


Exploring the Mechanisms of Self-Control Improvement

Michael Inzlicht^{1,2}, Lisa Legault³, and Rimma Teper¹

¹Department of Psychology, University of Toronto; ²Rotman School of Management, University of Toronto; and ³Department of Psychology, Clarkson University

Current Directions in Psychological Science
2014, Vol. 23(4) 302–307
© The Author(s) 2014
Reprints and permissions:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/0963721414534256
cdps.sagepub.com


Abstract

Good self-control is central to success across life domains, from school to work to relationships. In this article, we provide a framework to better understand how self-control can be improved. Using cybernetic principles, we identify and integrate important mechanisms for self-control improvement that have previously been overlooked. The cybernetic model suggests that control relies on three separate processes: setting goals, monitoring when behavior diverges from goals, and implementing behavior aligned with goals. Within each of these stages, we incorporate recent research identifying key features of good self-control, including setting the “right kind” of goals; the role of conflict detection, attention, and emotional acceptance in goal monitoring; and the effects of fatigue, shifting priorities, and intentions on implementing behavioral changes. Self-control is not easy, but by revealing it as reliant on these diverse processes, we offer a more comprehensive perspective on self-control, as well as routes through which it can be improved.

Keywords

self-control, motivation, conflict monitoring, attention, acceptance, fatigue, goal setting

There has been a rush of research on self-control in the past decade. And it is no wonder: Self-control is thought to underlie an impressive array of behavior, and its failure, the root of societal ills ranging from financial debt to marital infidelity, from obesity to criminality (Baumeister, Heatherton, & Tice, 1994). Self-control—known colloquially as willpower and more formally as executive function—refers to the mental processes that allow people to overcome urges, juggle competing tasks, and sustain attention.

Part of the excitement surrounding this research is the promise of what it can uncover: By studying how self-control works, we can discover how to improve it. Many of us would like to know how to better control our behavior, and reducing self-control to its basic operations may facilitate this. Here, we provide a framework that helps organize various methods that have been used to improve self-control.

We expand upon the well-known cybernetic model of control by identifying various overlooked mechanisms relevant to self-control. Cybernetic principles suggest that control relies on three separate processes: setting goals,

monitoring when behavior conflicts with these goals, and implementing behavior that supports these goals. We hone in on each of these processes and integrate important features within each stage, including setting the “right kind” of goals; the role of conflict detection, attention, and emotional acceptance in goal monitoring; and the effects of fatigue and intentions on implementing changes in behavior. By revealing self-control as jointly reliant on these diverse processes, we suggest some ways in which this difficult-to-master skill can be developed.¹

Cybernetics

Cybernetics is the scientific study of control (Wiener, 1948). It is based on the characteristics of feedback loops and is used to model control in people, animals, and machines (Carver & Scheier, 1981). Cybernetic models

Corresponding Author:

Michael Inzlicht, University of Toronto, Department of Psychology,
1265 Military Trail, Toronto, Ontario M1C 1A4, Canada
E-mail: michael.inzlicht@utoronto.ca

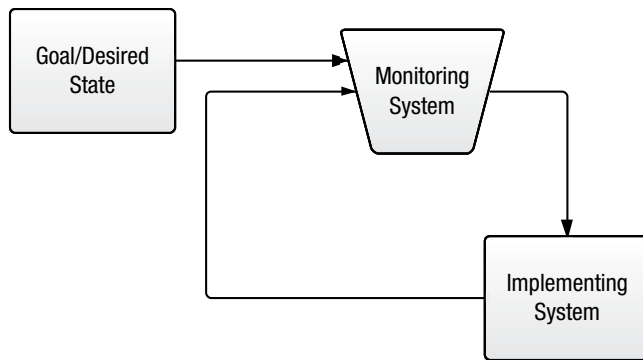


Fig. 1. The cybernetic model of control. The cybernetic model reduces self-control to three components: (a) goal setting, (b) monitoring for mismatches between goals and current behavior, and (c) implementing behavior that is consistent with goals to reduce the size of behavior–goal mismatches. These three components are connected to one another via a feedback loop, whereby the output of the implementing system feeds into the monitoring system so that the size of any behavior–goal mismatch is constantly monitored until it is reduced to some acceptable level.

reduce control to three components (see Fig. 1): (a) goal setting, (b) monitoring for mismatches between goals and current behavior, and (c) implementing behavior that is consistent with goals to reduce the size of behavior–goal mismatches. Crucially, these components are connected to one another via a feedback loop: The output of the implementing system feeds into the monitoring system, so that the size of any behavior–goal mismatch is constantly monitored until it is reduced to some acceptable level.

Controlling one’s eating behavior, for example, works on cybernetic principles: First, a dieter sets a specific goal for the kinds of food he wants to eat (e.g., “Eat more broccoli, less chips”). Second, he monitors his eating behavior, looking for instances when his behavior deviates from his eating goals (e.g., “I’m eating chips now”). Third, when such discrepancies are detected, he changes his behavior (e.g., “Put down the chips, grab broccoli!”). Although self-control is difficult, people can improve their self-control by acting on any one (or more) of these three processes.

Improving Control by Setting Better, More Self-Aligned Goals

The first step in establishing and improving self-control is setting goals.² Goals are mental representations of future desired outcomes to which people are committed (Mann, de Ridder, & Fujita, 2013). Goals are more than fleeting desires and intentions (e.g., “I wish I weighed less”); setting goals implies that a person has committed thought, emotion, and behavior to attain them. Because goals refer to a future desired state that differs from the current

state, goal setting can be thought of as a process that creates a discrepancy between what one wants to be like and what one is currently like. Creating this discrepancy is what sets self-control in motion.

According to goal-setting theory (Locke & Latham, 2006), which synthesizes hundreds of laboratory and field studies, the simple act of setting a specific, challenging, yet attainable goal leads to better self-control (Latham & Locke, 1991) than setting a vague goal or not setting a goal at all. For example, a dieter can improve his self-control if he sets a specific goal (e.g., “Eat salad for lunch three times a week for the next month”) as opposed to an abstract goal (e.g., “Try my best to eat well”). Setting concrete and measurable goals with a time frame leads to superior performance because it allows for straightforward monitoring of goal–behavior mismatches; it allows for the generation of feedback that provides information about the degree to which standards are being met. If an individual does not set a goal or sets a goal that is vague and indefinite, feedback is difficult or impossible. This undermines the capacity to make goal-directed changes.

However, not all goals are created equal. Setting goals that are aligned with personal values will contribute to greater self-control. Decades of research in self-determination theory has indicated that the impact of motivation on behavioral implementation depends on the quality (and not just the quantity) of motivation (Deci & Ryan, 2000). When goals are internally driven—that is, when they are perceived as personally meaningful—behavior becomes easier to control, even in the face of fatigue (Hockey & Earle, 2006). For example, when people are encouraged to adopt a goal and reflect on why the goal is important and personally meaningful, they are better at controlling and overriding their impulses compared with when they reflect on why the goal is a socially expected obligation (Legault, Gutsell, & Inzlicht, 2011). The reason for this is that autonomously selected goals are monitored with greater urgency, thereby facilitating the implementation of control (Legault & Inzlicht, 2013). Setting goals that are self-aligned, then, is an effective way to improve self-control; although not easy, this can be done for otherwise unappealing tasks (e.g., doing one’s homework) when they are reinterpreted as being instrumental to other personal goals (e.g., becoming an astronaut).

Improving Control by Monitoring

After people have set specific self-aligned goals, the next step in establishing and improving self-control is paying attention to discrepancies between these goals and current behavior. These discrepancies alert people to the possibility that their goals are in jeopardy and, in so doing, arouse shifts in behavior from routine to deliberate.

In particular, people should pay attention to when they have failed to meet a goal, or when goal failure is likely. Attention to such failures can help individuals avoid future mistakes. For example, a person trying to quit smoking must pay attention to situations in which she is likely to face temptation—say, when she is invited for a drink at the pub. She also needs to pay attention to when she makes a “goal mistake,” such as when she accepts her friend’s offer of a cigarette. By becoming aware that her current behavior is in conflict with her nonsmoking goal, she is better poised to stop herself from smoking.

Conflict monitoring

Neuroscience models of control place great emphasis on brain systems that function to monitor for conflicts between goals and actual behavior (e.g., Botvinick, Braver, Barch, Carter, & Cohen, 2001). In fact, these models suggest that control is initiated by a conflict-monitoring system localized to a brain region called the anterior cingulate cortex and captured by an evoked brain potential called the *error-related negativity* (ERN; Gehring, Goss, Coles, Meyer, & Donchin, 1993). This brain potential represents a quick neural response to errors or conflict (Botvinick et al., 2001) and reflects not only the detection of conflict, but also the affective response to conflict (Inzlicht & Al-Khindi, 2012).

Those who notice and react emotionally to goal conflicts and errors possess the most self-control. Emerging research indicates that childhood obesity and teen alcoholism are reduced among people who can effectively monitor goal conflicts, as assessed using the ERN (Skoranski et al., 2013; Smith & Mattick, 2013). The ERN has further been related to the ability to control one’s emotions (Compton et al., 2008) and to college achievement (Hirsh & Inzlicht, 2010). People who set autonomous or self-aligned goals have particularly high ERNs, which may be why these same people have superior self-control (Legault & Inzlicht, 2013). Control is established, then, by attending and reacting to how one’s goals and current behaviors align, and it can be improved by cultivating this attentional capacity.

Attention

One way to cultivate the capacity to monitor for goal conflicts is through mindfulness meditation, which refers to the practice of nonjudgmentally focusing on the present moment. In our lab, we have found that meditation is associated with improved attention to goal conflicts, as indicated by higher ERNs (Teper & Inzlicht, 2013). This developed ability to monitor for conflicts may explain why mindfulness improves self-control, including the

ability to resist sweets (Jenkins & Tapper, 2013) and immediate rewards (Teper & Inzlicht, 2014).

Acceptance

The above discussion on conflict monitoring may make it seem like the right course of action when people notice their self-control errors is to condemn themselves. However, just the opposite is true—self-control is improved when people acknowledge and accept their errors. The reason for this may be that the acceptance of errors increases people’s ability to remain focused on their goals and to monitor for further goal conflicts (see Teper, Segal, & Inzlicht, 2013). By “acceptance,” we refer to the open and nonjudgmental ownership of mistakes. When people consider their errors without defense or judgment, they gain the ability to attend to them without distraction and are able to respond to them adaptively; acceptance, in other words, sharpens conflict monitoring.

Indeed, the reason meditators in our study exhibited superior conflict monitoring was that they were more accepting of their thoughts and emotions than nonmeditators: Acceptance directly predicted ERN amplitudes (Teper & Inzlicht, 2013). In a separate study (Legault, Al-Khindi, & Inzlicht, 2012), we found that a self-affirmation exercise designed to increase openness could similarly amplify the monitoring of goal conflicts and improve self-control. Finally, acceptance of mistakes as learning opportunities (Dweck, 2006) predicts brain-based measures of conflict monitoring, which in turn improves self-control (Moser, Schroder, Heeter, Moran, & Lee, 2011).

This connection between acceptance and monitoring can explain the benefits of acceptance for self-control. It could be why overeating does not lead to further indulgence for dieters who treat their self-control mistakes compassionately (Adams & Leary, 2007) or why ex-smokers who are able to forgive their occasional slipups do not return to full-time smoking (Curry, Marlatt, & Gordon, 1987). Thus, the more people respond to their self-control lapses with acceptance, the more they can objectively appraise and correct them.

Improving Control by Implementing Goal-Directed Behaviors

Once a person sets a goal and attends to instances of self-control conflict, the next challenge is to implement behaviors that will reduce these conflicts. One barrier to the implementing system is mental fatigue.

Depletion and fatigue

Recent models have suggested that the implementing system is based on some limited resource, fatiguing

quickly after use (Baumeister & Heatherton, 1996; Schmeichel & Baumeister, 2004). That is, the power of the implementing system to engage control seems weakened after it exerts itself. Although many studies have seemed to confirm this resource account, a newer crop of studies is inconsistent with it, instead suggesting that self-control depletion, or fatigue, is better characterized as a change in motivational priorities (Inzlicht & Schmeichel, 2012). The idea here is that after people have engaged in cognitive work to control their impulses, they prefer to engage in some form of cognitive leisure rather than to continue working. According to this view, self-control is effortful and aversive, with self-control fatigue being the result of decreased motivation to pursue goals seen as obligations and duties and increased motivation to pursue goals that are inherently interesting and gratifying (Inzlicht, Schmeichel, & Macrae, 2014). Thus, although fatigue is a real barrier to the implementing system, it has less to do with depleted resources and more to do with changes in people's preferences.

Understanding the implementing system as being based on a limited resource has implications for how to improve self-control. The resource view suggests that this resource can be increased with practice. Although some evidence supports the practice hypothesis, other evidence is mixed (e.g., Muraven, Baumeister, & Tice, 1999; see also Melby-Lervag & Hulme, 2013). In contrast, the motivational-priorities hypothesis suggests that the implementing system can become resilient against fatigue by reconsidering the personal benefits of the self-control goal and by providing a meaningful rationale to pursue the goal (Legault et al., 2011). Critically, personally meaningful goals promote self-control even in the face of fatigue (Legault, Green-Demers, & Eadie, 2009).

Implementation intentions

Another way to strengthen the implementing system is by forming *implementation intentions* (Gollwitzer, 1999), or behavioral plans that link anticipated situations with specified behaviors; they specify the when, where, and how of goal-directed behavior in advance (e.g., "When I get home from work, I will exercise for 30 minutes"). Implementation intentions improve control by associating the control of one's behavior with specific situations—when the anticipated situation is encountered, it automatically cues the behavior, even under conditions of fatigue (Webb & Sheeran, 2003). The power of intentions was demonstrated in a field study in which children exhibited better control of their behavior when they elaborated upon their implementation intentions (Duckworth, Grant, Loew, Oettingen, & Gollwitzer, 2011).

Putting It All Together

Although we have described the three cybernetic mechanisms separately, they are in actuality quite interrelated. Goal setting shapes monitoring, which shapes implementing, which feeds back into monitoring, and so on. Setting an accuracy goal on a task increases monitoring for errors, which improves the implementation of control (Gehring et al., 1993). Likewise, increased monitoring (e.g., menu labeling in the case of monitoring food behavior) increases the efficiency of the implementing system, even under conditions of distress (Brochu & Dovidio, 2013). Critically, autonomous motivation plays a privileged role in our analysis, being important for setting goals that are personally relevant, for monitoring for goal-behavior conflicts, and for defending the implementing system against fatigue. Goal setting, goal monitoring, and goal implementing are thus intricately linked.

Conclusion

Although we are hopeful for the prospect of self-control improvement, we must stress that self-control poses a significant challenge for most people. Eating better, exercising more, and inhibiting biases are by no means easy. By its very nature, self-control is effortful, with most people at pains to avoid it (Kool, McGuire, Rosen, & Botvinick, 2010). By elaborating on the cybernetic framework, we help to reveal why self-control is often difficult. Undermining forces include the setting of goals that are not amenable to feedback or that are not aligned with personal values and the failure to monitor for goal conflicts, to openly approach and attend to goal failure, or to adopt goals and strategies that protect against fatigue. Thus, while a more precise understanding of how self-control works offers a number of prescriptions for self-control improvement, it also highlights the many places where self-control can fail. The challenge for future research will be to identify how to avoid these pitfalls and support the development of effective self-control.

Recommended Reading

- Carver, C. S., & Scheier, M. F. (1981). (See References). An introduction to an important idea in the psychology of self-control, the cybernetic principle of a discrepancy-reducing feedback loop.
- Deci, E. L., & Ryan, R. M. (2000). (See References). A detailed review of self-determination theory, including the importance of autonomous motivation for goal pursuit.
- Hockey, R. (2013). *The psychology of fatigue: Work, effort, and control*. Cambridge, England: Cambridge University Press. An exhaustive review of the psychology of fatigue, which includes a contemporary view of fatigue that is based on motivation.

Inzlicht, M., & Legault, L. (in press). No pain, no gain: How distress underlies effective self-control (and unites diverse social psychological phenomena). In J. Forgas & E. Harmon-Jones (Eds.), *The control within: Motivation and its regulation*. New York, NY: Psychology Press. A review paper highlighting the importance of noticing and emotionally reacting to self-control errors in contributing to goal attainment.

Mann, T., de Ridder, D., & Fujita, K. (2013). (See References). A review of research on how goal setting and goal striving influence self-control in health behaviors.

Terry, M. L., & Leary, M. R. (2011). Self-compassion, self-regulation, and health. *Self and Identity*, *10*, 352–362. A theoretical review of why acceptance or self-compassion can improve self-control in the domain of health.

Acknowledgments

We thank Uli Schimmack, Jennifer Gutsell, Elizabeth Page-Gould, and Naomi Sarah Ball for valuable insights.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Funding

This research was supported by grants from the Ontario Ministry of Research and Innovation and the Social Sciences and Humanities Research Council to Michael Inzlicht.

Notes

1. Note that space constraints prevent a thorough discussion of the complete self-control-improvement literature. We have therefore focused selectively on lab studies that speak to process, oversampling from studies that can provide information supporting the links between the cybernetic framework and self-control.

2. Although self-control requires the setting of some goal, goal setting does not always require self-control to translate to goal pursuit. Rather, goal pursuit can occur without conscious control through, for example, nonconscious self-regulatory means (e.g., Fishbach & Shah, 2006).

References

- Adams, C. E., & Leary, M. R. (2007). Promoting self-compassionate attitudes toward eating among restrictive and guilty eaters. *Journal of Social & Clinical Psychology*, *26*, 1120–1144.
- Baumeister, R. F., & Heatherton, T. F. (1996). Self-regulation failure: An overview. *Psychological Inquiry*, *7*, 1–15.
- Baumeister, R. F., Heatherton, T. F., & Tice, D. M. (1994). *Losing control: How and why people fail at self-regulation*. San Diego, CA: Academic Press.
- Botvinick, M. M., Braver, T. S., Barch, D. M., Carter, C. S., & Cohen, J. D. (2001). Conflict monitoring and cognitive control. *Psychological Review*, *108*, 624–652.
- Brochu, P. M., & Dovidio, J. F. (2013). Would you like fries (380 calories) with that? Menu labeling mitigates the impact of weight-based stereotype threat on food choice. *Social Psychological & Personality Science*, *5*, 414–421. doi:10.1177/1948550613499941
- Carver, C. S., & Scheier, M. F. (1981). *Attention and self-regulation: A control-theory approach to human behavior*. New York, NY: Springer-Verlag.
- Compton, R. J., Robinson, M. D., Ode, S., Quandt, L. C., Fineman, S. L., & Carp, J. (2008). Error-monitoring ability predicts daily stress regulation. *Psychological Science*, *19*, 702–708.
- Curry, S., Marlatt, G. A., & Gordon, J. R. (1987). Abstinence violation effect: Validation of an attributional construct with smoking cessation. *Journal of Consulting and Clinical Psychology*, *55*, 145–149.
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*, 227–268.
- Duckworth, A. L., Grant, H., Loew, B., Oettingen, G., & Gollwitzer, P. M. (2011). Self-regulation strategies improve self-discipline in adolescents: Benefits of mental contrasting and implementation intentions. *Educational Psychology*, *31*, 17–26.
- Dweck, C. S. (2006). *Mindset: The new psychology of success*. New York, NY: Random House.
- 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.
- Gehring, W. J., Goss, B., Coles, M. G., Meyer, D. E., & Donchin, E. (1993). A neural system for error detection and compensation. *Psychological Science*, *4*, 385–390.
- Gollwitzer, P. M. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist*, *54*, 493–503.
- Hirsh, J. B., & Inzlicht, M. (2010). Error-related negativity predicts academic performance. *Psychophysiology*, *47*, 192–196.
- Hockey, G. R. J., & Earle, F. (2006). Control over the scheduling of simulated office work reduces the impact of workload on mental fatigue and task performance. *Journal of Experimental Psychology: Applied*, *12*, 50–65.
- Inzlicht, M., & Al-Khindi, T. (2012). ERN and the placebo: A misattribution approach to studying the arousal properties of the error-related negativity. *Journal of Experimental Psychology: General*, *141*, 799–807.
- Inzlicht, M., & Schmeichel, B. J. (2012). What is ego depletion? Toward a mechanistic revision of the resource model of self-control. *Perspectives on Psychological Science*, *7*, 450–463.
- Inzlicht, M., Schmeichel, B. J., & Macrae, C. N. (2014). Why self-control seems (but may not be) limited. *Trends in Cognitive Sciences*, *18*, 127–133. doi:10.1016/j.tics.2013.12.009
- Jenkins, K. T., & Tapper, K. (2013). Resisting chocolate temptation using a brief mindfulness strategy. *British Journal of Health Psychology*. Advance online publication. doi:10.1111/bjhp.12050
- Kool, W., McGuire, J. T., Rosen, Z. B., & Botvinick, M. M. (2010). Decision making and the avoidance of cognitive demand. *Journal of Experimental Psychology: General*, *139*, 665–682.

- Latham, G. P., & Locke, E. A. (1991). Self-regulation through goal setting. *Organizational Behavior and Human Decision Processes*, *50*, 212–247.
- Legault, L., Al-Khindi, T., & Inzlicht, M. (2012). Preserving integrity in the face of performance threat: Self-affirmation enhances neurophysiological responsiveness to errors. *Psychological Science*, *23*, 1455–1460.
- Legault, L., Green-Demers, I., & Eadie, A. L. (2009). When internalization leads to automatization: The role of self-determination in automatic stereotype suppression and implicit prejudice regulation. *Motivation and Emotion*, *33*, 10–24.
- Legault, L., Gutsell, J. N., & Inzlicht, M. (2011). Ironic effects of antiprejudice messages: How motivational interventions can reduce (but also increase) prejudice. *Psychological Science*, *22*, 1472–1477.
- Legault, L., & Inzlicht, M. (2013). Self-determination, self-regulation, and the brain: Autonomy improves performance by enhancing neuroaffective responsiveness to self-regulation failure. *Journal of Personality and Social Psychology*, *105*, 123–138.
- Locke, E. A., & Latham, G. P. (2006). New directions in goal-setting theory. *Current Directions in Psychological Science*, *15*, 265–268.
- Mann, T., de Ridder, D., & Fujita, K. (2013). Self-regulation of health behavior: Social psychological approaches to goal setting and goal striving. *Health Psychology*, *32*, 487–498.
- Melby-Lervag, M., & Hulme, C. (2013). Is working memory training effective? A meta-analytic review. *Developmental Psychology*, *49*, 270–291.
- Moser, J. S., Schroder, H. S., Heeter, C., Moran, T. P., & Lee, Y. H. (2011). Mind your errors: Evidence for a neural mechanism linking growth mind-set to adaptive posterror adjustments. *Psychological Science*, *22*, 1484–1489.
- Muraven, M., Baumeister, R. F., & Tice, D. M. (1999). Longitudinal improvement of self-regulation through practice: Building self-control strength through repeated exercise. *The Journal of Social Psychology*, *139*, 446–457.
- Schmeichel, B. J., & Baumeister, R. F. (2004). Self-regulatory strength. In R. F. Baumeister & K. D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 64–82). New York, NY: Guilford Press.
- Skoranski, A. M., Most, S. B., Lutz-Stehl, M., Hoffman, J. E., Hassink, S. G., & Simons, R. F. (2013). Response monitoring and cognitive control in childhood obesity. *Biological Psychology*, *92*, 199–204.
- Smith, J., & Mattick, R. P. (2013). Evidence of deficits in behavioural inhibition and performance monitoring in young female heavy drinkers. *Drug and Alcohol Dependence*. Retrieved from <http://dx.doi.org/10.1016/j.drugalcdep.2013.06.020>
- Teper, R., & Inzlicht, M. (2013). Meditation, mindfulness and executive control: The importance of emotional acceptance and brain-based performance monitoring. *Social Cognitive and Affective Neuroscience*, *8*, 85–92.
- Teper, R., & Inzlicht, M. (2014). Mindful acceptance dampens neuroaffective reactions to external and rewarding performance feedback. *Emotion*, *14*, 105–114. doi:10.1037/a0034296
- Teper, R., Segal, Z. V., & Inzlicht, M. (2013). Inside the mindful mind: How mindfulness enhances emotion regulation through improvements in executive control. *Current Directions in Psychological Science*, *22*, 449–454. doi:10.1177/0963721413495869
- Webb, T. L., & Sheeran, P. (2003). Can implementation intentions help to overcome ego-depletion? *Journal of Experimental Social Psychology*, *39*, 279–286.
- Wiener, N. (1948). *Cybernetics: Or control and communication in the animal and the machine*. Oxford, England: John Wiley.