Can't Control Yourself? Monitor Those Bad Habits

Jeffrey M. Quinn, Anthony Pascoe, Wendy Wood and David T. Neal

Pers Soc Psychol Bull 2010; 36; 499
DOI: 10.1177/0146167209360665

Can't Control Yourself? Monitor Those Bad Habits

Personality and Social Psychology Bulletin
36(4) 499–511

DOI: 10.1177/0146167209360665
http://pspb.sagepub.com
SAGE

Jeffrey M. Quinn[1], Anthony Pascoe[1], Wendy Wood[2], and David T. Neal[2]

Abstract

What strategies can people use to control unwanted habits? Past work has focused on controlling other kinds of automatic impulses, especially temptations. The nature of habit cuing calls for certain self-control strategies. Because the slow-to-change memory trace of habits is not amenable to change or reinterpretation, successful habit control involves inhibiting the unwanted response when activated in memory. In support, two episode-sampling diary studies demonstrated that bad habits, unlike responses to temptations, were controlled most effectively through spontaneous use of vigilant monitoring (thinking "don't do it," watching carefully for slipups). No other strategy was useful in controlling strong habits, despite that stimulus control was effective at inhibiting responses to temptations. A subsequent experiment showed that vigilant monitoring aids habit control, not by changing the strength of the habit memory trace but by heightening inhibitory, cognitive control processes. The implications of these findings for behavior change interventions are discussed.

Keywords

self-control, habits, temptations, behavior change

Received January 15, 2009; revision accepted August 23, 2009

Daily life exposes people to various cues that trigger unwanted habits. A glimpse of the TV remote can derail a plan to go jogging; the sound of a new e-mail can trigger a habit of procrastinating on the Web. The ability to control these bad habits, as with other prepotent responses, depends on a variety of self-control processes, including detecting that self-regulation is necessary (Carver & Scheier, 2008) and having sufficient self-regulatory capacity (Muraven & Baumeister, 2000). In addition, successful control depends on the particular strategy people use to curb an undesired response (Metcalfe & Mischel, 1999). In the present research, we focus on this latter component of the self-control puzzle and seek to identify the strategies successful at controlling everyday habits.

Self-control of habits involves exerting control over the specific type of automaticity underlying habitual responding (Neal & Wood, 2009). Habits form when people gradually learn associations between a response and cues in the performance context (e.g., places, preceding actions; Verplanken & Aarts, 1999; Wood & Neal, 2007). Once habits form, the simple perception of the context activates the associated response in memory (Neal, Quinn, & Wood, 2006). Unlike some other forms of automaticity, habit cuing is rigid and nonmalleable because habits are encoded in a conservative, slow-learning procedural memory system that reflects knowledge slowly accrued over repeated instances of behavior (Daw, Niv, & Dayan, 2005; Poldrack et al., 2001). In the present article, we argue that because habit associations cannot easily be changed or reinterpreted in memory, an effective avenue for self-control is to break the habit by inhibiting its performance.

Current knowledge of self-control strategies largely addresses responses to affective temptations. Responses to temptations, like habits, are promoted through automaticity (see Moors & De Houwer, 2006). But temptations present different challenges for self-control than do habits. Temptations trigger responses by activating *visceral factors* such as hunger, thirst, and sexual desire (Loewenstein, 1996). People control reactions to such hot, emotional stimuli by overriding the affect with cool cognitions (Metcalfe & Mischel, 1999). Thus, strategies for temptation control involve not inhibition but removal of the hot stimulus or distraction from it.

To identify the self-control strategies that best provide traction over unwanted habits, the current research used a

[1]Duke University, Durham, North Carolina, USA
[2]University of Southern California, Los Angeles, California, USA

Corresponding Author:
Wendy Wood, Department of Psychology, University of Southern California, Los Angeles, CA 90089
Email: wendy.wood@usc.edu

two-phase approach. We began with a diary study assessing the spontaneous strategies that people use in everyday life to inhibit unwanted habits and responses to temptations.[1] For habit control, we focused in particular on an inhibitory strategy, *vigilant monitoring*, which involves heightened attentional focus on a response to ensure that it is not performed. The naturalistic diary data allowed us to contrast vigilant monitoring with two additional strategies known to be effective in controlling responses to temptations: *stimulus control,* or removing oneself from the situation, and *distraction,* or thinking about something else. In the second stage of the research, we validated the diary findings concerning habit control with a laboratory experiment that directly manipulated the use of vigilant monitoring and pinpointed the mechanisms by which it helps people control unwanted habits.

Successful Control of Habits Through Vigilant Monitoring

Habit cues gradually gain strength through repeated associations with the habitual response. As habits strengthen, perception of the cues automatically activates the response in memory. In consequence, control of strong habits is most likely to be accomplished through monitoring for the response and inhibiting its performance. Specifically, habit control should be enabled by, in the words of our pretest participants, actively thinking "don't do it," and watching carefully for mistakes or slipups.

We were less certain that self-control of habits would be promoted through stimulus control, which involves avoiding or reducing the salience of relevant cues in the environment that trigger unwanted habits. On the one hand, the success of this strategy is suggested by Wood, Tam, and Guerrero Witt's (2005) finding that changes in performance environments when students transferred to a new university disrupted everyday performance of habits (e.g., reading the newspaper, exercising). On the other hand, this strategy may not be successful if people cannot easily identify triggering stimuli for habits. Unlike temptation triggers that are likely to be affectively prominent (e.g., sight of chocolate cake), cues for habit performance are more difficult to identify because they can include any element of the context (e.g., preceding actions, location) that consistently covaried with the habitual response in the past. For example, a smoker may be unaware that the entrance to her workplace has come to cue the habit through the many smoking breaks she took in that location. Thus, spontaneous use of stimulus control might gain little traction over habits because of the difficulty identifying the relevant cues.

Another potential strategy involves distraction, or focusing one's attention on factors other than responding to the stimulus. Distraction is unlikely to be effective because habit performance is triggered by limited, even nonconscious, perception of stimulus cues. Consider, for example, a person trying to limit food intake by controlling a habit of eating everything on his plate. If he is distracted by talking with others or watching TV, then he is not attending fully to how much he is consuming, and his consumption habit is likely to be activated by the remaining food. Suggesting also that distraction is not helpful for habit control, Reason's (1992) diary studies of action slips in daily life revealed that habit intrusions were especially common when people were distracted or otherwise preoccupied and not attending to what they were doing.

Successful Control Over Temptations Through Stimulus Control and Distraction

Control over response to temptations forms the template for current understanding of self-control strategies. Thus, we briefly consider temptation control to highlight the differences between control of habits and temptations and thus the extent to which strategy success depends on the type of response being controlled.

Vigilant monitoring is not likely to be a successful strategy for temptations because it heightens attention to the tempting stimulus. For example, children attempting to delay the gratification of eating a small, tempting treat right now in order to receive a larger or more desirable treat later were more likely to fail when the initial treat was saliently displayed (Mischel, Ebbesen, & Zeiss, 1972). In line with these findings, the experience of craving develops through the elaborated thoughts and imagery that arise when people consciously focus on food and other desired appetitive stimuli (Kavanagh, Andrade, & May, 2005). In these ways, a focus on the tempting stimulus exacerbates the power of the hot cues to active impulsive responses.

Stimulus control, in contrast, is likely to be especially successful as a strategy for control of temptations. In the delay of gratification paradigm, children were more successful at waiting when the treats were placed out of sight (Mischel & Ebbesen, 1970). This strategy is reminiscent of behavior modification techniques involving control of the performance environment (Follette & Hayes, 2001). Thus, addicts are counseled to avoid triggers that promote cravings (e.g., Witkiewitz & Marlatt, 2004), and the overweight are counseled to reduce the salience of food cues (Wansink, 2006). Also, in stages of behavior change models, stimulus control strategies promote progression through different stages, especially action and maintenance (Prochaska, DiClemente, & Norcross, 1992).

As with stimulus control, distraction has proven effective in controlling temptations. For example, children might delay gratification by directing their attention away from the tempting treat (Mischel et al., 1972). Also, dieters reported fewer food cravings when they imagined being on their favorite vacation than when they imagined eating their

favorite food (Harvey, Kemps, & Tiggemann, 2005; see similar results for smokers, Versland & Rosenberg, 2007).

In summary, a strategy of vigilant monitoring is likely to be successful in controlling performance of unwanted habitual responses, whereas less success is expected for stimulus control, given the difficulty of identifying the triggering stimulus for habits, and for distraction, given that habits are likely to be triggered even when people are thinking about something else. Importantly, this pattern of results should not hold with control over temptations, as the latter should be promoted most by stimulus control and distraction and least by vigilant monitoring.

The Present Research

In our two-stage approach to understanding habit control, we first conducted two diary studies using an event-sampling procedure to determine whether vigilant monitoring is preferentially useful for habit control. In the second stage in the research, we conducted a laboratory experiment that validated the findings of spontaneous self-control from the diary studies by manipulating vigilant monitoring and exploring the mechanisms by which it is useful in controlling habits.

Participants in the diary studies made contemporaneous reports when they recognized the need for self-control—when they felt that they should not do something. They recorded the response that they wanted to inhibit and rated the strategies they used (if any) to do so. We started this program of research by conducting extensive pretesting to identify the strategies that people commonly use to control their behavior. The diary reports included all of the most commonly mentioned strategies. However, a number of the strategies we assessed, such as rewarding oneself for a desired response, were not used sufficiently often by the diary participants to permit analysis.

To test our hypotheses, we first determined what kinds of responses participants were trying to control. A response was classified as strongly habitual if participants reported that it had been performed often in the past and usually in the same location. A response was classified as cued by strong affective temptations if, despite being unwanted, participants reported that they would experience immediate, high levels of positive affect from performance. Thus, participants rated each unwanted response to reflect whether it was a strong habit as well as a response to a strong temptation.

To test our hypotheses about the effectiveness of self-control strategies, we constructed regression models predicting success at self-control from the strength of response being controlled (strong vs. weak habits; strong vs. weak temptations) and the use of each self-control strategy that was reported with sufficient frequency to be included in the analysis (vigilant monitoring vs. stimulus control vs. distraction). Overall, we anticipated significant interactions between strength of response and strategy use in the analyses on habits and intentions. Specifically, for controlling strong habits, this interaction should reflect that vigilant monitoring is most successful at inhibiting performance of the response activated in memory, whereas stimulus control and distraction may not enable this inhibition. For controlling strong temptations, the interaction should reflect that vigilant monitoring is unsuccessful but stimulus control and perhaps distraction reduce focus on the hot qualities of the tempting cue and thus successfully reduce impulsive responses to it.

Studies 1a and 1b

Method

Participants

Study 1a. Sixty-one female and 38 male undergraduate students at Duke University participated for partial fulfillment of a requirement in their introductory psychology course.

Study 1b. Thirty-three students from Duke University and the University of North Carolina, Chapel Hill participated in return for $40 payment.

Data from 5 additional participants in Study 1a and 2 additional participants in Study 1b were excluded because they reported during the debriefing session that they had recorded 50% or fewer of their attempts at self-control.[2]

Procedure

The two diary studies used slightly different response formats. In Study 1a, participants reported only on responses they were trying to inhibit. Study 1b extended reports of change efforts to include attempts to implement desired behaviors as well as to inhibit undesired ones. Because our hypotheses concern only self-control, we conduct and report analyses only on inhibitory attempts. Nonetheless, by assessing self-control in multiple ways, we ensured that the diary findings were not a product of specific reporting instructions.

Both studies consisted of three phases: an introductory session, a recording period, and continuation sessions in which participants provided additional information.

Phase 1: Introductory session. Participants attended in groups of about 25 (Study 1a) or 3 (Study 1b) in a study of how people change their thoughts, feelings, and behaviors. They tracked their responses for the next 7 (Study 1a) or 14 (Study 1b) days, making written reports on diary forms provided by the experimenter. Participants received pocket-sized booklets containing the diary forms to be used during the recording period and detailed instructions about how to complete them. Participants also received examples of completed diary reports (e.g., "not overeating, not tripping over a crack in the sidewalk, not sleeping during an early morning class, not smoking, and avoiding nervous thoughts prior to a big test").

Because the research aimed to investigate the full range of successful and unsuccessful attempts at self-control,

instructions emphasized that participants complete a report even when they felt they *should* change a response but made no effort to do so. Participants were instructed to carry the booklets with them at all times and to make diary reports within 15 min of the events' occurrence to maximize accurate reporting. To ensure that participants understood the instructions, they listed behaviors that they might try to inhibit (Study 1a) or change (Study 1b) during a typical day and completed a sample form for one of their listed behaviors. Participants also signed a "contract," by which they agreed to keep a complete diary. Participants then scheduled the first follow-up session.

Phase 2: Recording behaviors. For Study 1a, participants reported "every time you try not to do some unwanted activity." For Study 1b, participants kept "track of the times that you think about or feel the need to change your behavior—to stop doing some unwanted act or to start doing something different."

Phase 3: Continuation sessions. Participants returned to the lab every 2 to 3 days for continuation sessions in which they first rated the success of each attempt at response change listed in their diary, along with additional questions (see the following "Success at Behavior Change" section). Success ratings were obtained after the actual diary reports so as to accurately record instances in which initial success at self-control was followed by failure (e.g., a decision not to ruminate that is successful only for a few minutes). Participants turned in completed diary booklets, received blank ones, and scheduled their next session.

Continuation meetings were held every 2 to 3 days to make certain that participants accurately remembered the success of their control efforts and to ensure that participants provided recordings across the entire period. During the recording period, participants attended approximately three (Study 1a) or six (Study 1b) continuation sessions, the last concluding with a debriefing.

Measures

Diary behavior reports: (a) Content of behavior. Participants gave a brief written description of each activity they desired to inhibit/change. Participants in Study 1b also described the type of change attempt by circling whether it involved *trying to* stop *doing something*, *trying to* start *doing something*, or *both*. We focus here on only the 51% of reports that were attempts at inhibiting or trying to *stop*, but we note also that 27% were attempts at initiating or trying to *start*, and 23% were a combination.

(b) Strategies. Participants also checked the strategies they used to keep from performing the unwanted act. The set of strategies had been identified through extensive pretesting and included the following: (a) vigilant monitoring, which was assessed with respect to inhibition (Study 1a) as *thinking "don't do it" or watching carefully for mistakes* and, with respect to general behavior change (Study 1b), as *monitoring my behavior carefully;* (b) *distracting myself;* (c) stimulus control of *removing myself from the situation or removing the opportunity to do it;* or (d) *nothing—I did not try to stop this time.*[3]

(c) Habit strength of unwanted responses. Participants rated how often they had performed the unwanted behavior in the past, with options of 1 (*monthly or less often*), 2 (*at least once a week*), 3 (*just about every day*), or 4 (*several times per day*). They also indicated the extent to which they performed the unwanted act in the same location each time, with acts that usually occurred in the same location coded 1 and acts that rarely or sometimes occurred in the same location coded 0. To calculate the habit strength of each diary report, the context stability measure was multiplied by participant ratings of past performance frequency (see Ji & Wood, 2007; Wood et al., 2005). Habit strength of the unwanted response was calculated to range from 0 (representing weak/no habit) to 4 (representing strong habit). Examples of strong habits were staying up too late, fighting with one's sister, not waking up on time, eating too much, arriving late, and biting finger nails.

(d) Temptation strength. Participants rated "right now, how much would performing the unwanted behavior make you feel good" on a scale ranging from 1 (*not at all*) to 5 (*extremely*). Temptation strength was reflect in anticipated immediate positive feelings, despite that the response was one that participants wanted to inhibit or change. Examples of strong temptations were: eating too late at night, using the computer too much, and massaging muscles.

Success at behavior change. At the next follow-up session, participants rated the overall success of each prior reported attempt to change their behavior from 1 (*unsuccessful*) to 7 (*successful*).[4] Specifically, participants rated whether they had stopped or inhibited each unwanted response. Obtaining a success rating for each report at the follow-up session, separately from the ongoing diary reports, was designed to tap longer term success. Thus, participants were able to accurately report failure if they resisted immediately a second helping of dessert but then succumbed to the temptation half an hour later.

Results

The richness of the data can be seen in the content of the diary reports listed in Table 1. The reports spanned an array of self-control domains pertaining to consumatory behaviors, social interactions, health-related activities, decision making, and coping with everyday events.

Participants reported a mean of 23.94 (SD = 10.01) unwanted responses during the 7 days of Study 1a and 19.94 (SD = 14.75) unwanted responses during the 2 weeks of Study 1b (see Table 2). Apparently, participants were consciously aware of their own attempts to inhibit unwanted thoughts, feelings, and actions at an average rate of 3.50 times per day for Study 1a and 1.42 times per day for Study 1b.[5] In

Table 1. Unwanted Activities Frequently Reported in Participants' Diaries: Studies 1a and 1b

Activity domain	Proportion of diary reports in Study 1a	Proportion of diary reports in Study 1b	Examples from participants' diaries: "trying not to . . ."
Sleeping	.23	.13	sleep too late; fall asleep in class; stay up too late
Eating	.17	.17	eat junk food; have fries with lunch; snack because I'm stressed
Procrastinating, inactivity	.10	.21	procrastinate on [homework]; be lazy and not go to the gym; goof off while trying to study
Excessive entertainment	.09	.08	watch TV; play video games instead of getting much needed rest; talk online
Unwanted emotions	.07	.02	feel depressed about all the things that are going wrong in my life; stress out over a paper due tomorrow; be mad at my mom for waking me up
Making mistakes, forgetting	.06	.05	trip while walking up the stairs; be late to class; shoot badly while playing basketball; forget about a meeting
Daydreaming, inattention	.05	.03	get distracted in class; have my mind wander while I am trying to read
Nervous habits	.05	.04	bite my nails; crack my knuckles; keep straightening my hair, a habit I picked up in middle school
Negative social interactions	.04	.08	say something sarcastic/obnoxious to a friend; get in a fight with [girlfriend]; argue
Socializing	.04	.02	socialize—I need to exercise instead; socialize instead of study; go out
Cigarettes, alcohol	.02	.01	smoke a cigarette after class; party too much; get too drunk
Inappropriate speech	.02	.01	curse; talk about other people; gossip
Unwanted thoughts	.02	.01	think bad thoughts; have unpleasant thoughts about the future; think about my ex-boyfriend
Other	.04	.01	

Proportions were computed for each participant, and the mean value that is reported in the table was calculated across participants in the sample.

addition, participants reported only a modest overall level of success at inhibiting the unwanted responses, with a mean success rate on the 7-point scale of 3.57 ($SD = 1.04$) for Study 1a and 3.85 ($SD = 2.04$) for Study 1b.

Participants' ratings of the strength of the habitual and tempting nature of the responses that they were trying to control are given in Table 2. The percentage of unwanted responses that were strong habits, performed almost daily and usually in the same context, was 13% in Study 1a and 10% in Study 1b. The percentage of unwanted responses that were hot, affective reactions to temptations, yielding immediate positive affect, was 41% in Study 1a and 34% in Study 1b. Only a small percentage of responses was categorized as both strong habits and strong temptations (4% in Study 1a, 2% in Study 1b). Given this small percentage, we were not able to evaluate the strategies that were uniquely successful with this doubly automated response.

The analyses were conducted combined across the data from the two studies. To evaluate the feasibility of this approach, we included study as a predictor in all models. However, study was not a significant main effect predictor in any analysis, nor did it interact with any other predictors.

Table 2. Means and Standard Deviations of Variables Assessed in Studies 1a and 1b

Variable	Study 1a		Study 1b	
Number of unwanted acts per participant	23.94	(10.01)	19.94	(14.75)
Number of unwanted acts per participant per day[a]	3.50	(1.40)	1.42	(0.60)
Participant ratings of:				
Success at inhibition	3.57	(1.04)	3.85	(2.04)
Habit strength	1.16	(0.59)	1.03	(0.60)
Immediate positive feelings from performance	3.24	(0.80)	2.86	(0.85)

Success at inhibiting the unwanted response was rated on a scale ranging from 1 (*unsuccessful*) to 7 (*successful*), habit strength of the unwanted response was rated on a scale from 0 (*weak/no habit*) to 4 (*strong habit*), and immediate anticipated positive feelings was rated on a scale ranging from 1 (*not at all*) to 5 (*extremely*). The values in the table first were aggregated within participants and then averaged across participants. Standard deviations are given in parentheses.

[a] Because a few participants provided data for fewer than the required number of days (5 in Study 1a, 7 in Study 1b), the diary reports per day were calculated for each participant by dividing the total number of reports by the number of days of participation.

Table 3. Frequencies of Use of Strategies of Self-Control for Temptations and Habits: Studies 1a and 1b

	Temptations				Habits			
Strategy used	Strong		Weak		Strong		Weak	
Vigilant monitoring	.21	(.35)	.23	(.24)	.20	(.30)	.31	(.36)
Distracting myself	.04	(.11)	.09	(.14)	.08	(.21)	.08	(.19)
Stimulus control: Removing myself from situation	.17	(.33)	.09	(.15)	.10	(.26)	.06	(.18)
All other strategies (e.g., rewarding myself)	.24	(.35)	.28	(.27)	.17	(.30)	.24	(.30)
No strategy used ("I did not try to stop this time")	.18	(.32)	.13	(.20)	.33	(.38)	.08	(.20)

Proportions were computed for each participant, and the mean value that is reported in the table was calculated across participants in the sample. Standard deviations are reported in parentheses.

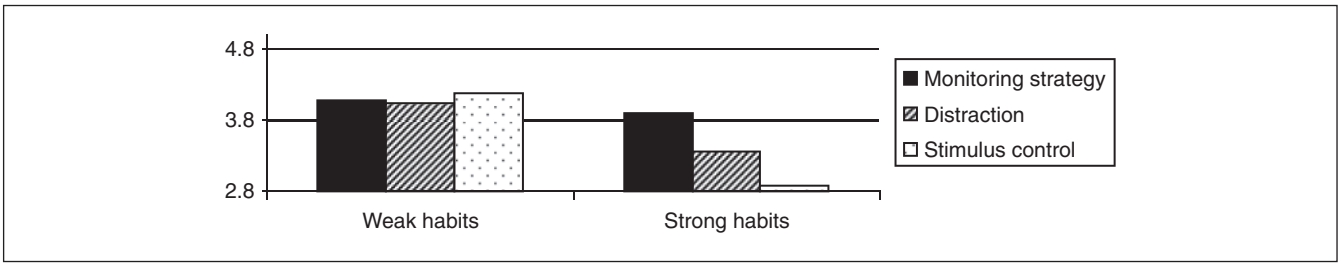

Figure 1. Participant-rated success of self-control varies with habit strength and use of self-control strategies: Studies 1a and 1b

Frequencies of strategy use. Table 3 shows the frequencies with which respondents reported using each strategy. Vigilant monitoring was the most frequently used strategy for control of all responses, along with the default strategy of doing nothing. Less often used were the strategies of distracting myself and stimulus control of removing myself from the situation.

Success at self-control of habits and temptations. The data structure resulting from the diary design was hierarchical, with individual diary reports nested within participants. To account for the nonindependence of individual diary reports, we used multilevel modeling techniques (Kenny, Kashy, & Bolger, 1998; Raudenbush & Bryk, 2002). Continuous predictors in the multilevel models were grand mean centered, and dichotomous predictors were left uncentered. All models were estimated allowing for random intercepts, slopes, and a covariance between intercepts and slopes. The degrees of freedom were estimated using the Satterwaithe (1941, 1946) approximation.

To test our hypotheses about the effectiveness of different strategies to control habits and temptations, we constructed regression models predicting success at self-control from effect-coded predictors representing use of the different strategies (distraction vs. stimulus control vs. vigilant monitoring vs. doing nothing vs. all other strategies), strength of the habit/temptation (strong vs. weak), and the interaction between these predictors. These variables were analyzed at the level of reports.

In the analysis on habits, the regression model revealed a main effect for strategy, reflecting largely that doing nothing ($M = 1.90$) was less successful than using any of the strategies ($M = 3.93$), $t(163) = 8.75$, $p < .01$. In addition, strong habits ($M = 3.00$) were more difficult to control than weak habits ($M = 3.75$), $t(49) = 12.55$, $p < .01$. Also, the predicted interaction emerged between habit strength and strategy use, $F(4, 329) = 3.46$, $p < .01$ (see Figure 1). For inhibiting strong habits, vigilant monitoring ($M = 3.83$) was more successful than stimulus control ($M = 2.81$), $t(200) = 2.06$, $p < .05$. Distraction did not differ from either of these strategies (*ns*). For inhibiting weak habits, the strategies did not differ in effectiveness (ts < 1). In comparisons across strong and weak habits, stimulus control was significantly worse for strong than for weak habits, $t(118) = 2.86$, $p < .01$, and distraction revealed a nonsignificant trend in the same direction.

We conducted a similar regression model to test the effectiveness of different strategies for the control of strong and weak temptations. The regression model revealed a main effect for strategy, reflecting largely that doing nothing ($M = 1.95$) was less successful than using any of the strategies ($M = 3.98$), $t(411) = 14.57$, $p < .01$. In addition, the predicted interaction emerged between temptation strength and strategy use, $F(4, 1033) = 1.74$, $p = .05$ (see Figure 2). As anticipated, the strategies were differentially successful at controlling strong temptations. For inhibiting responses to strong temptations, stimulus control ($M = 5.00$) was more successful than vigilant monitoring ($M = 3.86$), $t(595) = 2.55$, $p < .05$, and distraction

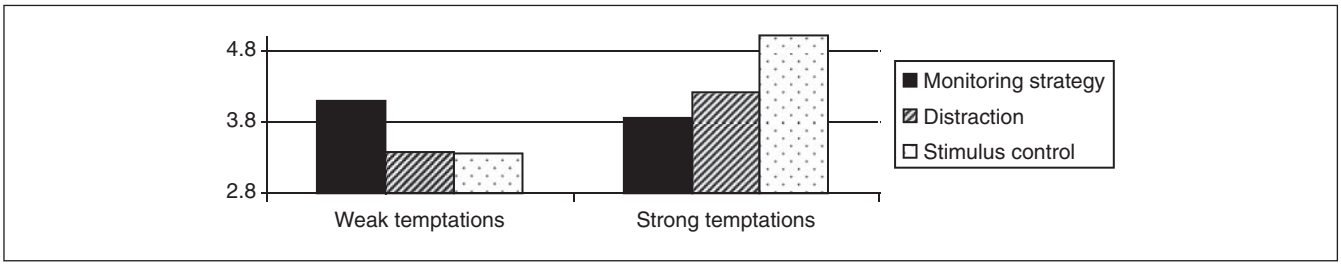

Figure 2. Participant-rated success of self-control varies with temptation strength and use of self-control strategies: Studies 1a and 1b

did not differ from either of these strategies (*ns*). For inhibiting weak temptations, the strategies did not differ in effectiveness. In comparisons across strong and weak temptations, stimulus control was more successful at inhibiting responses to strong than to weak temptations, $t(696) = 2.79$, $p < .01$, but the other strategies did not differ with temptation strength (*ns*).

Discussion

As anticipated given the nature of habit cuing, vigilant monitoring was a successful control strategy in daily life for strong habits. With habits, the simple perception of context cues directly activates the cognitive representation of the response. Furthermore, the slow learning of habit associations across repeated experiences makes it difficult to alter or reinterpret the learned association. For these reasons, effective control strategies involve stopping the tendency to act on the response. Given the success of vigilant monitoring in controlling habits, it is no surprise that our participants used this more than any other control strategy.

Only vigilant monitoring and not the other strategies that we evaluated provided traction in inhibiting habits. Stimulus control in the form of removing oneself from the situation was not an effective strategy for control of habits, presumably because people were not able to identify reliably the situational cues that trigger their habits and thus could not easily remove or avoid those cues. In contrast, the hot cues to temptations are likely to be highly salient and thus more amenable to stimulus control. Additionally, distraction was not especially effective, presumably because people who are distracted are not sufficiently oriented to attend to and inhibit unwanted habitual responses.

A successful strategy for controlling strong temptations, in contrast, involved limiting exposure to the hot stimulus properties that elicit automatic, impulsive responses. Thus, participants inhibited their strong affective impulses by removing themselves from the tempting stimulus. Admittedly, the successful control of temptations through stimulus control replicates already-established experimental research findings (e.g., Mischel et al., 1972). Nonetheless, we provide some of the first evidence that the effectiveness of spontaneously adopted strategies in everyday life mirrors that of manipulated strategies in experimental research.

The findings for temptations also clearly differentiate self-control of temptations from control of habits. As anticipated, vigilant monitoring was unsuccessful in controlling response to temptations—despite that participants used this strategy more often than any other in attempts to control strong temptations. By extending research on self-control strategies to include habits, we can explain the puzzlingly high frequency of using vigilant monitoring. By using monitoring, our participants were relying on a strategy that was ineffective in controlling responses to temptations but that was effective at habit control.

Contrary to expectations, the distraction strategy was not especially useful in temptation control. Distraction did not differ from the other strategies in its effectiveness. We speculate that some of our participants did not use distraction in the most effective way. Engaging in a single distracting activity can be helpful in muting the hot stimulus cues of a temptation and thus reducing impulsive responding to it (Mischel & Ebbesen, 1970). However, distraction is not helpful when people focus on a variety of alternative thoughts and actions and thereby link the unwanted impulse to many different features of their environment so that it can be activated by them as well as by the hot stimulus cues (Wegner, Schneider, Carter, & White, 1987). Thus, distraction is likely an effective temptation control strategy primarily when people focus on a single activity or thought that can be avoided in the future.

Readers might wonder whether the vigilant monitoring strategy is linked with a broader motivational orientation, especially an orientation to prevent an unwanted outcome (Higgins, 1997). We evaluated this possibility in a number of ways, but we did not find any evidence linking use of vigilant monitoring to prevention motives. In each study, we assessed several individual difference measures during the introductory session and conducted analyses relating these to the diary outcomes. Use of the monitoring strategy was not related to scores on trait prevention and promotion scales in Study 1a (Lockwood, Jordan, & Kunda, 2002), desire for

control in Study 1a (Burger, 1992), trait prevention and promotion in Study 1b (Higgins et al., 2001), or trait self-control in Study 1b (Tangney, Baumeister, & Boone, 2004). Also, none of these measures predicted the frequency or success of reported inhibitory attempts. Additionally, we initially included strategies in the diary rating forms that were directly related to the motivational orientations of avoiding negative outcomes and approaching positive ones (see Note 3). However, these strategies were not systematically linked to successful control and, furthermore, were unrelated to the broad motives. Given that monitoring appears to be independent of broader promotion and prevention motives, we follow precedence in interpreting it as a specific control strategy (see Metcalfe & Mischel, 1999).

Our finding that monitoring yields successful habit control is understandable given the mechanism behind habit cuing, but it is the first evidence we know of indicating the success of this technique. Past research has emphasized primarily the counterproductive effects of thinking about an unwanted response because it heightens desire for tempting stimuli (e.g., Kavanagh et al., 2005). Thus, the second stage of this research involved an experiment to demonstrate under controlled conditions that monitoring is a successful form of willpower for habits. Convincing demonstration of the effects of vigilant monitoring requires experimentation in which both the strength of habit cues and the use of monitoring are manipulated independently. Additionally, this experiment provided insight into the cognitive mechanisms through which monitoring exerts its effects.

Study 2

To provide an experimental test of vigilant monitoring as a form of self-control over habits, we adapted a classic paradigm for the study of habits from cognitive psychology (Hay & Jacoby, 1996, 1999). In this procedure, participants first form habits in an experimental task and then attempt to inhibit their performance. In using this paradigm, we follow other tests of habit formation and performance with experimental tasks (e.g., DeWall, Baumeister, Gailliot, & Maner, 2008)

In the task, participants first practiced giving a particular response word to a stimulus word. They repeated the response frequently to form strong habits or less frequently to form weak ones. Then, in the second phase of the study, they learned an alternate response word to the stimulus word. Finally, they were tested for how well they could inhibit the earlier learned habitual response and override it with the newly learned alternate response. Thus, participants who had formed strong habits in the initial part of the learning session were functionally in the same position as the participants in the diary studies trying to inhibit an unwanted strong habit.

To evaluate the success of vigilant monitoring, we instructed some participants to carefully monitor their responses during the final test. This experimental manipulation was designed to follow closely the way that vigilant monitoring was described in the diary investigations, which in turn was based on the descriptions that our pretest participants gave for this form of self-control in our extensive pretesting of inhibitory strategies. It involved thinking "don't do it" and carefully monitoring behavior to ensure that the unwanted response was not performed.

The experiment also pinpointed why vigilant monitoring was successful. Because habits are learned gradually over repeated experience, we anticipated that vigilant monitoring would not alter the habit memory trace but instead heighten the cognitive control capacity to inhibit responding. Our cognitive paradigm tested this mechanism by providing an estimate of the strength of habits and the strength of cognitive control. Additionally, we anticipated that the effectiveness of monitoring stems specifically from inhibition—that it establishes a readiness to inhibit the habitual response once activated in memory. To test this feature of the strategy, we included a control strategy that heightened attention to responding but without an inhibitory focus. Thus, in the *focus on success* control, we instructed participants to think about the correct, desired performance outcomes. We also included a true control condition in which participants did not receive any instructions about strategy.

We anticipated that participants using a monitoring strategy would be more able than those with no strategy (control) to inhibit strong habits and give the correct response. Also, we anticipated that monitoring would heighten cognitive control but have little impact on the strength of habit memories. Furthermore, if the effectiveness of monitoring stems from the detection and inhibition of errors, the monitoring strategy will be more successful than one involving a focus on success.

Method

Participants. Sixty-five undergraduate students (38 women, 27 men) at Duke University participated in partial fulfillment of a requirement in their introductory psychology course. Two additional participants were not included because of computer errors.

Procedure

The design closely followed the procedure used by Hay and Jacoby (1996, 1999), with the addition of a manipulation of self-control strategy. It consisted of two main phases: habit formation and habit inhibition. Participants completed the experiment individually on a personal computer.

Phase 1: Habit formation. The first phase of the experiment created habitual associations between stimulus and response words. Participants viewed pairs of words on the computer screen. Initially, these word pairs appeared with one word intact on the left side of the screen and another word on the right side missing some of its letters (e.g., knee–b_n_).

Participants guessed silently how the word fragment would be completed to form a word related in meaning to the other word in the pair (i.e., the cue word). Shortly after the word pair appeared, a "correct" completion of the fragment was shown (e.g., knee–bend). Participants said aloud the correct completion word. Cue-fragment pairs appeared for 2 s followed immediately by the presentation of the cue paired with its correct completion for 1 s and a 500-ms intertrial interval before the next word pair. In total, the first phase consisted of five blocks of 80 trials.

Stimuli consisted of 20 different cue words, each of which appeared four times per block in training. Cue words were paired with two different completion words. The frequency with which each completion appeared as the correct choice in training served as the manipulation of habit strength. In the *high-frequency*, strong habit condition, one completion appeared with high frequency and the alternate completion appeared with low frequency. Pairing one completion with the cue word 75% of the time made that completion the strongly habitual response, whereas pairing the alternate completion with the cue on only 25% of the trials made that completion the nonhabit (Hay & Jacoby, 1996, 1999). In the *moderate-frequency* condition, each completion word appeared on half of the trials, resulting in the formation of weak habits. One of the two completions in the moderate frequency condition was arbitrarily designated the "frequent" response for use in statistical analyses. Participants were told that cue words would appear multiple times, that cues would be paired with more than one correct completion, and that some completions may appear more frequently than others.

Phase 2: Habit inhibition. After forming habits, participants were told that their responses would be tested and that they should use a specific strategy during the upcoming tests. Specifically, we instructed participants to vigilantly monitor or to focus on successful performance, or we gave them no strategy instructions.

The *vigilant monitoring* strategy was designed to follow closely the wording from the diary reports (i.e., thinking "don't do it," watching carefully for mistakes, monitoring my behavior carefully). Specifically, participants were told:

> You will want to do well and avoid making mistakes. When you study the word lists, be vigilant and try to anticipate which words will be hardest to remember—this kind of precautionary studying will protect you from making incorrect responses in the tests. It might help to think to yourself, "don't make mistakes."

The *focus on success* strategy was designed to increase task motivation and attention to particular response outcomes—similar to the vigilant monitoring strategy, but to do so while orienting participants to successful performance. Specifically, participants were told

> You will want to do well and achieve your ideal performance. . . . When you study the word lists, be quick to focus on correct responses—this kind of proactive studying provides an opportunity to ensure correct answers in the tests. It might help to think to yourself, "do your best."

For the *no-instructions* control strategy participants, no strategy was specified.

All participants then received a short list of eight word pairs from the habit formation phase. Each stimulus–response pair appeared on the computer screen for 1 s followed by a 500-ms intertrial interval. Participants studied these word pairs silently and attempted to remember them for the subsequent test. At the end of the list, a random three-digit number appeared on the screen, and participants counted backward by 3 s from the number shown on the screen for 30 s to prevent rehearsal. Next, participants completed the test in which they received stimulus words and cues to response words, and attempted to complete the fragment using the words recalled from Phase 2. The stimulus words remained on the screen until participants gave a verbal response, which was recorded by the experimenter.

Participants completed 20 study–test cycles. Across the 20 study lists, each cue word appeared eight times, and word pairs maintained their associative strength established in Phase 1 habit formation. That is, stimulus cues appeared with frequent response words 75% of the time and with infrequent words 25%, whereas moderate-frequency cues appeared with both completions 50% of the time. Test trials called for *habit performance* when they required participants to produce the strong or weak habitual responses from Phase 1 or *habit inhibition* when they required participants to inhibit habits from Phase 1 and respond with the words learned in Phase 2.

To evaluate self-control, we focus on performance in the habit inhibition trials. Habit performance trials were not informative regarding participants' ability to inhibit habitual response tendencies. In essence, these trials represent instances when people are trying to continue to perform existing habits. Overall, participants were successful at doing this, and the only significant effect was for frequency of repetition in Phase 1. Greater success was found at performing strongly habitual, frequently practiced words (79%) than moderately practiced, less habitual words (68%, $p < .05$). The findings from habit performance trials are not discussed further.

Results

Self-control performance. The percentage of correct inhibition trials immediately following the strategy instructions was calculated for each participant, and these percentages were subjected to a Self-Control Strategy (monitoring for errors vs. focusing on success control vs. no instructions

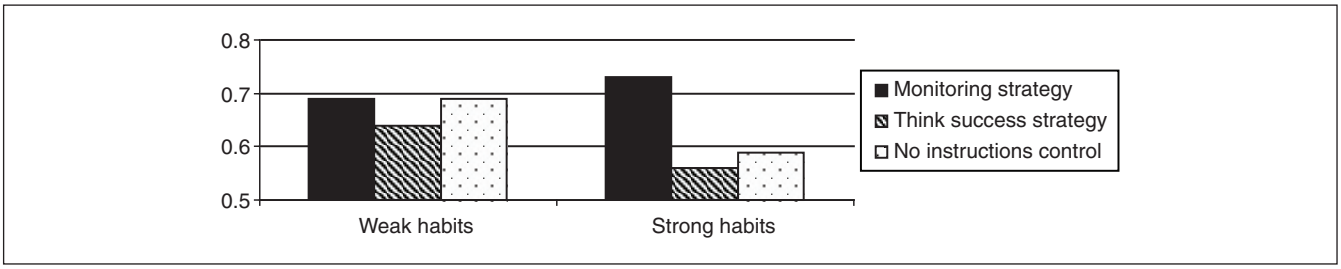

Figure 3. Success of self-control, as reflected in percentage trials correct, varies with habit strength and use of monitoring strategy: Study 2

control) × Repetition Frequency (high vs. moderate) ANOVA design with repetition frequency as a within-subjects factor.

A main effect for frequency of practice in Phase 1, $F(1, 62) = 4.61$, $p < .05$, reflected that participants were less successful at self-control when trying to inhibit a high frequency, strong habit ($M = 62\%$) than a moderate-frequency, weak habit ($M = 68\%$). A main effect for strategy, $F(2, 62) = 3.94$, $p < .05$, reflected that participants using a monitoring strategy ($M = 71\%$) were more successful at inhibition than either of the control conditions—that is, than the no strategy ($M = 64\%$) or focus on success strategy ($M = 60\%$). Most importantly, the predicted two-way interaction, $F(2, 62) = 3.85$, $p < .05$ (see Figure 3), reflected that when attempting to inhibit a strong habit, participants were more successful when using a monitoring strategy than the focus on success strategy, $F(1, 62) = 12.39$, $p < .01$, or no strategy, $F(1, 62) = 8.61$, $p < .01$. When trying to inhibit a weak habit, the strategies did not differ from each other in effectiveness (Fs < 1).

Cognitive processing mechanisms in self-control. We anticipated that vigilant monitoring was an effective habit control strategy, not because it influenced the strength of habit memories but because it heightened the conscious control processes by which people override their unwanted habits. To evaluate this, we essentially estimated the strength of the two processes involved in self-control—the process stopping the response, which in this case is conscious intention to inhibit, and the process promoting the response, which in this case is habit (see Hay & Jacoby, 1996, 1999).

The estimates of conscious inhibition and habit strength were subjected to two separate Strategy (vigilant monitoring vs. focusing on success control vs. no instructions control) × Repetition Frequency (high vs. moderate) ANOVA designs. Analyses on estimates of inhibition strength revealed only a significant main effect of strategy, $F(2, 129) = 8.04$, $MSE = 0.56$, $p < .05$. Inhibition of the incorrect, unwanted response was greater for participants using a monitoring strategy ($M = 50\%$) than for those using the success strategy ($M = 36\%$) or no particular strategy ($M = 36\%$). Analyses on habit strength did not vary with strategy. Only the main effect of frequency of repetition in Phase 1 reached significance, $F(1, 129) = 34.31$, $MSE = 0.82$, $p < .05$. Reliance on habits was greater in the high-frequency ($M = 63\%$) than in the moderate-frequency ($M = 49\%$) condition. Thus, consistent with the basic process dissociation model (Kelley & Jacoby, 2000), strength of inhibitory processes vary with capacity for working memory and available cognitive resources, and in our study, self-control strategy, whereas the strength of habits vary with strength of the associative connections in memory or automaticity.

Discussion

This experiment demonstrated that vigilant monitoring is an effective form of control for inhibiting strong habits. The experiment was a laboratory analogue of the everyday control of unwanted habits. It examined inhibition of response habits in a laboratory task instead of in daily life. Also, the experiment formed strong habits through repeated practice instead of measuring habit strength through self-reports of past behavior in stable contexts. In the laboratory simulation, just as in real life, participants who used a strategy of vigilant monitoring and focused on possible mistakes, thinking "don't do it," were better able to inhibit unwanted habits and give the desired response. Monitoring did not offer any particular benefits when participants had weak habits that could easily be inhibited. Then, the strategy of monitoring was essentially as effective as any other form of self-control in ensuring the intended, correct response.

The experiment also provided insight into the mechanisms through which monitoring promoted inhibition of strong habits. The process dissociation analysis revealed that monitoring did not influence habit strength, which is a function of response repetition, but instead increased the strength of conscious, intentional processes. The estimates from Jacoby's (1991) process dissociation procedure revealed that monitoring did in fact heighten intended, conscious recall and thereby helped participants inhibit the automatic triggering of strong habits. By these effects, the strategy of vigilant monitoring functions much like youth and other influences on executive control in enhancing inhibitory control (see Kelley & Jacoby, 2000). Monitoring apparently was not as useful for generating the desired response when habits were

weak. With weak habits, participants did not have to override an unwanted response activated in memory to give the desired response. Thus, the increased cognitive control was not required for them to respond as they wished.

The focus on success control condition also is relevant to understanding the mechanisms underlying monitoring effects. That is, the conscious, intentional processes specifically involved inhibition and not the execution of the desired, correct response. A focus on success did not stop participants from acting on the habitual response accessible in memory and thus did not improve performance. Thus, this study locates the mechanism of vigilant monitoring in the readiness to prevent acting on the response brought to mind by the associative cue.

One promising implication of our findings is that people can be trained to engage in a monitoring strategy. Given the effectiveness of our monitoring instructions, it seems that people can consciously adopt this strategy and inhibit unwanted habitual behavior. Participants primed to monitor their behavior successfully inhibited unwanted habits in the lab, much like participants in the diary studies who spontaneously chose to use the strategy to control everyday bad habits.

General Discussion

Are people stuck hopelessly repeating their bad habits? Our answer, from research on what people do in their everyday lives when trying to change their responses, is not necessarily. Participants in our studies were reasonably successful at exerting control over unwanted responses when they used self-control strategies that were tailored to the specific cuing mechanisms that produced the response—whether habits or temptations. Thus, as suggested in earlier research on delay of gratification, having sufficient self-control strength is not a guarantee of success. The participants in our diary and laboratory studies were most successful when they exerted control in ways best suited to inhibit habit or temptation cuing.

Motivation of course plays an important role in self-control. People change responses when they intend to do so and when they believe they have the efficacy to perform an alternative response. Accordingly, most traditional theories of persuasion, social influence, and behavior change have focused on people's desire to change (see Albarracín, Johnson, & Zanna, 2005). However, simply being motivated does not ensure that people will overcome effectively the conflicting automatic triggers in performance environments. Even implementation intentions, or if–then plans, that link intentions to particular times and places (e.g., "I will order salad for lunch tomorrow") are not very successful at controlling strong habits (Webb, Sheeran, & Luszczynska, 2009). Exertion of self-control over habit cuing requires effortful inhibition of the automatically activated habitual response, a form of inhibition that is promoted by some control strategies more than others.

We used a two-stage approach to study habit control. We first collected data on everyday inhibition of habits and responses to temptations. In so doing, we replicated earlier experimental research that manipulated strategies and found that effective suppression of responses to temptations involved stimulus control (e.g., Mischel & Ebbesen, 1970). Also, we were able to show that although vigilant monitoring of behavior is not useful for temptations, it is an especially effective form of self-control for habits. Because habit responses are activated in memory upon perception of associated context cues and are not amendable to dynamic change because of their slowly learned nature, the challenge for habit control is to inhibit tendencies to perform that activated response (Wood & Neal, 2009). Careful monitoring for unwanted responses provided this control over habits in everyday life. After establishing the effectiveness of vigilant monitoring in everyday habit control and distinguishing it from the forms of self-control useful with temptations, we undertook an experiment that manipulated monitoring in the lab and examined its effectiveness as a habit control strategy. This strategy yielded the same benefits for inhibiting unwanted habits in the experimental task in the laboratory as in the diary research tapping everyday behaviors. Furthermore, its success arose from marshalling cognitive control to inhibit the habitual response activated in memory and not from altering the habit memory trace. The limited effect of focusing on success suggests further that strategies did not enhance control through heightened attention to the desired response.

Despite that participants' monitoring facilitated their attempts to suppress unwanted habits both in our diary reports of naturalistic responses and in the lab experiment, past researchers have questioned the longer term efficacy of this strategy. Successful exertion of inhibition over the long term increases negative affect, generates preoccupied thinking about the inhibited response (Polivy, 1998), and produces ironic effects involving increases in the unwanted responding (Wenzlaff & Wegner, 2000). In addition, it is unclear whether people can sustain effortful inhibitory strategies in daily life. People's capacity to inhibit strong habits is reduced with everyday fluctuations in their self-control resources (Muraven & Baumeister, 2000; Pascoe, Neal, Toner, & Wood, 2010).

We speculate that effortful inhibition contributes most productively to long-term behavior change when the suppression of unwanted habits is undertaken in conjunction with performing a new, desired response. That is, inhibition might be effective as a short-term strategy to suppress an unwanted habit so as to establish a new, more desired pattern of responding. If the new response is repeated in contiguity with context cues, new good habits might be formed. Over time, the new habits might become sufficiently strong to be performed without requiring inhibition of the old habit. For example, a dieter's effortful inhibition of unhealthful eating habits may promote long-term behavior

change only insofar as it creates a temporary window of opportunity in which to establish new healthful eating patterns. In this view, the inhibition of cued responding is a short-term means of control that, although perhaps inherently unsustainable in itself, enables the development of new, more desired patterns of response consistent with current goals. Yet, an important limitation to this process is that when newly learned associations override older habitual ones (e.g., through extinction), the new learning is inherently unstable and the original habit memory trace may readily be reactivated under a variety of circumstances (Bouton, 2000). This spontaneous recurrence is one feature of habits that makes them difficult to change once formed. Nonetheless, the monitoring strategy that we identified in the present investigation provides an initial handle on how to break unwanted habits.

Authors' Note

Jeffrey M. Quinn is now at Sprint/Nextel, Kansas City, Missouri.

Acknowledgments

The authors thank Tanya Chartrand, Phil Costanzo, Jennifer Labrecque, John Lynch, Timothy Strauman, and Kaitlin Toner for their comments on an earlier version of the article. We also thank Larry Jacoby and Karen Daniels for sharing the experimental procedure used in Study 2.

Declaration of Conflicting Interests

The authors declared no conflicts of interest with respect to the authorship and/or the publication of this article.

Funding

The authors received the following financial support for the research and/or authorship of this article: Wendy Wood supported by a fellowship from the Radcliffe Institute during preparation of the article.

Notes

1. Self-control also emerges through automatic mechanisms, as when people who have a goal to be thin activate that goal automatically when faced with temptations such as dessert that would thwart goal attainment (see Fishbach & Shah, 2006). We speculate that such automatic self-regulation emerges in part through people's repeated practice of the kinds of effortful self-control investigated in the present research.
2. We excluded from the analyses participants who reported only a minority of their self-control attempts because of the possibility that these selective reports would be biased toward the most memorable strategies or outcomes (e.g., failures).
3. During pretesting, respondents listed a number of additional strategies. These were not used with any frequency in the diary studies and analyses on them did not yield any systematic effects. Thus, we do not report further data on the following: *thinking about reasons why "it's not worth it," talking to someone, seeking support, thinking about how I really want to act, thinking about what I ought to do, thinking of ideal performance, putting myself in a situation to succeed,* and *being eager to find opportunities for success.*
4. The continuation questionnaire also assessed a number of items that failed to produce interpretable results and are not discussed further (e.g., difficulty of inhibition, amount of effort and thought required for inhibition).
5. The number of reported change attempts per day in Study 1b is somewhat lower than in Study 1a. One possible reason is that Study 1b took place during the summer, when students had fewer demands on their time and thus fewer reasons to try to change their responses. It also might be that the longer reporting period in this study increased fatigue and thus the number of overall reports each participant provided.

References

Albarracín, D., Johnson, B. T., & Zanna, M. P. (Eds.). (2005). *Handbook of attitudes and attitude change*. Mahwah, NJ: Lawrence Erlbaum.

Bouton, M. E. (2000). A learning theory perspective on lapse, relapse, and the maintenance of behavior change. *Health Psychology, 19*, 57-63.

Burger, J. M. (1992). *Desire for control: Personality, social, and clinical perspectives*. New York: Plenum.

Carver, C. S., & Scheier, M. F. (2008). Feedback processes in the simultaneous regulation of affect and action. In J. Y. Shah & W. Gardner (Eds.), *Handbook of motivation science* (pp. 308-324). New York: Guilford.

Daw, D. N., Niv, Y., & Dayan, P. (2005). Uncertainty-based competition between prefrontal and dorsolateral striatal systems for behavioral control. *Nature Neuroscience, 8*, 1704-1711.

DeWall, C. N., Baumeister, R. F., Gailliot, M. T., & Maner, J. K. (2008). Depletion makes the heart grow less helpful: Helping as a function of self-regulatory energy and genetic relatedness. *Personality and Social Psychology Bulletin, 34,* 1653-1662.

Fishbach, A., & Shah, J. Y. (2006). Self control in action: Implicit dispositions toward goals and away from temptations. *Journal of Personality and Social Psychology, 90*, 820-832.

Follette, W. C., & Hayes, S. C. (2001). Contemporary behavior therapy. In C. R. Snyder & R. Ingram (Eds.), *Handbook of psychological change* (pp. 381-408). New York: John Wiley.

Harvey, K., Kemps, E., & Tiggemann, M. (2005). The nature of imagery processes underlying food cravings. *British Journal of Health Psychology, 10,* 49-56.

Hay, J. F., & Jacoby, L. L. (1996). Separating habit and recollection: Memory slips, process dissociations, and probability matching. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 22*, 1323-1335.

Hay, J. F., & Jacoby, L. L. (1999). Separating habit and recollection in young and older adults: Effects of elaborative processing and distinctiveness. *Psychology and Aging, 14*, 122-134.

Higgins, E. T. (1997). Beyond pleasure and pain. *American Psychologist, 52*, 1280-1300.

Higgins, E. T., Friedman, R. S., Harlow, R. E., Idson, L. C., Ayduk, O. N., & Taylor, A. (2001). Achievement orientations from subjective histories of success: Promotion pride versus prevention pride. *European Journal of Social Psychology, 31*, 3-23.

Jacoby, L. L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language, 30*, 513-514.

Ji, M., & Wood, W. (2007). Habitual purchase and consumption: Not always what you intend. *Journal of Consumer Psychology*, *17,* 261-276.

Kavanagh, D. J., Andrade, J., & May, J. (2005). Imaginary relish and exquisite torture: The elaborated intrusion theory of desire. *Psychological Review, 112*, 446-467.

Kelley, C. M., & Jacoby, L. L. (2000). Recollection and familiarity: Process-dissociation. In E. Tulving & F. I. M. Craik (Eds.), *The Oxford handbook of memory* (pp. 215-228). New York: Oxford University Press.

Kenny, D. A., Kashy, D. A., & Bolger, N. (1998). Data analysis in social psychology. In D. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *Handbook of social psychology* (4th ed., Vol. 1, pp. 233-265). New York: McGraw-Hill.

Lockwood, P., Jordan, C. H., & Kunda, Z. (2002). Motivation by positive or negative role models: Regulatory focus determines who will best inspire us. *Journal of Personality and Social Psychology, 83*, 854-864.

Loewenstein, G. (1996). Out of control: Visceral influences on behavior. *Organizational Behavior and Human Decision Processes, 65*, 272-292.

Metcalfe, J., & Mischel, W. (1999). A hot/cool-system analysis of delay of gratification: Dynamics of willpower. *Psychological Review, 106*, 3-19.

Mischel, W., & Ebbesen, E. B. (1970). Attention in delay of gratification. *Journal of Personality and Social Psychology*, *16*, 329-337.

Mischel, W., Ebbesen, E. B., & Zeiss, A. R. (1972). Cognitive and attentional mechanisms in delay of gratification. *Journal of Personality and Social Psychology, 21*, 204-218.

Moors, A., & De Houwer, J. (2006). Automaticity: A theoretical and conceptual analysis. *Psychological Bulletin, 132*, 297-326.

Muraven, M., & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin, 126*, 247-259.

Neal, D. T., & Wood, W. (2009). Automaticity in situ: Direct context cuing of habits in daily life. In E. Morsella, J. A. Bargh, & P. Gollwiter (Eds.), *Oxford handbook of human action* (pp. 442-457). New York Oxford University Press.

Neal, D. T., Wood, W., & Quinn, J. M. (2006). Habits: A repeat performance. *Current Directions in Psychological Science, 15*, 198-202.

Pascoe, A., Neal, D. T., Toner, K., & Wood, W. (2010). *Habits as external self-control*. Manuscript submitted for publication, University of Southern California.

Poldrack, R. A., Clark, J., Paré-Blagoev, E. J., Shohamy, D., Creso Moyano, J., Myers, C., et al. (2001). Interactive memory systems in the human brain. *Nature, 414*, 546-550.

Polivy, J. (1998). The effects of behavioral inhibition: Integrating internal cues, cognition, behavior, and affect. *Psychological Inquiry, 9*, 181-204.

Prochaska, J. O., DiClemente, C. C., & Norcross, J. C. (1992). In search of how people change: Applications to addictive behaviors. *American Psychologist, 47*, 1102-1114.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Thousand Oaks, CA: Sage.

Reason, J. T. (1992). Cognitive underspecification: Its varieties and consequences. In B. J. Baars (Ed.), *Experimental slips and human error: Exploring the architecture of volition* (pp. 71-91). New York: Plenum.

Satterwaithe, F. W. (1941). Synthesis of variance. *Psychometrika, 6*, 309-316.

Satterwaithe, F. W. (1946). An approximate distribution of estimates of variance components. *Biometrics Bulletin, 2,* 110-112.

Tangney, J. P., Baumeister, R. F., & Boone, A. L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality, 72*, 271-322.

Verplanken, B., & Aarts, H. (1999). Habit, attitude, and planned behaviour: Is habit an empty construct or an interesting case of goal-directed automaticity? *European Review of Social Psychology, 10*, 101-134.

Versland, A., & Rosenberg, H. (2007). Effect of brief imagery interventions on craving in college student smokers. *Addiction Research and Theory, 15*, 177-187.

Wansink, B. (2006). *Mindless eating.* New York: Bantam Books.

Webb, T. L., Sheeran, P., & Luszczynska, A. (2009). Planning to break unwanted habits: Habit strength moderates implementation intention effects on behaviour change. *British Journal of Social Psychology, 48*, 507-523.

Wegner, D. M., Schneider, D. J., Carter, S. R., III, & White, T. L. (1987). Paradoxical effects of thought suppression. *Journal of Personality and Social Psychology, 53*, 5-13.

Wenzlaff, R. M., & Wegner, D. M. (2000). Thought suppression. *Annual Review of Psychology, 51*, 59-91.

Witkiewitz, K., & Marlatt, G. A. (2004). Relapse prevention for alcohol and drug problems: That was Zen, this is Tao. *American Psychologist, 59*, 224-235.

Wood, W., & Neal, D. T. (2007). A new look at habits and the habit-goal interface. *Psychological Review, 114*, 843-863.

Wood, W., & Neal, D. T. (2009). The habitual consumer. *Journal of Consumer Psychology, 19,* 579-592.

Wood, W., Tam, L., & Guerrero Witt, M. (2005). Changing circumstances, disrupting habits. *Journal of Personality and Social Psychology, 88*, 918-933.