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Examining five pathways on how self-control is associated with emotion regulation and affective well-being in daily life

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Abstract

Objective: Self-control is positively connected to well-being, but less is known about what, on the mechanistic level, explains this association. We hypothesized five pathways how this connection could be explained by emotion regulation, that is, by facilitating (a) strategy effectiveness, (b), adaptive strategy selection, (c) situation selection, (d) strategy variability, or (e) social sharing.

Method: To explore these pathways, we integrated two ambulatory assessment data sets (N = 250 participants, N = 22,796 observations) that included assessments of participants' emotions and their emotion regulation efforts.

Results: We found that self-control was positively associated with affective well-being. Moreover, momentary but not trait self-control was associated with favoring adaptive and interpersonal strategy selection and less emotion regulation in general as well as with increased variability across strategies. However, these emotion regulation facets could not sufficiently explain the association between self-control and affective well-being.

Conclusions: Our main conclusion is that emotion regulation is not a mediator of the strong relation between self-control and affective well-being. Instead, we found evidence for the affective benefits of employing ways of emotion regulation that are less taxing mentally, which we discuss in light of current knowledge about self-control and emotion regulation.

KEYWORDS

affective well-being, emotion regulation, mediation, self-control

1 | INTRODUCTION

Self-control (SC) is the ability to overcome a temptation or prepotent response in favor of a competing goal (Milyavskaya et al., 2019), enabling individuals to, for example, eat healthier or to exercise more when confronted with tempting alternatives. However, lack of SC is the major reason why most people do not follow through with such changes, with 27% indicating lack of SC as being the most significant barrier to change in the 2011 Stress in America survey (Stress in America, 2012). However, this same survey also demonstrated that 71% of respondents reported believing that SC is not immutable but can be learned. Moreover, they responded that more SC would help them improve their ability to make

changes and to feel better about themselves. Research underlines the importance of SC for individuals' affective well-being (AWB), demonstrating that individuals high in self-control do not renounce the joys of life more regularly in order to achieve their goals but instead report greater AWB (Cheung et al., 2014; Hofmann et al., 2014; Wiese et al., 2018). In order to help people to increase their affective well-being, it is important to know what processes underlie these changes to derive effective interventions that target these processes. In the present study, we focus on the association between SC and AWB (de Ridder et al., 2012) and how this association may be explained by different emotion regulation (ER) processes, such as more effective, adaptive, flexible, or interpersonal ER.

1.1 | Trait self-control and affective well-being

Trait self-control (TSC) is often viewed as the individual's ability to override predominant response tendencies in order to pursue long-term goals (Metcalfe & Mischel, 1999). Measures of TSC correlate with important real-life outcomes such as weight (Crescioni et al., 2011) and substance abuse (Moffitt et al., 2011). TSC is also strongly associated with psychological adjustment (de Ridder et al., 2012), happiness (Cheung et al., 2014), positive affect, and life satisfaction (Hofmann et al., 2014). Moreover, having too much self-control is also not a problem, as prior research demonstrated only evidence for a linear but not an inverted U-shaped relationship between SC and AWB (Wiese et al., 2018). This evidence suggests that individuals high in TSC do not live joyless lives informed by iron self-discipline, but happier ones by avoiding conflicts between highly valued and disvalued goals (Hofmann et al., 2014). Building on this line of research, we hypothesized that individuals high in TSC report higher levels of AWB than individuals low in TSC (Hypothesis 0).

1.2 | Trait self-control and emotion regulation

However, although the relationship between TSC and AWB is intriguing, less is known about what can explain this association. Here, we explore a set of hypotheses, which share one common cause, in that the relationship is assumed to be mediated by ER, i.e., the ability to inhibit and adapt one's own thoughts and feelings according to personal or social standards (Koole, 2009). Conceptually, we built on the prominent process model of ER (Gross, 1998), which divides the ER process into four temporal dimensions (Figure 1). ER strategies before the emotional response are antecedent-focused, whereas suppression is considered as response-focused. Research commonly studied distraction and rumination as strategies directed at attentional deployment, reappraisal as a way of facilitating cognitive change, and suppression as a response modulation strategy (Webb et al., 2012).

Traditionally, ER and SC have been studied more or less separately, despite their obvious similarities. Both involve overriding automatic responses in favor of controlled ones and are interrelated in daily life, since emotions can signal the need to regulate individual's emotions, thoughts, and behavior (Paschke et al., 2016). Moreover, research studying the beneficial effects of SC and ER found associations with similar outcomes, such as higher levels of AWB (Côté et al., 2010; Hofer et al., 2011) or academic success (Tangney et al., 2004). However, it is unclear how exactly ER mediates the relationship between TSC and AWB. Importantly, Hofmann and colleagues (2014) found that emotional distress

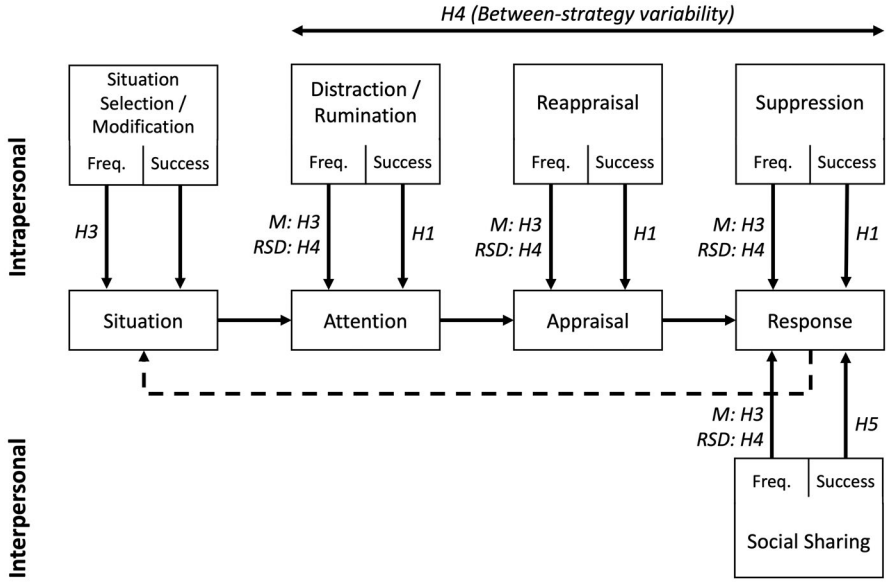

FIGURE 1 The process model of emotion regulation (Gross, 1998), modified to include all investigated pathways: strategy effectiveness (Hypothesis H1), adaptive strategy selection (H2: reappraisal and distraction (ADA) versus. suppression and rumination), situation selection (H3), strategy variability (H4; *RSD* = relative standard deviation), and interpersonal ER (H5: social sharing versus. intrapersonal ER). Frequency and success of the emotion regulation strategies refer to the emotional response

partially mediated the link between SC and AWB and, thus, ways to deal and reduce emotional distress might not only help to understand why SC is linked with AWB, but might also offer a promising starting point for interventions.

Thus, in the present paper, we test whether individuals high compared to low in TSC (a) use ER strategies more effectively (*strategy effectiveness*; Hypothesis (H1) in Figure 1), (b) favor adaptive over maladaptive ER strategies (H2: *strategy selection*), (c) need to use fewer ER strategies in general due to experiencing less emotion-eliciting events (H3: *situation selection and modification*), (d) use ER strategies more variably (H4: *strategy variability*), or (e) use more social sharing (H5: *interpersonal ER*). To test these ideas, we used data from two studies that employed ambulatory assessment (Trull & Ebner-Priemer, 2013) in order to capture these relationships in daily life.

1.2.1 | Strategy effectiveness

Evidence for H1 is mainly derived from research that studied brain activity when individuals were watching or regulating emotional stimuli and from research on cognitive control. For example, research has demonstrated a downregulation in the amygdala, which is associated with processing of emotions, during reappraisal of negative emotional facial expressions in order to downregulate negative affect (Drabant et al., 2009). At the same time, reduced amygdala activity was accompanied by an upregulation in the prefrontal cortex, which is associated with cognitive control, indicating that the downregulation of affect may be due to SC efforts (Drabant et al., 2009). Likewise, participants who exerted SC in a prior task showed higher amygdala reactivity and a reduced functional amygdala-prefrontal cortex connectivity when they subsequently watched negative emotional stimuli (Silvers & Guassi Moreira, 2019; Wagner & Heatherton, 2013), indicating reduced control due to initial SC efforts. Moreover, reappraisal ability was positively associated with individual differences in working memory capacity (Schmeichel et al., 2008) and task switching (McRae et al., 2012) but not in cognitive inhibition (Gyurak et al., 2012). Although this line of research is fairly far away from research on TSC and ER in daily life, research has outlined that executive functions are necessary prerequisites for the capacity to engage in SC (Hofmann et al., 2012). Recent research extended the findings from cognitive control to TSC research by showing that individuals high compared to low in TSC reported less intense negative emotions when using reappraisal (Paschke et al., 2016). Thus, we wanted to further extend this line of research to daily life process and propose that one explanation regarding how TSC is related to AWB in daily life could be that individuals high compared to low in TSC use ER strategies more effectively in improving AWB (Hypothesis 1).

1.2.2 | Strategy Selection

However, research on SC in the recent decade challenged the view that individuals high in TSC are better at effortful inhibition of predominant response tendencies in order to better achieve longer term goals (e.g., de Ridder & Gillebaart, 2017; Hofmann et al., 2012). Instead, this line of research shifts the focus to individuals' knowledge, goals, beliefs, values, and environmental affordances as important mechanisms underlying the beneficial outcomes of TSC. The remaining four pathways connect to this line of research, with pathway 2 focusing on strategy selection.

Prior research on ER has focused on the general effectiveness of ER strategies by classifying them into adaptive and maladaptive strategies. According to a meta-analysis (Webb et al., 2012), reappraisal and distraction were positively associated with ER success (*adaptive* ER strategies), whereas rumination was negatively and suppression not significantly associated with ER success (*maladaptive* ER strategies). However, evidence for the role of TSC is scarce and based on single assessments, showing TSC to be associated with reports of more adaptive and less maladaptive strategies when coping with stress (Moshontz et al., 2020). Thus, it may be that individuals experience themselves as more self-controlled in their everyday life due to a better knowledge about and selection of ER strategies that are generally more adaptive. However, clearly more research is needed to test how this hypothesis applies to the everyday life of individuals. We, thus, wanted to add more evidence by hypothesizing (Hypothesis 2) that individuals high compared to low in TSC more strongly favor adaptive (social sharing, reappraisal, distraction) over maladaptive ER strategies (suppression and rumination).

1.2.3 | Situation selection and modification

So far, we considered that TSC is associated with either increased strategy effectiveness (H1) or with favoring generally adaptive strategies (H2). However, these strategies draw on cognitive resources (Hofmann, et al., 2012), rendering them effortful which individuals might want to avoid (Inzlicht et al., 2018). Thus, a third possibility is that individuals high in TSC are better at structuring their surroundings by selecting and modifying situations in their everyday life in such a way that lessens the need for effortful ER. For example, individuals might avoid going to the pub if they want to limit their consumption of alcoholic beverages. Thus, people high in TSC may not be better in reappraising or suppressing negative emotions per se. Instead, they may have formed good habits, which allowed them to influence their surroundings in a way that reduces the emergence of emotion-eliciting situations, making effortful ER uncalled-for

(Carden & Wood, 2018). Compared to reappraisal and suppression, situation selection has received less attention from research, although research has demonstrated that individuals more likely choose activities that matched subsequent ER demands (Tamir & Ford, 2009, 2012). Moreover, older compared to younger adults were more likely to avoid negative information to minimize the need to regulate their affect (Livingstone & Isaacowitz, 2015; Sims et al., 2015). Situation selection was particularly effective for individuals who described themselves as having more regularly ER difficulties (Webb et al., 2018). Research on TSC found that TSC was not associated with more effective regulation of conflicted desires, but with less regulation effort and fewer conflicts in daily life (Hofmann, et al., 2012). Moreover, subjective depletion and goal attainment have not been significantly associated with the active regulation of conflicted desires, but with the increased experience of these desires itself (Milyavskaya & Inzlicht, 2017). More direct support with regard to AWB comes from three ambulatory assessment studies, in which the relationship between TSC and life satisfaction was partially mediated by individuals high in TSC experiencing significantly fewer conflicts, which indirectly improved life satisfaction via improved momentary PA (Hofmann et al., 2014). In a similar vein, individuals high compared to low in TSC reported fewer conflicts relating to food and faster resolution of SC conflicts (Gillebaart et al., 2016), indicating that installing and keeping routines is beneficial for SC, as it reduces effortful control over conflicted desires (de Ridder & Gillebaart, 2017). Thus, individuals high in TSC could be best characterized as being better at effortless SC through developing more automatic behavior (Baumeister & Alquist, 2009) and more adaptive habits (Adriaanse et al., 2014), which then leads to better AWB (Galla & Duckworth, 2015). Translating this notion of a lessened regulatory need in individuals high in TSC to ER research, we hypothesized that individuals high compared to low in TSC select situations that require less use of effortful ER (Hypothesis 3).

1.2.4 | Strategy variability

Although meta-analyses support the notion of adaptive and maladaptive strategies, the effect sizes are heterogeneous and only small to moderate in size (Webb et al., 2012). Consequently, research increasingly acknowledges the role of variability within and between ER strategies, such that some ER strategies are not generally adaptive (Bonanno & Burton, 2013). Instead, it is also important to fit the ER strategies to the context in which they are most effective: Individuals who could switch more variably between enhancing and suppressing emotions reported higher levels of AWB after 3 years (Westphal et al., 2010), which was moderated by the knowledge of the ER strategy effectiveness (Southward & Cheavens, 2017). Variability in some ER strategies is also significantly negatively associated with psychopathological symptoms (Aldao & Nolen-Hoeksema, 2012). Moreover, research showed that reappraisal was only helpful in uncontrollable but detrimental in controllable situations, both in the laboratory (Troy et al., 2013) and in daily life (Haines et al., 2016).

The presented evidence focused on variability within ERS (i.e., variance by which one strategy is employed across several situations). Current research increasingly focuses on variability between ERS (i.e., variance by which several strategies are selected in a given situation). However, evidence is scarce so far, with only one study reporting that between-strategy variability but not within-strategy variability is consistently negatively associated with NA (Blanke et al., 2019). Based on this very early evidence, we wanted to explore the hypothesis that individuals high compared to low in TSC report higher variability within and between ER strategies (Hypothesis 4). This hypothesis is based on the idea that individual high in TSC might describe themselves as better at SC due to their increased repertoire of strategies to control their emotions and behaviors and their increased knowledge on when to employ each strategy.

1.2.5 | Interpersonal emotion regulation

The process model of ER views ER as an individual process where individuals employ a wide range of intrapersonal strategies to regulate their emotions. However, individuals often involve others to disclose and deal with their emotional experiences to others (Rimé, 2009). In the last decade, theories emerged that aimed at investigating the differences and benefits of interpersonal compared to intrapersonal ER (Reeck et al., 2016; Zaki & Williams, 2013). However, evidence is scarce, with one study showing that individuals who favored interpersonal over intrapersonal ER reported higher levels of AWB (Williams et al., 2018). Clearly more research is needed that directly examines differences in the usage, effectiveness and variability of intra- and interpersonal ER in daily life. Thus, we sought to remedy this research gap by including social sharing as an interpersonal ER to examine the effectiveness, selection, and variability of social sharing compared to the intrapersonal ER strategies. We explored whether individuals high compared to low in TSC favor interpersonal over intrapersonal ER strategies (Hypothesis 5).

1.3 | The present paper

We wanted to test five possible pathways how SC is associated with AWB in daily life by using two data sets with 125

individuals each where participants completed ambulatory assessment on average 173 times during 6 weeks (72.1% adherence; Data set 1) and 59 times during 1 week (69.6% adherence; Data set 2). Such a design reduces reporting biases, such as overestimating infrequent events and underestimating frequent situations (Brose et al., 2013), and helps increase ecological validity by assessing in individuals' natural environments. Moreover, it allows assessing not only TSC, which was predominantly assessed in the presented evidence, but also state self-control (SSC), which is less biased by how participants remember these episodes and how they want to perceive themselves. Thus, assessing the individuals' different capacities to control themselves at their command over time enables us to study the relationship between SC and AWB not only on the between-person level (between-person processes), but also on the within-person level (within-person processes), which is necessary to study the relationship between SC and AWB on the mechanistic level.

2 | METHODS

2.1 | Disclosures

We affirm that we reported all manipulations and exclusions in the present study. However, we did not report all measures, because Data set 1 is from the REDACTED study, which examined the effectiveness of a mindfulness intervention in influencing mindfulness, SC, and affective processes (citation redacted for blind review), and Data set 2 is from a project that examines affect dynamics and regulation in romantic dyads (citation redacted for blind review). Data set 1 was registered with clinicalTrials.gov (citation redacted for blind review) and a study protocol was published (citation redacted for blind review), whereas Data set 2 was preregistered on OSF (https://osf.io/957ew/?view_only=b8b429c907144e4592464ea74c2fb3c8). However, none of the hypotheses and analysis plans of the current study were preregistered. The protocols were approved by the ethics committee of the Institute of Psychology in REDACTED (reference codes REDACTED). All participants provided informed consent. All data, statistical analyses, and the full results can be found at https://osf.io/4fnwh/?view_only=2cc3cc8fb9804b828b3692d5de025c00.

2.2 | Participants

2.2.1 | Data set 1

The power of the parent study was based on a small effect of Cohen's $d = .33$ for the mindfulness training on the primary outcome of state mindfulness, with $\alpha = .05$ and 10% expected attrition. To achieve 95% power, 137 participants were recruited through flyers, mailing lists, social networks, bulletins, and direct approaches; 11 participants dropped out throughout the course of the study. After excluding data from participants with less than 33% completed signals (Myin-Germeys et al., 2001), 125 participants (77.6% female; $M = 22.9$ years, $SD = 5.1$) remained in the final sample.

2.2.2 | Data set 2

The parent study took a pragmatic approach and preregistered that data collection would stop once 90 dyads were enrolled. Since it was a study on romantic dyads, university students were recruited together with their partners via bulletins. Participants could choose between partial course credit or 50 € (approx. US$ 60) as compensation. Since TSC data were not originally assessed, they were collected in an additional assessment approximately half a year later via an online questionnaire approximately, which was completed by 126 participants of the first assessment. Again, we excluded participants with less than 33% completed ambulatory signals ($n = 1$). This resulted in a final sample of 125 participants (57.8% female; $M_{age} = 24.23$ years, $SD_{age} = 3.79$).

2.3 | Procedure

2.3.1 | Data set 1

The parent study was a combined laboratory and ambulatory assessment study, with 7 weekly laboratory sessions and a 6-week experience sampling period. After signing an informed consent form, participants completed several trait questionnaires of which only TSC was of interest for this study (a complete overview regarding the design, procedure, and material can be found in the study protocol, REDACTED). Starting the next day and for 40 subsequent days, participants received six randomly distributed signals per day ($M_{interval} = 103.4$ min, $SD = 34.3$, Range: 45–200 min) between 10 a.m. and 8 p.m. that presented them with questionnaires regarding their momentary emotions and ER strategies on the Android applications movisensXS (movisens GmbH, Karlsruhe, Germany). Participants returned to the laboratory each week to keep adherence high, and complete questionnaires; those in the mindfulness training condition also performed a computer-based guided-breathing meditation, which we controlled for in the statistical analyses.

2.3.2 | Data set 2

The procedure of the study producing Data set 2 was similar. However, the experience sampling part lasted 7 days with 12

signals a day. Participants could choose between three options as to when the signals would be delivered: (a) between 9 a.m. and 9 p.m. (31.5% of the initial 184 participants chose that option), (b) between 10 a.m. and 10 p.m. (47.8%), or (c) between 11 a.m. and 11 p.m. (20.7%). Given the dyadic structure, the distribution of the signals was randomized for each day with the condition that each signal had to be at least 30 min apart (M = 58.3 min, SD = 20.6). The specific times of each signal for each day, as well as options, can be found in the online supplement (https://osf.io/957ew/?view_only=b8b429c907144e4592464ea74c2fb3c8).

2.4 | Measures

The descriptive statistics of the measures of both data sets can be found in Table 1.

2.4.1 | Affect

Positive and negative affect were assessed using four items each (Kuppens et al., 2010), with "happy," "excited," "relaxed," and "satisfied" indicating positive affect and "anxious," "angry," "depressed," and "sad" indicating negative affect. Each item was rated on a visual analog scale that ranged from 0 to 100 (Data set 1) or from 0 (*not at all*) to 6 (*very much*) (Data set 2). To compare the data, the scale in Data set 2 was transformed to the scale in Data set 1 by multiplying the values with 100/6. The mean of positive and reversed negative affect served as the AWB measure on the within-person level, McDonalds's ω = 0.81 (Geldhof et al., 2014).

2.4.2 | Well-being

Well-being was assessed twice in Data set 1 at the beginning and at the end of the ambulatory assessment, using the five items of the WHO-5 Wellbeing Index (WHO-5) with a scale ranging from 0 (*at no time*) to 5 (*all of the time*). The mean of the z-standardized averaged WHO, positive affect and negative affect (reversed) served as the AWB measure on the between-person level (McDonalds's ω = 0.67). Prior research has found good levels of test-rest reliability, ICC = .81 (Schougaard et al., 2018).

2.4.3 | Emotion regulation strategies

At each signal, participants indicated how they had regulated their emotions since the last signal using a scale ranging from 0 (*not at all*) to 6 (*very much*). Each item began with "since the last signal or since awakening…" (German: "Seit dem letzten Signal/ seit dem Aufwachen…"), followed by one item for social sharing, reappraisal, suppression, distraction, and rumination for Data set 1 (Koval et al., 2015) and Data set 2 (Pavani et al., 2017). See Appendix SI, Table S1 for the English and German items.

2.4.4 | Trait self-control

TSC was assessed using the German short version (Bertrams & Dickhäuser, 2009) of the Brief Self-Control Scale (BSCS; Tangney et al., 2004), which includes 13 items rated on a scale from 1 (*not at all*) to 5 (*very much*). Prior research

TABLE 1 Means, standard deviations, range, and reliabilities of the variables in Data set 1 and 2

	Data set 1						Data set 2					
Dependent variables	*M*	*SD*	Min	Max	$\omega_{between/odd}$[a]	ω_{within}	*M*	*SD*	Min	Max	$\omega_{between/odd}$[a]	ω_{within}
Positive affect	52.58	21.79	0	100	.92	.81	52.57	18.42	4.17	100	.86	.80
Negative affect	15.83	17.81	0	100	.92	.68	7.59	13.23	0	100	.92	.72
Social sharing	1.01	1.50	0	6	.76[a]	–	1.39	1.97	0	6	.88[a]	–
Reappraisal	0.91	1.34	0	6	.89[a]	–	0.81	1.38	0	6	.90[a]	–
Suppression	1.20	1.59	0	6	.86[a]	–	0.78	1.29	0	6	.92[a]	–
Distraction	1.30	1.64	0	6	.86[a]	–	1.19	1.59	0	6	.93[a]	–
Rumination	1.77	1.83	0	6	.90[a]	–	0.80	1.37	0	6	.92[a]	–
Trait self-control	3.09	0.60	1.54	4.54	.80	–	3.26	0.58	1.62	4.54	.78	–
State self-control	6.30	1.08	1	7	.82	.67	–	–	–	–	–	–
Positive events	37.03	33.95	0	100	.80[a]	–	32.94	35.54	0	100	.86[a]	–
Negative events	19.75	27.35	0	100	.74[a]	–	10.83	21.95	0	100	.79[a]	–

Note: $\omega_{between}$ = between-person reliability (Geldhof et al., 2014); ω_{within} = within-person reliability (i.e., change from observation to observation).

[a]For single-item scales, we computed correlation between odd and even study days as a measure of between-person reliability.

demonstrated an acceptable test-retest stability of $r = .66$ (Brevers et al., 2017).

2.4.5 | State self-control capacity

In Data set 1, participants also completed three items of the State Self-Control Capacity Scale (SSC; Bertrams et al., 2011). Using a scale ranging from 1 (*not true*) to 7 (*very true*), the SSC captures the current capacity to regulate oneself in a particular moment (e.g., "I feel like my willpower is gone").

2.4.6 | Events

Participants were asked to "Think about the most negative event since the last signal, how intense has it been?" and rate it on a slider ranging from 0 (*no negative event*) to 100 (*very negative event*).

2.4.7 | Statistical approach

To maximize the statistical power and reliability of our analyses, we combined the data from both data sets ($N = 250$) to perform a *mega-analysis* or *integrative data analysis* (Curran & Hussong, 2009), which is recommended when raw data are available (Boedhoe et al., 2019) due to increasing statistical power and sample heterogeneity. To that end, we harmonized the measures to counterbalance scale differences and integrated the two data sets (Bainter & Curran, 2015). Additionally, we controlled statistically for the differences between the data sets by using residual variables in the analyses of the TSC relationships given that (only) these were based on both data sets. More specifically, we computed three-level models (individuals' aggregated observations nested within dyads nested within data sets) predicting the respective variable by the mindfulness training of Data set 1 (0 = controls or participants from Data set 2, 1 = mindfulness training). In the result section, we only report the results utilizing the integrated data set; the results for each single data set are reported in the online supplemental materials (please note that this only pertains to the TSC results given that SSC data were only collected in Data set 1). All analyses were performed in STATA 15 (College Station, TX, USA: StataCorp LP) and were controlled for the mindfulness training[1] and the different data sets. For all analyses, we used structural equation modeling (SEM) with measurement models for TSC, SSC, positive and negative affect, and WHO-5. To ease interpretation of the results, we chose to report the standardized coefficients of the SEM. In the case of within-person analyses, we first within-person standardized the manifest variables to better separate between between- and within-person processes before entering the variables in the SEM. Please note that we chose within-person standardization over centering because it is less biased when between-person differences in within-person standard deviations exist, which was the case in our data (Wang et al., 2019). Due to not recruiting individuals with psychiatric diagnoses that might experience higher levels of negative affect and due to the nature of ER strategies of being only implemented at specific times during individuals' everyday life, most variables in our analyses were right-skewed. To respect these deviations, we used robust variance estimation procedure that utilizes the Huber-White sandwich estimator to estimate robust standard errors (White, 1980).

A posteriori power analysis was performed using the Shiny App (https://yilinandrewang.shinyapps.io/pwrSEM/) by Wang and Rhemtulla (2020). As indicated in Table 2, which shows the a posteriori power for the parameter of interest for each hypothesis for a very small ($\beta = .05$), small ($\beta = .10$), medium ($\beta = .20$), and large effect ($\beta = .30$; guidelines based on Funder & Ozer, 2019), we had sufficient power ($\geq .80$) to detect a medium effect size in the TSC and SSC within-person analysis.

3 | RESULTS

3.1 | The relationship between SC and AWB

As predicted, SC was positively associated with AWB both between- and within-person and across all measures, except for the association between TSC and positive and negative affect (Figure 2a). Given the consistency across the measures, we computed the mean of positive and negative affect (within-person associations) plus WHO-5 (only in the between-person associations) as an aggregated AWB measure to simplify the following analyses (see online supplementary materials for the results for each AWB measure, Table S1 and Figures S1 to S12).

3.2 | The relationship between SC and ER

3.2.1 | Hypothesis 1: Strategy effectiveness

Strategy effectiveness was operationalized as the interaction of SC and ER in predicting change in AWB. Thus, we predicted manifest AWB by the latent two-way interaction between the recently used ER strategy and either latent TSC or latent SSC (online Supporting Informations, Tables S2 to S10 and Figures S13 to S21). To test interactions, we adapted the double-mean-centering strategy (Lin et al., 2010) but standardized instead of centered the variables. Thus, all scale

TABLE 2 Power analysis for parameter estimation in the performed structural equation models

	TSC (between-person)			SSC (between-person)			SSC (within-person)		
Hypothesis (H)	**β = .10**	**β = .20**	**β = .30**	**β = .10**	**β = .20**	**β = .30**	**β = .05**	**β = .10**	**β = .20**
H0: AWB	.29	.79	.98	.16	.55	.89	1	1	1
H1: Strategy effectiveness	.32	.83	.99	.34	.85	1	1	1	1
H2: Strategy selection	.29	.85	1	.18	.50	.85	1	1	1
H3: Situation selection	.24	.76	.98	.16	.54	.86	.99	1	1
H4: Within-strategy variability	.27	.75	.97	.20	.56	.84	–	–	–
H4: Between-strategy variability	.33	.81	.99	.19	.54	.89	.99	1	1
H5: Interpersonal ER	.34	.82	.98	.19	.49	.83	1	1	1
Mean power for H0 to H5	.30	.80	.98	.20	.58	.88	1	1	1
Mediation	β = .01	β = .04	β = .09	β = .01	β = .04	β = .09	β = .01	β = .04	β = .09
Mediation (predicted)	.02	.51	.97	.01	.20	.79	1	1	1
Mediation (reverse)	.01	.45	.96	.01	.11	.55	1	1	1

Note: Power was estimated for the target effect size β using the Shiny App (https://yilinandrewang.shinyapps.io/pwrSEM/) by Wang and Rhemtulla (2020).
Abbreviations: AWB, affective well-being; ER, emotion regulation; SSC, state self-control; TSC, trait self-control.

items were first within-person standardized and the product of each within-person standardized measure comprising the interaction term were within-person standardized again after calculating the interaction.

As shown in Figure 2b, all 95% CIs included zero, except for social sharing on the within-person level, indicating that neither TSC nor SSC significantly and robustly moderated the effectiveness of any of the five ERS on AWB.

3.2.2 | Hypothesis 2: Strategy selection

To examine strategy selection, we computed the difference score between adaptive and maladaptive ER strategies, with higher scores indicating that participants favored adaptive over maladaptive ER strategies. For the between-person analyses, the aggregated difference score between the mean of adaptive (reappraisal, distraction) and maladaptive ER strategies (suppression, rumination) was predicted by either the latent TSC or SSC variable (online Supporting Informations, Table S11 and Figures S22 to S26). The results revealed that only the association with SSC reached significance, β = .31, *SE* = .10, 95% CI [.12, .50], but not with TSC, β = .01, *SE* = .07, 95% CI [−.12, .14]. For the within-person analyses, we used the nonaggregated data to predict the difference score by prior SSC levels, including the random participant intercepts and a random slope for prior SSC. This model yielded a significant effect of prior SSC, β = .04, *SE* = .01, 95% CI [.02, .07], such that participants with higher SSC than usual favored significantly more adaptive than maladaptive ER strategies subsequently.

3.2.3 | Hypothesis 3: Situation selection

We did not have specific items that assessed how individuals selected and modified elements of their surroundings. Instead, we approached situation selection indirectly by examining whether individuals live in surroundings that require less effortful ER, reflected in less ER employment and less exposure to negative events. For the former, we predicted the mean of each ER strategy or a latent ER strategy variable on which the five ER strategies loaded onto by either latent TSC or SSC (online Supporting Informations, Table S12 and Figures S27 to S56). Only SSC but not TSC on both between- and within-person levels was consistently significantly negatively associated with ER strategy endorsement, yielding medium to large effect size for the between-person and small effect sizes for the within-person analyses (Figure 2c). Thus, participants high compared to low in SSC but not in TSC demonstrated reduced ER efforts.

To test whether this association was due to experiencing less adverse events, we added a path from SSC to negative events and a path from negative events to the ER strategy latent variable in the structural model. This model revealed that negative events were significantly negatively associated with SSC on the between-person level, β = −.61, *SE* = .08, 95% CI [−.76, −.45], and mean ER strategy endorsement, β = .38, *SE* = .10, 95% CI [.19, .58]. Since both paths were significant, we bootstrapped the indirect effect with $n = 1{,}000$ repetitions, which indicated that 33% of the total effect of β = −.57, *SE* = .09, bias-corrected and accelerated 95% CI_{bca} [−.73, −.37], was mediated by negative events, β = −.23, *SE* = .07, 95% CI_{bca} [−.40, −.10]. However, the direct effect was still significant and medium in size, β = −.34, *SE* = .13,

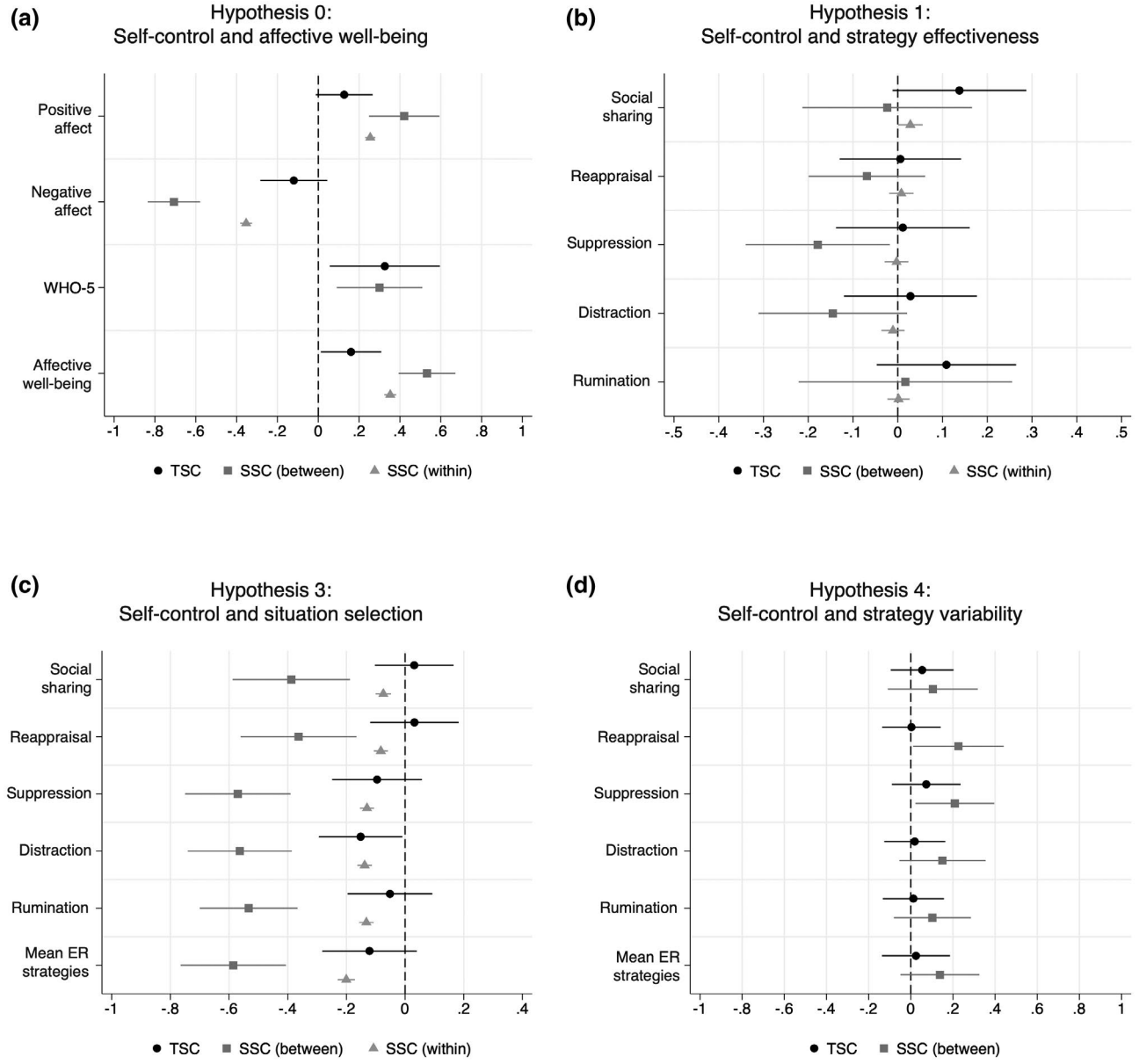

FIGURE 2 Coefficient plots show the regression coefficients (the dots) and their 95% CI (the whiskers) for the association between self-control (SC) and either (a) affective well-being, (b) strategy effectiveness, (c) situation selection captured via mean strategy endorsement, or (d) strategy variability

95% CI_{bca} [−.58, −.07], hinting at other possible mediators. The same pattern was reversed on the within-person level, with an indirect effect of β = −.04, *SE* = .004, 95% CI [−.04, −.03] that mediated 18.1% of the total effect, with a significant direct effect of β = −.20, *SE* = .015, 95% CI [−.23, −.17].

3.2.4 | Hypothesis 4: Strategy variability

To test for between-person differences in within-strategy variability, we repeated the analyses for Hypothesis 2 but included the relative standard deviation (*RSD*) instead of the mean of each ER strategy (online Supporting Informations, Table S13 and Figures S57 to S80). We chose the *RSD* over the *SD* since recent research has demonstrated that the *RSD* is less confounded with mean than the *SD* (Mestdagh et al., 2018), making it easier to determine that the results are actually driven by the variability and not by the confound with the mean. As illustrated in Figure 2d, TSC was not significantly associated with variability within a particular strategy; instead, SSC was consistently positively associated with within-strategy variability, ranging from β = .10 to .23, of which only the effect sizes for suppression reached significance. Using a latent variable covering the *RSD* for each strategy revealed only small and nonsignificant associations with both TSC and SSC. Thus, although consistent across the ER strategies for SSC, the data do not provide strong

evidence for increased within-strategy variability in individuals high in SSC or TSC.

We also examined the variability between ER strategies, which yielded a very small and nonsignificant association of β = .07, *SE* = .07, 95% CI [−.07, .21] for TSC. SSC, on the contrary, was significantly associated with between-strategy variability on the between-person level, β = .32, *SE* = .10, 95% CI [.13, .52], indicating that individuals high compared to low in SSC demonstrated a larger variance in general with which they selected ER strategies in a given situation. However, this association was not present on the within-person level, β = .01, *SE* = .01, 95% CI [−.01, .03].

3.2.5 | Hypothesis 5: Interpersonal ER

To examine how interpersonal ER differed from intrapersonal ER, we predicted the difference score between social sharing and the mean of the intrapersonal ER strategies by either latent TSC or SSC (online Supporting Informations, Table S14 and Figures S81 to S85). The between-person analyses revealed that both TSC, β = .12, *SE* = .06, 95% CI [<.01, .24] and SSC, β = .26, *SE* = .08, 95% CI [.10, .42], were positively associated with favoring interpersonal ER. For the within-person analyses, prior SSC levels significantly predicted subsequent interpersonal ER preference, β = .04, *SE* = .01, 95% CI [.02, .07]. Additionally, we examined to what extent SC was associated with the likelihood to dominantly utilize social sharing in a given moment. Using structural equation modeling, we predicted dominant interpersonal ER use (1 = social sharing most endorsed, 0 = social sharing not most endorsed; either z-standardized or within-person standardized) by the latent TSC or latent SSC with either z-standardized or within-person standardized indicators. This analytic approach confirmed the results for the difference score, with TSC being positively but not significantly associated with dominant interpersonal ER use, β = .09, *SE* = .07, 95% CI [−.03, .22]. SSC, on the contrary, was significantly associated both on the between-person level, β = .44, *SE* = .08, 95% CI [.29, .59], and on the within-person level, β = .08, *SE* = .01, 95% CI [.05, .10]. Taken together, we found only support for Hypothesis 5 for SSC.

3.3 | Mediation analyses

Taken together, we did not find any support for our hypotheses for TSC. Thus, none of the facets of ER investigated in the present paper is a promising mediator of the significant association between TSC and AWB of β = .25. Following recent recommendations to first establish the significance of all component paths before examining the magnitude of an indirect effect to minimize type-I errors (Yzerbyt et al., 2018), we did not bootstrap the indirect effects for TSC. However, SSC was significantly associated with favoring adaptive and interpersonal ER strategies, with less ER endorsement in general and with less intense negative events as well as with more variability between ER strategies. Thus, these five ER pathways were used as mediator candidates by examining their relation to AWB in Data set 2 and, if significant, bootstrapping the indirect effects with *n* = 1,000 repetitions to estimate their magnitudes.

3.3.1 | The relationship between ER and AWB

Figure 3a shows the results of the path models predicting AWB by each ER separately (path b in a mediation model), both on the between- and within-person level (full results: Table S15 and Figures S86 to S88). All associations between ER and AWB were significant, and, with the exception of within-person between-strategy variability, small to medium in size. Thus, we can conclude that favoring adaptive and interpersonal ER, endorsing less ER, experiencing less intense negative events, or reporting higher variability between strategies was positively associated with AWB within and between individuals. Consequently, we computed the mediation models for all five ER facets to explain the SSC-AWB link. As shown in Table 2, we had sufficient power to detect a large indirect effect as modeled by the product of two large effect sizes (.30*.30 = .09), except for the reverse mediation models.

ER as the mediator (hypothesized mediation model)

Again, we used the aggregated data to examine between-person associations and the nonaggregated data to examine within-person associations, with a bootstrap with *n* = 1,000 repetitions to obtain the standard errors for the indirect effects (path a x path b). The results for all ten mediation models are illustrated in Figure 3b (full results: Table S16 and Figures S89 to S90). Regarding the between-person analyses, only interpersonal ER significantly mediated the association between SSC and AWB, with an indirect effect of β = .06 and approximately 10% of the total effect mediated. Regarding, the within-person analyses, all indirect effects were significant, except for between-strategy variability. Mean ER endorsement and negative events were the two strongest mediators of the within-person association between SSC and AWB, with 13.3% (mean ER endorsement) and 20.7% (negative events) of the total effect mediated. Thus, individuals who reported higher levels of SSC in one moment reported higher levels of AWB 1 to 2 hr later partly due to experiencing less ER demand. The proportion to the total effect of the other indirect effect was negligible small with 0.1% to 2.0%.

SC as the mediator (reverse mediation model)

Taken together, the results are rather sobering given the small percentages of the total effect that is mediated by the five ER

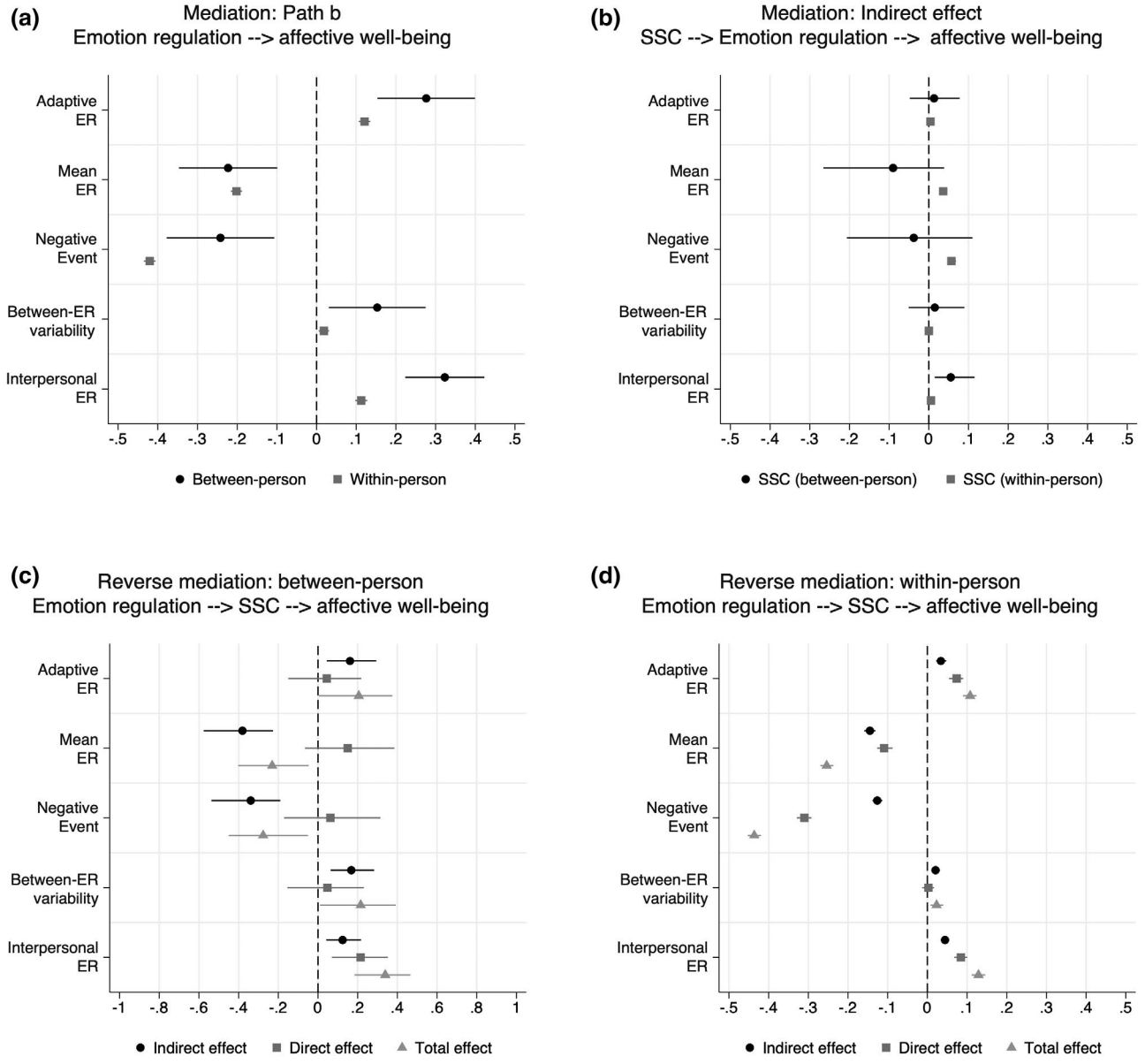

FIGURE 3 Coefficient plots show the regression coefficients (the dots) and their 95% CI (the whiskers) for (a) the association between emotion regulation facets and affective well-being (AWB), (b) the indirect effects of state self-control on affective well-being via emotion regulation facets, or the indirect of emotion regulation facets on affective well-being via state self-control on the (c) between- and (d) within-person level

facets. One possible reason for the small effects could be that the assumed causal order of the variables in the mediation model does not reflect the true causal order. Thus, instead of ER being a mediator of the association between SSC and AWB (Figure 2a), it is conceivable that SSC mediates the relationship between ER and AWB (Figure 3a). We, thus, repeated the analyses with ER facet as the predictor and SSC as the mediator. The results in Figure 3c (full results: Table S17 and Figures S91 to S92) demonstrate small-to-medium sized indirect effect sizes ranging from an absolute value of $\beta = .12$ to .38 on the between-person level, with 36.6% (interpersonal ER) up to 78.5% (adaptive ER) of the total effect were mediated by the between-person ER facets. The within-person mediation (Figure 3d) also showed larger effects with SSC as the mediator than when ER facets were used as a mediator, with the absolute value of β ranging within .02 to .14 and the percentage of total effect mediated ranging from 29.0% (negative events) to 88.6% (between-strategy variability).

4 | DISCUSSION

Despite a continuing theoretical discourse on the role of self-control in emotion regulation and well-being (Cheung et al., 2014; Hofmann et al., 2014; Paschke et al., 2016), there has yet to be a comprehensive study conducted in

daily life examining the many possible ways in which SC is associated with ER. Investigating these processes in the everyday life of individuals is crucial given the changing environments from timepoint to timepoint that may influence the complex ER processes. In the present paper, we hypothesized that SC was associated with improved ER and derived five possible pathways from the literature. We found that both TSC and SSC were positively associated with AWB measures (Hypothesis 0), replicating prior evidence for this relationship (Cheung et al., 2014) and highlighting the importance of SC for AWB in daily life. However, these results could not be explained by any of the five ER pathways such as increased strategy effectiveness. Although SSC was significantly associated with many of these ER facets, its explanatory power in explaining SSC-AWB link was fairly limited. Instead, we found that SSC was better characterized as a mediator of the ER-AWB link, such that endorsing ER was effortful and leads to lower levels of momentary SC, impacting how people feel in daily life. Thus, our results highlight the importance of cognitive resources as the common denominator of facets of ER that are seen to be beneficial for individuals such as adaptive ER strategies (Webb et al., 2012), employing strategies situated in the early stages of the process model of emotion regulation (Gross, 1998), or sharing the burden of regulation with others (Reeck et al., 2016) in that these facets are less mentally taxing, freeing up resources that could be used for boosting one's own AWB.

4.1 | Theoretical discussion of the results

Regarding Hypothesis 1, we could not extend the evidence of increased strategy effectiveness due to increased cognitive control obtained from laboratory research to daily life, such that participants high in SC did not report more success when using an ER strategy. Thus, SC and ER are not tautological in daily life, such that believing to be good at overriding predominant response tendencies does not predict the actual override predominant emotional response tendencies in daily life. These results add to the literature that shows that TSC is not associated with better resistance itself (Hofmann, et al., 2012), such that individuals high in SC are not better at endorsing effortful SC or ER strategies. Instead, our data support the notion that individuals high in SC may be better adapted to their surroundings: Whereas TSC was not significantly associated with selecting more adaptive ER strategies (Hypothesis 2) or less strategies in general (Hypothesis 3), SSC was, both on the between- and within-person level. Moreover, the association between mean ER endorsement and AWB was partially mediated by negative events, such that individuals high in SC regulated their emotion less intensely due to perceiving less intense negative events. These results demonstrate the importance of capturing SC and ER directly in daily life instead of relying on trait measures when examining how individuals regulate their emotions.

Finally, we found strong evidence that SSC was associated with engaging in more interpersonal ER, both between-person and within-person. Thus, participants high compared to low in SSC not only share their thoughts and feelings more intensely with others, but they also do it when they indicate beforehand to have a higher capacity for SC. Preferring inter- over intrapersonal ER was, furthermore, associated with increased AWB, which may be due to relishing the sense of affiliation (Rimé, 2009) or due to a better recruitment of social support (Gable et al., 2004). This demonstrates the importance of interpersonal aspects for AWB, which has been somewhat neglected in research on SC and ER. Thus, future research may turn to the social support literature to not only focus on the self, but also include the context the self utilizes to regulate their thoughts, emotions, and behaviors. For example, research found that social support is highly associated with greater life satisfaction (Helliwell et al., 2010) as well as less NA (Diener et al., 2000) and better health (Wu et al., 2003).

However, the explanatory power of the ER pathways was very limited, with no significant paths between TSC and ER, although TSC and AWB were moderately associated. Regarding SSC, the mediation analyses demonstrated small indirect effect sizes with a mean percentage of the total effect mediated of only 10% on the individual and 7% on the within-person level. Thus, our results do not strongly suggest that differences in ER are well suited to explain the shared variance between SC and AWB in daily life. Instead, we found much stronger evidence for the notion that ER is capacity-based and that the exerted effort impacts AWB: When using momentary self-control capacity (SSC) as the mediator, it could explain on average 52% of the association between ER pathways and AWB on the between-person level and 27% on the within-person level. In other words, favoring adaptive or interpersonal ER strategies cannot sufficiently explain why individuals high in SC report increased AWB. Instead, selecting them is beneficial for AWB because they tax less cognitive resources by reducing the continual self-monitoring and modulation of emotional response tendencies (Bonanno et al., 2004). Consequently, the results provide strong evidence for the affective benefits of decreasing ER demands by better structuring one's environment to elicit less adverse situations and to provide options for social support. However, they only provide weak evidence for the notion that SC is associated to AWB due to better ER such as less effortful ER.

As Table 2 shows, we had sufficient power to detect medium effect sizes in Hypotheses 1 to 5. Thus, we do not think that the null findings for TSC can be easily attributed to statistical power issues but instead are more likely due to the generally very small effect sizes in the TSC analyses, which renders them irrelevant in practice.

Finally, following recent recommendations to test for the equivalence of processes at the between- and within-person level (Fisher et al., 2018), our results provide clear evidence for ergodicity regarding the relationship between SSC, ER, and AWB, that is, they generalize from the between-person level (differences between people) to the within-person level (differences within people).

4.2 | The suitability of the brief self-control scale in explaining ER differences

One reason for these anticlimactic results might be the choice of SC measures. Although we selected the most popular self-report questionnaire of TSC—the BSCS (Tangney et al., 2004), which had been cited, as of May 22, 2019, 1,784 times (Web of Science, 2019)—there are a number of issues associated with this scale, and with questionnaires assessing TSC in general, that may explain our mostly nonsignificant results. First, TSC is not consistently associated with behavioral task measures of SC (e.g., Stroop task), as evidenced by a meta-analysis that found only a small correlation of $r = .15$ (Duckworth & Kern, 2011). Moreover, it has been argued that trait questionnaires only assess individuals' perceptions of how well they can control themselves, but not this ability itself (Grund & Carstens, 2019); these authors demonstrate that individuals with higher levels of self-perceived SC do not actually report more acts of SC. Our assessment of emotions and their regulation was more focused on actual experiences; in contrast, the assessment of TSC via the BSCS draws more on beliefs about one's self (Conner & Barrett, 2012). We recommend that future research tries to capture SC on the level of the experiencing self (i.e., assessing or counting actual instances of SC). This methodological change may then increase the variance in the emotion regulation measures that can be explained by those SC measures.

Second, it is also important to note that the BSCS is a measure of SC and, thus, focuses on inhibition and on the resolution of SC dilemmas. This instrument does not assess other important activities, such as the setting, pursuing, shielding of, and switching between goals, all of which some researchers associate with the broader term of *self-regulation* (Milyavskaya et al., 2019). A trait (and state) measure of self-regulation incorporating aspects such as people's knowledge, goals, beliefs, values, and environmental affordances may be better suited to testing our hypotheses.

4.3 | Limitations and suggestions for future research

The present research project is not without its fair share of limitations. Due to the nature of the mega-analysis, we combined multiple data sets that differ in methodical aspects such as different wordings regarding the ER strategies (online Supporting Informations, Table S0), number of days and ambulatory assessments per day, as well as the inclusion of a mindfulness training (Data set 1) and romantic dyads only (Data set 2). However, given that the results were mostly consistent across the two samples, we view the methodical differences as an advantage of the mega-analysis demonstrating robustness rather than a disadvantage.

Due to the commonly difficult trade-off between space constraints and reliability in ambulatory assessment studies (Brans et al., 2013; Koval et al., 2015), the ER strategies were assessed with only one item, which limits their reliabilities. Although ER strategies are comparatively narrow concepts that are possibly well captured using single items, future research to improve the trade-off. (Bergkvist & Rossiter, 2018).

Moreover, we did not make different predictions regarding the relationship between TSC and specific ER strategies. For example, one could image that SC relates differently to suppression—a very effortful, high-control ER strategy—as compared to rumination—which has been characterized by lack of control (Papageorgiou & Wells, 2003), despite both being designated maladaptive strategies. Given that this might explain the lack of associations with strategy selection, future research might tap into more specific relationships between SC and ER strategies.

Importantly, our selection of emotion regulation strategies was more strongly geared toward strategies that aimed at downregulating negative affect such as suppression and reappraisal, except for social sharing. However, prior research has shown that individuals use different strategies for upregulating positive affect, with savoring, broadening, capitalizing, and reminiscing being among the strategies that individuals use most often to increase their positive affect (Heiy & Cheavens, 2014). Thus, we cannot test how strategies more specific to the upregulation of positive affect relate to the association between SC and AWB.

Furthermore, our measure social sharing captured only one facet of the complex dynamics of interpersonal ER (Reeck et al., 2016) since there was not necessarily a goal to regulate emotions inherent in it. Moreover, it is important to note that the generalizability of our findings to the general population is limited given that mostly female undergraduate students within 18 and 30 years were recruited in Data set 1. Data set 2 included more individuals who identified themselves as males and less highly educated individuals, but its sample is still not representative of the general population. Therefore, it is important to note that the generalizability of our findings to the general population is limited.

Finally, only the main research questions of the parent studies but none of the hypotheses of the present research project were preregistered given that they were not the

focus of the parent studies. However, to increase transparency with regard to researcher's degrees of freedom, we made the data and analyses available under OSF (https://osf.io/4fnwh/?view_only=2cc3cc8fb9804b828b3692d5de025c00).

4.4 | Conclusion

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CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

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ENDNOTE

[1] The mindfulness training did not affect the well-being measures nor the ER strategy employment (full results in Table S18–20 in the online supplement).

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