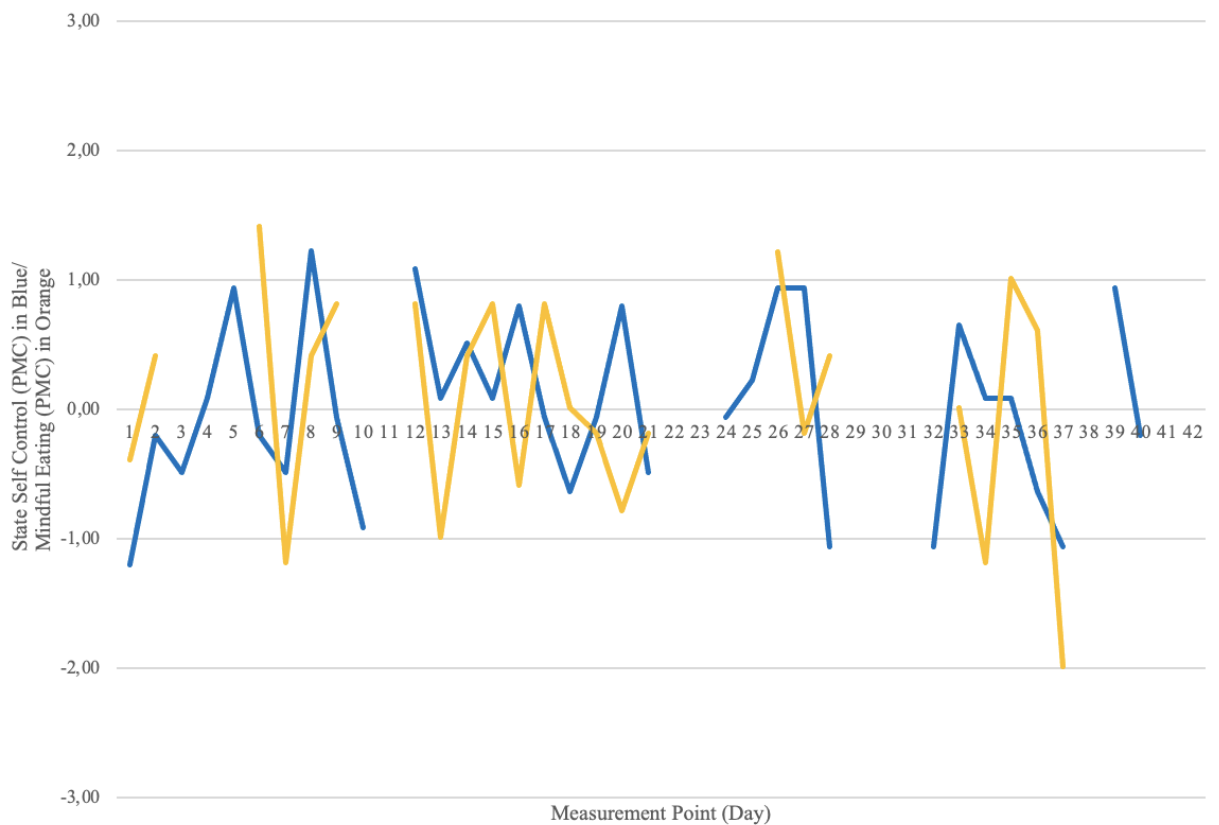
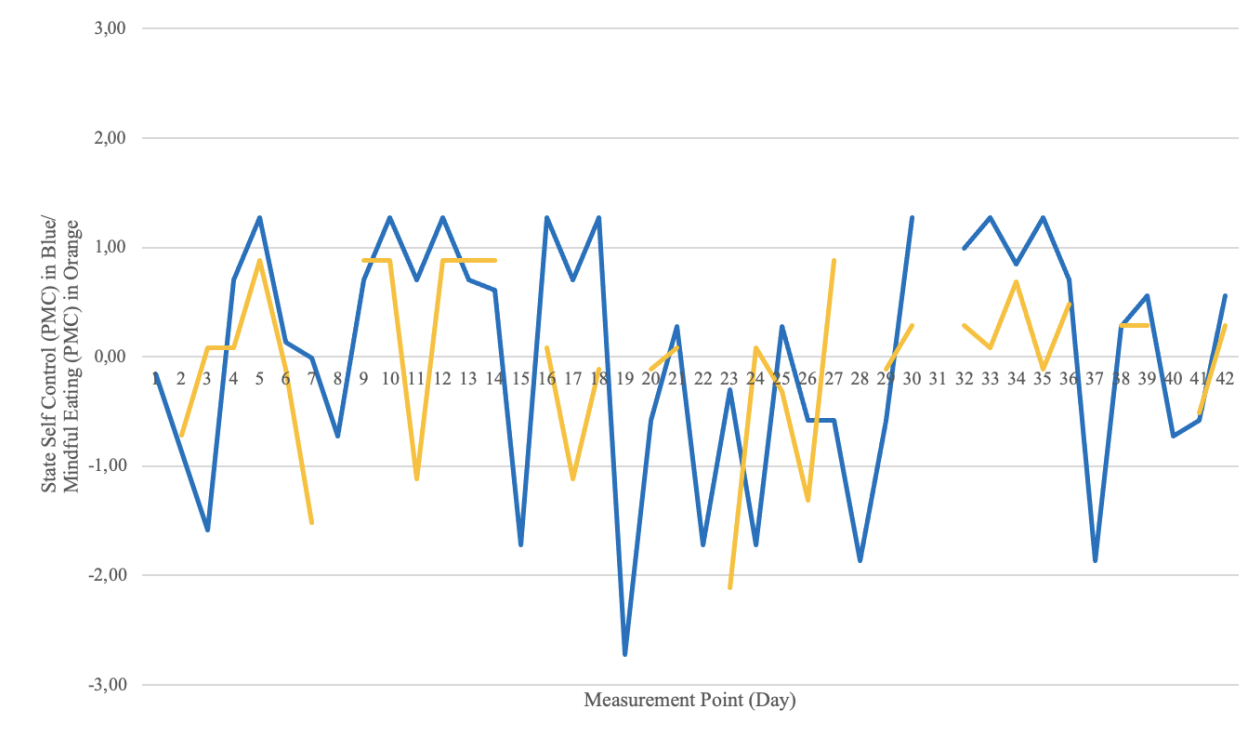


Figure 4 shows fluctuations in daily self-control and mindful eating in a participant (#63757) that is generally highly self-controlled with a mean score of 2.46 in trait self-control. The individual fluctuates in state self-control between -2.73 to 1.27. In daily mindful eating, the participant fluctuated throughout the study between -2.12 and 0.88. The individual generally showing high trait self-control only missed a few measurement points.

**Figure 4**

*Person Mean Centred Score of State Self-Control (in Blue) and Person Mean Centred Score of Mindful Eating (in Orange) per Measurement Point of Participant (#63757) High in Trait Self-Control*



### **Linear Mixed Models**

#### ***Association Between Trait Self-Control and State Self-Control***

The z-score of trait self-control was set as the independent variable and the standardised person mean score of state self-control as the dependent variable. The analysis shows a positive association ( $\beta = 0.61$ ,  $p < .001$ ; 95% CI [0.49, 0.74]).

#### ***Association Between Initiatory Trait Self-Control and Initiatory State Self-Control***

The z-score of initiatory trait self-control was set as the independent variable and the standardised person mean score of initiatory state self-control as the dependent variable. The analysis shows a positive association ( $\beta = 1.11$ ,  $p < .001$ ; 95% CI [1.06, 1.16]).

#### ***Association Between Inhibitory Trait Self-Control and Inhibitory State Self-Control***

The z-score of inhibitory trait self-control was set as the independent variable and the standardised person mean score of inhibitory state self-control as the dependent variable. The analysis shows a positive association ( $\beta = 0.59, p < .001; 95\% \text{ CI } [0.43, 0.76]$ ).

***Association Between Initiatory State Self-Control and State Mindful Eating***

The standardised variable of mindful eating was set as being dependent on the fixed, independent covariates: the standardised person mean of initiatory self-control and the person mean centred of initiatory self-control. The between-person analysis shows no association ( $\beta_{\text{pm}} = 0.11, p = .14; 95\% \text{ CI } [-0.04, 0.26]$ ). The within-person analysis shows a positive association ( $\beta_{\text{pmc}} = 0.16, p = .03; 95\% \text{ CI } [0.02, 0.31]$ ).

***Association Between Inhibitory State Self-Control and State Mindful Eating***

Standardised mindful eating was set as being dependent on the fixed, independent covariates: the standardised person mean score and person mean centred score of inhibitory self-control. The between-person analysis shows a positive association ( $\beta_{\text{pm}} = 0.20, p = .003; 95\% \text{ CI } [0.07, 0.32]$ ). The within-person analysis shows a positive association ( $\beta_{\text{pmc}} = 0.24, p = .001; 95\% \text{ CI } [0.09, 0.38]$ ).

***Association Between Inhibitory and Initiatory State Self-Control and State Mindful Eating***

Standardised mindful eating was set as being dependent on the fixed, independent covariates: the standardised person mean score and person mean centred score of inhibitory self-control as well as the standardised person mean score and person mean centred score of initiatory self-control. For initiatory self-control, the between-person analysis shows no association ( $\beta_{\text{pm}} = -0.13, p = .22; 95\% \text{ CI } [-0.34, .08]$ ). The within-person analysis also shows no association ( $\beta_{\text{pmc}} = 0.02, p = .77; 95\% \text{ CI } [-0.14, .2]$ ). For inhibitory self-control, the between-person analysis shows a positive association ( $\beta_{\text{pm}} = 0.29, p = .005; 95\% \text{ CI } [0.09, 0.5]$ ). The within-person analysis shows a positive association as well ( $\beta_{\text{pmc}} = 0.21, p = .02; 95\% \text{ CI } [0.04, 0.38]$ ). That means that inhibitory state self-control is most correlated with mindful eating compared to initiatory state self-control, both for people who are in general better at controlling themselves as well as throughout the day within one individual.

**Discussion**

Rising non-communicable diseases and malnutrition increase interest in promoting healthy eating behaviours (World Health Organization, 2020). One element of healthy eating is mindful eating, a non-restrictive diet approach that promotes savouring food, appreciating sensory qualities,

and being aware of satiety sensations (Mantzios & Wilson, 2015; Palascha, 2021). Therefore, non-restrictive diet approaches such as mindful eating are of public health relevance (Schaefer & Magnuson, 2014). The results of this study help to understand how to promote healthy eating patterns, such as mindful eating. The current study aimed to observe possible associations between different types of self-control and mindful eating over time. Self-control can be seen as a stable characteristic and a fluctuating capacity susceptible to situational influences (De Ridder et al., 2012; Tangney et al., 2004). Therefore, the experience sampling method, a short-term longitudinal design with multiple measurements, was used to capture both between-person effects and within-person variations of self-control (Curran & Bauer, 2011). Next, this research anticipated replicating the positive association between trait self-control and state self-control (Bagala, 2021; Daniel, 2021; Vos, 2022), as well as replicating associations between subscales of trait self-control and state self-control. The data suggest that trait self-control and aggregated means of state self-control, as well as inhibitory and initiatory trait and state self-control, are positively associated. Further, this study found that inhibitory state self-control and mindful eating are also positively associated on between-person level, as well as within-persons. In a single analysis with initiatory state self-control and mindful eating, initiatory state self-control was found to be positively associated on the within-person level.

### **Theoretical and Practical Implications**

#### ***Association Between Trait Self-Control and State Self-Control***

A comparison of the findings with those of other studies confirms that people who are generally highly self-controlled also tend to have, on average, more self-control throughout the day (Bagala, 2021; Daniel, 2021; Vos, 2022). Moreover, previous studies showed that initiatory and inhibitory self-control are distinct but related aspects of self-control when measured as traits (De Ridder et al., 2011). In this study, associations were found with their average state equivalents (treated trait-like). People who generally show high levels of inhibitory self-control also show high levels of inhibitory self-control during the day. This also accords with initiatory self-control. These findings help to transfer the conceptualisation of distinguishable yet related concepts of self-control by De Ridder et al. (2011) to the state self-control questionnaire by Bagala (2021). Since studies on state self-control are rising, this study implies that scientists should not only look at state self-control but also consider their subdimensions when investigating associations with other variables.

Just as research found that inhibitory trait self-control is associated with healthy eating (Hofmann et al., 2014), it is worth continuing to analyse subtypes of state self-control with healthy eating.

### ***Association Between State Self-Control and Mindful Eating***

Very little was found in the literature on how mindful eating is associated with inhibitory and initiatory self-control. A positive association between initiatory state self-control and mindfulness was expected because initiatory self-control can manifest as mindfulness (Lopez et al., 2021). Mindfulness is the non-judgmental regulation of attention to the present moment (Kabat-Zinn, 2003; Bishop et al., 2004), which is then applied to mindful eating. Mindful eating is an activity that *directs attention* to hunger cues and the satiety experiences of food (Mantzios & Wilson, 2015; Palascha, 2021). In this study, the subscale ‘eating while focusing on food’, also known as ‘eating with awareness’ of the MEBS, was used to study mindful eating (Winkens et al., 2018).

Contrary to expectations, initiatory state self-control was found not to be associated with mindful eating, both for people who generally score high on initiatory state self-control and mindful eating, as well as within each individual during the day. When analysing solely initiatory state self-control and mindful eating, it was found that individuals who show high levels of initiatory state self-control at a specific moment also report high levels of mindful eating. The differences in results may be because, in the single model, inhibitory state self-control is not included. Thus, the effect of initiatory state self-control is more present. In the model of initiatory and inhibitory state self-control and mindful eating, inhibitory state self-control may cover the effect of initiatory state self-control. Additionally, the participants in this research were homogeneous in their levels of self-control (Table 3), which may lead to nonsignificant associations on the between-person level.

Valikhani et al. (2019) also stated that a fundamental determinant of initiatory self-control is maintaining attention towards initiating and pursuing goals. Due to this *attention regulation* aspect, they proposed initiatory self-control to be associated with mindfulness. However, Valikhani et al. (2019) reported higher correlations between mindfulness and inhibitory self-control than initiatory self-control. They suggested that after the selection of the goal, in this case, to eat mindfully, one does not only require to maintain attention to attain this goal. One also needs to pursue the goal and, therefore, inhibit thoughts and emotions that interfere with the attainment of this goal (Valikhani et al., 2019). This might explain the unexpected results of inhibitory state self-control in this research. Inhibitory state self-control is positively associated with mindful eating as



opposed to initiatory state self-control and mindful eating. People who are, in general, scoring high on inhibitory state self-control also show high levels of mindful eating. During the day, individuals who score high on inhibitory state self-control also report high levels of mindful eating. The pursuit of eating mindfully involves the inhibition of unrelated, impulsive thoughts, namely inhibitory state self-control. This may overshadow the effect of initiatory state self-control found on an individual level in the single analyses of initiatory state self-control and mindful eating.

Previous studies discussed not only the effortful inhibition of undesired behaviour by inhibitory self-control but also investigated effortless ways of handling self-control dilemmas (De Ridder et al., 2018). One such effortless way of inhibitory self-control is through the development of habits (De Ridder et al., 2018). Part of mindful eating is the *unconditional permission* to eat and to pay attention to bodily sensations, such as hunger and satiety cues (Schaefer & Magnuson, 2014). Non-restrictive approaches to healthy eating, and therefore being allowed to eat healthy and unhealthy food, may lead to habituation with these foods, which leads to a decrease in behavioural and physiological responses after repeated exposure (Palascha, 2021). Therefore, these foods do not seem as exciting or tempting anymore (Palascha, 2021). This habituation leads to effortless inhibition that does not involve active mental representations of goals (Galla & Duckworth, 2015). Once these habits are formed, they can work without the conscious intention to use less working memory and give more space to the cognitive capacity for state self-control (Galla & Duckworth, 2015; Palascha et al., 2021). This might explain why mindful eating as a non-restrictive diet is more associated with inhibitory self-control than initiatory self-control.

The recent study does not provide insight into the causal nature of the relationship between state self-control and mindful eating. A number of studies have shown how practising self-control in one specific area can transfer to other areas of life (Baumeister et al., 1998). Self-control develops in individuals between six to twelve years, throughout adolescence, and into early adulthood (Berkman et al., 2012). Deliens et al. (2014) highlighted the importance of enhancing self-control in university students to increase healthy eating. Taking together the results of this study, focusing on training inhibitory self-control may improve mindful eating, but it could also be vice versa. Previous studies even reported improvements in self-control associated with non-restrictive diets (Tanco et al., 1998). Tanco et al. (1998) explained this by participants' increasing interoceptive awareness of relying on hunger and satiety signals. Previous studies found that mindfulness as a strategy can help manage impulses toward tempting food (Papies et al., 2012).

Mindfulness can manifest as a *consciously initiated attention* to the mental state (e.g., Broderick, 2005; Papies et al., 2012; Zeidan et al., 2010). Several studies suggest that mindfulness training leads to a meta-cognitive awareness of thoughts. These mental experiences can be perceived and let go of without getting absorbed by them as being real (e.g., Broderick, 2005; Zeidan et al., 2010). This becomes particularly interesting with attractive food. Individuals begin to simulate the experience of consuming food as soon as they see it (Papies et al., 2012). This happens through non-conscious mental representations, which leads to an enhanced desire for that food. Mindful attention towards thoughts and emotions emerging from tempting food diminishes impulsive reactions (Papies et al., 2012). Metacognitive awareness of implicit associations with food (attentive observation of one's thoughts, perception of thoughts as mental events rather than subjective experiences and letting go) helped people not to give in to tempting foods. Changing implicit associations to tempting food (e.g., through mindfulness) is an effortless, non-conscious way to influence self-control (Fujita & Han, 2009). Neurophysiological interventions, such as the stop-signal task, show improvements in behavioural response inhibition and activity in brain regions involved in inhibitory self-control (Berkman et al., 2012). Teaching techniques to self-regulate and activities that promote attention and memory improve inhibitory self-control (Berkman et al., 2012; Diamond et al., 2007). Hence, mindful eating itself may be an activity that trains and enhances self-control.

In Western culture, dietary programmes often focus on weight loss using a restrictive eating approach (Schaefer & Magnuson, 2014). In contrast, non-restrictive approaches lead to better physical and mental health and enhanced well-being (Schaefer & Magnuson, 2014). Studies showed that mindfulness-based interventions are also effective in treating eating disorders, such as binge eating disorders (Kristeller & Hallett, 1999) and other eating disorders, such as anorexia nervosa (Albers, 2013). Previous research found that individuals high in trait self-control primarily use inhibitory self-control to refrain from unhealthy food (Hofmann et al., 2014). As a result, people who are generally highly self-controlled eaters tend to experience less temptation (De Ridder et al., 2012; Williamson & Wilkowski, 2020). To the state of knowledge of the researcher, no study investigated mindful eating in association with initiatory and inhibitory state self-control over time. Thus, this study showed that people generally showing high inhibitory state self-control tend to report high levels of mindful eating, as well as within individuals during the day. This implies to future researchers that frameworks on inhibitory trait self-control and healthy eating

(primarily focused on weight loss and restrictive diets) may also be applied to inhibitory state self-control and mindful eating as a non-restrictive approach to healthy eating. For example, a large meta-analysis by De Ridder et al. (2012) suggests a strong link between automatic behaviours and trait self-control. People scoring high in trait self-control are good at creating and breaking habits. They can react effortlessly and unconsciously to temptations. De Ridder et al.'s (2012) meta-analysis also showed that people scoring high in trait self-control have fewer habits eating unhealthy food and, consequently, consume less unhealthy food.

### **Strengths and Limitations of this Study**

The experience sampling method is a design that offers high ecological validity, the data was measured in a more natural environment compared to laboratory studies (Van Berkel et al., 2017; Csikszentmihalyi & Larson, 2014). Moreover, retrospective bias is minimised due to repeated measurements (Van Berkel et al., 2017). Additionally, ESM is an effective tool to capture fluctuations of phenomena like self-control or mindful eating (Myin-Germeys & Kuppens, 2022).

Keeping response rates high is a typical issue with ESM formats (Myin-Germeys & Kuppens, 2022). A limitation of this study was the response rate to the trait self-control questionnaire, which makes the results less representative. Additionally, the generalisability of results is limited to the sample of this study. The sample was not diverse, mainly consisting of women and Germans. De Ridder et al. (2012) showed that self-control is equally strong for females and males. However, in general, self-control seems to be weaker in students (De Ridder et al., 2012). Another limitation is that the study design did not allow for claims on causality.

### **Recommendations for Future Research**

To the researcher's knowledge, no study investigated mindful eating, initiatory state self-control and inhibitory state self-control. Hence, no specific theoretical frameworks explain the underlying mechanisms behind the associations. A greater focus on the conscious and unconscious processes of mindful eating in association with state self-control is needed. Therefore, further research needs to be conducted to determine whether habits mediate the relationship between mindful eating and state self-control. Further experimental studies on mindful eating and self-control could produce interesting findings. For example, an experimental approach on implicit associations in participants that attend an eight to ten-week health-centred program about mindful eating. This could determine whether changes in implicit associations towards food (for example, from starting as a weight-concerned, restrictive individual to a non-restrictive, health-centred

individual) produce changes in food choice during a self-control dilemma task (e.g., healthy versus unhealthy or caloric-dense food). Moreover, experimental studies might explore the effect of training (inhibitory) state self-control on mindful eating and the effect of practising mindful eating on (inhibitory) state self-control. Additionally, controlling missing data would help to establish a greater degree of accuracy, for example, by using the suggestions formulated by Kwasnicka et al. (2019). Finally, future researchers are suggested to continue studying fluctuating concepts like self-control and mindful eating using the experience sampling method and to replicate the current findings with a more extensive and diverse sample. More ESM studies would add to the rising research base on studying in natural settings compared to laboratory settings. Researchers may also consider individual and contextual factors, such as eating attitudes.

### **Conclusion**

To summarise, this study set out to investigate how different types of self-control are associated with mindful eating over time. Since self-control is not only a stable characteristic but also a fluctuating capacity that can be trained, this research aimed to identify if self-control and its subdimensions may help to promote healthy eating behaviours. This investigation replicated positive associations between trait self-control and average mean state self-control, as well as between their subscales of initiatory and inhibitory self-control. Further, this study has shown that the association between inhibitory state self-control and mindful eating is stronger than with initiatory state self-control, both for people who are generally better at controlling themselves as well as throughout the day within each individual. Taken together, these findings suggest the significance of teaching inhibitory self-control strategies to students to promote their healthy eating behaviour. The present study has been one of the first attempts to explore inhibitory and initiatory state self-control and a non-restrictive approach to food, namely mindful eating. The findings provide an indication that frameworks of inhibitory trait self-control and healthy eating may translate to inhibitory state self-control and mindful eating. Notwithstanding the relatively limited sample, this work offers valuable insights into the fluctuating nature of concepts like mindful eating and self-control over time. Therefore, future research should continue using the experience sampling method to explore mindful eating and self-control, as well as taking factors such as habituation, implicit associations, and eating attitudes into account. Further work needs to be done to establish whether practising inhibitory state self-control leads to eating more mindful and vice versa.

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## Appendices

### Appendix A

#### *Informed Consent (based on the study by Bagala, 2021)*

This study aims at identifying the association between mindful eating and self-control. At the beginning of participation, you will be asked to fill in a questionnaire that takes approximately 15 minutes. Over a time span of 15 days, you are asked to answer a short questionnaire three times a day that takes approximately 5 minutes.

- I confirm that I am over the age of 18 and can consent to take part in the study myself, voluntarily
- I have read the information sheet and fully understand what the study entails and why it is being conducted
- I understand that the researcher will be able to access my data, however, the data will remain anonymous
- I agree to take part in this study, understanding what it involves and which burden it may entail
- I understand I can withdraw my data at any time by sending an email to the researcher with a self-generated identification code
- I am not diagnosed with an eating disorder according to the DSM-5 or ICD-10.

If you have any further questions or would like to receive more information about the study, please feel free to contact the researcher Kimberly Gerlach via ...

If you have ethical complaints about the study, please contact the Ethics Committee of the Faculty of Behavioural Sciences at the University of Twente:

Email: ...

- I agree to the information provided and hereby give my informed consent.
- I do not agree and hereby I would like to quit the study.

### Appendix B

#### *Demographic Questions*

1. Please indicate the gender you currently identify as.
  - Woman

- Man
  - Non-binary
  - Prefer not to say
2. Please disclose your nationality.
    - Dutch
    - German
    - Other
  3. If you selected "Other" in the previous question, please specify what nationality you hold.
  4. Please indicate your age.
  5. What is the highest level of education you have completed?
    - HAVO/ high school
    - VWO/ Gymnasium
    - HBO
    - Bachelor's degree
    - Master's degree
    - Other
  6. To ensure anonymity, we would like you to create a self-generated identification code that enables us to sort your data without revealing your identity. Please create the code by answering the following questions: "In what month is your birthday?", "What is the first letter of the city you were born?" and "What are the first three letters of your mother's first name" (Example: If your birthday is in January, you were born in Amsterdam and your mother's first name is Catherine, your code would be 01Acat)
- Your self-generated code:

## Appendix C

### *Brief Self-Control Scale (Tangney et al., 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 \*

*Note.* Items that are marked with this symbol \* are reversed coded. Rating scales range from 0 (*not at all like me*) to 4 (*very much like me*).

## **Appendix D**

### ***State Self-Control Questionnaire (Bagala, 2021)***

#### **Ego Depletion**

1. "In the past couple of hours, have you felt that it is 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, Initiatory 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 (e.g. eating healthy food)?"
5. "In the past couple of hours, were you able to stick to your goals?"

#### **Inhibitory Self-Control**

6. "In the past couple of hours, how easy was it for you to refrain from doing something "bad" you really wanted to do (e.g. snacking)?"
7. "In the past couple of hours, were you able to resist temptations?"

*Note.* Items that are marked with this symbol \* are reversed coded. Rating scales range from 0 (*not at all*) to 4 (*very much*).

## **Appendix E**

### ***Eating While Focusing on the Food***

1. When I was eating (breakfast/ lunch/ dinner), I noticed flavors and textures when I'm eating my food.
2. When I was eating (breakfast/ lunch/ dinner), I stayed aware of my food while eating.
3. When I was eating (breakfast/ lunch/ dinner), I noticed how my food looks.
4. When I was eating (breakfast/ lunch/ dinner), I noticed the smells and aromas of food.
5. When I was eating (breakfast/ lunch/ dinner), it was easy for me to concentrate on what I eat.

*Note.* Items based on Winkens et al. (2018) are adjusted to ESM format measuring a time span introduced when participants answered “Yes” to the criterion “In the past couple of hours, did you eat (breakfast/ lunch/ dinner) yet?”. Rating scales range from 0 (*not at all*) to 4 (*very much*).

## **Appendix F**

### **Welcome Message to Participants When Opening the Recruiting Link to the Study (based on Bagala, 2021)**

Dear participant,

Thank you for signing up for this study! Overall, the purpose of this study is to measure self-control in daily life and how it affects certain aspects of our behaviour, such as mindful eating. We can gain insight into the dynamic interaction by using monitoring tools that help us identify the daily fluctuations of constructs related to mental health!

#### **Procedure & Duration**

The study will run for 15 days. On the first day, it starts with a so-called baseline questionnaire. This kind of questionnaire needs to be filled out at the beginning of the study. 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 following questionnaire (please note: it is necessary to allow Ethica to send you notifications on your mobile device)! That will happen three times a day (in the morning, in the afternoon, and in the evening). The questionnaires are very short and can be completed within approximately 2–3 minutes (please note: it is important to fill out the questions as soon as possible, up to 1 hour after notification).

To participate in this study, you must be above 18 years of age, fluent in English, and have not been diagnosed with an eating disorder according to the DSM-5 or ICD-10.

Questions?

If you need more information about the study now or in the future, feel free to send an email to ...

Thank you very much for your support!

Kimberly

**Welcoming Mail to Participants When Joining the Study on Ethica Data (based on Bagala, 2021)**

Dear participant,

Thank you for taking the time and effort to support me with my master's thesis study!

PLEASE COMPLETE THE FOLLOWING TO-DO LIST BEFORE THE STUDY BEGINS:

- Please download the Ethica Data application on your mobile device
- Please allow Ethica notifications to remind you to complete the questionnaires within the time frame specified.
- verify your email address (after registering, you can join the study using the code 2921).

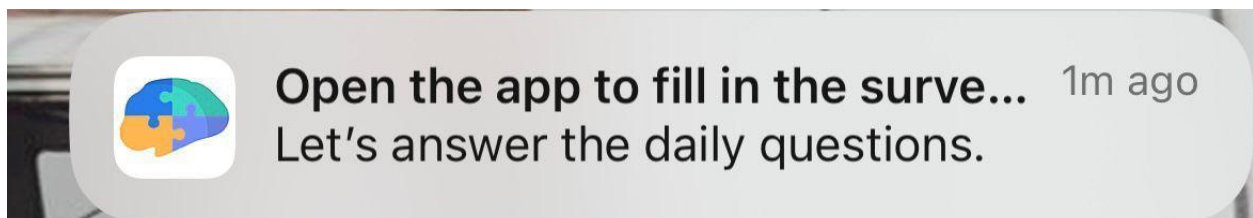
Overall, the study aims to investigate self-control in daily life and how it affects certain aspects of our behaviour, such as mindful eating. The study will run for 15 days. Tomorrow, you will receive the first questionnaire. On the first day, the so-called "baseline questionnaire" starts. This kind of questionnaire needs to be filled out once. 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: it is not necessary to allow Ethica to send you notifications on your mobile device)! That will happen three times a day (in the morning, in the afternoon, and in the evening). The questionnaires are very short and can be completed within approximately 1-2 minutes (please note: it is important to fill out the questions as soon as possible (the latest 1 hour after notification) because the questionnaire expires then. If you have any questions, feel free to answer this email! Kimberly

**Appendix G**

**Screenshots of Push Notifications that Participants Received During The Study**

**Figure 5**

*Screenshot of Push Notifications*



**Figure 6**

*Screenshot of Push Notification Reminder*

