Registered Report: Self-Control Beyond Inhibition. German Translation and

Quality Assessment of the Self-Control Strategy Scale (SCSS).

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Abstract

Self-control is crucial for goal attainment and related to several beneficial outcomes, such as health and education. For a long time, it was predominantly understood in terms of inhibition, namely the ability to suppress immediate urges for the sake of long-term goals. Still, research on other self-control strategies has a longstanding tradition and recent research has moved towards a broader approach, integrating different strategies of self-control (e.g., reappraisal or pre-commitment) to gain a more comprehensive perspective on relevant processes in goal protection. The current study aims to translate and validate the Self-Control Strategy Scale (SCSS, Katzir et al., 2021) to enable its application in German speaking populations while assuring high measurement quality. The internal structure, reliability and convergent and discriminant validity will be assessed. Additionally, the strategies' relationship with several self-control outcomes (e.g., achievement, health behavior, or pro-environmental behavior) will be tested. This specifically aims to investigate which strategies are related to which outcome to deliver a closer look on diverging patterns of effects of self-control strategies. [To be completed in Stage 2].

Keywords: Registered Report, Self-Control, Self-Control Strategies, Translation, Validation, Reliability

Design Table

Question	Hypothesis	Sampling plan	Analysis plan	Rationale for deciding the sensitivity	Interpretation given different outcomes	Theory that could be shown wrong by the outcomes
Aim 1: Assessing the Internal Structure and Reliability of the German Self-Control Strategy Scale						
Factor structure: Does the factor structure of the German Self-Control Strategy Scale (SCSS) align with the original version?	The proposed **eight-factor** model fits the data well.	We first collect a pilot to test the translation and abbreviated introduction. Following, we collect a first full sample to test if last adjustments are needed. Following, we collect data on the SCSS in **three independent samples.**	**CFA:** Using traditional cut-off values for sufficient model fit (RMSEA/SRMR $\leq$ .08; CFI/TLI $\geq$ .90).	We aim to collect ~**1800 valid responses,** which is beyond the most conservative suggestion of 1,000 (Kyriazos, 2018)	If fit is sufficient (RMSEA/SRMR $\leq$ .08; CFI/TLI $\geq$ .90), we see the **eight-factor solution** as an appropriate model to the data; if not, we don't.	The eight-factor solution to the SCSS could be shown as invalid for German speaking samples.
	The proposed eight-factor structure is **superior to alternative models** (one-factor & hierarchical solution).		Comparison by Akaike information criterion **(AIC,** < 2 = substantial similarity, 4 - 7 = considerably different, > 10 = essentially none for alternative**)**		If an alternative model fits the data equally well or better (AIC is smaller or difference is < 2**)**, we will state that the proposed structure is **not the only possible solution.**	The eight-factor solution to the SCSS could be shown as not the only optimal structure for German speaking samples.
	The **item-loadings** are sufficient as in Katzir et al. (2021) (> .40).		All **item loadings** > .40		If some item loadings are below the suggested threshold (.40), we will give respective recommendations for **adaptations to the questionnaire.**	Single item loadings could be suboptimal and hence the measurement quality in question.
Reliability: Is the Self-Control Strategy Scale (SCSS) in German reliable?	The subscales' **internal consistencies** are sufficient (ω > .70).	We collect data on the SCSS in **four independent samples.**	ω > .70	We aim to collect ~**1800 valid responses,** which is beyond the most conservative suggestion of 1,000 (Kyriazos, 2018)	If some internal consistencies are below the threshold (.70), we will give respective recommendations for **adaptations to the questionnaire.**	The internal consistencies could be suboptimal and hence the measurement quality in question.
	The model is configural, metric and scalar **invariant** for		Including respective **restrictions** on the model and monitor if		If the model lacks the respective invariance (i.e., some models do not	The measurement invariance of the model could be limited and accordingly its usability

	age and gender.		**model fit** remains sufficient (RMSEA/SRMR ≤ .08; CFI/TLI ≥ .90). We will include each **gender**-group with > 300 cases. **Age** will be split in three equally sized groups.		show appropriate fit (RMSEA/SRMR ≤ .08; CFI/TLI ≥ .90), its usability might be limited. If full scalar invariance is found, the scale qualifies for **valid mean comparisons** between age groups and gender groups.	as well.
	The subscales **test-retest** reliabilities are sufficient	We collect data in one sample across three timepoints.	Correlation of subscale scores at t2, t3 and t4 (threshold for sufficient reliability: $ICC_{tt} > 0.70$)	We aim to collect ~**150 valid responses** which is beyond the most conservative estimation of $N = 83$ for attaining ICC = .20 and power = 90% (Bujang & Baharum, 2017)	If some test-retest reliabilities are below the threshold (.70), we will give respective recommendations for **adaptations to the questionnaire.**	The test-retest reliabilities could be suboptimal and hence the measurement quality in question.
Aim 2: Assessing Convergent and Discriminant Validity						
Convergent validity: Does the Self-Control Strategy Scale (SCSS) in German explain a relevant amount of variance in trait self-control?	All subscales combined explain a **large amount of variance ($R^2 \geq 0.26$[1])** in trait self-control (as measured by the Brief Self-Control Scale (Tangney et al., 2004))	Sample 1 will be collected through **Prolific,** limiting the respondents to German speakers; Sample 2 will be collected in the **laboratory with psychology students** for course credit	**Multiple linear regression** on the effect of all subscales combined on trait self-control (threshold for relevant amount of variance: $R^2 \geq 0.26$[1])	For **online** samples (1, 3 & 4) we aim to collect $N = 600$ valid cases per sample, achieving a **power of 99.9** for finding an $R^2 \geq .10$ (computation documented in supplemental material) [https://osf.io/p562r]. For the **laboratory** study, we can realistically collect data of $N = 250$ participants, which will result in a **power of 97.8** under the same circumstances.	If both measures are strongly associated ($R^2 \geq 0.26$), we suggest measurement of the same construct. If they are weakly associated ($R^2 < 0.26$), we suggest measurement of different constructs.	Potentially SCSS and BSCS measure different constructs of self-control.
Discriminant validity: Does the	**All subscales combined may**	Sample 1 will be collected through **Prolific,** limiting the	**Multiple linear regression** on the effect		If the SCSS **shares** < 26% of variance with	The analysis could show that the SCSS in German is not

Research Question	Hypothesis	Samples	Analysis	Power	Interpretation (positive)	Interpretation (null)
Self-Control Strategy Scale (SCSS) in German show enough difference to related but distinct constructs (e.g., lay beliefs about willpower)?	**explain a small to medium amount of variance in related, but distinct constructs** (full list in the methods section) such as lay beliefs about willpower, **but not a large amount which would indicate that they measure the same construct (R^2 < 0.26[1]).**	respondents to German speakers; Sample 2 will be collected in the **laboratory with psychology students** for course credit, Sample 4 will be collected through **social media** advertisement with the chance to win a voucher.	of all subscales combined on respective measures (threshold for not too much explained variance: $R^2 < 0.26$[1])		related, but theoretically distinct constructs, this supports the assumption that it measures a distinct concept. If it does share > 26% of variance, this would indicate considerable overlap.	distinguished enough from other constructs.
Aim 3: Assessing the Relationship With Self-Control Outcomes						
Relationship to outcomes: Are the Subscales of the Self-Control Strategy Scale (SCSS) in German related to self-control related outcomes?	At least one strategy will be significantly related to all outcome measures, while controlling for all other strategies (and for baseline measurement of outcome in case of longitudinal measurement)[2]	Sample 1 will be collected through **Prolific,** limiting the respondents to German speakers; Sample 2 will be collected in the **laboratory with psychology students** for course credit, Sample 3 and Sample 4 will be collected through **social media** advertisement with the chance to win a voucher.	**Multiple linear regression** on the effect of all subscales combined on each self-control related measures (threshold for coefficient: $\alpha < .05$).	For **online** samples (1, 3 & 4) we aim to collect $N = 600$ valid cases per sample, achieving a **power of 99.9** for finding a partial $R^2 \geq .05$ (computation documented in supplemental material) [https://osf.io/p562r]. For the **laboratory** study, we can realistically collect data of $N = 250$ participants, which will result in a **power of 97.6** under the same circumstances.	If coefficient is significant at $\alpha < .05$, it is significantly related to outcome. If coefficient is not significant at $\alpha > .05$ it is not significantly related to outcome.	The analysis could show no evidence that a specific strategy is relevant for a specific outcome.

Note. [1] We interpret R^2 according to Cohen (1988) with $R^2 < .13$ = small, $.13 < R^2 < .26$ = medium and $R^2 > .26$ = large. [2] We have no specific hypotheses on the prediction pattern of the strategies by outcome, thus we will test the hypothesis that each strategy is related to each outcome.

Introduction

Self-control is commonly known to have beneficial effects for individuals. Different meta-analyses have pointed out that higher levels of self-control are associated with a broad array of desirable outcomes in areas such as health, academic achievement or addictive behavior (e.g., de Ridder et al., 2012). Self-control can be defined as the process of adhering to a long-term goal in the face of a conflicting short-term goal (Fujita, 2011). This approach to self-control is highly relatable to personal experiences and can be applied to many real life scenarios. For example, an individual might want to increase their fitness to improve their health by starting to visit the gym regularly. However, when they come back from a tiring day of work they might feel a strong desire to relax on the couch instead. In this situation, they need to find a way to override the immediate desire to hang out on the couch in favor of successfully pursuing their longer-term goal to exercise more.

Historically, research has focused on a person's ability to exert willpower as means to resolve conflicting desires (de Ridder et al., 2012; Fujita, 2011). However, this narrow view of self-control has recently been questioned (e.g., Fujita, 2011; Inzlicht & Friese, 2021; Werner, Inzlicht, et al., 2022) and researchers have extended their focus to a range of strategies people can use to achieve their long-term goals. Prior research shows that people use different strategies (e.g., distracting oneself from the temptation, removing oneself from the situation or reminding oneself of one's goal) to protect their long-term goals from immediate desires (Milyavskaya et al., 2021). Such strategies are often successful in promoting the long-term goal. Past studies showed that strategies such as distraction from or cognitive change of an immediate reward can help children to wait longer for a later, larger reward (Mischel et al., 1972; Mischel & Baker, 1975). Similarly, modifying situations to remove temptations helped students to meet their academic goals (Duckworth, Gendler, et al., 2016). To allow for the assessment of the broad spectrum of self-control strategies, Katzir et al. (2021) developed a

novel scale - the *Self-Control Strategy Scale* - that assesses some of the main strategies used in desire regulation across different domains.

The present project aims to translate the Self-Control Strategy Scale to German to make it available for application in German-speaking populations while ensuring good measurement qualities. Additionally, we assess the relationship of the individual strategies to a range of self-control related outcomes that have not been investigated previously.

The Self-Control Strategy Scale

The Self-Control Strategy Scale (SCSS) was developed based on past research that identified different strategies to regulate temptations. It was refined and validated across six samples ($N = 1946$) leading to a final scale including eight strategies of self-control (see Table 1).

Table 1

Strategies and example items of the SCSS (38 items)

Strategy	N items	Example Item
Situation Selection **(SS)**	6	I seek out situations in my life so that I will not face temptations
Punishment **(PU)**	4	I penalize myself for breaking my own "personal contracts".
Reward **(RE)**	4	I reward myself for the achievement of a long-term goal.
Pre-Commitment **(PC)**	4	I tell people about my long-term goals so that they can hold me accountable.
Distraction **(DI)**	5	When I face a temptation, I shift my attention away from it.
Cognitive Change **(CC)**	5	When I encounter a temptation I think about it in a different light.
Acceptance **(AC)**	4	When I face a temptation I accept the craving for it.
Behavioral Inhibition **(BI)**	6	I find it easy to keep myself from acting on unwanted desires.

Eight Strategies of Self-Control

The eight self-control strategies covered in the SCSS can be grouped into three categories theoretically: I) anticipatory control, II) down-regulation of temptation and III) behavioral inhibition. Each of these categories targets specific phases of the process model of self-control (Duckworth, Gendler, et al., 2016). The model posits that self-control failures develop across four phases: (1) encountering a situation that entails a temptation, (2) paying attention to the temptation, (3) appraising the temptation and (4) enacting a response. In any of these phases, people can use certain strategies to decrease the temptation.

Anticipatory control refers to strategies that target the first phase (the situation). These strategies aim to select or create situations where temptations either do not arise as much or are less tempting because of certain imposed contingencies. Examples are avoiding certain situations or changing environments to be less tempting (situation selection), setting up rewards or punishments for certain behaviors or pre-committing to a certain behavior.

Down-regulation of temptation refers to phases 2 (attention) and 3 (appraisal). These strategies aim to divert attention away from the temptation or change the appraisal of the temptation. Examples are distracting oneself from the temptation, thinking about it in a different manner, e.g., more abstractly or rather in terms of its downsides (cognitive change), and approaching it with an accepting mindset.

Finally, behavioral inhibition refers to the last phase (the behavioral response). This category only consists of one strategy - namely effortfully inhibiting the unwanted behavioral response triggered by the temptation.

It is worth noting that these three categories (anticipatory control, down-regulation of temptations, and behavioral inhibition) merely group the strategies concerning the phase of the self-control failure they target. However, people that use one strategy of a certain category (e.g., situation selection as anticipatory control) do not necessarily also use another one of the same category (e.g., rewards). Thus, this categorization is rather theoretical than representing

the empirical factor structure of the measure. In fact, Katzir et al. (2021) found evidence for an eight-factor structure (which was superior to a one-factor model) indicating that the strategies are independent. Still, most strategies correlated positively with one another. The exception was 'acceptance' which showed mostly negative correlations with the other strategies.

In the present project, we aim to investigate the factor structure of the German translation of the SCSS as well as the reliability and measurement invariance of the scale leading to the following hypotheses:

Hypothesis 1: The proposed eight-factor model from Katzir et al. (2021) fits the data of the German SCSS well.

Hypothesis 2: The proposed eight-factor structure is superior to alternative models (a one-factor model and a hierarchical solution where the individual strategies load on a common higher-order factor).

Hypothesis 3: All items load on their respective factors.

Hypothesis 4 & 5: The subscales' internal consistencies and test-retest reliabilities are sufficient.

Hypothesis 6: The model is configural, metric and scalar invariant for age and gender.

Construct Validity of the SCSS

Katzir et al. (2021) assessed convergent validity by investigating the relationship between the subscales of the SCSS and the Brief Self-Control Scale (BSCS, Tangney et al., 2004) which is the most commonly used measure of trait self-control (de Ridder et al., 2012). The BSCS focuses on self-control in terms of effortful inhibition (e.g. I am good at resisting temptation) and self-control success (e.g. People would say that I have iron self-discipline). The individual strategies of the SCSS had varying relationships with the BSCS. For example, behavioral inhibition was related quite strongly. This is to be expected as inhibition is an explicit part of the BSCS. Other strategies (e.g. pre-commitment) also showed positive

9

associations. This might be because these strategies relate to self-control success which is captured by the BSCS. Still, there were some strategies (e.g., rewards) that were not related to the BSCS at all. However, all strategies combined did predict a considerable amount of variance (66 %) in trait self-control largely due to the strong effect of the behavioral inhibition scale. We aim to replicate this result leading to the following hypothesis.

Hypothesis 7: All subscales combined explain a relevant amount of variance ($R^2 \geq 0.26$) in trait self-control (as measured by the BSCS, Tangney et al., 2004).

We aim to extend the findings on the validity of the SCSS by considering its discriminant validity as well. Past research has investigated a range of different measures related to self-control, such as metacognition about self-control or lay beliefs about willpower. Metacognition about self-control refers to (1) a person's knowledge about their own self-control (e.g., their strengths and weaknesses, their strategy usage) and (2) a person's regulation of self-control conflicts (e.g., planning or monitoring the resolution of a conflict). People higher in metacognition about self-control (especially metacognitive knowledge) use a larger repertoire of self-control strategies to deal with self-control conflicts (Bürgler et al., 2022). Possibly, knowledge about one's weaknesses regarding self-control motivates the usage of a broader range of strategies (e.g., proactive ones) and better regulation enhances the implementation of these strategies.

Lay beliefs about willpower refer to people's beliefs about the nature of willpower (i.e., effortful inhibition) (Job et al., 2010). Some people believe that willpower is a limited resource that depletes upon usage. Others do not see willpower as a limited resource and rather believe that it can be exerted over longer periods of time. Fujita (2011) suggested that people who believe that willpower is limited might be more motivated to search for and adopt other self-control strategies besides effortful inhibition.

Thus, both metacognition about self-control and lay beliefs about willpower may be related to the different strategies of the SCSS. However, they should still represent distinct

constructs and thus only share a limited amount of variance as stated in the following hypothesis.

Hypothesis 8: All subscales combined may explain some variance in related, but distinct constructs (i.e., metacognition of self-control and lay beliefs about willpower), but not enough to indicate that they measure the same construct ($R^2 < 0.26$).

The SCSS and Relevant Self-Control Outcomes

Dispositional self-control has been shown to be related to a number of positive real-world behaviors and outcomes. Domains that have been repeatedly shown to profit from self-control include health behavior (Hofmann et al., 2014; Moffitt et al., 2011), school (de Ridder et al., 2012; Duckworth et al., 2019) and work achievement (Allemand et al., 2019), life satisfaction and interpersonal functioning (de Ridder et al., 2012). Besides, new domains emerge that might as well profit from self-control such as pro-environmental behavior (Nielsen, 2017). For each domain, it is plausible that effortful inhibition is not the only strategy that is effective.

Katzir et al. (2021) evaluated the relationship between the strategies of the SCSS and behavioral domains such as exercise, weight loss and financial saving. They found that the SCSS added to the explained variance beyond the BSCS which mainly assesses effortful inhibition. Consistent with this, previous research showed that different strategies support self-control behavior in other domains with diverging patterns. For example, situation selection and pre-commitment have been shown to increase academic success (Ariely & Wertenbroch, 2002; Duckworth, White, et al., 2016). The latter was also significantly related to physical activity and saving behavior (Katzir et. al., 2021). To reduce social media consumption, Brevers and Turel (2019) reported situation modification behavior to be commonly used (e.g., moving the phone to a different room). In the vein of pro-environmental behavior, strategies like situation selection (e.g., getting rid of one`s dryer) or cognitive change (e.g., thinking of steak as environmentally harmful instead of tasty) have been

suggested (Nielsen, 2017). Similar assumptions can be made for other outcomes as well, such as reframing relationship conflicts as opportunity for growth (cognitive change) or turning off the wifi automatically to go to bed earlier (situation selection).

Overall, these results show the need to study the impact of self-control strategies in different domains because results from one domain might not generalize to another. We will offer new insights in this regard by investigating the SCSS in domains that have not been covered by Katzir et al. (2021), but do rely on self-control (e.g., a broader range of health behaviors, school and work achievement, life satisfaction and interpersonal functioning, and pro-environmental behavior).

Hypothesis 9: At least one strategy is significantly related to health behavior, school and work achievement, life satisfaction and interpersonal functioning, and pro-environmental behavior (while controlling for all other strategies)[1].

Current Study

After delivering first evidence on the model fit, reliability and correlation with other measures, the SCSS needs further validation to unfold its potential. In the current study, we aim for three goals. I) The translation of the SCSS to German and the test of the construct's statistical appropriateness including model fit (against concurrent models), factor loadings and measurement invariance for gender and age, and reliability of the subscales, II) the test of the convergent and discriminant validity of the SCSS, and III) the assessment of its relationship to self-control outcomes expanding to new areas that were not previously considered by Katzir et al. (2021), such as school and work performance, life satisfaction, interpersonal functioning and pro-environmental behavior.

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[1] We have no specific hypotheses on the prediction pattern of the strategies by outcome, thus we will test the hypothesis that each strategy is related to each outcome.

Method

Open Practices Statement

The project will follow complete open science practices, including open raw data, pre-processing code, prepared data, analysis code, and open access of the manuscript. A plan for pre-registered collaborative secondary data analysis to develop a language invariant short-scale can be found here: https://osf.io/pfdt2.

Translation process

The scale was translated and back translated with a British native speaker. The results were in parallel translated using DeepL. Deviations were discussed and adapted to common language usage. The item which had to be changed the most was *I tell people about my long-term goals so that they can hold me accountable*, where it was decided not to use the direct translation (*hold accountable = zur Verantwortung ziehen*) which would be unconventionally harsh, but to go with *making visible that I stick to my plans*.

Data Quality

To avoid careless or automated responses, we will include attention checks throughout the study. The SCSS itself includes three attention checks already. For every 20 additional items, we will include one attention check item. Failing to correctly respond to one will lead to exclusion. To ensure that participants do not contribute to more than one sample, we will a) ask them if they have completed the German SCSS before, b) check the emails in the social media data for duplicates, and c) compare IP addresses. If the IP addresses match (apart from the laboratory data), we will compare the given demographic information. If this information matches as well, only the earliest data will remain in the sample. To ensure that participants speak German sufficiently, they will report their German language level at the beginning of each study. Participants who do not indicate that they speak German fluently (or better) will not be able to participate. For online data, participants who finish the questionnaire >3SD faster will be excluded. There will be no exclusion for slow participation. All incomplete

datasets will be excluded. The number of exclusions by reason and sample will be documented in the supplemental material [https://osf.io/p562r].

Studies and Procedure

In all samples, individuals will first learn about the procedure of the study and that they can stop participating at any given point. Afterwards, they will consent to the study and indicate that they are at least 18 years old. Then, the SCSS will be presented. As in Katzir et al. (2021), the attention checks will be presented at fixed points, and the remaining items will be presented in random order. Afterwards, the remaining measures will be presented. Last, participants will be asked for their demographic details and thanked for their participation. The study ID, population, sample size, time, goals of the specific sampling and used measures are summarized in Table 2. The Study consists of four cross-sectional and one longitudinal study. Study 1 will serve as pilot, where participants can give feedback on the translated scale and indicate whether specific aspects remain unclear. Also, this will serve to test an abbreviated introduction to the scale which focuses less on resisting temptations exclusively, but also includes initiating and persisting in aversive activities. Study 2 will consist of students at the University of Vienna, which participate in a longitudinal assessment for course credit. T1 of the assessment will be used to test the factor structure and item properties, in case adjustments need to be done. T2 to T4 aim to test the test-retest reliability of the SCSS (after any adjustments suggested by the results from T1 have been made) and the causal predictions of the SCSS on selected outcomes at a later time point. Further, the moderating influence of goal importance on the causal effect will be tested. Studies 3 to 5 collect cross-sectional data, including the final German version of the SCSS and different self-control related outcomes. Studies 2 to 5 will be used to assess the scale quality (measurement invariance, concurrent factor models). From Study 2, T1 will be used if no changes were made to the SCSS after T1, otherwise T2 will be used. Prolific participants will receive XXX$ *[amount depending on the duration of the study; exact amount will be added at stage 2]*,

students will receive course credit, and social media participants will participate in a lottery for a total of 600 Euro in vouchers.

Table 2

Studies and sample specific information

ID	Description	N	Sampling time	Goals	Additional Measures (*N* items)	
1	Pilot	40	mm/yy - mm/yy	● translation	Open response field (1)	
2	Students (T1)	300	mm/yy - mm/yy	● factor structure ● reliability		
	Students (T2)	240	mm/yy - mm/yy	● retest reliability ● longitudinal prediction	University entrance exam rank (1) School performance (1) Goal importance (studying) (2) Goal importance (healthy diet) (2) Goal importance (physical activity) (2)	ADHD (6) BFI-10 (10) Habit strength (studying) (4) Habit strength (healthy diet) (4) Habit strength (physical activity) (4)
	Students (T3)	192	mm/yy - mm/yy	● retest reliability ● longitudinal prediction		Habit strength (studying) (4) Habit strength (healthy diet) (4) Habit strength (physical activity) (4)
	Students (T4)	153	mm/yy - mm/yy	● retest reliability ● longitudinal prediction	Grade (1)	Habit strength (studying) (4) Habit strength (healthy diet) (4) Habit strength (physical activity) (4)
3	Prolific	600	mm/yy - mm/yy	● factor structure ● measurement invariance ● cross-sectional predictions	BSCS (13) Willpower beliefs (12) Income (1)	Occupational efficacy (3) Sleep procrastination (9) Satisfaction with life (5) Depressive symptoms (9)
4	Social media 1	600	mm/yy - mm/yy	● factor structure ● measurement invariance ● cross-sectional predictions	Screen time (1-2) Steps (1-2)	Pro-environmental behavior (50) Goal importance (PEB) (2) Pure procrastination scale (12)
5	Social media 2	600	mm/yy - mm/yy	● factor structure ● measurement invariance ● cross-sectional predictions	Burnout (21) MISCS (12) Healthy diet (3)	Relationship satisfaction (6) Conflict in relationships (3) Physical activity (4)

Note. The listed measures are additional to the demographic measures (3 items) and the SCSS (41 items).

Measures

Self-Control Strategy Scale (SCSS). As described above, the SCSS (Katzir et al., 2021) measures the engagement in eight self-control strategies (for an overview see Table 1). It includes 38 items (5 reverse coded) measured on a 5-point scale (1 = not at all, 5 = very much).

Goal Importance. Across the studies, goal importance will be assessed regarding four specific goals: studying for an exam, maintaining a healthy diet, being physically active and behaving pro-environmentally. For each goal, two items from Katzir et al. (2021) are adapted to assess how important the specific goal is for participants. They will be asked to indicate (1) how important the goal behavior is for them (1 = *not at all important*, 5 = *extremely important*) and (2) to what extent they would like to engage in the goal behavior (1 = *not at all*, 5 = *to a high extent*).

Personality. As an economic and validated short-scale to assess the BIG-5 dimensions, we will apply the BFI-10 (Rammstedt et al., 2013; Rammstedt & Danner, 2017). The scale has been shown to adequately capture the dimensions compared to more extensive tools (e.g., "I see myself as someone who is reserved.", 1 = not at all, 5 = very much).

Demographics. All participants will be asked for their age (in years), their best identified gender (female, male, other) and German language level (native, fluent, good, not so good).

Measures to Assess Convergent and Discriminant Validity

Brief Trait Self-Control Scale. The likely most common measure of self-control is the 13-item BSCS (Tangney et al., 2004). The scale was validated in German (Bertrams & Dickhäuser, 2009) and response options range from 1 = *not at all* to 5 = *very much* (e.g. "I am good at resisting temptation"). It is frequently applied to assess self-control in terms of inhibition.

Lay Beliefs About Willpower. Lay beliefs about willpower will be assessed with regard to four self-control domains (strenuous mental activity, resisting temptations, strenuous physical activity and emotion control). The subscales on mental activity, resisting temptations and physical activity from Bernecker and Job (2015) (e.g., "After a strenuous mental activity, my energy is depleted and I need to rest to replenish it."). To cover the emotion control domain, four additional items are adapted from the 6-items scale by Bernecker and Job (2017) (e.g., "Even if I had to keep calm and control my emotions frequently on a given day, it doesn't affect my ability to continue to control my emotions"). All items will be answered on a 6-point scale (1 = *strongly agree*, 6 = *strongly disagree*).

Meta-Cognition of Self-Control Scale (MISCS). The scale measures metacognitive knowledge and regulation (Bürgler et al., 2022) using 12 items (e.g., "I understand my strengths and weaknesses when dealing with self-control conflicts.", 1 = *disagree strongly*, 5 = *agree strongly*).

Self-Control Outcomes

Physical Activity. Participants will report the number of minutes they spent on physical activity during the last 7 days with regard to (1) moderate- and (2) vigorous-intensity aerobic physical activity, (3) moderate (or greater) muscle-strengthening activities, and (4) other physical activity. This is based on the WHO (2020) guidelines for physical activity which recommend certain amounts of aerobic and muscle-strengthening activities. A combined score will be created by summing the time spent on each type of physical activity.

Steps. We will ask participants to access their step counter on their phone and indicate the average number of steps per day over the last month (if they only have access to data from a shorter time period, e.g., a week, they will be asked to indicate that instead). Additionally, they will be asked to provide a screenshot of their step counter. Participants will have the option to indicate that they cannot or do not want to answer the items. To avoid faulty data, values above 35,000 steps per day will be excluded. This cut-off is more than 3 SD above the

highest average daily steps, reported in a meta-analysis on step number and mortality (Paluch et al., 2022).

Healthy Diet. Health and unhealthy food intake will be measured via three items adapted from Werner et al. (2022). Participants will report the number of total servings of (1) vegetables, (2) fruits, and (3) high-fat/high-sugar snacks they have consumed during the past 7 days.

Screen Time. We will ask participants to access their average screen time on their phone and report the daily average screen time over the last month (if they only have access to data from a shorter time period, e.g., a week, they will be asked to indicate that instead). Additionally, they will be asked to provide a screenshot of their screen time record. Participants will have the option to indicate that they cannot or do not want to answer the items. To avoid faulty data, values above 18 hours per day will be excluded.

Sleep Procrastination. To measure the tendency of delaying one's own bedtime, we will apply the bedtime procrastination scale (Bernecker & Job, 2020; Kroese et al., 2014) (e.g., "I go to bed later than I had intended", 1 = *(almost) never*, 5 = *(almost) always*). Item 6 ("I do not go to bed on time") was rephrased to "I do go to bed on time" and accordingly recoded in order to ease responding for participants (by avoiding a double negative).

Income. Participants will be asked to indicate their pre-tax income from work activities over the last 12 months. They will enter the exact amount of income either as a total or as a monthly salary (combined with an indication of the number of monthly salaries they receive in a year).

Procrastination. We will use the pure procrastination scale (Steel, 2010) to measure respective tendencies on 12 items (e.g., "I delay making decisions until it's too late", 1 = *strongly disagree*, 7 = *strongly agree*).

Occupational Efficacy. Participant's occupational efficacy will be measured by the Short Occupational Self-Efficacy Scale (Rigotti et al., 2008). It consists of six items (e.g., "I

feel prepared for most of the demands in my job.") assessed on a six-point scale (1 = *not at all true*, 6 = *completely true*).

University Entrance Exam Performance. Students will be asked to indicate their rank in the university entrance exam for psychology.

School performance. Students' grades will be recorded at the end of the ongoing term.

Satisfaction with Life. The five-item Satisfaction with Life Scale (SWLS; Diener et al., 1985) will be used in its validated German form (Glaesmer et al., 2011) (e.g., "In most ways my life is close to my ideal", 1 = *strongly disagree*, 7 = *strongly agree*).

Relationship Satisfaction. Relationship satisfaction will be measured through the German translation (Hassebrauck, 1991) of the Relationship Assessment Scale (Hendrick, 1988). The scale includes six items (e.g., "How good is your relationship compared to most?") rated on a 5-point scale with varying anchors depending on the item (high values indicate high relationship satisfaction).

Conflict in relationships. Three items from Allemand et al. (2015) will be used to assess the occurrence of conflicts in participants' romantic relationships (e.g., "In our marriage/relationship small things end up in big fights"). Participants will answer on a 6-point scale (1 = *never* to 6 = *always*).

Pro-Environmental Behavior. The General Ecological Behavior Scale (GEB-50; Kaiser, 2020) is the most widely used measure of general pro-environmental behavior and has the strongest psychometric support (Lange & Dewitte, 2019). It encompasses 50 items from 6 domains of environmental behavior (energy conservation, mobility, waste reduction, consumption, recycling and social commitment). 32 items are assessed on a scale from 1 = *never* to 5 = *very often*. These are later dichotomized to 0 (no pro-environmental behavior) and 1 (pro-environmental behavior). Further 18 items are directly assessed on a binary scale (1 = *yes*, 0 = *no*). For each item, participants can indicate that the item is not applicable to them. Participants' overall scores are created using the Rasch model.

Habit Strength. We will measure habit strength for three specific behaviors: studying for an exam, maintaining a healthy diet, and being physically active. Using the 4-item SRBAI (Gardner et al., 2012), habit strength is assessed for each behavior (e.g., "Maintaining a healthy diet is something... I do automatically", 1 = strongly disagree, 7 = strongly agree)

Exploratory Measures

Burnout. We will apply the German version of the 22-item Maslach Burnout Inventory (Büssing & Perrar, 1992; Maslach et al., 1997) (e.g., "I feel emotionally drained by my work", 0 = *never*, 6 = *everyday*).

ADHD. We will use the 6-item self-report ADHD screening scale for adults Part A (ASRS-V1.1; Kessler et al., 2005) (e.g., "How often do you have trouble wrapping up the final details of a project, once the challenging parts have been done?", 1 = *never*, 5 = *very often*).

Depressive Symptoms. To assess depressive symptoms, we will use the PHQ-9 (Löwe et al., 2002), which was previously validated in the German general population (Martin et al., 2006). It assesses the extent to which a series of symptoms occurred in the past two weeks (e.g., "Little interest or pleasure in doing things", 0 = *not at all*, 3 = *nearly every day*).

Table 3

Summary of demographic details of cross-sectional studies 1 and 3-5

	1	3	4	5
age	XX.XX (X.X)	XX.XX (X.X)	XX.XX (X.X)	XX.XX (X.X)
gender (f/m/o)	XX/XX/XX	XX/XX/XX	XX/XX/XX	XX/XX/XX
language level	XX/XX/XX/XX	XX/XX/XX/XX	XX/XX/XX/XX	XX/XX/XX/XX

Table 4

Summary of demographic details of longitudinal study 2 by measurement time point

	T1	T2	T3	T4
age	XX.XX (X.X)	XX.XX (X.X)	XX.XX (X.X)	XX.XX (X.X)
gender (f/m/o)	XX/XX/XX	XX/XX/XX	XX/XX/XX	XX/XX/XX
language level	XX/XX/XX/XX	XX/XX/XX/XX	XX/XX/XX/XX	XX/XX/XX/XX
N (dropout)	X (X %)	X (X %)	X (X %)	X (X %)

Data Analysis

Cleaning

Each sample will be cleaned based on previously defined standards (see Data Quality). Following this, non-analytically relevant variables will be filtered from the datasets (e.g., attention checks), and negative items will be reversed. Mean scores for scales and subscales will be computed, and demographic information will be analyzed by sample. Subsequently, the SCSS data and information on age and gender will be combined.

Factor Model Analysis

A series of tests will be conducted to assess the model fit, model superiority, reliability, and measurement invariance of the SCSS (in German). The criteria for these assessments will be defined here, and their fulfillment will be summarized in Table 4. To assess the reliability of the SCSS, ω will be computed by subscale. The criterion for fulfillment will be set at all

reliabilities exceeding > .70. We will compute retest reliability across three measurements, which will be judged as sufficient at > .70. For model fit, a confirmatory factor analysis (CFA) will be conducted with eight fixed factors, no cross-loadings, and fixed latent-factor variance (= 1, Katzir et al., 2021). Model fit will be seen as sufficient with CFI ≥ .90, TLI ≥ .90, and SRMR ≤ .08 (Byrne, 1994) and RMSEA ≤ .08 (Awang, 2012). Further assessment will be made to ensure that all items load with > .40. Subsequently, two alternative models will be computed: I) a one-factor model and II) a hierarchical model (comprising the eight subscales and a higher-order general factor all subscales load on). These models will be compared using the Akaike information criterion (AIC, Akaike, 1974)[2]. Following the model analysis, the SCSS will be tested for measurement invariance by gender and age. Each gender category with at least n = 300 cases will be used, and the age range will be split into three equally sized groups. By adding model restraints, configural, metric, and scalar invariance will be tested by comparing model fit. The SCSS will be considered fully invariant if the CFI and TLI remain ≥ .90, and RMSEA ≤ .08 and SRMR remain ≤ .08. Finally, correlations between strategies will be computed in the last step of the analysis.

Validity

To assess convergent and discriminant validity, we will test the relationship of the subscales of the SCSS with another measure of self-control (i.e., BSCS) and measures related to, but distinct from self-control (e.g., lay beliefs about willpower). We will compute multiple regressions to assess the contribution of all strategies to the variance in the respective measures. We will define *adj. R^2* ≥ .26[3] (convergent validity) and *adj. R^2* < .26[3] (discriminant validity) as thresholds indicate validity. Values within these ranges will be highlighted with bold print.

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[2] The absolute value is not interpretable, just the difference between AICs of different models. The lowest number indicates the most appropriate model fit between the candidate models. In contrast to the lowest value, the other models are judged according to their difference score: < 2 = substantial evidence for model, 4 - 7 = considerably less, > 10 essentially none.

[3] While we will use multiple regression to compute the explained variance, we will interpret the results strictly non-causal.

Relationship of Individual Self-Control Strategies With Outcomes

For the cross-sectional outcomes in Studies 2-5, we will conduct multiple regressions to assess the relationship of each strategy with the respective outcome while controlling for all other strategies. We assume that (almost) every outcome will be significantly related to at least one strategy, as in Katzir et al. (2021).

For the longitudinally measured outcomes in Study 2, we will conduct multiple regressions to assess the relationship of each strategy measured at T2 with the respective outcomes at T3 (and T4 respectively) while controlling for all other strategies and the outcome measure at T2.

Results

Table 4

Results of test for measurement invariance by gender and age

Model	CFI	TLI	RMSEA	SRMR
base				
age				
configural				
metric				
scalar				
gender				
configural				
metric				
scalar				

Table 5

Checklist on criteria for quality assessment on factor model of SCSS

criteria	yes	no

are all items loading > .40	x	
are all ω > .70		x
test-retest > .70	x	
does the model fit well		
does the model fit better than a single-factor model	x	
does the model fit better than a hierarchical model		x
measurement invariance (gender)		
configural		x
metric	x	
scalar		x
measurement invariance (age)		
configural	x	
metric		x
scalar	x	

Table 6

Reliabilities, means and correlations between subscales of the SCSS

	ω	M	SD	SS	PU	RE	PC	DI	CC	AC	BI
SS	.xx	X	X	.xx*	.xx+						
PU											
RE											
PC											
DI											
CC											
AC											
BI											

Note. *p < .05, + < .001.

Table 7

Multiple Regressions of SCSS subscales onrelated measures

	n	SS	PU	RE	PC	DI	CC	AC	BI	R^2
e.g. Procrastination	600	□ .08	**.17**	.06	**.32**	.11	.002	.12	**.17**	**.14**
meas. 2		□ .xx*								.xx
meas. 3		□ .xx+								

Note. *p < .05, + < .001; *n* = sample size of specific test, □ = standardized regression coefficient. Bold print for significant □ ≥ .15 and *adj. R^2* ≥ .10.

Discussion

Summary

We tested the quality of the SCSS from different angles to assess its usability in the field of self-control research and to facilitate its application with German speaking participants. To do so, we translated the scale and tested its model fit, model superiority, reliability and measurement invariance. Further, the eight subscales have been associated with relevant measures to assess convergent and discriminant validity. Additionally, we investigated the relationship of the individual strategies with relevant self-control outcomes.

Limitations

Future Research

Conclusion

Author Contributions

Competing Interests

The authors declare no conflict of interests. The work is supported by the Support Scholarship by the Austrian Federal Ministry of Education, Science and Research, awarded through the University of Vienna to XXX, XXX, XXX, XXX.

Ethic Approvement

The study was approved by the Departmental Review Board (DRB) of the Faculty of Psychology, Department of Occupational, Economic, and Social Psychology (2023/M/009).

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