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Improvements in self-control from financial monitoring

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Abstract

We tested whether the repeated practice of self-control could improve regulatory strength over time. Regulatory performance was assessed at baseline, then at monthly intervals for a period of four months using a visual tracking task. Perceived stress, emotional distress and self-efficacy were assessed by questionnaire. Participants entered a four-month self-control exercise drill designed to increase regulatory strength: a financial monitoring program. Participants showed significant improvement in self-regulatory capacity as measured by an enhanced performance on the visual tracking task following a thought-suppression task. Perceived stress, emotional distress and self-efficacy remained stable. A control group not participating in any self-control exercise showed no signs of improvement over the same time span.

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1. Introduction

The ability to alter the self is an important feature of human behavior. Self-regulation (or self-control) refers to the self's capacity to exert control over responses and states

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(Baumeister, Heatherton, & Tice, 1994). Self-regulation overrides one pattern of responses, and substitutes another (or lack of) in its place. These responses may include thoughts (e.g., suppressing thoughts), emotions (regulating moods), managing performance (e.g., performing under distraction), and impulse control (e.g., delaying gratification). One regulatory domain that has enjoyed recent attention is consumer psychology (Vohs & Faber, in press; Vohs & Faber, 2004). US consumer debt has doubled over the past 10 years, and it is not at all surprising when we consider all the desirable goods splashed across billboards, movie screens and the Internet which continually tempt us (Durkin, 2000). Unfortunately few can afford to purchase all that the heart desires. Yet we often find ourselves splurging precious dollars on unnecessary, but immediately satisfying goodies, instead of working toward the greater, distal goal of long-term investment.

Self-regulation has been portrayed as having three key components: (1) standards (or goals); (2) engaging in actions that lead to obtaining one's standard or goal; and (3) monitoring progress toward the goal (Baumeister et al., 1994; Carver & Scheier, 1998). Together, these components are called a test-operate-test-exit (TOTE) system. The TOTE system conceptualizes self-regulation as occurring within a feedback loop, which "tests" current behavior against standards such as goals and/or expectations (Carver & Scheier, 1981). The loop will continue until the standard is achieved.

A recent model of self-regulation considers the "operate" phase of the TOTE system, and proposes that the process of change required for goal attainment relies upon a common, limited supply of energy (Baumeister et al., 1994). The nature of this energy is considered to be akin to muscular strength. Like a muscle, the capacity for self-control is likely to deplete under conditions of repeated or constant activation.

In experiments testing the effects of ego depletion, participants are administered consecutive regulatory tasks. The first regulatory task is expected to deplete regulatory strength rendering further acts of self-control less likely to succeed. For instance, Vohs and Heatherton (2000) found that dieters ate significantly more when instructed to suppress emotional responses to a video clip, compared to when they could respond naturally. The findings of depletion have been replicated several times with individuals unable to maintain self-regulatory behavior in the second instance across a variety of behavioral domains (Finkel & Campbell, 2001; Muraven, Tice, & Baumeister, 1998; Vohs & Heatherton, 2000; Vohs & Schmeichel, 2003).

Despite the many results showing the depletion of self-regulatory resources, the effect of depletion manipulations is not inevitably a loss of self-regulatory behavior. Prior research suggests that individuals will call up their energy when the incentives to do so are sufficient, but will fail to do so when the outcome is less important (Brehm & Self, 1989; Muraven & Slessareva, 2003; Wright, 1996). Muraven and Slessareva (2003) found that individuals who are sufficiently motivated are able to override the effects of depletion. For example, depleted individuals who had received extra incentives (small monetary rewards or a chance to help scientific research) performed better on a subsequent test of self-control than individuals who were depleted and lower in motivation. Hence, depleted individuals may compensate for their lack of self-control resources when sufficiently motivated. Therefore, both self-regulatory resources and motivation determine regulatory success.

The findings of motivation overcoming depletion are encouraging, but there is further reason for optimism. Individuals who practice self-control may be able to improve their regulatory abilities. Muraven, Baumeister, and Tice (1999) had participants perform

various self-control drills, such as improving posture, keeping track of eating habits, or regulating emotions, over the course of two weeks. Participants subsequently showed an improved regulatory performance on laboratory tasks relative to a control group who had not engaged in any of the self-control drills. There are two ways in which self-control strength could be improved. These are consistent with the ways in which muscular strength can be increased: power (an increase in the baseline capacity), and stamina (a reduction in vulnerability to fatigue). Muraven et al. (1999) found evidence for increased stamina. That is, the repeated practice of self-control appeared to improve people's ability to resist the debilitating effects of resource depletion.

We sought to extend these findings in a series of experiments that involved the adoption of a self-control program (academic study program or physical activity program) over the course of a university semester (Oaten & Cheng, 2006a, 2006b). We found significant improvements in a wide range of self-regulatory behaviors, including a laboratory task (visual tracking under distraction) and on many self-reported everyday regulatory behaviors. In particular, individuals who participated in either of the self-control drills (academic study program or physical activity program) showed increments in a range of self-control domains: related (e.g., improved study habits or improved healthy eating), unrelated (e.g., reduced impulsive spending), and laboratory based (better visual tracking). The exercise of self-control appears to improve people's ability to resist the debilitating effects of resource depletion.

1.1. Present research

The present study was designed to replicate our earlier findings that the repeated practice of self-control could improve regulatory strength. In order to test the generality of the resource model we deliberately selected a self-control drill from a behavioral domain not previously targeted. The self-control exercise used in the present study had participants engage in a financial monitoring program (Dominguez & Robin, 1992).

Many of us find ourselves spending more money than we would like, at some time in our lives. Typically, we find it relatively difficult to rein in our spending because Western society provides endless opportunities for impulse spending. Credit card holding has increased steadily over the past 20 years. According to a recent survey of consumer finances (SCF, 1998), more than two-thirds of US households had a bank-type credit card, compared to only 43% in 1983 (Durkin, 2000). The majority of households with a bank-type credit card had not paid off their last credit card bill in full, and thus carried an outstanding balance, not including new charges, on that card at the time of the survey interview. Furthermore, research on the attitudes of credit card holders shows that about 40% of cardholders perceive self-control problems emanating from the availability of credit cards and the possibility of overspending and overextending financial resources (Durkin, 2000). Recent research in consumer psychology suggests that self-control problems occur when the rewards of consumption occur earlier than the costs (Hoch & Loewenstein, 1991).

In a recent set of studies, the effect of impulsive spending on self-regulatory resources was tested (Vohs & Faber, in press). Participants who had to control their thoughts felt stronger urges toward impulsive buying than did control participants. In a second study, participants whose regulatory resources were depleted reported that they would spend more money in a simulated spending situation compared to control participants. Finally, in a third study, participants who had suppressed their thoughts spent more

money and purchased more items than non-depleted participants. These findings suggest that depleting people's regulatory resources leads to impulsive spending. Collectively, the abovementioned findings suggest that managing one's spending and saving habits requires significant regulatory effort, and the implementation of a financial monitoring program was therefore considered an appropriate self-control drill for the present study.

We have found evidence for regulatory improvement in just two weeks (Oaten, Cheng, & Baumeister, unpublished data) and eight weeks (Oaten & Cheng, 2006a, 2006b). We sought to extend our past work by lengthening the self-control drill: the present study tracked regulatory behavior over a period of four months. In experimental design, two cohorts participated in the study. The Experimental Cohort entered the financial monitoring program; they were tested at the commencement of the financial monitoring program (baseline), and again each month, for a period of four months. The Control Cohort was tested across the same time span, but they did not take on any self-control program. We measured self-control performance on a standard lab task. We used visual tracking under distraction, which required participants to perform a computerized visual tracking task (VTT) while a distracter video played simultaneously (see Oaten & Cheng, 2006a, 2006b). In the present study, the VTT was administered twice in each testing session. In between the two VTT runs (during each session) participants were told to control their thoughts by not thinking about a white bear. If the thought suppression task depleted self-regulatory strength, people would perform worse on the second VTT compared to the first. Our previous research has found that performance on this task is sensitive to an intervening thought-suppression task, with decrements in regulatory performance following just 5 min of thought suppression (Oaten & Cheng, 2006a, 2006b). The self-control drill, however, attenuated the detrimental effect of the thought-suppression task on VTT performance. In this study, we were interested in finding out whether a financial monitoring program would produce the same effects. If the repeated practice of self-control does augment regulatory resources, we would expect an improvement in self-regulatory behavior across the financial monitoring program in the Experimental Cohort but not in the Control Cohort.

2. Method

2.1. Participants

Sixty (18 men and 42 women) Macquarie University undergraduates recruited from an introductory psychology subject-pool website volunteered to participate, in return for a partial course credit. Participants were randomly assigned to one of the two cohorts (Experimental or Control) via online registration for project participation. Each cohort was assigned 30 participants.

Forty-nine (12 men and 37 women) attended the first experimental session. Participants assigned to the Experimental Cohort ($n = 29$; 7 men and 22 women; mean age of 24 years) entered the financial monitoring program. Participants assigned to the Control Cohort ($n = 20$; 5 men and 15 women; mean age of 26 years) provided general controls.

All participants were individually tested in five experimental sessions, separated by four-week interim periods. The initial testing session for the Experimental Cohort was of 60-min

duration; all sessions thereafter were of 30-min duration. All testing sessions for the Control Cohort were of 30-min duration. Participants did not know the experimenters personally.

2.2. Personal financial monitoring program for experimental cohort

Participants were instructed to bring any personal spending and/or banking records (i.e., cheque butts, bank statements, credit card statements, receipts, etc.) from the last month to provide a baseline measure of personal spending and/or banking. The experimenter discussed with the participant their financial goals, and a personalised financial monitoring program was then prepared (Dominguez & Robin, 1992).

Money is an area in which people commonly display a lack of self-control (Dominguez & Robin, 1992). People tend to consume today at the expense of saving for tomorrow. The financial monitoring program requires self-control in that participants have to manage immediate spending and saving patterns to attain long-term financial goals. To assist the participant in adhering to their new personalized financial program we devised spending diaries (spreadsheets) and program logs that would help the participants' track their spending over the relevant months. Participants were first instructed to figure out the spending categories that best reflect the uniqueness of their life. The categories decided upon by the participant were then entered into the spending diary spreadsheet.

Participants then received direction regarding diary maintenance. Participants were advised that at the end of each relevant month the following calculations needed to be made: Add up their income column(s) to get their total monthly income (A); Add up the expenditures in each category column and enter the total at the bottom of that column, and to then add the totals for all expenditure categories to get their total monthly expenses (B); Participants were then asked to subtract total monthly expenses (B) from total monthly income (A) to calculate total monthly savings (C). Participants were then instructed to record progress in the spending diaries provided and to return them prior to each experimental session.

The program log was employed as a manipulation check to ensure that participants were adhering to the personal financial monitoring program. Participants were asked the following questions: "Detail any non-planned purchases, if any, in the last month"; "How do you feel about those purchases now?"; "What level of difficulty, if any, have you experienced complying with the program?"; "Do you feel you are progressing with the program?"; "Do you wish to comment on the program generally?". Participants were instructed to record comments in the program log and to return them prior to each experimental session.

2.3. Psychosocial self-reports

2.3.1. The general health questionnaire

Emotional distress was assessed in all sessions using the 28-item version of The general health questionnaire (GHQ; Goldberg, 1972). This measure assesses symptoms of emotional distress in four areas: anxiety/insomnia, somatic symptoms, social and cognitive dysfunction, and depression. The questionnaire referred to respondents' experiences over the past week and was coded using a method that assigns weights of 0, 1, 2 and 3 to each answer option. Reliability was evaluated using the test–retest method and internal

consistency was assessed using Cronbach's alpha. A high degree of internal consistency was reported with Cronbach's alpha of 0.87. The test–retest correlation coefficient was reported as 0.88.

2.3.2. Perceived stress scale

Perceived stress was measured in all sessions using the 10-item version of the perceived stress scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). Each item (e.g., "In the last week, how often have you felt that things were going your way?") was assessed on a five-point scale, with higher scores indicating a greater stress. The PSS has an overall Cronbach alpha of .87 and retest reliability was reported as .85 (Cohen et al., 1983).

2.3.3. General self-efficacy scale

Self-efficacy was measured in all sessions using the 10-item version of the general self-efficacy scale (GSES; Jerusalem & Schwarzer, 1992). Each item (e.g., "It is easy for me to stick to my aims and accomplish my goals") was assessed on a five-point scale, with higher scores indicating higher perceived self-efficacy. The scale typically yields internal consistencies between alpha = .76 and .91. Its stability is satisfactory with retest reliability reported as .75 (Jerusalem & Schwarzer, 1992).

2.4. Visual tracking under distraction

A laboratory task of self-control was administered, twice in each testing session. Participants performed a computerized visual tracking task (VTT) while a distracter video aired simultaneously. The distracter video included excerpts from a comedic performance by Eddie Murphy (Murphy, Tieken, & Wachs, 1983). The VTT calls for participants to visually track the movement of multiple targets displayed on a computer monitor. The participant must ignore the humorous distracter video content and attend to the computer monitor to do well on the (VTT). In some recent work, VTT performance deteriorated only when following tasks that required some form of regulatory exertion, in particular, a thought-regulation task, or emotion-regulation, but was unaffected when following tasks that did not require self-control (watching humorous videos; Oaten, Chau, & Cheng, in preparation). Thus, this task is sensitive to depletion manipulations, but not to non-depleting tasks, and has been validated in previous research to assess self-regulatory capacity (Oaten & Cheng, 2006a, 2006b).

Stimuli were displayed on an i-mac computer equipped with a 15-inch monitor set to a resolution of 800 × 600 pixels and a refresh rate of 95 Hz. Participants were seated 54 cm away from the monitor. The VTT was controlled and measured using Psyscript (Bates & D'Oliviero, 2000). Each VTT consisted of 16 trials. At the beginning of each trial, six black squares (20 × 20 mm) were presented in a horizontal line. After 2 s, three target items were highlighted with small flashing probes (disappearing and reappearing for five flashes). Then all items moved in random trajectories for 5 s. After all of the items stopped moving, the subject had to indicate the three target items using the mouse. The final mouse-click caused the display to disappear, and the subject initiated the next trial with a key-press.

Forty-eight sets of trajectories (and target selections) were generated and stored off-line. Subjects completed a practice trial for which the data were not collected, and then completed the experimental trials in a randomized order (different for each subject).

2.5. Thought-suppression task

Following the initial measure of self-regulatory performance, a thought suppression exercise was administered to manipulate regulatory exertion. The procedure, developed by Wegner, Schneider, Carter, and White (1987), requires the participant not to think about a white bear. This task has been used previously to deplete self-regulatory strength (Muraven et al., 1998, 1999). The thought-suppression task was used in all experimental sessions for measurement uniformity. Participants were first instructed to write down all their thoughts on a piece of paper for 5 min, one thought per line, so that the experimenter could "see how you use words in naturally occurring sentences" (Muraven et al., 1998). Participants were then instructed to list any thoughts that came to mind with the admonition that they should avoid thinking about a white bear. Participants were told that whenever they thought of a white bear, they should write that thought down, but then try very hard not to think of a white bear again.

2.6. Control Cohort

The participants in the Control Cohort provided controls over the same time period as the Experimental Cohort. During this period, they behaved like the Experimental Cohort (i.e., attending five experimental sessions, separated by four-week interim periods), except that they did not engage in the financial monitoring program. The control group tests whether any obtained findings were the result of repeated testing (practice effects).

2.7. Procedure

In each session, participants signed experimental consent forms, were administered in order a visual tracking task, the thought-suppression task, and then a second visual tracking task. Measures of emotional distress, perceived stress, and self-efficacy were then obtained. Participants were debriefed in the final experimental session.

3. Results

3.1. Manipulation checks

3.1.1. Spending diaries

The Experimental Cohort returned all spending diaries as instructed. Fig. 1 summarizes the mean monthly totals for income, spending and saving. The Experimental Cohort was the only cohort to participate in the financial monitoring program and was therefore the only cohort included in the following analyses. The reported monthly totals for spending were entered into a Session (Baseline, 1 month, 2 months, 3 months, 4 months) repeated measures ANOVA. The ANOVA found a significant main effect for Session, F (4, 112) = 104.00, $p < .001$. Reported monthly saving totals were also entered into a Session (Baseline, 1 month, 2 months, 3 months, 4 months) repeated measures ANOVA. There was a significant main effect for Session, F (4, 112) = 109.66, $p < .001$. There was no effect for income. These results suggest that while average income did not change, participants' saved increasingly more money each month.

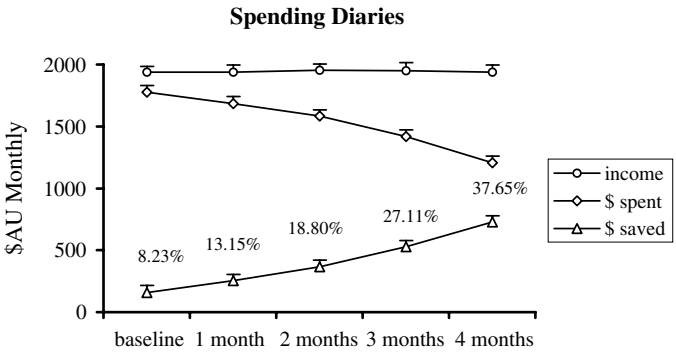

Fig. 1. Reported monthly totals for income, spending and saving (M ± SE) for the Experimental Cohort, across the testing sessions (financial monitoring program). Reported percentages are average percentage saving (saving as percentage of income). Error bars represent standard errors of the mean.

We tested whether the observed differences in monthly spending totals differed between testing sessions. Monthly spending totals (baseline vs. 1 month; 1 month vs. 2 months; 2 months vs. 3 months; 3 months vs. 4 months) were entered into protected paired *t*-tests ($\alpha = 0.05/5$). Monthly spending totals differed significantly between all testing sessions: Baseline vs. 1 month, t (28, [M.diff = 94.44]) 5.857, $p < .001$; 1 month vs. 2 months, t (28, [M.dif = 97.46]) 6.556, $p < .001$; 2 months vs. 3 months, t (28, [M.diff = 165.39]) 7.798, $p < .001$; 3 months vs. 4 months, t (28, [M.diff = 211.82]) 7.364, $p < .001$. These findings suggest that spending patterns improved, as demonstrated by the significant decrease in reported spending totals across sessions.

We also tested whether the monthly saving totals differed between testing sessions. Monthly saving totals (baseline vs. 1 month; 1 month vs. 2 months; 2 months vs. 3 months; 3 months vs. 4 months) were entered into protected paired *t*-tests ($\alpha = 0.05/5$). Monthly saving totals differed significantly between all testing sessions: Baseline vs. 1 month, t (28, [M.diff = −95.48]) −6.134, $p < .001$; 1 month vs. 2 months, t (28, [M.diff = −112.29]) −8.191, $p < .001$; 2 months vs. 3 months, t (28, [M.diff = −161.15]) −7.720, $p < .001$; 3 months vs. 4 months, t (28, [M.diff = −201.24]) −9.168, $p < .001$. These findings suggest that saving patterns improved with a significant increase in reported monthly banking totals across sessions.

3.1.2. Program log

The Experimental Cohort returned all program logs as instructed. An inspection of the logs indicated that all participants recorded progress on the financial monitoring program as instructed. Accordingly, the content of the program log suggested a roughly equal expenditure of effort from all participants.

Entries from the spending diaries indicate that the financial monitoring program required self-control. For example, some participant comments include: "I really want to buy a car, but it is so hard banking each week because I feel like I am missing out on so many things … but I think it will be worth it in the long run" and "I'm actually saving … I pretty much have to stay indoors so that I don't end up blowing my budget on lots of little things … I have to use all my willpower because I really want to go on a nice holiday at the end of semester." Participant comments also suggest that the financial monitoring program

required ongoing regulatory effort. For example, some comments include: "My balance is definitely improving, but I have to constantly watch myself, so I don't spend money I'm not supposed to"; "I carry a notepad to record every cent I spend with the hope that this will help me stop wasting my money … but I often end up shopping with my friends"; and "I love looking at my bank account now that it has some money in it … but now it seems all my self-control is used up trying to not spend it."

3.2. Visual tracking task

3.2.1. Between-subjects effects

Figs. 2a and 2b summarizes the performance of the Experimental Cohort on the VTT across the financial program. The thought-suppression task caused a deterioration of performance during the baseline session of the financial program (baseline), but this deterioration appeared to attenuate across testing sessions (1 month, 2 months, 3 months, 4 months). We conducted a mixed analysis with Session and Time serving as within-subjects variables and Cohort as the between-subjects variable. The ANOVA compared Experimental and Control Cohorts, with Session (Baseline, 1 month, 2 months, 3 months, 4 months) × Time

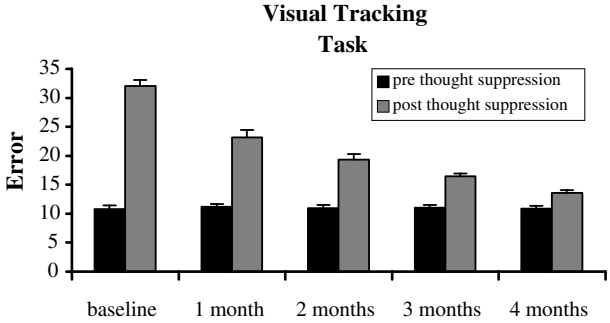

Fig. 2a. Error rate on the visual tracking task (M ± SE) for the Experimental Cohort, measured before and after the thought-suppression task over time.

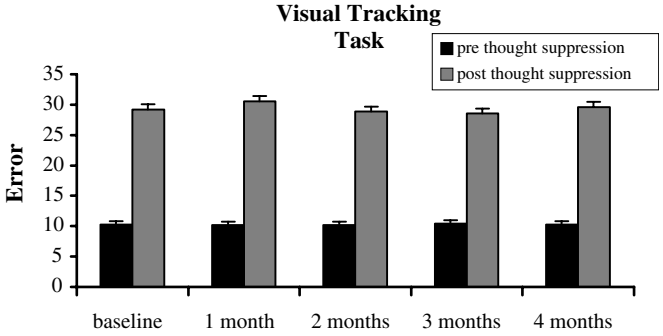

Fig. 2b. Error rate on the visual tracking task (M ± SE) for the Control Cohort, measured before and after the thought-suppression task over time.

(before thought-suppression vs. after thought-suppression) × Cohort (Experimental Cohort vs. Control Cohort) as factors. The ANOVA found a significant main effect for Time, $F(1, 47) = 1690.20$, $p < .001$, indicating a general tendency toward depletion following a previous self-regulatory act. There was also a significant Time × Cohort interaction, $F(1, 47) = 167.35$, $p < .001$, indicating that the rates of depletion differed across the cohorts. The ANOVA found significant main effect for Session, $F(4, 188) = 34.26$, $p < .001$, suggesting that VTT performance differed across Sessions, a significant Session × Cohort interaction, $F(4, 188) = 32.48$, $p < .001$, indicating that VTT performance differed across cohorts, a significant Session × Time interaction, $F(4, 188) = 52.16$, $p < .001$, indicating that rates of depletion differed across Sessions, and importantly, a significant Session × Time × Cohort interaction, $F(4, 188) = 48.13$, $p < .001$. These findings suggest that relative to controls, participation in the financial monitoring program improved regulatory stamina, increasing resistance to the debilitating effects of a manipulation of regulatory depletion.

3.2.2. Within-subjects effects

We were interested to test whether VTT performance of the Experimental Cohort (pre- and post-thought-suppression) differed at each testing session. Performance on the VTT (pre- and post-thought-suppression) at each testing session was entered into protected paired t-tests ($\alpha = 0.05/5$). There was a significant difference between pre- and post-suppression VTT performance at each testing session of the financial program, baseline, t (28, [M.diff = −21.28]) −28.031, $p < .001$; 1 month, t (28, [M.diff = −12.00]) −10.145, $p < .001$; 2 months, t (28, [M.diff = −8.34]) −9.381, $p < .001$; 3 months, t (28, [M.diff = −5.41]) −15.825, $p < .001$; 4 months, t (28, [M.diff = −2.72]) −15.285, $p < .001$. These findings suggest that the financial program helped to reduce but not eliminate the effects of depletion.

We wanted to check that the observed effects were not practice induced. We tested whether the pre-thought-suppression performance of the Experimental Cohort on the VTT differed across Sessions. Performance on the VTT (pre-thought-suppression) at each testing session was entered into a repeated measures analysis of variance, with Session (Baseline, 1 month, 2 months, 3 months, 4 months) as the within-subjects factor. The ANOVA showed no effect of Session. There was no improvement on pre-measure VTT performance across sessions. These findings speak against practice effects.

We also entered the VTT performance of the Control Cohort into a Session (baseline, 1 month, 2 months, 3 months, 4 months) × Time (before thought-suppression vs. after thought-suppression) repeated measures ANOVA. The ANOVA found a significant main effect for Time, $F(1, 19) = 1041.24$, $p < .001$, indicating a general tendency toward depletion following a thought-suppression task. This effect of depletion remained unchanged across sessions for controls. There were no other significant effects. These findings also speak against practice effects.

3.3. Psychosocial self-reports

Table 1 shows reports of self-efficacy (GSES), perceived stress (PSS), and emotional distress (GHQ) across Sessions. We conducted a mixed analysis with Session as within-subjects variables and Cohort as the between-subjects variable. The repeated-measures analyses for the GSES, PSS, and GHQ showed no effect of Session or Cohort. Reports of self-efficacy, perceived stress and emotional distress remained stable across sessions. These

Table 1
Psychosocial self-reports, means (standard error)

	Baseline	1 month	2 months	3 months	4 months
Experimental Cohort					
Self-efficacy (GSES)	19.6 (0.5)	19.5 (0.5)	19.3 (0.4)	19.5 (0.4)	19.6 (0.4)
Perceived stress (PSS)	19 (0.5)	19.2 (0.5)	19.1 (0.5)	19.5 (0.4)	19.2 (0.4)
Emotional distress (GHQ)	18.8 (0.3)	18.6 (0.3)	18.8 (0.2)	18.9 (0.3)	18.6 (0.3)
Control Cohort					
Self-efficacy (GSES)	19.4 (0.5)	19.2 (0.4)	19.6 (0.5)	19.3 (0.5)	19.3 (0.5)
Perceived stress (PSS)	19.6 (0.5)	19.2 (0.5)	19.2 (0.5)	19.4 (0.4)	19.8 (0.4)
Emotional distress (GHQ)	19 (0.5)	18.2 (0.3)	18.6 (0.3)	18.9 (0.3)	18.5 (0.4)

findings suggest that the observed increments in regulatory behavior are not the product of changes in self-efficacy, perceived stress, or emotional distress.

VTT performances (see data in Figs. 2a and 2b) for the Experimental Cohort were also entered into a Session (Baseline, 1 month, 2 months, 3 months, 4 months) × Time (before thought-suppression vs. after thought suppression) repeated measures ANCOVAs, with self-efficacy, or perceived stress, or emotional distress as covariates. The effects of these variables (self-efficacy, perceived stress, or emotional distress) were not significant, and therefore do not contribute to the observed improvements in self-regulation.

4. Discussion

The results are consistent with the predictions of the resource model of self-control. The main finding to emerge from this investigation was that the repeated practice of a self-control (i.e., financial monitoring) program over a four-month period produced significant improvements in a laboratory measure (VTT) of regulatory behavior. In the laboratory task, we found that exercising self-control made participants less vulnerable to the effects of ego depletion. During the first experimental session (baseline), participants showed patterns similar to those observed in previous studies (Baumeister, 2002; Muraven et al., 1999; Oaten & Cheng, 2006a, 2006b): Trying to suppress forbidden thoughts led to a subsequent decrement in self-regulation, as measured by impaired performance on the VTT. Decrements in VTT performance following the thought-suppression task were observed in all experimental sessions. After just one month of participating in the financial monitoring program, however, the depleting effects of that same thought-suppression exercise had significantly lessened. Such attenuation continued across the course of the financial monitoring program. This suggests that adherence to the financial monitoring program made people less vulnerable to the general tendency for self-control to deteriorate quickly in response to immediate demands.

This finding is consistent with past research on personal change (Prochaska, DiClemente, & Norcross, 1992). For example, alcoholic individuals who have managed to overcome their addiction are subsequently more successful than others at defeating their addiction to nicotine (Zimmerman, Warheit, Ulbrigh, & Auth, 1990). This pattern suggests that in some way they build up their facility to quit smoking, and one conceivable mechanism for this gradual improvement is an increase in self-control strength. Overcoming one addiction may produce an increase in self-regulatory strength owing to the repeated practice of self-control, and hence subsequent undertakings that require self-control may

be more successful. Previous research has confirmed that in the short-term, exertions of self-control lead to decrements in subsequent self-control (Baumeister, 2002; Muraven et al., 1998; Vohs & Heatherton, 2000). Our current results complement those findings by indicating that the long-term effects of such exercise may be an improvement in self-control.

Several limitations of our study require attention. First, our sample was small and therefore more prone to exaggerated effects and decreased generalizability, compared to larger samples. Second, the ideal control phase would involve participants engaging in a behavior that is equal to the financial monitoring program in every way except the self-control component. We were concerned, however, that monitoring spending patterns during a control period would involve the demands of self-control, thus fail to provide appropriate controls. The "no-practice" control protocol was therefore selected. Third, longitudinal studies inevitably sacrifice some control and uniformity. However, the present research has averted some of the difficulties that plague many longitudinal studies. Every participant that attended the first experimental session also attended the follow-up sessions. This is in part due to the relatively short duration of the study, and to the distribution of diaries that helped keep participants engaged in the program. It was not possible to ensure that all participants complied with the reporting instructions and diary maintenance throughout the program. If non-compliance were at all substantial, however, it would reduce observed differences between groups, acting against the experimental hypothesis. Therefore, the findings can be taken with some confidence.

4.1. Alternative explanations

Although the resource model fits the data well, alternative explanations are possible. The extant data allow us to rule out a number of alternative explanations. For example, the data indicates that perceived stress, emotional distress, and self-efficacy remained stable across the financial monitoring program. These findings are consistent with those of Oaten and Cheng (2006a, 2006b), which found regulatory improvement in the absence of changes in perceived stress, emotional distress, or self-efficacy.

Practice effects are a common factor that can distort longitudinal research findings and therefore need to be considered. For example, participants may have become better at performing the VTT due to simple practice, such that the task became more automatic. However the data speak against practice effects. First, the Control Cohort showed no improvement on the VTT across sessions. Second, participants receiving the experimental intervention showed no improvement at all on pre-thought-suppression performance on the VTT across sessions. The pattern of data gives confidence that the observed effect is one of strengthening regulatory resources rather than one of practice.

We also acknowledge that demand characteristics cannot be ruled out. It could be argued that the observed regulatory improvements might be due to distorted reporting (diary maintenance) and performance (laboratory task) on the part of those undertaking the experimental manipulations. In an attempt to control against such effects, we ensured that the experimenter administering the follow-up sessions was blind to the subject's condition. Even so, participants could have guessed the experimental goals from the diaries provided, which in turn may have influenced diary reporting. Social desirability could have also influenced diary maintenance. However, in our previous work, subjects readily reported impaired regulatory behavior during periods of high academic demand (without any intervention program Oaten & Cheng, 2005, 2006a, 2006b). We believe this indicates that

subjects were not simply presenting a good impression to the experimenter. Moreover, our data from the objective lab task (VTT) make a strong case against demand characteristics. First, regulatory improvement on the VTT required no reporting. Second, if participants did guess the intended response pattern, why was regulatory improvement only observed following thought-suppression? It is hard to explain such selective improvement in terms of demand characteristics.

Achieving mastery over one's finances might improve mood. A recent series of experiments found that induced positive mood resulted in a cost in terms of increased distractibility (Dreisbach & Goschke, 2004). These results suggest that positive mood might hinder, rather than enhance performance on the laboratory task. Ruling out alternative explanations is a difficult and ongoing process. It will take a number of studies to fully unconfound the effects of various possible factors. We have, however, demonstrated this effect of strengthening in unrelated self-control programs (i.e., academic study, physical activity and financial monitoring), which supports the building strength hypothesis. The evidence from the present study is consistent with a resource model of self-control. The present study replicates previous research (Muraven et al., 1999; Oaten & Cheng, 2006a, 2006b), which found that the exercise of self-control improved the strength or capacity for self-regulation. We believe models that treat self-regulatory capacity as a strength variable best explain the present findings.

Our findings are both theoretically and practically important. Theoretically, the study demonstrates that the 'resource' of self-control is not fixed, and may be augmented by suitable behaviors. Although the route to regulatory improvement needs elucidation, the data clearly demonstrate one route that has far reaching beneficial consequences. Practically, self-control is implicated in many important personal and societal problems. For example, self-control is required for behaviors that an individual may be trying to inhibit, including cigarette smoking, excessive gambling or unsafe sexual practices. People often fail at such self-control efforts (Baumeister et al., 1994). The resource model not only offers an explanation for regulatory failures, but also solutions for regulatory success (Baumeister & Exline, 2000). The suggestion that regulatory exercise can gradually improve self-control helps put the earlier findings of regulatory depletion in context (Baumeister, 2002; Muraven et al., 1998; Vohs & Heatherton, 2000). Those studies consistently found impairments in regulatory performance following acts of self-control, and some people might conclude that the best strategy is to avoid exerting self-control whenever possible (so as to avoid depleting regulatory resources). Our findings, however, offer a more positive message: People should exercise self-control because such exercise may increase their regulatory capacity in the long-term.

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