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Just Do It: Engaging in Self-Control on a Daily Basis Improves the Capacity for Self-Control

Denise de Ridder, Anouk van der Weiden, Marleen Gillebaart, Jeroen Benjamins, and Jan Fekke Ybema
Utrecht University

Self-control is considered a crucial capacity that helps people to achieve important objectives in the face of temptation. However, it is unknown to what extent self-control is a stable disposition that is unaffected by how often people engage in self-control, or more like a skill that develops and grows over time. In the present study, we employed an electronic diary to examine how regular engagement in self-control practice affects self-control capacity. A diverse community sample was followed for 4 months while they engaged in daily practice of a self-chosen self-control behavior. Consistent with our hypothesis, regular practice led to an improvement of medium effect size in self-control capacity. Critically, the level of improvement was dependent on the actual times of practice during a specific interval, and largely independent from beliefs about self-control or self-efficacy. We conclude that "just doing" self-control is the underlying mechanism of increased capacity for self-control.

Keywords: self-control, electronic diary, community sample

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Self-control, defined as the capacity to control thoughts, behaviors, and feelings, has been shown to be important for success in many areas of life (De Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Tangney, Baumeister, & Boone, 2004). A large body of evidence exists, exhibiting that high self-control is associated with numerous positive outcomes, including better academic performance (Duckworth & Seligman, 2005), maintaining satisfying relationships (Tangney et al., 2004), good physical health (Moffitt et al., 2011), and happiness (Hofmann, Luhmann, Fisher, Vohs, & Baumeister, 2014). In view of these widely documented beneficial effects of self-control, it is important to consider the question whether self-control is a stable disposition that is unaffected by how often people engage in self-control or more like a skill that develops and grows over time.

Only a handful of studies have addressed this issue and all of them relate to the development of self-control capacity in early childhood (e.g., Tao, Wang, Fan, & Gao, 2014) or adolescence (e.g., Steinberg et al., 2008). Studies that examine how self-control may gradually develop during adulthood are lacking. It is typically assumed that self-control capacity remains stable after initial maturation to the extent that early childhood levels of self-control are used as a predictor of outcomes over the course of decades without considering the evolution of self-control in the years in between (Mischel, Shoda, & Rodriguez, 1989; Moffitt et al., 2011). This assumption, however, has hitherto not been the subject of empirical research. As a result, there is a limited understanding of whether it matters that people more or less frequently engage in tasks that demand self-control once they have grown up. In the present study, we will address the critical question in what way regular practice of self-control affects the capacity for self-control in a large and representative community sample of adults.

Theoretically speaking, there are three ways of how self-control practice may impact the capacity for self-control. First, regular engagement in self-control may have no noticeable effects on self-control capacity, corresponding with the notion that self-control is a stable disposition that remains unaffected by how often it is practiced. This possibility is in accordance with the general understanding of personal dispositions that leave little room for within-person variability over time and over situations (Fleeson, 2004), even though it has been argued that personality traits retain the possibility of change into old age (Caspi & Roberts, 2001). A second possibility is that more frequent usage of self-control

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Denise de Ridder, Anouk van der Weiden, and Marleen Gillebaart, Department of Social Health and Organizational Psychology, Utrecht University; Jeroen Benjamins, Departments of Social Health and Organizational Psychology and Experimental Psychology, Utrecht University; Jan Fekke Ybema, Department of Social Health and Organizational Psychology, Utrecht University.

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The experiment reported in this article was not formally preregistered. Neither the data nor the materials have been made available on a permanent third-party archive; requests for the data or materials can be sent via e-mail to the lead author at d.t.d.deridder@uu.nl

Correspondence concerning this article should be addressed to Denise de Ridder, Department of Social Health and Organizational Psychology, Utrecht University, P.O. Box 80140, 3508 TC Utrecht, the Netherlands. E-mail: d.t.d.deridder@uu.nl

impairs the capacity for self-control, which is consistent with theorizing about self-control as a limited resource that depletes with repeated engagement in self-control efforts (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Wilkowski, Ferguson, Williamson, & Lappi, 2018). This line of research also suggests that self-control can be improved through repeated practice of tasks that require self-control, just as a muscle grows stronger with exercise (Muraven, Baumeister, & Tice, 1999). A third possibility implicates that the capacity for self-control does not wear out with frequent usage but, in contrast, improves after repeated exertion, akin to a skill. This latter possibility resonates well with the literature on cognitive plasticity, suggesting that the adult mind has a natural capacity for change beyond restorative adjustment in response to incidents (Lövdén, Bäckman, Lindenberger, Schaefer, & Schmiedek, 2010). Several mechanisms may be involved in the gradual growth of self-control, such as self-control becoming more routinized (Gillebaart & De Ridder, 2015), greater self-efficacy after repeated self-control performance (Berkman, 2018), or prior acts of self-control leading to enhanced self-control effort (Savani & Job, 2017).

In agreement with recent theorizing on the underlying mechanisms of successful self-control (De Ridder & Gillebaart, 2017), we hypothesize that regular exercise of self-control will lead to an improvement of self-control capacity rather than impairment or stability. These novel insights posit that capacity for self-control is associated with the ability to apply smart self-control strategies that lend themselves for amelioration over time, such as decreased experience of temptations that may challenge self-control (Hofmann, Baumeister, Förster, & Vohs, 2012), earlier detection of self-control dilemmas (Gillebaart, Schneider, & De Ridder, 2016), employment of proactive (rather than reactive) strategies (Ent, Baumeister, & Tice, 2015), or having a broader repertoire for resolving dilemmas (Duckworth, Gendler, & Gross, 2016), including routines to avoid temptation (De Ridder et al., 2012; Galla & Duckworth, 2015). Based on the new understanding that self-control is associated with employing strategies rather than a fixed disposition, we hypothesize that the regular practice of self-control will contribute to an increased capacity for self-control.

The Present Study

The capacity for self-control is typically assessed with the Self-Control Scale (Tangney et al., 2004), which requires people to report on how good they are at achieving their long-term goals and not doing things that are bad for them in the long run. Assessing one's own capacity for self-control has some obvious disadvantages, such as being vulnerable to inflated views or demand characteristics. Indeed, the Self-Control Scale generates subjective judgments of how successful people consider themselves in exerting self-control rather than their actual capacity and thus suffers from flaws that are inherent in self-report. Notwithstanding these flaws, we argue that the self-reported capacity for self-control is a good reflection of how people view themselves when actually practicing self-control, which is the central theme of the current study. In addition to assessing whether people actually engage in self-control as a means to understand their capacity for self-control, we also examine to what extent improvement of self-control capacity is associated with beliefs about self-control—that is, the belief that self-control is nonlimited versus limited (Job, Dweck, & Walton, 2010). Previous research has demonstrated that lay theories about willpower as either nonlimited or limited may affect performance on an ego depletion task (Job et al., 2010). Here, we examine to what extent such lay theories influence one's own assessment of self-control capacity. Theoretically, people can still improve on their capacity when they believe that self-control is limited, but so far empirical evidence on this topic is lacking. We also examine whether beliefs about self-control may change in response to repeated exertion of self-control because the experience of doing well at self-control may alter these beliefs. In a similar vein, it is important to consider greater self-efficacy that may accompany self-control practice (Berkman, 2018). Although self-efficacy is often regarded a precursor of better (self-control) performance to the extent that self-efficacy promotes engaging in self-control behavior, greater self-efficacy may also result from regular practice of a specific behavior (Bandura, 1997). When people experience getting better at self-control after repeated engagement in self-control, they may become more efficacious in doing so. In the present study we will therefore investigate whether practicing self-control for a prolonged period of time (about 4 months) improves the capacity for self-control while accounting for the role of self-control beliefs and self-efficacy.

We do so in a community sample who were instructed to report on their attempts for goal progress in a self-chosen domain on a daily basis and whether or not they had engaged in actual practice. By doing so, we provided them with more personally meaningful tasks than the relatively trivial exercises that are employed in most self-control lab studies (e.g., squeezing a hand grip). Thus far, the majority of self-control research has employed student samples. However, if self-control findings are eventually being made available to the general public, it is mandatory to account for diversity in terms of social status. Our study therefore also includes a significant number of participants with poor socioeconomic backgrounds.

To study the development of self-control over time, we employ an electronic app diary that allows for examining people's activities, thoughts, and feelings nightly—thus minimizing recall bias. Every day, participants were asked to report whether they had practiced self-control and every 2 weeks they reported on their self-control capacity (as well as a number of other measures). Previous experience sampling studies on self-control have focused on unraveling the complex relationships between temptation, response inhibition, and goal progress (Hofmann et al., 2012; Milyavskaya & Inzlicht, 2017), but none so far have examined changes in self-control capacity over time as a result of practice. To our knowledge, this study is the first that has used electronic diary methodology to map the course of self-control in everyday life over a period of several months in a community sample. In doing so, we aim to improve the theoretical insight into the nature of self-control capacity and to what extent it may naturally improve.

Method

The study protocol was approved by the ethical review board of the Faculty of Social and Behavioral Sciences at Utrecht University.

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Participants and Design

A community sample was recruited via the population register of a large city in the Netherlands and additional recruiting via social media and the alumni register of Utrecht University. All people between the ages of 18 and 65 who indicated that they were interested in practicing a specific desired behavior in a self-selected domain and who possessed a smartphone were eligible (participants who didn't own a smartphone were provided with one, $N = 5$). The within-subjects design (with participants repeatedly reporting on their capacity for self-control over time with a large number of assessments) entailed a baseline assessment at the university campus, as well as multiple assessments every day or every (other) week using a mobile application during a period of 110 days at maximum (range: 10–110 days, $M = 75.8$ days, $SD = 27.7$). In total, 171 people participated in the baseline assessment, of whom 147 were included in the analyses when they completed at least one follow-up assessment of self-control. This sample size allows for the detection of medium size effect in our main dependent variable capacity for self-control. The number of follow-up assessments of self-control ranged from one to nine ($M = 5.2$, $SD = 2.1$); the number of app registrations of behavioral practice ranged from seven to 110 ($M = 50.9$, $SD = 25.4$). In line with the descriptive aim of a prospective electronic diary study, the intensive design (which, in our case, also lasted for an exceptionally long time as most diary studies follow participants for 1 or 2 weeks only) did not entail a control condition (see Dohle & Hofmann, 2018; Hofmann et al., 2012; Milyavskaya & Inzlicht, 2017; Prinsen, Evers, Wijngaards, van Vliet, & De Ridder, 2018 for similar descriptive designs). However, repeated measures with lagged variables allowed for within person control over time.

Procedure and Practice Paradigm

The study required participants to report on practicing a behavior they considered personally important but did not manage to perform on a regular basis. They were provided with a choice of behaviors relating to either health, interpersonal, financial, or environmental issues. Participants then indicated which behavior they wanted to practice and in which particular context, according to 60 preset combinations of behaviors and contexts (e.g., eating fruit when having breakfast, being patient when talking to a friend, saving money when in the supermarket, or recycling when tidying up; see the online supplemental materials for a full overview). Participants could choose from about three to seven contexts (depending on the type of behavior) for behavioral practice. It was emphasized that they should choose a context that allowed them to practice on a daily basis (e.g., when they chose exercise, it was explained that a 10-min walk was more feasible than an hour at the gym).

Measurements

This research was part of a large prospective study on the role of self-control in habit formation, and as such, multiple measures were included that are not reported here (see the online supplemental materials for an overview). At baseline, capacity for self-control was assessed with the 13-item (e.g., "I am good at resisting temptation") version of the Self-Control Scale (on a 1 to 5 scale with 1 = *not at all* and 5 = *very much*; Tangney et al., 2004). Also the personal importance of the behavior that was chosen for practice, and motivation for practicing (assessed on a 1 to 5 scale with 1 = *not at all important/motivated* and 5 = *very important/motivated)* were registered at baseline. A maximum of nine follow-up measures of capacity for self-control were administered every 2 weeks by filling out the questionnaire in the smartphone app. Participants also registered the actual practice of the chosen behavior by indicating whether or not they had engaged in the behavior on that specific day. Every other week, they filled out questionnaires on self-control beliefs and self-efficacy for practicing the behavior (alternating both measures). Self-control beliefs were assessed with the Implicit Theories about Willpower Scale (12 items; e.g., "After a strenuous mental activity you feel energized for further challenging activities"—on a 6-point scale with 1 = *strongly agree* and 6 = *strongly disagree*; Job et al., 2010), with higher scores reflecting beliefs that self-control is limited. Self-efficacy was assessed by the General Self-Efficacy Scale (10 items; e.g., "When I have something unpleasant to do, I stick to it until I finish it"—on a 4-point scale with 1 = *strongly disagree* and 4 = *strongly agree*; Sherer et al., 1982) with higher scores indicating greater self-efficacy. For exploratory reasons, we also included an ego depletion task at final follow up (after ~4 months) because previous research on repeated self-control effort has primarily focused on performance at an ego depletion task as an outcome, showing inconsistent results (Beames, Schofield, & Denson, 2018; Friese, Frankenbach, Job, & Loschelder, 2017; Inzlicht & Berkman, 2015). However, we did not find an effect of repeated self-control exertion on ego depletion and will not report on this further (details are provided in the online supplemental materials).

Figure 1 shows a comprehensive overview of all measures that are reported in the present study.

Analytic Strategy

We first examined the growth curve for self-control capacity to determine the level of improvement over time, as well as the growth curve of the daily practice of behavior. We also examined growth curves for self-control beliefs and self-efficacy to discern whether engaging in self-control practice affected either of these variables. Next, we tested our main hypothesis that more practice of the chosen behavior would increase the capacity for self-control. Because of the data structure with repeated assessments (every day for behavioral practice and every other week for self-control) nested within participants, a hierarchical multilevel regression analysis was conducted with capacity for self-control as the dependent variable (Hox, 2010). Four subsequent models were tested. In Model 1, the random intercept was included to determine the intraclass correlation (ICC) of self-control as an indicator of the variance at person level. A high ICC means that most of the variance in self-control capacity is between persons rather than within persons. This may limit the likelihood of finding changes over time and the influence of within-person predictors. In Model 2, lagged self-control (i.e., capacity for self-control at the previous measurement) was entered to analyze the change over time in capacity for self-control. In Model 3, daily practice of the chosen behavior (measured by the proportion of app-measurements in which the chosen behavior was performed during the interval between the previous and the current self-control assessment) was

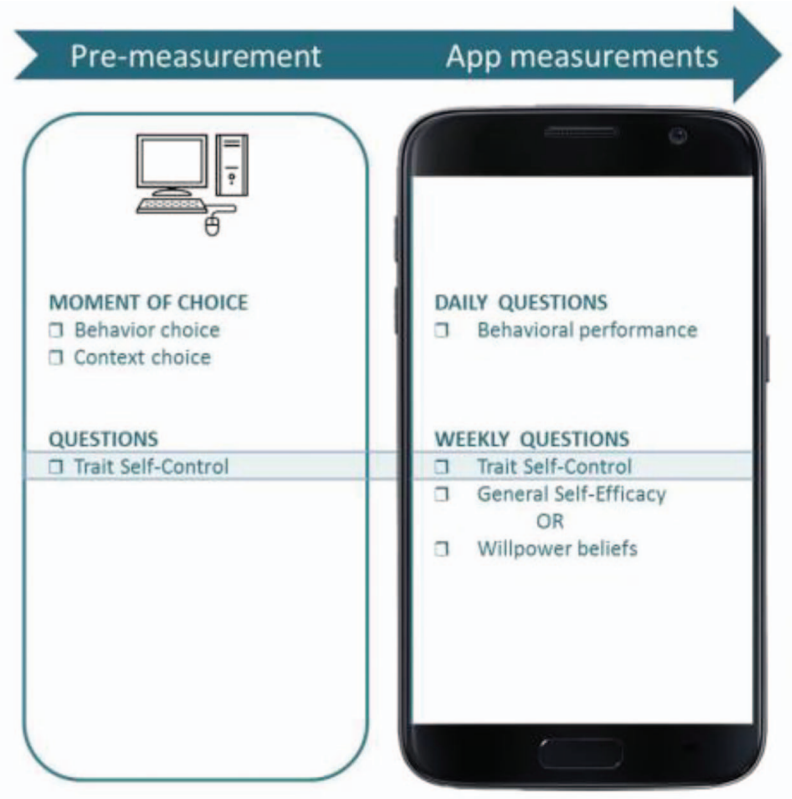

Figure 1. Overview of measures at baseline and in the smartphone application. See the online article for the color version of this figure.

entered, as well as a number of control variables such as, for example, the length of the interval between consecutive self-control assessments. Finally, in Model 4, self-efficacy and self-control beliefs (averaged over time) were entered to examine whether change in self-control capacity was dependent on these constructs (see the online supplemental materials for a full account of this analysis and the following multilevel analyses). We also tested whether self-efficacy and self-control beliefs moderated the relationship between self-control practice (i.e., performing the chosen behavior) and capacity for self-control by entering the cross-level interactions between these variables. Full details of this analysis are provided in the online supplemental materials (Table 1, Model 5), showing that self-efficacy did not interact with practicing the chosen behavior but self-control beliefs did: when self-control was considered limited, practicing the self-control behavior of choice was related to increased self-control capacity.

Following this main analysis, we examined to what extent participants' capacity for self-control as assessed at a previous measurement (lagged self-control) predicted behavioral practice to examine potential reversed effects of capacity for self-control on practicing the behavior as required. We conducted a hierarchical logistic multilevel regression analysis with (either or not) practice of the chosen behavior as the dependent variable. In Model 1 the random intercept was tested to examine the ICC of behavioral practice. In Model 2, a number of control variables were entered. In Model 3, (lagged) capacity for self-control assessed at a previous moment was entered as the main predictor.

Finally, we examined the effects of (lagged) capacity for self-control and behavioral practice on the belief that self-control is (not) limited and self-efficacy to address potential additional benefits of increased capacity for self-control. We did so by performing two hierarchical multilevel regression analyses with self-control beliefs and self-efficacy as the respective outcomes. In Model 1, the random intercept was tested to examine the ICC of self-control beliefs and self-efficacy, respectively. In Model 2, lagged self-control beliefs (or lagged self-efficacy) was entered in the regression in order to examine changes in these variables. In Model 3, capacity for self-control at the previous assessment (lagged self-control) and daily practice of the chosen behavior were entered as the main predictors together with a number of control variables.

Results

Descriptives

A total of 147 people (119 women, 28 men) with an average age of 31.6 years (SD = 12.7; range 18–61 years) participated in the study. More than half of them (57.8%) were community residents (including alumni) and less than a half (42%) comprised a group of bachelor's level students. Socioeconomic status of participants was based on neighborhood characteristics (derived from their postal code and representing information about education, incomes, and work status of neighborhood residents, as provided by the Neth-

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erlands Institute for Social Research) and revealed that about 13.7% of the participants lived in underprivileged neighborhoods, 74.5% lived in middle class neighborhoods, and 11.8% came from privileged neighborhoods. Participants' initial level of self-control capacity was moderate ($M = 3.0$, $SD = 0.6$). They rated the personal importance of the behavior they had chosen for practice as relatively high ($M = 3.8$, $SD = 0.7$ on a 5-point scale) and were reasonably motivated for practicing this behavior ($M = 3.7$, $SD = 0.7$ on a 5-point scale). Participants were generally undecided in their belief that self-control is either limited or nonlimited ($M = 3.5$, $SD = 0.6$; assessed on a scale from 1 to 6) and reported a relatively high level of self-efficacy ($M = 3.1$, $SD = 0.4$ on a scale from 1 to 4). Most participants (80%) chose a health related behavior for practicing self-control and 20% chose a behavior related to financial, relationship, or sustainability issues (a full account is provided in the online supplemental materials). On average, they registered this behavior 8.3 times ($SD = 3.4$; range 0 to 25) during the intervals between two self-control assessments which generally comprised 2 weeks but could be longer in case of irregular completion of the Self-Control Scale. Twenty-six participants registered the daily practice of behavior less than 25 times during the entire training period. There was no evidence that participants with relatively few registrations differed from those who registered more frequently in terms of baseline capacity for self-control, $F(1, 145) = 0.43$, *ns*; self-control practice (i.e., the proportion of the registered days on which they practiced), $F(1, 145) = 2.52$, $p = .11$; self-control beliefs, $F(1, 143) = 0.05$, *ns*; or self-efficacy, $F(1, 144) = 0.54$, *ns*.

The descriptive statistics and correlations between variables in the model at person level (i.e., averaged across measurements for each participant), are presented in Table 1. Capacity for self-control was positively related to self-efficacy and negatively to the belief that self-control is limited. Participants who practiced self-control relatively often reported somewhat higher self-control capacity than those who practiced less. Table 1 further shows that participants who filled out more follow-up self-control measurements also filled out more daily behavioral measurements between consecutive self-control measurements (i.e., they were more conscientious in filling out questionnaires). Moreover, participants who, on average, reported a larger number of days between consecutive self-control measurements had lower self-control capacity and engaged in self-control practice less often. It should be mentioned that these correlations do not take within-person variation into account. We will consider within-person variation in the multilevel analyses.

Capacity for Self-Control and Self-Control Practice Over Time

We first examined whether the capacity for self-control increased over time. Figure 2a shows a significant increase of about 0.4 *SD* (a medium effect size according to Cohen, 1992) in the capacity for self-control over a period of 110 days with a relatively steep increase in the first 2 weeks and leveling off after 10 weeks. Both the linear trend, $t = 6.74$, $p < .001$ and the quadratic trend ($t = -4.57$, $p < .001$) were significant. We also examined whether there was a time trend in the actual practice of the behavior (as registered in the app). Figure 2b shows that the behavior was practiced more often later on in the study period with a significant linear trend, $t = 5.05$, $p < .001$, but no quadratic trend ($t = -.93$, ns). The time trends for capacity for self-control and for behavioral practice were similar when the analysis was restricted to participants who filled out the app measurement at least 25 times ($N = 121$). During the period of training, there was a small but significant increase in self-efficacy ($t = 2.86$, $p < .01$; see Figure 2c). Changes in self-control beliefs over time were absent, $t = 0.18$, ns.

Effects of Practice on the Capacity for Self-Control

Our main analysis addresses the hypothesis that repeated practice of a self-relevant behavior increases the capacity for self-control. Table 2 shows the results of a hierarchical multilevel analysis and reveals that a higher level of capacity for self-control at follow up is strongly associated with the capacity for self-control as assessed at a previous moment (lagged self-control). Importantly, more self-control practice during the interval between both self-control measurements resulted in a greater increase in self-control capacity. These findings lend support to our hypothesis that more regular practice of the self-chosen behavior during a specific interval (i.e., the proportion of registrations at which participants claim to have practiced the behavior on that specific day) is a meaningful predictor of self-control improvement, as witnessed by a significant improvement of the model fit and a small but significant increase in the explained variance. The results also demonstrate that the measurement number is negatively related to self-control, implying that self-control increases more in

Table 1
Descriptive Statistics and Correlations for All Variables at Person Level

Variables at person level	*M*	*SD*	1	2	3	4	5	6
1. Self-control capacity	3.18	.50						
2. Self-efficacy	3.11	.36	.26**					
3. Self-control beliefs	3.59	.65	−.27***	−.25**				
4. Number of follow-up self-control measurements	5.20	2.10	.15	−.02	.09			
5. Average number of daily measurements between two self-control measurements	7.47	2.56	.13	−.13	−.09	.41***		
6. Average number of days between two self-control measurements	14.67	4.37	−.25**	.07	.03	−.24**	−.09	
7. Proportion of behavior carried out	.78	.20	.19*	−.03	.02	.12	.17*	−.26**

Note. $N = 147$.
* $p < .05$. ** $p < .01$. *** $p < .001$.

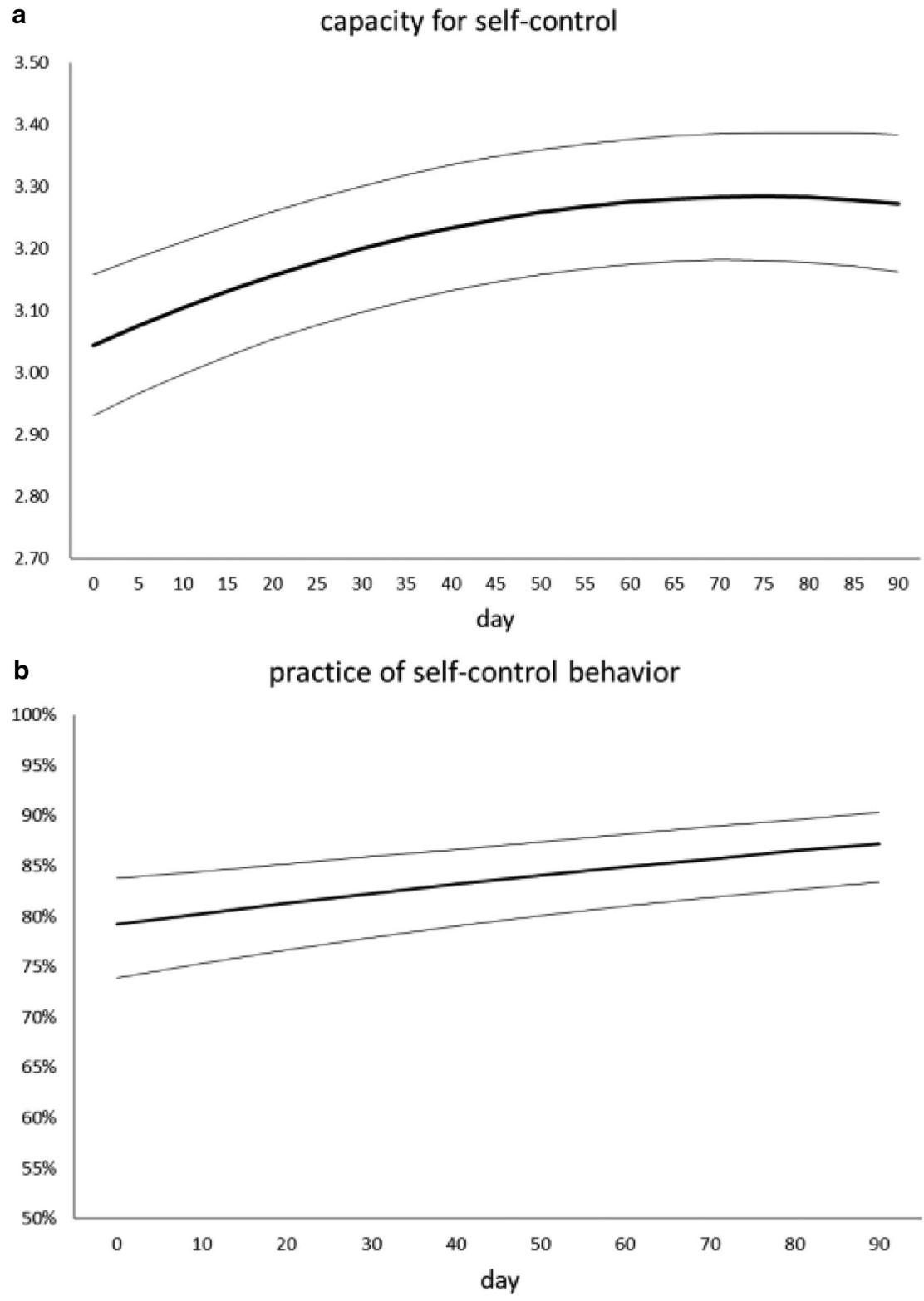

Figure 2. Time trends of capacity for self-control, behavioral practice, and self-efficacy ($N = 147$). (a) Capacity for self-control improvement over time, with 95% confidence bands. (b) Practice of self-control behavior over time, with 95% confidence bands. (c) Self-efficacy over time, with 95% confidence bands. *Note:* Time trends were tested over a period of 110 days. As for the majority of participants the final measurement was within 90 days, the figure shows the trend for the 90-day timeframe. (*Figure continues on next page*)

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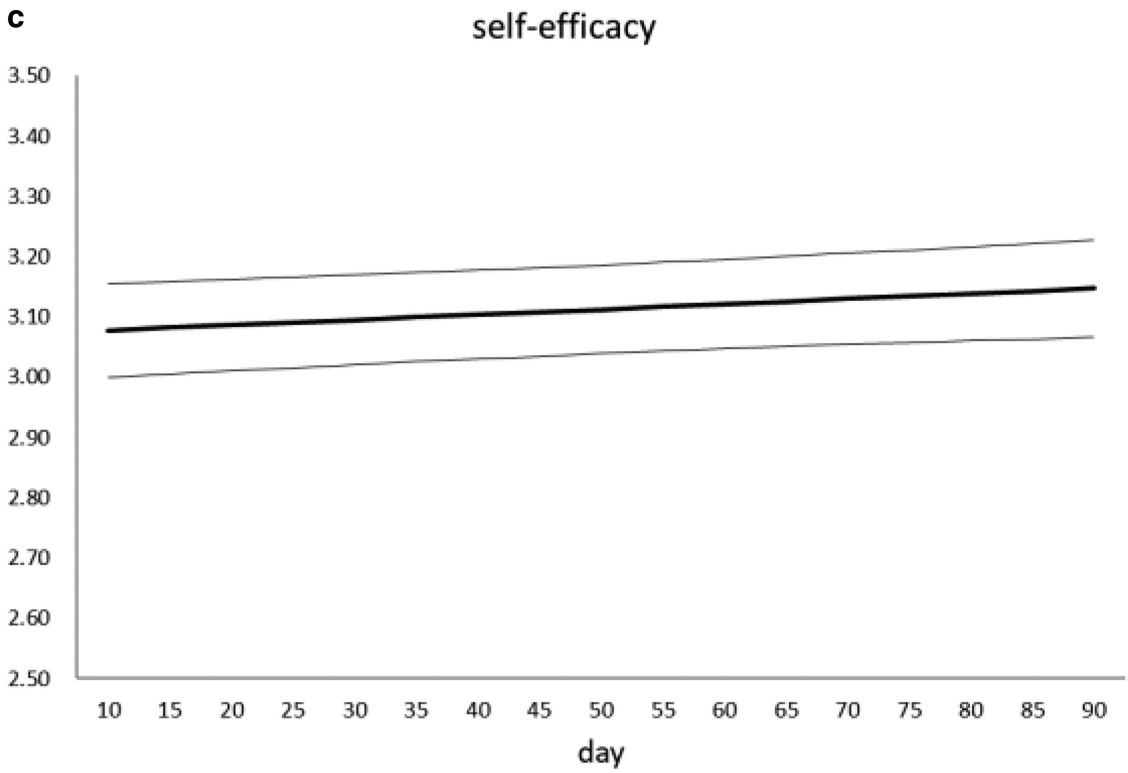

Figure 2. (*continued*)

the initial stage of the study than later on (confirming the pattern of self-control improvement as shown in Figure 2a). Finally, Table 2 shows that self-control beliefs (i.e., that self-control is not limited) and self-efficacy also contribute to the increase of capacity for self-control over time. Participants who believe that self-control is not limited reported a larger increase in capacity for self-control than those who believe that self-control is limited, as did participants who feel more self-efficacious. Taken together, these findings support the notion that regular practice of a specific behavior that requires self-control leads to a greater capacity for self-control and that this improvement is not solely driven by their beliefs about the nature of self-control or self-efficacy. Moreover,

Table 2
Hierarchical Multilevel Analysis With Capacity for Self-Control as the Dependent Variable

	Model 1		Model 2		Model 3		Model 4	
Predictors	*b*	*SE* (*b*)	*b*	*SE* (*b*)	*b*	*SE* (*b*)	*b*	*SE* (*b*)
Intercept	3.23	.04***	3.25	.01***	3.25	.01***	3.25	.01***
Lagged self-control			.79	.02***	.80	.02***	.77	.02***
Average self-efficacy							.08	.03**
Average self-control belief							−.06	.02***
Within person								
Measurement number					−.01	.01*	−.01	.01
Proportion behavior carried out					.21	.08**	.21	.08**
Fit (−2 log L)	435.82***		293.70***		279.36***		257.16***	
Δ fit			142.13		14.34***		22.20***	
df			1		4		2	
Variance								
Random intercept (τ^2)	.22***		.00		.00		.00	
Residual (σ^2)	.06***		.09***		.08***		.08***	
ICC	.79							
Explained variance			69%		70%		71%	

Note. $N = 147$. The contribution of two within-person level control variables in Model 3 are not shown in this table; see the online supplemental materials for more information. *df* = degrees of freedom; ICC = intraclass correlation.
* $p < .05$. ** $p < .01$. *** $p < .001$.

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additional analyses showed that participants who were initially low in self-control equally benefitted from practicing the behavior (see the online supplemental materials for details).

Capacity for Self-Control as a Predictor of Practice

We then examined to what extent participants' capacity for self-control assessed at a previous occasion predicts their engagement in the practice of the chosen behavior. Table 3 shows the results of the hierarchical logistic multilevel regression analysis with the daily practice of the chosen behavior as the dependent variable. These findings reveal that lagged self-control capacity (assessed at a previous occasion) does not predict whether or not a person engages in the practice of a behavior that requires self-control in the subsequent interval. Neither did self-control beliefs or self-efficacy contribute to self-control practice. The only two significant predictors of behavioral practice at a particular moment are the regular registration of the self-control measure (i.e., when the average number of days between 2 assessments of self-control is lower) and the time of assessment (i.e., later on during the study participants are more inclined to practice the chosen behavior, as indicated by a higher self-control assessment number).

Capacity for Self-Control as a Predictor of Self-Control Beliefs and Self-Efficacy

Finally, we examined whether a higher capacity for self-control and behavioral practice contributed to the belief that self-control is limited and/or a greater sense of self-efficacy. Results are shown in Tables 4 and 5. Although higher capacity for self-control seemed to promote the belief that self-control is not limited, this effect failed to reach significance ($p = .06$) after controlling for lagged self-control beliefs (i.e., the beliefs assessed at a previous moment). Behavioral practice did not significantly contribute to the change in self-control beliefs. Similar results were obtained for changes in self-efficacy over time with the exception that lagged self-control was a significant predictor of increased self-efficacy. This shows that a higher capacity for self-control promotes self-efficacy. More details of these analyses are presented in the online supplemental materials.

Discussion

Self-control is widely acknowledged as a key predictor of productive, happy, and healthy lives. Understanding how people respond to repeated exertion of self-control efforts is therefore a topic of tremendous importance (Wright & Mlynski, 2019; Wright, Mlynski, & Carbajal, 2019). In the present study we assessed the effects of frequent engagement in self-control over a prolonged period of time on the capacity for self-control. Engaging participants who wanted to practice a self-chosen self-control behavior on a regular basis led to an improvement of medium effect size in self-control capacity over a period of almost 4 months—also in participants who were initially low in self-control capacity. Critically, the level of improvement was dependent on the actual times of practice during a specific interval, suggesting that "just doing" self-control was the underlying mechanism of increased capacity for self-control.

This interpretation is supported by the finding that beliefs about self-control and self-efficacy did not change as a result of frequent self-control practice. Nevertheless, when participants endorsed the belief that self-control is not limited and possessed greater self-efficacy, they did demonstrate greater improvement of self-control capacity. It is noteworthy that, in turn, an increased capacity for self-control was associated with greater self-efficacy (but not with enhanced beliefs about self-control). We found no effect of self-control capacity on the number of times that participants engaged in practice. We interpret this finding as a strong point, suggesting that repeated performance of self-control behavior benefits people with initially lower levels of self-control, and not only those who start out with a higher capacity for self-control. However, one might also interpret the absence of this association between base-

Table 3
Hierarchical Logistic Multilevel Regression Analysis With Self-Control Practice as the Dependent Variable

	Model 1		Model 2		Model 3		Model 4	
Predictors	*b*	*SE* (*b*)	*b*	*SE* (*b*)	*b*	*SE* (*b*)	*b*	*SE* (*b*)
Intercept	1.62	.11***	1.69	.11***	1.69	.11***	1.70	.11***
Lagged self-control					−.00	.12	.02	.12
Person level								
Average self-efficacy							.10	.31
Average self-control beliefs							−.23	.18
Average days between measurements			−.07	.03**	−.07	.03**	−.07	.03**
Within person								
Measurement number			.08	.02***	.08	.02	.08	.02
Fit (−2 log L)	2,452.50***		2,415.20***		2,415.20***		2,413.20***	
Δ fit			37.30		.00		2.00	
df			6		1		2	
Quasivariance								
Random intercept (τ^2)	1.52***		1.40***		1.40***		1.4***	
Estimated residual ($\pi^2/3$)	3.29***		3.29***		3.29***		3.29***	
ICC	.32							
Explained variance			2%		2%		2%	

Note. $N = 147$. The contribution of two person level and two within-person level control variables in Model 2 are not shown in this table; see the online supplemental materials for more information. *df* = degrees of freedom; ICC = intraclass correlation.
** $p < .01$. *** $p < .001$.

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Table 4
Multilevel Regression With Self-Control Beliefs as the Dependent Variable (N = 147)

Predictors	Model 1		Model 2		Model 3	
	b	*SE* (*b*)	*b*	*SE* (*b*)	*b*	*SE* (*b*)
Intercept	3.60	.06***	3.62	.02***	3.63	.02***
Lagged self-control beliefs			.90	.02***	.88	.02***
Lagged self-control					−.06	.03
Within person						
Measurement number					−.02	.01
Proportion behavior carried out					.01	.13
Fit (−2 log L)	628.03***		445.46***		439.59***	
Δ fit			182.57		5.87	
df			1		5	
Variance						
Random intercept (τ^2)	.42***		.00		.00	
Residual (σ^2)	.09***		.13***		.13***	
ICC	.82					
Explained variance			74%		74%	

Note. $N = 147$. The contribution of two within-person level control variables in Model 3 is not shown in this table; see the online supplemental materials for more information. *df* = degrees of freedom; ICC = intraclass correlation.
*** $p < .001$.

line self-control capacity and self-control frequency as support for the notion that self-control capacity does not immediately result in self-control behavior. This would imply that well-known positive effects of self-control on life outcomes take place further down the line.

This notion aligns with our finding of a medium effect for improvement of self-control capacity over the entire period of almost 4 months that we followed up participants, suggesting that any changes over a shorter period (i.e., the 2 weeks are usually employed as a follow up; Beames et al., 2018; Friese et al., 2017; Inzlicht & Berkman, 2015) would be negligible.

Two issues warrant more discussion. First, the capacity for self-control as a relevant outcome for determining the effects of self-control practice needs consideration. Whereas it is obvious that capacity for self-control is a relevant parameter because it has been shown to be an important predictor of self-control success, one may wonder to what extent it can improve, given that it is generally considered a stable measure of the disposition to exert self-control. However, recent theorizing in personality psychology suggests that even traits are amenable to change, depending on the situational context (Fleeson, 2004). Providing participants with a context in which they were able to engage in repeated practice may have contributed to the slow-but-steady building up of capacity for self-control, suggesting that self-control resembles a versatile skill more than has been assumed previously (Baumeister et al., 1998). This interpretation resonates well with the absence of an effect of

Table 5
Multilevel Regression With Self-Efficacy as the Dependent Variable

Predictors	Model 1		Model 2		Model 3	
	b	*SE* (*b*)	*b*	*SE* (*b*)	*b*	*SE* (*b*)
Intercept	3.11	.03***	3.11	.01***	3.10	.01***
Lagged self-efficacy			.75	.03***	.73	.03***
Lagged self-control					.07	.02**
Within person						
Measurement number					.01	.01
Proportion behavior carried out					.01	.09
Fit (−2 log L)	253.19***		197.21***		183.82***	
Δ fit			55.98		13.39*	
df			1		5	
Variance						
Random intercept (τ^2)	.12***		.00		.00	
Residual (σ^2)	.05***		.08***		.08***	
ICC	.70					
Explained variance			54%		55%	

Note. $N = 147$. The contribution of two within-person level control variables in Model 3 is not shown in this table; see the online supplemental materials for more information. *df* = degrees of freedom; ICC = intraclass correlation.
* $p < .05$. ** $p < .01$. *** $p < .001$.

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repeated self-control exertion on the performance on an ego depletion task that assesses self-control as a limited resource.

A second issue relates to the underlying mechanism of beneficial effects of self-control practice. Previous research has suggested that a substantial improvement in capacity for self-control may reflect participants' beliefs that practice improves their self-control rather than actual change (Miles et al., 2016). However, our finding that beliefs about self-control (as an either or not limited) resource did not change because of practice suggests that the beneficial effects of practice are not driven by mere expectations of positive effects. Given that we assessed willpower theories rather than beliefs about willpower capacity, this implies that people can get better at self-control even when they believe that self-control is limited insofar they engage in regular self-control practice (as our moderation analyses, reported in the online supplemental materials, show). Indeed, the gradual improvement over time indicates that actual engagement in self-control behavior is the mechanism behind a greater capacity for self-control. We followed participants for about four months. It may well be that due to long-term practice, self-control behavior became more routinized over time. Whereas not all participants did practice for the entire period, the majority completed the study with intermittent behavioral practice and thus were involved for a considerable period of time. Previous research has demonstrated that it takes, on average, 2 months to install a new habit (Lally, Van Jaarsveld, Potts, & Wardle, 2010), suggesting that the long duration of practice allowed participants to develop a habit of practicing self-control. This also emphasizes the critical issue of long-term follow up to detect effects of self-control practice that we referred to earlier. A period of 2 weeks as is commonly used in self-control training studies may be too short to find any effects.

Strengths and Limitations

Our study has some noticeable strengths: the first being that we were able to involve a diverse sample including a substantial number of participants living in underprivileged neighborhoods. The impact of a disadvantaged environment on self-control performance is a critical but underinvestigated issue that calls for more research (Gillebaart & De Ridder, 2019). It should be noted though that the number of men participating in the study was relatively low. A second strong point is that despite the long-term commitment and the intensive study design, we were able to retain a relatively large number of participants. From the responses of the participants we may speculate that practicing personally meaningful tasks (rather than trivial pursuits that are usually employed in self-control studies) was an important reason to stay aboard. Our study also has limitations. First, although the study employed an intensive and ecologically valid electronic diary design that allows for analyzing the development of self-control capacity over time with advanced multilevel models, the data are correlational in nature and do not permit for cause-effect conclusions. Nevertheless, modeling the actual number of self-control practice registrations allowed for shedding some light on the underlying mechanism of self-control improvement in terms of "doing self-control." A second limitation lies in employing a self-report measure of capacity for self-control as the main outcome of practice, which may be vulnerable to bias. Notwithstanding the limitations of subjective report, the scale we used for assessing self-control capacity has proven a robust predictor of self-control success (including objective measures such as body mass index or grades) in a wide variety of domains of life outside the lab (De Ridder et al., 2012; Tangney et al., 2004), and thus has high ecological validity. Moreover, the very finding that frequent engagement in self-control behavior translates in greater self-judged capacity for self-control suggests that people are able to reflect on the experience of actual self-control practice.

Implications

In view of the benefits of high self-control, several attempts have been made to improve self-control by training (e.g., Denson, Capper, Oaten, Friese, & Schofield, 2011; Miles et al., 2016). Many of these training programs (if not all) have been inspired by the strength model of self-control (Baumeister et al., 1998), stating that self-control training reduces the risk of ego depletion, just as a muscle grows stronger with exercise (Muraven et al., 1999). Meta-analytic evidence on the effects of these kind of interventions is mixed (Beames et al., 2018; Friese et al., 2017; Inzlicht & Berkman, 2015). One reason for the divergent findings reported in the literature may lie in the way the effects of training have been assessed, focusing on performance at depletion tasks as a measure of state self-control. By definition, state measures fluctuate over time and are sensitive to contextual influences. Another and more important reason for the poor effects of self-control training may lie in the rationale behind these interventions, assuming that self-control is a resource rather than a skill. Previous studies have suggested several alternative mechanisms that might be involved in self-control improvement by training, such as goal setting (Inzlicht, Legault, & Teper, 2014) or enhanced self-control beliefs (Berkman, 2018). To date, none of these proposed mechanisms have been tested empirically. Our study is the first to demonstrate that actually practicing meaningful tasks that require self-control on a regular basis and for a longer period of time contributes to a significant improvement in capacity for self-control, which may be related to self-control becoming more habitual. The very finding that we observed these beneficial effects in a diverse sample after only minimal encouragement to practice gives credit to a new paradigm for self-control training that supports people in doing the things they want to do but often do not manage to do.

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