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Implicit Theories About Willpower Predict Self-Regulation and Grades in Everyday Life

Veronika Job
University of Zurich

Gregory M. Walton
Stanford University

Katharina Bernecker
University of Zurich

Carol S. Dweck
Stanford University

Laboratory research shows that when people believe that willpower is an abundant (rather than highly limited) resource they exhibit better self-control after demanding tasks. However, some have questioned whether this "nonlimited" theory leads to squandering of resources and worse outcomes in everyday life when demands on self-regulation are high. To examine this, we conducted a longitudinal study, assessing students' theories about willpower and tracking their self-regulation and academic performance. As hypothesized, a nonlimited theory predicted better self-regulation (better time management and less procrastination, unhealthy eating, and impulsive spending) for students who faced high self-regulatory demands. Moreover, among students taking a heavy course load, those with a nonlimited theory earned higher grades, which was mediated by less procrastination. These findings contradict the idea that a limited theory helps people allocate their resources more effectively; instead, it is people with the nonlimited theory who self-regulate well in the face of high demands.

Keywords: implicit theories about willpower, self-regulation, grades

Do people's beliefs about the nature of self-control affect their ability to exert self-control in everyday life settings? If so, what beliefs are most functional? One hypothesis is suggested by the strength model of self-control (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, Vohs, & Tice, 2007). This model proposes that self-control relies on a limited resource and that understanding this limit helps people use this resource judiciously, improving self-regulation especially when demands on self-control are high (Vohs, Baumeister, & Schmeichel, 2012). In the present research, however, we propose the opposite, namely, that this limited-resource theory undermines people's self-regulatory efforts and, moreover, does so especially when demands on self-control are high. The belief that willpower relies on a limited resource, we suggest, leads people to act as though their self-regulatory resources are depleted long before they reach any actual limit in their self-regulatory capacity. As a consequence, we expect that people with a limited-resource theory will reduce their effort and engage in various overindulgent behaviors when they face high demands on self-control. Instead, we propose that an alternative belief—the belief that willpower is not easily used up and can even be fueled by the exertion of self-control (a nonlimited theory)—promotes more successful self-regulation and performance when people encounter challenging self-regulatory demands.

Veronika Job, Department of Psychology, University of Zurich; Gregory M. Walton, Department of Psychology, Stanford University; Katharina Bernecker, Department of Psychology, University of Zurich; Carol S. Dweck, Department of Psychology, Stanford University.

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Correspondence concerning this article should be addressed to Veronika Job, Department of Psychology, University of Zurich, Binzmuehlestrasse 14/6, 8050 Zurich, Switzerland. E-mail: v.job@psychologie.uzh.ch

The Strength Model of Self-Control

Much contemporary research on self-regulation draws on the strength model of self-control, which, as noted, posits that self-control relies on a limited energy resource (Baumeister et al., 1998, 2007). According to this model, every act of self-control depletes this resource, directly reducing the capacity to exert further self-control—a phenomenon termed ego depletion. Empirical support for this model comes from numerous laboratory experiments, which show that, after an initial task requiring self-control, people exhibit worse self-control on subsequent tasks than do people who engaged in an initial undemanding task (for a meta-analysis, see Hagger, Wood, Stiff, & Chatzisarantis, 2010).

Recent field studies extend these findings to everyday self-regulation, and appear to suggest that the same principle applies. For instance, in an experience sampling study Hofmann, Vohs, and Baumeister (2012) found that the more participants controlled themselves by resisting desires the more likely they were to show self-control failures later in the day. Similarly, research on stress and self-regulation confirms that when people contend with stressful circumstances, such as daily hassles or academic examinations, they tend to engage in more problematic, potentially harmful, behaviors like eating unhealthy food, consuming alcohol, smoking, and spending excessively (Ng & Jeffery, 2003; Oaten &

Cheng, 2005; O'Connor, Jones, Conner, McMillan, & Ferguson, 2008; Steptoe, Lipsey, & Wardle, 1998). It is thus well documented that self-control often suffers when self-control demands are high, both in laboratory and in everyday life settings.

Given the importance of self-regulation for successful goal-striving, health, and overall functioning (e.g., Moffitt et al., 2011), identifying factors that predict better self-regulation, especially in the face of high demands, is critical. Recent research has identified several variables that moderate the ego depletion effect. For instance, motivational variables like incentives, expectations, and perceptions of a task can diminish or eliminate ego depletion in laboratory settings (Clarkson, Hirt, Jia, & Alexander, 2010; Martijn, Tenbult, Merckelbach, Dreezens, & De Vries, 2002; Muraven & Slessareva, 2003). Most pertinent to the present research, Job, Dweck, and Walton (2010) found that people's lay beliefs about willpower, so called *implicit theories*,[1] determined whether people showed ego depletion at all.

Implicit Theories About Willpower

Challenging the strength model of self-control, Job and colleagues (2010) demonstrated in a series of laboratory experiments that only people who believe that willpower is limited and easily depleted (a limited theory of willpower, assessed with questions like, "After a strenuous mental activity, your energy is depleted and you must rest to get it refueled again") show ego depletion, that is, perform worse after an initial self-control task. People who reject the view that willpower is highly constrained and who believe, instead, that willpower can even be self-generating (e.g., "After a strenuous mental activity, you feel energized for further challenging activities") showed no impairment over a series of demanding self-control tasks (see also Miller et al., 2012). We call the latter belief a *nonlimited* theory of willpower. We intentionally do not use the term "unlimited." People with a nonlimited theory may not believe that willpower is limitless or that they are immune to depletion from highly strenuous tasks of long duration. However, they reject the view that willpower is easily depleted by acts of self-control.

Job and colleagues found that implicit theories about willpower predict ego depletion both measuring theories about willpower as an individual difference and manipulating them experimentally, suggesting their causal role. These findings imply that self-regulatory failure following the brief exertion of self-control results from people's beliefs about their available resources rather than from a true lack of resources (see also Job, Walton, Bernecker, & Dweck, 2013).

How do implicit theories about willpower affect ego depletion? Research suggests that the belief that willpower is limited sensitizes people to cues that may signal the availability or unavailability of mental resources. For example, finding an initial self-control task exhausting predicted worse subsequent self-control performance for people with a limited theory but was unpredictive for people with a nonlimited theory (Job et al., 2010, Study 3). In another series of studies, ingesting glucose restored self-control for those with a limited theory but had no effect on those with a nonlimited theory, who continued to perform well on self-control tasks whether they had ingested glucose or not (Job et al., 2013). Previous research suggests that glucose signals the restoration of self-control resources (Chambers, Bridge, & Jones, 2009; Molden et al., 2012). Our results suggest that only people who believe that willpower is highly limited carefully monitor for cues to the availability of self-control resources.

Extending this research, Vohs and colleagues (2012) replicated the effects of implicit theories about willpower on ego depletion and raised an important question: Will the same effects hold when self-control demands are especially high? Vohs and colleagues hypothesized that implicit theories about willpower lead people to temporarily compensate for a lack of resources. They suggest that people can do so effectively in the face of mild or moderate self-control demands but not in the face of high demands, where "severe" depletion eventually takes its toll. In a laboratory experiment, they examined how a manipulation of theories about willpower interacted with three ego depletion conditions: a "no depletion" condition in which participants completed no initial self-control tasks; a "mild depletion" condition in which participants completed two initial self-control tasks; and a "severe depletion" condition in which participants completed four initial self-control tasks. Vohs and colleagues replicated the finding that a nonlimited theory of willpower improves self-control in the face of "mild depletion." But in the "severe depletion" condition, there was no positive effect of a nonlimited theory and on one of two measures of self-control performance the effect even reversed: participants led to adopt a limited-resource theory performed better. Vohs and colleagues concluded that a nonlimited theory can be counterproductive. Thinking that willpower is nonlimited, they write, "might undermine the normal tendency to conserve resources (Muraven, Shmueli, & Burkley, 2006) so that people find themselves severely depleted after multiple tasks" (p. 186).

Laboratory tasks, however, are not ideal for drawing conclusions about the limits of willpower. There are many reasons people might display less effort after a long series of demanding but potentially unmeaningful tasks. The critical test of how beliefs about willpower affect self-regulation must be conducted in real-world settings in which people contend with accumulating demands on their self-control as they strive to accomplish personal goals. Indeed, in contrast to Vohs and colleagues' conclusion, an earlier longitudinal study found that college students who endorsed a nonlimited theory of willpower exhibited superior everyday self-regulation during the week before final exams, when demands on self-control were assumed to be high (Job et al., 2010, Study 4). They ate less unhealthy food, procrastinated less, and pursued personal achievement goals more effectively than students with a limited theory.

The present research extends this prior study to provide a more detailed examination of how implicit theories about willpower predict everyday self-regulation. The study does so in several ways. First, the prior study simply assumed that self-regulatory demands were high for all students at a particular time; that is, as final exams approached. In the present research, we assessed the level of self-regulatory demands for each student on a week-by-week basis across an academic term so we could identify the students who faced consistently high demands and those who faced lower demands. We hypothesized that a nonlimited theory of

[1] Here the term "implicit" means that theories about willpower are most often not articulated. However, we assume that people are able to recognize their beliefs when asked to respond to items that make them explicit.

willpower would predict better self-regulatory outcomes among students who contended with high self-regulatory demands but not necessarily among students who faced low self-regulatory demands. Second, we assessed a broader range of self-regulatory outcomes than in past research, including not only procrastination and unhealthy eating but also ineffective time management, impulsive spending, and emotion-regulation failure. Finally, we examined a further important outcome that is determined in part by self-regulation, and that is not self-reported: participants' end-of-term grade point average (GPA) (see Duckworth & Seligman, 2005). We examined whether a nonlimited theory of willpower would predict a higher GPA that term (controlling for past GPA) especially among students who took a heavy course load. We further expected that any improvement in GPA would be mediated by better self-regulation, especially lower levels of procrastination.

In summary, we tested the hypothesis that students holding a nonlimited theory of willpower facing consistently high demands would display better self-regulation and consequently would reach higher grades than would students holding a limited theory facing similar circumstances. If this is the case, it would suggest that thinking of willpower as a nonlimited resource, rather than harming people by leading them to waste their resources, helps people stay focused on their goals when a heavy workload and accumulating demands make self-regulation challenging.

Method

Participants and Procedure

Participants were 176 students at a selective university in the Western United States (101 women; M_{age} = 21.21, SD = 2.62). They were asked to complete an online questionnaire at five time points, once each week during the second half of a 10-week term (T1–T5). Students received $3 for completing each questionnaire and a $10 bonus for completing all five questionnaires. A total of 113 participants completed all five questionnaires; 26 completed four, 13 completed three, 10 completed two, and 14 completed one. Data from all participants who completed at least two consecutive questionnaires were included in hierarchical linear modeling (HLM) analyses of self-regulation (N = 156). [Participants who completed the relevant measures versus those who did not did not differ in theories about willpower, $t(174) = -.84$, $p = .40$.] Each week on Monday morning, participants received a link to the online questionnaire with a request to respond that day. On average, 65% of participants completed the questionnaire that day (ranging from 83% at T1% to 54% at T4). Nonresponding participants were sent a reminder on Tuesday and could respond until Wednesday night.

At the beginning of the first questionnaire, participants provided informed consent and were asked to authorize the release of their college academic records from the term of their participation and the prior term. One hundred fifty-three participants (87%) authorized the release. [Participants who authorized the release of their academic record did not differ in their theories about willpower from those who did not, $t(174) = 0.23$, $p = .82$.]

Measure of Implicit Theories About Willpower

At Time 1 participants completed a 6-item measure assessing theories about willpower with respect to strenuous mental exertion (Job et al., 2010). Sample items include, "After a strenuous mental activity your energy is depleted and you must rest to get it refueled again" (limited-resource theory) and, "Your mental stamina fuels itself; even after strenuous mental exertion you can continue doing more of it" (nonlimited-resource theory) (*1 = strongly agree, 6 = strongly disagree*; α = .85). Items referring to the limited-resource theory were reverse-scored so that higher values represent greater agreement with the limited-resource theory (M_{grand} = 3.88, SD = .88).

Measures of Everyday Self-Regulation Failures and Self-Regulatory Demands

Our questionnaire allowed us to determine which students faced high demands over a several week period. Each questionnaire assessed, first, indices of everyday self-regulation failures during the previous week and, second, self-regulatory demands anticipated in the current week. This approach separates the assessment of the two critical variables for each week in order to prevent reports of one from biasing reports of the other. Since we had no measure of self-regulation failures during the last week of the study, we had complete information about anticipated self-regulatory demands and self-regulation failures for four weeks.

Everyday self-regulation. Each questionnaire (T1–T5) assessed self-regulatory failures during the prior week by asking participants to report the frequency of (a) procrastination, defined as engaging in nonacademic activities rather than studying (e.g., "How often did you meet friends instead of studying?"), (b) consumption of unhealthy (high fat/high sugar) foods and drinks, like chocolate bars or salty snacks, (b) poor time management (e.g., "How often did you come late to an appointment?"), (d) excess spending (e.g., "How often did you buy something knowing that it's actually too expensive for you?"), and (e) failure to control emotions, (e.g., "How often did you have trouble controlling your temper?") during the prior week (*1 = never, 2 = 1 time per week, 3 = 2 times per week, 4 = 3–4 times per week, 5 = 5–6 times per week, 6 = 1 time per day, 7 = two or more times per day*). Descriptive statistics and reliability information are presented in Table 1.

To assess whether the five indicators of self-regulation failure converged as indicators of a single latent variable, we conducted a confirmatory factor analysis with full information maximum likelihood estimation on the five measures assessed at T1. A one-factor model fit the data: $\chi^2(df = 5, N = 176) = 3.03$, $p = .70$, comparative fit index (CFI) = 1.00, root mean square error of approximation (RMSEA) = .00. All loadings were significant (standardized values: procrastination = .67, consumption of unhealthy foods = .22, poor time management = .59, excess spending = .46, emotion-regulation failure = .52). Therefore, in addition to examining each measure separately, we also created a composite index of self-regulation failure by averaging scores for the five variables at each time point.

Anticipated self-regulatory demands. We created a list of 13 demands undergraduate students commonly face over an academic term. These included academic tasks (e.g., "class presentations to deliver," "tests to take") and social stressors (e.g., "conflicts with one's professor or TA," "experience of social exclusion or rejection"). For each demand, participants were asked to "indicate how much you will have to deal with [this] task or experience during

Table 1
Means and Standard Deviations of Self-Regulation Failure (1 = Never, 7 = Two or More Times Per Day), Negative Affect (1 = Never, 5 = Very Often), and Forecasted Self-Control Demands (1 = Not at all, 4 = Very Much)

Scale	Sample item	Range	α	Week 1	Week 2	Week 3	Week 4
N				158	149	143	119
Procrastination	"How often did you meet friends instead of studying?" (6 items)	1–7	.78–.87	3.37 (1.14)	3.30 (1.26)	3.29 (1.28)	2.92 (1.31)
Unhealthy food	"How often did you eat chocolate or candy bars?" (6 items)	1–7	.67–.74	2.99 (1.00)	2.96 (0.95)	2.98 (1.00)	2.95 (1.03)
Poor time management	"How often did you come late to an appointment?" (4 items)	1–7	.62–.76	1.77 (0.73)	1.81 (0.81)	1.73 (0.91)	1.41 (0.62)
Excess spending	"How often did you buy something knowing that it's actually too expensive for you?" (6 items)	1–7	.80–.91	1.58 (0.68)	1.53 (0.65)	1.64 (0.88)	1.45 (0.66)
Emotion-regulation failure	"How often did you have trouble controlling your temper?" (3 items)	1–7	.76–.87	2.06 (0.92)	2.03 (1.08)	2.00 (1.03)	2.00 (0.92)
Forecasted self-regulatory demands	"How much will you have to deal with *papers/essays due*?" (13 items, summed)	1–4	.66–.72	25.74 (5.70)	24.99 (6.14)	25.13 (5.79)	24.32 (5.92)

the next seven days" (*1 = not at all, 2 = a little, 3 = somewhat, 4 = very much*). These ratings thus allowed us to summarize diverse anticipated self-regulatory demands to create a single index for each student.[2]

Academic performance and course load. Students' college academic records provided measures of (a) their GPA during the term the study was conducted and the previous term, and (b) their course load, that is, the number of units students enrolled in each term.

Trait Self-Control

If we find the hypothesized relationship between a nonlimited theory and fewer self-regulatory failures, a potential alternative explanation involves trait self-control: perhaps people with a nonlimited theory about willpower show better self-regulatory outcomes simply because they have greater self-control to begin with. To examine this possibility, we administered the brief Trait Self-Control Scale (Tangney, Baumeister, & Boone, 2004) at the end of the T2 questionnaire. Participants indicated on a 5-point scale (*1 = not at all, 5 = very much*) how well each of 13 statements about self-control described their typical behavior (e.g., "I'm good at resisting temptation," "I am lazy") ($\alpha = .88$).

Results

After reporting descriptive statistics and zero-order correlations, the results are divided into two main sections. First, we analyzed everyday self-regulation with a multilevel approach. Our primary focus was on between-participants differences in self-regulatory demands—whether students who faced high demands during the term self-regulated better or more poorly as a function of their implicit theory of willpower. We focused on this question because we expected self-regulatory demands and behavior to vary more between- than within-participants over this relatively short time period (i.e., five consecutive weeks within a term). However, we also examined within-participant (i.e., week-to-week) changes in self-regulatory demands to determine whether students showed differences in self-regulation, as a function of their theories about willpower, on weeks they had previously predicted would pose high versus low demands.

Second, we examined students' end-of-term GPA. A series of regression analyses tested the hypothesis that theories about willpower would predict GPA, that this relationship would be moderated by academic work-load, and that it would be mediated by procrastination.

Descriptive Statistics

Means and standard deviations of self-regulatory behaviors and self-regulatory demands for each week are presented in Table 1. Over the course of the five measurement times, levels of procrastination and time-management failure dropped: linear within-participant contrasts $F(1, 93) = 16.19$, $p = .001$ and $F(1, 93) = 25.32$, $p < .001$, respectively. As the end of the term and final exams approached, students procrastinated less and managed their time better.

Table 2 reports the means, standard deviations, and zero-order correlations of theories about willpower, course load in the current term, GPA in the current and previous term, as well as trait self-control. There were no significant zero-order correlations among willpower theories, course load, and GPA. As expected, current- and prior-term GPA were highly correlated and there was no mean difference between the two, $t < 1$. There was also a significant correlation between theories about willpower and trait self-control. Participants low in trait self-control agreed more with

[2] An important question concerns how self-regulatory demands change over the course of an academic term. In past research, we theorized that demands increase as finals week approaches (Job et al., 2010). The present data allow a test of this assumption. This was the case for academic demands. Specifically, participants' ratings of how much they would have to deal with tests increased over the four weeks as indicated by a significant linear within-participant contrast, $F(1, 128) = 59.20$, $p < .001$. There was no such increase for nonacademic demands; indeed, social stressors (e.g., social obligations) declined as the end of the term approached, $F(1, 128) = 5.67$, $p = .04$. A strength of the present study is that, rather than assuming that all students are facing high or low demands at certain times, we assessed the level of demands each student anticipated week by week over the second half of the term.

Table 2
Descriptive Statistics and Correlations for Participants-Level Variables

Variable	2	3	4	5	6	*M*	*SD*
Willpower theory	−.07	−.13	−.01	−.17*	.10	3.88	.88
Course load[a]		−.01	.02	−.16+	−.39**	14.60	3.64
Current term GPA			.68**	.23**	.25**	3.57	.46
Previous term GPA				.17*	.28**	3.60	.42
Trait self-control					−.10	3.07	.72
Age						20.58	1.74

Note. $N = 149$.
[a] Units taken in the current term.
$^{+}p < .10$. $^{*}p < .05$. $^{**}p < .001$ (two-tailed).

a limited-resource theory. As will be seen, however, this difference did not account for the effect of theories about willpower on self-regulation and performance.

Everyday Self-Regulation Failure and Self-Regulatory Demands

Our data on students' weekly self-regulation failure and self-regulatory demands conform to a two-level hierarchical structure (repeated measures nested within individuals). Therefore, we used hierarchical linear modeling (HLM 6.2 statistical software package, Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2004) to analyze between- and within-person differences in self-regulation as our dependent variable. We first estimated an unconditional model with no predictors at either level of the hierarchy, to see how much variation in weekly self-regulation lay between- versus within-participants. This analysis revealed that, as might be expected, most of the variance in self-regulation was between-participants (81%) ($\tau_{00} = 0.35$); only 19% was within-participants ($\sigma^2 = 0.08$). Similarly, an unconditional model predicting forecasted demands showed that more of the variance was between-participants (62%) than within-participants (38%) ($\sigma^2 = 0.12$, $\tau_{00} = 0.08$).

To estimate effects of self-regulatory demands at both the between-participants and the within-participants levels of analysis we ran a compositional model including the aggregated score for mean demands across weeks as a participant-level predictor, as well as weekly scores of demands (group-centered) as the week-level predictor (Enders & Tofighi, 2007; Raudenbush & Bryk, 2002). This is the full model:

$$\text{Self-Regulation}_{ij} = B_{0j} + B_{1j}\,\text{Demands} + R_{ij}$$

$$B_{0j} = G_{00} + G_{01}\,\text{WillpowerTheory} + G_{02}\text{MeanDemands} + G_{03}\text{Theory} \times \text{Demands} + u_{0j}$$

$$B_{1j} = G_{10} + G_{11}\text{WillpowerTheory} + u_{1j}$$

G_{00} is the intercept. G_{01} and G_{02} represent the main effects of willpower theories and mean demands on participants' mean self-regulation failure reports. G_{03} represents the interaction between willpower theory and demands, which tests our hypothesis at the between-participants level. G_{10} represents the main within-participant effect of week-to-week changes in predicted self-regulatory demands on week-to-week self-regulation reports. Finally, G_{11} represents the cross-level interaction between willpower theory and self-regulatory demands, which tests effects at the within-participant level.

Table 3 contains the coefficients for this model predicting the composite self-regulation failure index as well as each measure of self-regulation failure. There was a highly significant main effect of mean demands (G_{02}): High demands were associated with more self-regulation failure. The main effect of willpower theories (G_{01}) (irrespective of self-regulatory demands) was significant for procrastination: The more students endorsed a limited-resource theory, the more they procastinated. Most importantly, the interaction between willpower theories and mean demands (G_{03}) was significant for both the composite index and each measure of self-regulation failure except poor time management. These results support our hypothesis: a limited theory about willpower predicted

Table 3
Unstandardized Coefficients From a Multilevel Linear Model of Self-Regulation and Affect

Predictor	Composite self-regulation failure	Procrastination	Unhealthy food	Poor time management	Excess spending	Emotion-regulation failure
G_{00} intercept	2.31 (0.04)***	3.26 (0.08)***	3.00 (0.07)***	1.71 (0.05)***	1.56 (0.04)***	2.03 (0.06)***
G_{01} willpower theory (WT)	0.08 (0.04)+	0.23 (0.09)*	0.04 (0.08)	0.11 (0.06)+	0.02 (0.05)	−0.02 (0.06)
G_{02} mean demands	0.95 (0.10)***	1.18 (0.22)***	0.55 (0.19)**	0.92 (0.13)***	0.73 (0.12)***	1.27 (0.15)***
G_{03} WT × mean demands	0.17 (0.04)***	0.33 (0.09)**	0.18 (0.08)*	0.05 (0.05)	0.12 (0.06)*	0.13 (0.06)*
G_{10} weekly demands	0.05 (0.06)	0.28 (0.14)*	−0.03 (0.10)	0.32 (0.10)**	−0.04 (0.10)	−0.23 (0.14)
G_{11} WT × weekly demands	−0.07 (0.7)	−0.01 (0.18)	−0.17 (0.12)	0.09 (0.12)	−0.00 (0.12)	−0.25 (0.17)

Note. WT = willpower theory; standard errors are given in parentheses.
$^{+}p < .10$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

more self-regulation failure among students who experienced greater self-regulatory demands than their peers.

Figure 1 depicts predicted values of the composite index for students with a limited-resource (+1 *SD*) and a nonlimited theory (−1 *SD*) who dealt with high (+1 *SD*) or low (−1 *SD*) mean self-regulatory demands. Among students who generally faced high demands, those with a limited-resource theory reported significantly more self-regulatory failures than those with a nonlimited theory, $b = 0.27$, $se = 0.07$, $t(152) = 3.98$, $p < .001$.

Among students who faced lower demands, self-regulatory failures were far less frequent. Interestingly, however, among these students those with a nonlimited theory showed marginally worse self-regulation than those with a limited-resource theory, $b = -0.12$, $se = 0.07$, $t(152) = -1.81$, $p = .072$. We return to this interesting effect later.

Next, we tested the key contrast for each index of self-regulation failure. Among students who faced high demands, those with a limited-resource theory, relative to those with a nonlimited theory, procrastinated more ($b = 0.61$, $se = 0.14$, $t(152) = 4.20$, $p < .001$), consumed more unhealthy foods ($b = 0.24$, $se = 0.12$, $t(152) = 1.99$, $p = .048$), managed their time marginally more poorly ($b = 0.16$, $se = 0.09$, $t(152) = 1.91$, $p = .058$), and spent more excessively ($b = 0.16$, $se = 0.08$, $t(152) = 2.06$, $p = .041$). For emotion regulation there was a weak trend in the same direction ($b = 0.14$, $se = 0.10$, $t(152) = 1.39$, $p = .17$). To illustrate the interactions, Figure 2 depicts procrastination and unhealthy eating behavior for participants with a limited or nonlimited theory who faced high versus low demands.

For students who faced low demands, willpower theories were not significantly related to procrastination ($b = -0.15$, $se = 0.14$, $t(152) = -1.06$, $p = .29$), unhealthy eating ($b = -0.16$, $se = 0.12$, $t(152) = -1.35$, $p = .18$), bad time management ($b = 0.03$, $se = 0.08$, $t(152) = 0.38$, $p = .70$), or excess spending ($b = -0.11$, $se = 0.07$, $t(152) = -1.52$, $p = .13$). Students with a nonlimited theory, however, reported marginally worse emotion regulation when demands were low ($b = -0.18$, $se = 0.10$, $t(152) = -1.86$, $p = .064$).

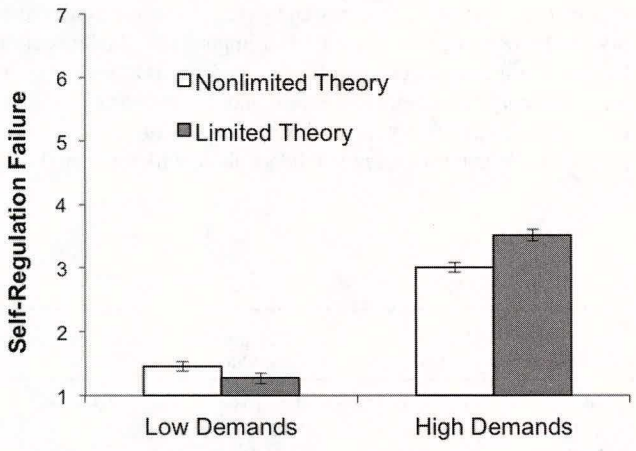

Figure 1. Mean self-regulation failure (composite index) as a function of forecasted self-regulatory demands and willpower theory. The limited and nonlimited-resource theory groups represent participants 1 *SD* above and below the mean on the willpower-theories measure. High versus low demands represents ± 1 *SD* from the grand mean.

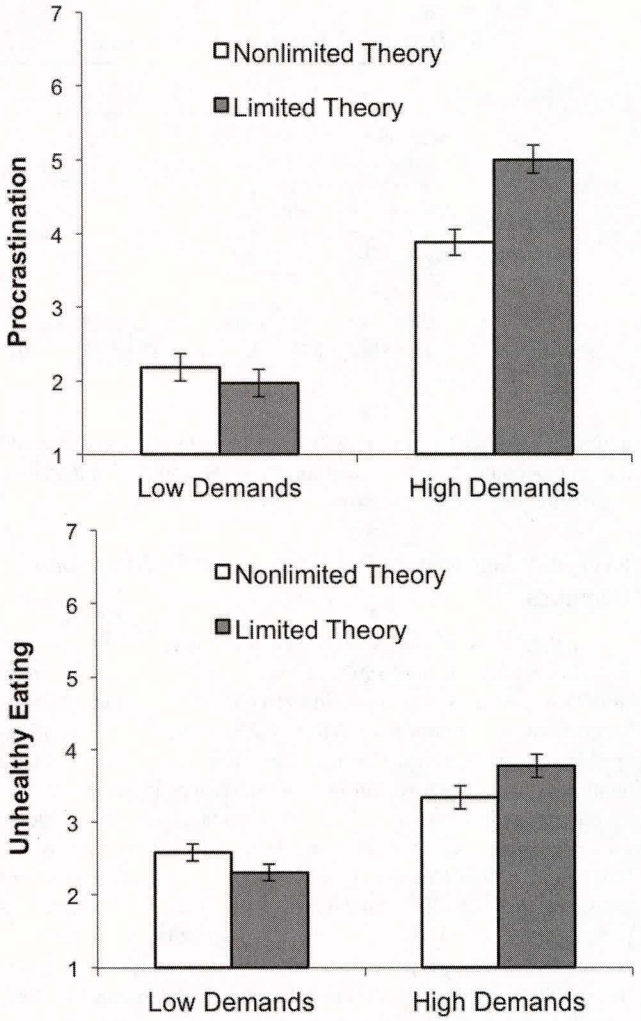

Figure 2. Mean procrastination and unhealthy eating (*1 = never, 2 = 1 time per week, 3 = 2 times per week, 4 = 3–4 times per week, 5 = 5–6 times per week, 6 = 1 time per day, 7 = two or more times per day*) as a function of self-regulatory demands and willpower theory. The limited and nonlimited-resource theory groups represent participants 1 *SD* above and below the mean on the willpower-theories measure. High versus low demands represents ± 1 *SD* from the grand mean.

We have suggested that a limited-resource theory undermines self-regulation when self-regulatory demands are high. A potential alternative explanation is that students with a limited theory anticipate and have more self-regulatory demands than students with a nonlimited theory. This was not the case. We ran an HLM analysis on students' anticipated self-regulatory demands with theories about willpower as a participant-level predictor. This analysis showed no relationship between implicit theories and anticipated demands, $b = -0.01$, $se = 0.02$, $t(552) = -0.40$, $p = .69$. Furthermore, the correlation between theories about willpower and mean self-regulatory demands was not significant, $r = -.026$, $p = .75$. Students with a limited and a nonlimited theory anticipated similar self-regulatory demands. But only students with a limited theory responded to high demands with more self-regulation failures.

A second potential alternative explanation, as noted earlier, involves trait self-control: perhaps students who endorse a limited willpower theory self-regulate less effectively in the face of self-regulatory challenges simply because they have less trait self-control. This was not the case. We ran an HLM-model predicting the composite index of self-regulation failure from theories about willpower, mean demands, and their interaction, as well as trait self-control and its interaction with mean demands as participant-level predictors. There was a significant main effect for trait self-control, $b = -0.39$, $se = 0.05$, $t(146) = -7.92$, $p < .001$: students lower in trait self-control reported more self-regulatory failures. The interaction between trait self-control and demands was also significant, $b = -0.07$, $se = 0.03$ $t(146) = -2.20$, $p = .030$: When demands were high, students low in trait self-control reported the most self-regulatory failures. However, importantly, in this analysis the interaction between theories about willpower and mean demands remained significant, $b = 0.09$, $se = 0.04$, $t(146) = 2.43$, $p = .017$. The effect of theories of willpower is not accounted for by differences in trait self-control.

In contrast to these between-participants results, within-participant results were not significant (see Table 3). First, within-participant (week-to-week) changes in demands (G_{10}) predicted only procrastination and time management failure. They were not related to the composite index of self-regulation failure. Second, there was no cross-level interaction between willpower theories and within-participant changes in demands (G_{11}). That is, there was no conjoint effect of participants' week-to week changes in demands, corrected for their mean level of demands, and theories about willpower on weekly reports of self-regulation. We suspect that a longitudinal study with more intervals over a longer period of time might be able to better detect conjoint effects of willpower theories and within-person changes in demands on participants' self-regulation. Another reason for the lack of within-person effects could be that the cumulative estimate of mean demands provides a more reliable measure of the demands a student faces than week-by-week predictions. For example, on the Monday of one week a student might predict low demands for the upcoming week, but then might accomplish less over the next few days and end up having high demands the rest of the week. Or a student might predict that the week will be a high-demand week but then an instructor grants the class an extension on an assignment and the week becomes lower in demands. If so, the anticipation of demands on a week-by week basis may be less accurate than cumulative estimates of demands over several weeks.

Academic Performance and Course Load

The self-report measures provide nuanced insight into how willpower theories predict everyday self-regulation in the face of self-regulatory demands. Next, we tested whether willpower theories also predict an objective (nonself-reported) and cumulative index of successful self-regulation over time: students' end-of-term GPA calculated from official school records. If this shows the same pattern, it would extend the self-reported indices of self-regulation and further illustrate the implications of theories about willpower for students' lives.

Willpower theories and academic performance. To test whether willpower theories predicted students' end-of-term GPA, we conducted a hierarchical regression analysis. First, we controlled for standardized GPA in the prior term, $R^2 = .47$, $F(1, 146) = 128.01$, $p < .001$. Second, we added standardized willpower theories, which was significant, $\beta = -.12$, $b = -.06$, $se = .03$, $\Delta R^2 = .02$, $F(1, 145) = 4.18$, $p = .04$. Thus, even controlling for prior GPA, the more students endorsed a limited-resource theory, the lower was their end-of-term GPA.

Next, we tested whether this was especially the case among students taking a heavy course load. We added course load and the willpower theories by course load interaction (willpower theories and course load were independent, $r = -.06$, ns). In the final model ($\Delta R^2 = .04$, $F(1, 143) = 10.74$, $p = .001$), the main effect of willpower theories was marginally significant, $\beta = -.11$, $b = -.05$, $se = .03$, $t(143) = -1.80$, $p = .08$. There was no main effect of course load, $\beta = -.04$, $b = -.02$, $se = .03$, $t < 1$. However, the willpower theories by course load interaction was significant, $\beta = -.19$, $b = -.09$, $se = .03$, $t(143) = -3.28$, $p = .001$. As shown in Figure 3, willpower theories did not predict GPA among students taking a light course load (1 *SD* below the mean, or 10.96 units out of a possible 20), $\beta = .12$, $b = .04$, $se = .12$, $t(144) = 1.01$, $p = .31$. But among students taking a heavy course load (1 *SD* above the mean, or 18.14 units), those with a limited-resource theory earned lower GPAs ($M_{est} = 3.41$) than those with a nonlimited theory about willpower ($M_{est} = 3.69$), $\beta = -.41$, $b = -.14$, $se = .11$, $t(144) = -3.77$, $p < .001$. In addition, a heavy course load was associated with worse performance only for students with a limited-resource theory, $\beta = -.32$, $b = -.11$, $se = .12$, $t(144) = -2.81$, $p = .006$. Students with a nonlimited theory actually performed slightly better when they had a heavy course load, $\beta = .21$, $b = .07$, $se = .11$, $t(144) = 1.81$, $p = .07$.

We also tested whether a limited theory predicted worse grades on a longitudinal basis—that is, when students' course load increased from one term to the next. We examined students' current-term GPA, with prior-term GPA controlled, and tested the effects of willpower theories, change in course load (difference between current term course load and previous term course load,

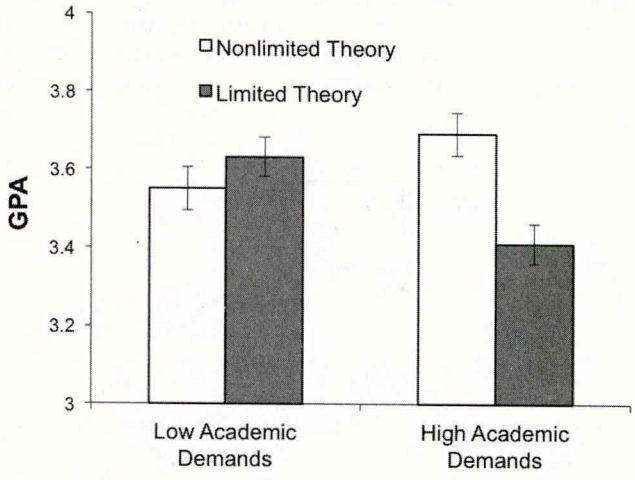

Figure 3. Mean GPA as a function of academic demands (units taken) and willpower theory (± 1 *SD* on the willpower theory measure). High versus low demands represent ± 1 *SD* from the grand mean. Means are adjusted for prior-term GPA, age, and sex.

$M_{change} = -0.76$ units, $SD = 3.26$ units) from the prior term to the current term, and the willpower theories by change-in-course-load interaction. The interaction was significant, $\beta = -.13$, $b = -.06$, $se = .03$, $t(143) = -2.17$, $p = .03$. Among students whose decrease in course load was high ($M_{change} - 1\ SD = -0.76 - 3.26$ = decrease of 4.02 units), there was no effect of willpower theories on grades, $t < 1$. But among students whose course load highly increased ($M_{change} + 1\ SD = -0.76 + 3.26$ = increase of 2.5 units), those with a limited theory earned worse grades than those with a nonlimited theory, $\beta = -.35$, $b = -.12$, $se = .12$, $t(144) = -2.95$, $p = .004$. These findings confirm that GPA varies with students' implicit theories about willpower and their changing course load.

As was the case for everyday self-regulation, the effect of willpower theories on GPA was not accounted for by trait self-control. We conducted a hierarchical regression predicting GPA from previous-term GPA (block 1), theories about willpower, course load, and trait self-control (block 2), as well as the interactions between course load and trait self-control and between course load and willpower theories (block 3). In the final model ($\Delta R^2 = .54$, $F(6, 124) = 24.04$, $p < .01$) the main effects for trait self-control and willpower theories were both nonsignificant, $\beta = .10$, $b = .04$, $se = .03$, $t(124) = 1.49$, $p = .14$, and, $\beta = -.08$, $b = -.04$, $se = .03$, $t(124) = -1.31$, $p = .19$, respectively. The course load by trait self-control interaction was also not significant, $\beta = -.07$, $b = -.03$, $se = .03$, $t(124) = -1.08$, $p = .28$. However, the course load by willpower theory interaction remained significant, $\beta = -.23$, $b = -.10$, $se = .03$, $t(124) = -3.71$, $p < .01$. In the face of a heavy course load, willpower theories predict GPA above and beyond trait self-control.

Mediation. Finally, we tested whether greater procrastination explained the relationship between a limited willpower theory and GPA. Past research shows that procrastination leads to lower grades (Steel, 2007). Likewise, in the present research mean procrastination (averaged over five weeks) predicted GPA controlling for previous-term GPA [partial $r(145) = -.32$, $p < .001$]. Since the previous analysis showed that theories about willpower affect students' procrastination, we tested whether students' mean procrastination mediated the effect of willpower theories on GPA controlling for previous-term GPA (Figure 4). We did so using the INDIRECT macro (Preacher & Hayes, 2008), which uses bootstrapping to estimate the indirect effect of an independent variable (i.e., willpower theories) on a dependent variable (i.e., GPA) through a mediator (i.e., procrastination). Because the macro provides only unstandardized path coefficients all variables were z-standardized prior to using the macro to generate standardized coefficients. The mediational model was significant, $R^2 = .53$, $F(3, 144) = 52.71$, $p < .001$. As reported earlier, there was a main effect for willpower theories predicting procrastination; a limited theory predicted greater procrastination, $\beta = .18$, $se = .07$, $t(144) = 2.60$, $p = .01$. The direct effect of procrastination on GPA was also significant, $\beta = -.11$, $se = .03$, $t(144) = -3.75$, $p < .001$. The more students procrastinated the lower was their end-of-term GPA. The bootstrapped indirect effect was different from zero, 95% CI ($-.005$, $-.047$), and the direct effect of willpower theories on GPA was no longer significant, $\beta = -.03$, $se = .03$, $t(144) = -1.30$, $p = .20$. The other indicators of self-regulatory failure did not show this meditational pattern. The results suggest that the more students endorsed a limited-resource theory of willpower, the more they procrastinated and the lower the GPA they earned.

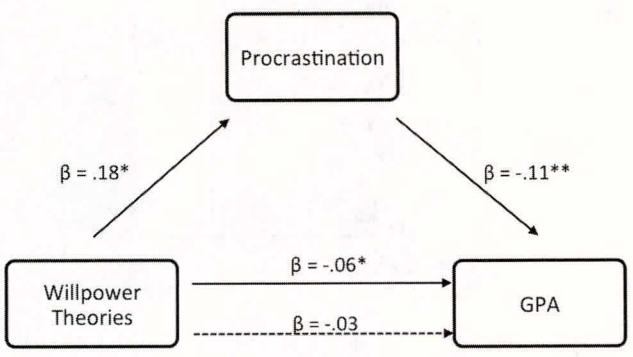

Figure 4. Mediation model testing the indirect effect of willpower theory on GPA through procrastination. * $p < .05$. ** $p < .001$.

General Discussion

The present research shows that students who think that willpower is limited and easily depleted—the view of willpower suggested by the strength model of self-control—self-regulate less well in their everyday lives when they face high self-regulatory demands. Far from conserving their resources and showing strong self-regulation when needed, students who endorsed the limited theory and who faced high demands over the term, procrastinated more (e.g., watching TV instead of studying), ate more junk food, and reported more excessive spending as compared to students with a nonlimited theory about willpower. This was the case even though students with a limited and a nonlimited theory faced similar self-regulatory demands. By measuring students' self-regulatory demands, the present study provides the first direct evidence that it is precisely in the face of consistently high demands that a nonlimited theory of willpower predicts better everyday self-regulation.

Importantly, we found the same pattern for students' term grades, an objective and inherently important variable resulting from successful self-regulation. Among students who took a heavy course load, students with the limited theory earned lower grades than students with the nonlimited theory. They did so, a mediation analysis suggested, because they were more likely to procrastinate in completing their work. By contrast, the nonlimited theory led people to deploy their resources more effectively when they were needed most. Notably, the effects of willpower theories on everyday self-regulation and on GPA did not arise because students with a limited theory had lower trait self-control. The patterns remained significant controlling for trait self-control.

Our findings contradict the hypothesis that a nonlimited theory about willpower undermines self-regulation and does so especially when demands are high. Relying on a laboratory experiment, Vohs and colleagues (2012) suggested that the belief that willpower is nonlimited might counteract ego depletion only in cases of mild or moderate demands but not when self-control demands are "severe." They speculated that this belief could even amplify ego depletion and worsen self-regulation by undermining people's

"normal tendency" to conserve their resources and then deploy them when they were needed. To the contrary, examining students' success and failure self-regulating in a highly demanding academic environment, we found that the nonlimited theory was most predictive of better outcomes among students who faced the greatest demands on their self-regulation.

In fact, it was only among students who faced *low* demands—when self-regulation lapses may be less costly—that students with a nonlimited theory "wasted" their self-regulatory resources relative to those with a limited theory. Under these conditions, they reported giving in to impulses and pursuing nonacademic activities at least as much as, if not more than, students with a limited theory. Thus, students with a nonlimited theory are not self-control super heroes who never give in to temptations; nor are they unwilling to admit self-regulatory failure. This view is further supported by the rather low correlation between theories about willpower and trait self-control (−.17), suggesting that those with a nonlimited theory are not simply natural self-regulators or people with outsized self-control abilities. Rather, those with a nonlimited theory are people who lean in when demands on self-regulation are high.

This pattern was replicated in the analysis of students' academic performance, where a nonlimited versus limited willpower theory predicted higher GPA among students who took heavy course loads. It was also interesting to find that participants with a nonlimited theory tended to earn even higher grades when they were dealing with a heavy course load than when they were taking a light course load. These latter findings suggest that people with a nonlimited theory may even profit from challenging circumstances. Indeed, it is possible that in situations where they are not sufficiently challenged (e.g., in a boring job), people with a nonlimited theory might be the ones to show lower performance. For them, boredom or lack of challenge may be depleting! In short, people with a nonlimited theory about willpower look strong when high demands require effective self-regulation but do not perform better when demands are low.

Why did Vohs and colleagues (2012) find a different pattern in a laboratory study—that the benefits of a nonlimited theory for self-control performance disappeared as the number of self-control tasks increased? As a laboratory session wears on, many other factors beyond participants' self-control capacity may affect their willingness to exert further self-control on laboratory tasks. For instance, participants may simply decide that they have done enough and/or that the tasks are no longer interesting or consequential. A nonlimited theory about willpower would not be functional if it led people to engage on a high level with every task that came along regardless of its value or purpose. Future laboratory research may decompose the capacity to exert self-control from the value or meaning of a task to the self.

In Vohs and colleagues' (2012) research as well as in other recent theorizing on ego depletion (Inzlicht & Schmeichel, 2012; Inzlicht, Schmeichel, & Macrae, 2014) the effects of willpower theories are grouped together with those of other "motivational" factors such as monetary incentives. It is often assumed that both counteract ego depletion through enhanced motivation. Research on theories about willpower, however, proposes a different perspective. A nonlimited theory does not just motivate people to regulate themselves better; instead, it removes a process that undermines self-regulation. Our previous research suggests that a limited-resource theory makes people more sensitive to or more vigilant for cues that signal the availability of mental resources, like perceived exhaustion or ingested glucose (Job et al., 2010, 2013). From this perspective people with a limited-resource theory perform worse under high demands because as soon as they experience even low-level signs of strain or exhaustion (as soon as they perceive any "depletion") they begin to reduce effort on the task at hand. Instead of staying focused on a demanding task they turn toward saving and/or replenishing their presumably limited resources. Thus, willpower theories are not simply another variable that changes the incentive value of a task. Rather, by affecting the fundamental assumptions people make about the nature and workings of willpower, they can change how people approach and enact self-regulation itself.

The present results suggest that a nonlimited theory of willpower is functional in a student sample facing high demands and likely in other populations facing self-regulation challenges. But if so, why do many people believe that willpower is limited? Vohs and colleagues (2012) argued that if a nonlimited theory were beneficial, these benefits would have led the theory to spread across individuals and cultures. But a belief need not be functional to spread. It just has to be simple and appealing (Bangerter & Heath, 2004; Dawkins, 2006; Wagner, Kronberger, & Seifert, 2002). A fixed mindset about intelligence (the belief that intelligence is fixed not malleable) is a simple and widespread idea that can have clear negative effects, for instance, in undermining students' resilience and academic achievement (Blackwell, Trzesniewski, & Dweck, 2007; Dweck & Leggett, 1988; Hong, Chiu, Dweck, Lin, & Wan, 1999). Furthermore, both a fixed mindset about intelligence and a limited-resource theory about willpower can have psychological benefits; for instance, as a justification for putting forth low effort in the face of challenging tasks or temptations (see, e.g., Job et al., 2010; Robins & Pals, 2002).

Although a limited-resource theory might serve some psychological functions, the present research documents its costs. The ability to self-regulate successfully is one of the most robust predictors of major life outcomes, including health, wealth, and well-being (Moffitt et al., 2011). A critical question for future research involves better understanding the causal effects of willpower beliefs in everyday settings and, if causal, how to change these beliefs to increase self-regulatory success. Laboratory studies show that implicit theories about willpower can be manipulated and that their effects when manipulated parallel their effects when measured (Job et al., 2010, 2013; Miller et al., 2012). Thus, it seems probable that willpower beliefs have causal effects in everyday life settings and, in these settings too, they may be changed. Nevertheless, randomized field-experiments that manipulate willpower beliefs and examine everyday self-regulatory outcomes are necessary to establish causality. Such field experiments would also test a novel means to improve people's self-regulatory outcomes, a pressing issue (Diamond, 2012; Duckworth, Grant, Loew, Oettingen, & Gollwitzer, 2011). Previous field experiments show that it is possible to change people's implicit theories about intelligence and personality in field settings, with beneficial consequences, including for academic performance (Aronson, Fried, & Good, 2002; Blackwell et al., 2007) and social outcomes (Yeager, Trzesniewski, & Dweck, 2013). Such interventions give people information (e.g., scientific reports) about the nature of human qualities and help them internalize this information using pow-

erful persuasive techniques (e.g., "saying-is-believing" exercises, Aronson, 1999; see also Yeager & Walton, 2011). Could this approach change people's beliefs about the nature of willpower in a relatively enduring way?

Importantly, it may be essential to pair such learning opportunities with information about effective strategies that can help people avoid self-regulatory failures. Although the present research did not examine self-regulation strategies, these strategies may be an important consideration in the development of interventions to promote a nonlimited theory of willpower. Ironically, simply learning that willpower is stronger than one might have supposed could backfire if this encourages people to put themselves in situations they are ill-equipped to deal with (e.g., keeping temptations close at hand in the belief that they will be able to resist them indefinitely). Effective self-regulation strategies may involve formulating plans to cope with temptations (e.g., implementation intentions) or structuring one's environment to avoid temptations (e.g., putting junk food in a high cabinet, blocking Facebook while trying to study) (Duckworth et al., 2011; Magen & Gross, 2007; Neal, Wood, & Drolet, 2013; Stadler, Oettingen, & Gollwitzer, 2010; Webb & Sheeran, 2003). Both for broad populations in demanding environments (e.g., students) and for clinical populations (e.g., diabetics), it would be exciting if exercises to teach people a nonlimited theory plus effective self-regulatory strategies could increase their success as they face stressful demands and strive to accomplish their goals.

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