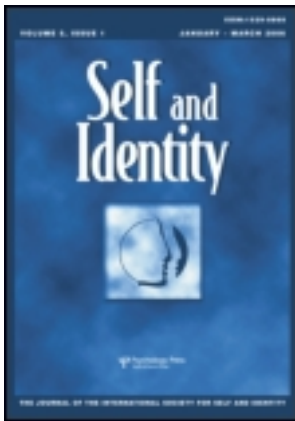


This article was downloaded by: [University of Basel], [Malte Friese]

On: 28 June 2011, At: 12:09

Publisher: Psychology Press

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Self and Identity

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/psai20>

On taming horses and strengthening riders: Recent developments in research on interventions to improve self-control in health behaviors

Malte Friese^a, Wilhelm Hofmann^b & Reinout W. Wiers^c

^a University of Basel, Basel, Switzerland

^b University of Chicago, Chicago, IL, USA

^c University of Amsterdam, Amsterdam, The Netherlands

Available online: 28 Jun 2011

To cite this article: Malte Friese, Wilhelm Hofmann & Reinout W. Wiers (2011): On taming horses and strengthening riders: Recent developments in research on interventions to improve self-control in health behaviors, *Self and Identity*, 10:3, 336-351

To link to this article: <http://dx.doi.org/10.1080/15298868.2010.536417>

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: <http://www.tandfonline.com/page/terms-and-conditions>

This article may be used for research, teaching and private study purposes. Any substantial or systematic reproduction, re-distribution, re-selling, loan, sub-licensing, systematic supply or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

On taming horses and strengthening riders: Recent developments in research on interventions to improve self-control in health behaviors

Malte Friese¹, Wilhelm Hofmann², and Reinout W. Wiers³

¹University of Basel, Basel, Switzerland

²University of Chicago, Chicago, IL, USA

³University of Amsterdam, Amsterdam, The Netherlands

This article reviews recent developments in the design of interventions to improve health behavior. Based on dual-system models we classify intervention strategies according to whether they aim at: (i) changing impulsive structures; (ii) improving the ability to self-control; or (iii) changing reflective structures. We review recent work on re-training of automatic associations, attentional biases, and automatic approach–avoidance tendencies, training of self-control and executive functioning, and taxonomic work on health behavior intervention techniques. The theoretical framework as well as the empirical evidence suggest that a combination of both established and newly developed intervention techniques may prove fruitful for future intervention programs. However, several techniques are still in their infancy and more research is needed before clear recommendations can be given.

Keywords: Self-control; Health behavior; Impulsive processes; Intervention.

Picture a rider sitting on the back of his horse on a great plain. The rider seems to be somewhat aimless, orienting himself on where to go next when the horse suddenly starts bolting, taking off in a direction the rider never intended to go. While the horse is getting wild and wilder the rider can hardly keep himself on the horse's back. For future horse rides, at least three things would be helpful for the rider: First, a better idea on where to go; second, better strength to control the horse, and third, a tamed horse that doesn't willfully take off to anywhere it catches a glimpse of something interesting.

The metaphor of the horse and the rider illustrates the nature of many health-related self-control conflicts, in which the rider's uncertainty about the direction to go resembles a lack of action plans and personal standards, the deficient ability to control the horse resembles inadequate self-control capacities, and the wild horse represents one's impulses and urges that strive for immediate gratification.¹ In the remainder of this article, we will use the metaphor of the horse and the rider to give an overview of recent developments in research on psychological interventions to

This work was supported by a grant for a research visit from the Swiss National Science Foundation to Malte Friese and a grant from the German Science Foundation (DFG) to Wilhelm Hofmann (Hofm 4175/3–1).

We thank Denise van Deursen for helpful comments on an earlier version of this manuscript.

Correspondence should be addressed to: Malte Friese, Department of Psychology, University of Basel, Missionsstr. 60/62, 4055 Basel, Switzerland. E-mail: malte.friese@unibas.ch

improve self-control outcomes in health behaviors. To this end, we will first outline why self-control is important for health behavior. We will then present a model that serves as a theoretical guideline for the different intervention strategies that we will illustrate subsequently with a special emphasis on recent attempts to tame the horse and strengthen the rider.

The Importance of Self-control for Health Behavior

When we talk about self-control, we refer to the ability of the self to alter dominant responses or inner states such as impulses, urges, emotions, and thoughts and replace them with a different response in the service of higher order goals, attitudes, or standards (Baumeister, Schmeichel, & Vohs, 2007). Self-control failures, that is, failures to control impulses to eat unhealthy food, use drugs, smoke cigarettes, or drink alcohol (to name just a few) lie at the heart of many problematic health outcomes (Baumeister & Heatherton, 1996) and they lead to severe costs and problems both on the individual level and for society at large. For example, obesity caused direct and indirect costs of about \$75 billion in 2003 in the USA alone (Finkelstein, Fielbelkorn, & Wang, 2004). Similarly alarming numbers exist for other problematic behaviors such as drinking, smoking, or drug use, let alone the severe psychological and social consequences of these behaviors. There is a clear need for theory-based interventions aimed at ameliorating these problems (Taylor, 2008), especially because many interventions have disappointing long-term effects (e.g., Cutler & Fishbain, 2005; Garner & Wooley, 1991; Jeffery et al., 2000).

A Model Illustrating the Dynamics of Self-control Conflicts

A model aiming to explain the dynamics of self-control conflicts in health behavior needs to take into account at least three interacting components: (i) reflective processes such as attitudes and personal standards (the rider's idea on where to go); (ii) impulsive processes (the horse); and (iii) self-control abilities that allow the control of impulsive processes and the transfer of reflective processes into behavior if desired (the strength of the rider to tame the horse). We argue that contemporary dual-system models (e.g., Epstein, 1990; Metcalfe & Mischel, 1999; Smith & DeCoster, 2000) do a good job illustrating this dynamic. We will build on one prominent example of these models, the reflective-impulsive model (Strack & Deutsch, 2004; see Hofmann, Friese, & Wiers, 2008, for an application to health behavior), to illustrate how interventions to change health behavior can be designed based on this conceptualization (see Figure 1).

The reflective-impulsive model distinguishes between two separate, but interacting systems, the impulsive system and the reflective system that jointly guide behavior (Strack & Deutsch, 2004). The impulsive system consists of an associative store in which processes operate relatively fast and with little demands on resources such as cognitive capacity. Associations are believed to form as a consequence of learning experiences (De Houwer, Thomas, & Baeyens, 2001; Domjan, 2003; Klein & Mowrer, 1989). Upon perceiving a temptation, affectively laden automatic associations are activated and further guide attention and information processing. They are associated with largely automatic approach and avoidance tendencies toward the object, which prepare the organism to execute related behavioral schemata. To give an example, upon viewing an advertisement for cigarettes,

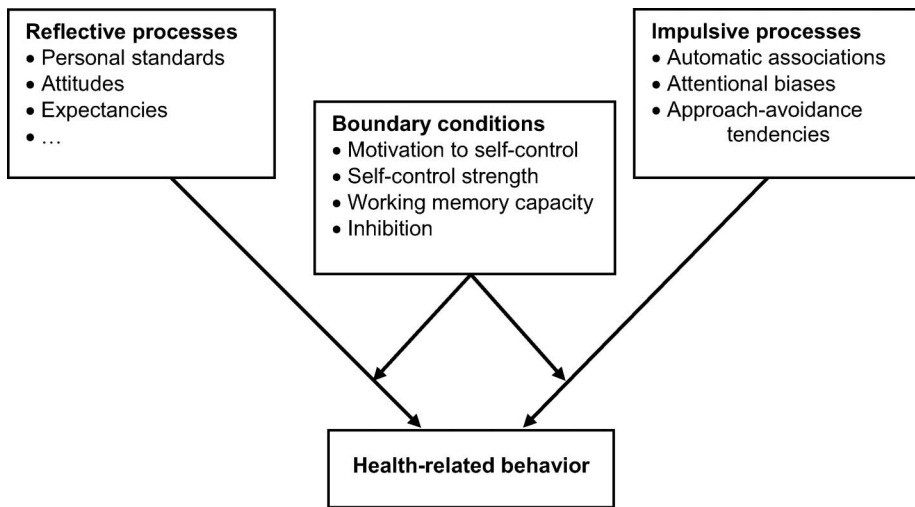


FIGURE 1 A model depicting the dynamics of health-related behavior. Impulsive processes compete with reflective processes for influence on behavior. Motivation and ability of the individual to guide behavior in line with one's standards and goals can shift the weights in favor of reflective processes. Psychological interventions to improve self-control behavior may aim at all three components of the model: (a) Building up clear and accessible standards and goals; (b) increasing motivation and ability to enforce these reflective structures in the face of temptation; and (c) reducing the strength of impulsive processes that may pull oneself towards the temptation (adapted from Hofmann et al., 2008).

automatic associations may lead to an approach reaction in a smoker that prepares the person to grab her pack of cigarettes, take one out and light it. Thus, the impulsive system generates a quick and rough suggestion for behavior execution, which we referred to as dominant responses in our definition of self-control above (Baumeister et al., 2007). It resembles the horse in the horse-and-rider metaphor.

By contrast, personal standards, attitudes, or expectancies reside in the reflective system. It is able to weigh pros and cons and to integrate information in order to arrive at short- or long-term plans for "reasoned action" and thoughtful decision making. These plans and decisions then activate proper behavioral schemata (the rider's idea on where to go) that compete with those provided by the impulsive system. Often, the behavioral schemata activated by the two systems will go hand in hand and facilitate behavior execution. For instance, imagine someone who is not attracted to sparkling wine, but to orange juice. If this person wants to restrain her or his consumption of alcohol, she or he will not have any difficulty choosing the orange juice if confronted with the choice between the two at a party. At times, however, the schemata will be incompatible (e.g., when someone is attracted to sparkling wine, but nevertheless wants to restrain her or his alcohol consumption). One important faculty of the reflective system is its ability to override the behavioral schemata activated by the impulsive system. This is what we referred to as the ability of the self to alter dominant responses and replace them with a different response (the rider's ability to tame the horse).

The faculty of the reflective system to curtail the influence of the impulsive system on behavior is effortful and comes at a cost: To the extent that a person is unwilling

or unable to make the effort, the behavioral schemata suggested by the impulsive system will be executed (Fazio & Towels-Schwen, 1999; Strack & Deutsch, 2004; Vohs, 2006). Thus, the relative impact of the impulsive and the reflective system on behavior determination changes not only as a function of the strengths of the respective system's contents, but also as a function of the motivation and ability to self-control (Friese, Hofmann, & Schmitt, 2008; Hofmann, Friese, & Strack, 2009). Interventions to improve health behavior may target each component separately, but programs seeking changes in more than one component may turn out to be even more effective.

To be sure, the model does not suggest that reflective processes necessarily lead to better (i.e., healthier) outcomes than impulsive processes. Indeed, we believe that more often than not self-control failures are driven by impulse rather than reflection (e.g., eat tempting, but unhealthy, food; give in to an illegitimate affair). However, better (worse) outcomes are by no means inherent to reflective (impulsive) processes per se. Whether or not reflective processes such as personal standards lead to healthy outcomes depends on the content of these standards, not on the question of whether a process is reflective or impulsive. Personal standards and attitudes may be highly detrimental to one's health, for example in anorexic individuals whose standard is to be thinner than what would be considered healthy by most people. Similarly, impulsive processes do not necessarily carry negative implications for health. Many impulsive reactions to health-relevant targets are unproblematic and may even foster healthy behavior, as is documented by many studies showing great variance in the impulsive reactions toward health-relevant foods and drinks or physical exercise (e.g., Bluemke, Brand, Schweizer, & Kahlert, 2010; Friese, Hofmann, & Wänke, 2008).²

Taming the Horse: Changing Contents of the Impulsive System

For some individuals, the impulsive system activates health-detrimental behavioral schemata in certain contexts (e.g., strong approach tendencies toward alcohol). It would be elegant to change these structures in a way that health-beneficial behavioral schemata were activated instead. If such interventions were successful they would reduce the need for effortful self-control, because horse and rider would go in similar directions. We will discuss three possible such toeholds: changing automatic associations, attentional biases, and approach tendencies.

Changing Automatic Associations

Automatic associations often form as a result of repeated pairings of an object with positive and negative affect. Evidence suggests that they can be changed by evaluative conditioning procedures in which a conditioned stimulus (e.g., alcohol) is repeatedly paired with an unconditioned stimulus of positive or negative affective value (De Houwer et al., 2001; Hofmann, De Houwer, Perugini, Baeyens, & Crombez, 2010).

In one recent study, alcohol-related and soft drink-related words were repeatedly paired with pictures of either positive or neutral valence (Houben, Havermans, & Wiers, 2010; see also Houben, Schoenmakers, & Wiers, 2010). As expected, participants seeing pairings of alcohol with positive pictures subsequently had stronger associations of alcohol with positive valence as indicated by scores on an Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998) as compared to

participants who saw alcohol-related pictures coupled with neutral pictures. Intriguingly, compared to the control group, participants in the alcohol-negative group drank less alcohol during the week after the study (controlling for pretest amount of consumption). This result is remarkable, especially because the evaluative conditioning procedure involved a total of only 120 trials. This study sets the stage for further research to more thoroughly investigate the presumed, but yet untested, mediating role of changes in automatic associations, and the stability of this effect. Based on previous findings, the effects of evaluative conditioning on health behavior should be particularly effective for individuals with low motivation or ability to control (Friese, Hofmann, & Schmitt, 2008; Gibson, 2008). Potentially, these effects have great implications for health behavior interventions, because evaluative conditioning effects have been argued to be rather resistant to extinction (De Houwer et al., 2001). However, recent research shows that counter-conditioning procedures may be capable of changing the maladaptive associations in favor of self-control goals (van Gucht, Baeyens, Vansteenwegen, Hermans, & Beckers, 2010).

Changing Attentional Biases

The control of attention plays a central role in the early stages of the self-control process (Baumeister et al., 2007; Metcalfe & Mischel, 1999). One obstacle for successful attention control is attentional biases, which are given when some stimuli attract and/or capture individuals' attention more strongly than others. Attentional biases have been observed for food (e.g., Mogg, Bradley, Hyare, & Lee, 1998), alcohol (Field & Cox, 2008), nicotine (e.g., Ehrman et al., 2002), and other drugs (e.g., Marissen et al., 2006). Several theories posit that they play an important role in substance-seeking behavior (Franken, 2003; Robbins & Ehrman, 2004; Robinson & Berridge, 1993).

A growing number of studies have tried to train individuals to direct their attention away from potentially harmful stimuli (e.g., alcohol) towards harmless, neutral stimuli (e.g., soft drinks). In some of these studies, participants completed a modified version of the visual-probe task (MacLeod, Mathews, & Tata, 1986). In this task, two pictures appear simultaneously on the screen and disappear after a short time. In the location of one of these stimuli a probe appears and participants are to indicate the location of the probe. If probe identification on average is faster when it appears in the location of a substance-related stimulus than a neutral stimulus, it is inferred that attention was captured by the substance-related cue. In the modified version of this task, the probe (almost) consistently appears behind the neutral stimulus, such that attention has to be directed away from the substance-related cues in order to indicate the location of the probe (e.g., Field & Eastwood, 2005).

The results of these studies have been mixed. Sometimes the effects generalized to new stimuli not used in the training task, other tasks, and behavior, and sometimes they did not (e.g., Attwood, O'Sullivan, Leonards, Mackintosh, & Munafò, 2008; Fadardi & Cox, 2009; Field et al., 2007; Field, Duka, Tyler, & Schoenmakers, 2009; Schoenmakers et al., 2010; Schoenmakers, Wiers, Jones, Bruce, & Jansen, 2007). The most encouraging results have been obtained when the attentional re-training spanned over several sessions and when participants were explicitly told about the purpose and theoretical rationale of the re-training tasks. This bears the interesting implication that at least a part of the change in impulsive structures may be mediated by reflective processing (Mitchell, De Houwer, & Lovibond, 2009). This notion also

fits recent evidence questioning the purely impulsive nature of attentional biases. In this study the strength of attentional biases toward alcohol was related to the strength of automatic associations with alcohol unless their influence was controlled through executive control processes (Friese, Bargas-Avila, Hofmann, & Wiers, 2010). If attentional biases were indeed independent of cognitive resources, a moderation of the relation with automatic associations by executive control processes should not have occurred. Clearly, more research is desirable to investigate the nature of attentional biases and when re-trainings of attentional biases transfer into behavior and when they do not.

Changing Approach Tendencies

The reflective–impulsive model postulates that automatic associations activate approach and avoidance tendencies toward the temptation at hand, which further differentiate in more nuanced behavioral schemata (Strack & Deutsch, 2004). In appetitive domains like those reviewed below, the challenge lies in changing approach biases into neutral reactions or even avoidance biases. From a theoretical point of view, re-training approach–avoidance tendencies is especially promising, because they are assumed to occur late in the behavior execution process, shortly before the behavioral schemata that were activated by the impulsive system compete for influence with those activated by the reflective system.

Approach–avoidance tendencies are often assessed by instructions to pull or push a joystick upon viewing a stimulus of a certain category (Chen & Bargh, 1999). Similar to the approach taken in the studies on attentional biases discussed above, researchers manipulated the contingency between the approach and avoidance movements on one side, and the contents that have to be sorted on the other side. For example, in one study one group of participants avoided words describing tasty, but unhealthy, foods by pushing the joystick and approached words related to healthy foods by pulling the joystick (Fishbach & Shah, 2006). For another group of participants this contingency was reversed. Later, those who pushed away words relating to unhealthy foods were less likely to pick unhealthy food items as a reward for their participation than participants who pulled unhealthy food items toward them in the joystick task. A similar approach was employed in a study involving hazardous drinkers (Wiers, Rinck, Kordts, Houben, & Strack, 2010). The training led to the expected effects of facilitated (vs. impeded) approach and avoidance tendencies and it generalized to a measure of automatic associations (an IAT; Greenwald et al., 1998). In a subsequent taste test participants who were successfully trained to avoid alcohol drank less than participants trained to approach alcohol. This effect was conceptually replicated and extended to an even more striking outcome (Wiers, Eberl, Rinck, Becker, & Lindenmeyer, in press). Alcoholic in-patients who underwent four 15-minute training sessions to avoid alcohol stimuli in the joystick task in addition to a regular cognitive behavioral therapy showed less relapse a year after treatment compared with control patients who only received the cognitive-behavioral therapy.

Strengthening the Rider: Improving the Ability to Self-control

In cases when impulsive tendencies work against health-related goals, the individual needs to control these tendencies, or, in terms of the horse-and-rider metaphor, the rider needs the strength to tame the horse. We will discuss two such approaches:

improving trait self-control and training basic executive functions that underlie many self-control efforts.

Trait Self-control

In their self-control model, Baumeister and colleagues (Hagger, Wood, Stiff, & Chatzisarantis, 2010; Muraven & Baumeister, 2000; see Hagger, Wood, Stiff, & Chatzisarantis, 2009, for an overview specifically targeting health behaviors) postulate that the ability to self-control relies on a limited resource. Like a muscle that is tired after exercise, exertion of self-control is assumed to deplete the resource and make subsequent attempts at self-control more likely to fail. Self-control in very different domains like keeping a healthy diet, abstaining from smoking and drinking or adhering to a medication regime all draw on the same resource so that efforts in one domain have implications for self-control in other domains as well. A wealth of studies supports this model (Hagger, et al., 2010), which has several implications for how to improve self-control outcomes. First, deliberately conserving the energy and planning its expenditures may prove helpful. For example, a smoker who tries to quit smoking and also to keep a healthier diet should (a) pick a time without too many other self-control challenges such as increased stress at work, and (b) may be more successful when both tasks are considered in consecutive time periods rather than simultaneously.

A second implication for improving self-control outcomes is to make sure that the resource can replenish after intensive usage, for example, through rest, active relaxation, or sleep (Tyler & Burns, 2008). Also, raising blood-glucose has been shown to improve self-control performance in the short-term (Gailliot & Baumeister, 2007), but for obvious reasons this is not a wise long-term strategy to improve self-control.

Third, an elegant way to improve self-control outcomes would enable individuals to perform supposedly effortful behaviors without expending great amounts of resources (i.e., taming the horse without exerting strength). One way to achieve this goal is by establishing implementation intentions (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006). Research suggest that if-then plans can counteract the resource-demanding effects of usually effortful behaviors (Webb & Sheeran, 2003), presumably because implementation intentions help to circumvent effortful operations of the reflective system to overcome a dominant response and select a more desired one by establishing a clear action plan in advance. Thus, implementation intentions can help to run a typically effortful behavior more efficiently.

Fourth, if self-control resembles a muscle, then it should be possible to train the muscle to achieve enduring and broad improvements in self-control (i.e., send the rider to the gym to gain strength). This idea pertains to the notion of trait self-control: stable individual differences in self-control, but not so stable that it would be impossible to gradually change them. Higher degrees of trait self-control are associated with positive outcomes including less susceptibility to impulse-control problems such as smoking, drinking, eating disorders, and substance abuse (Tangney, Baumeister, & Boone, 2004). Important for present purposes, there is evidence that individuals high in trait self-control are less influenced by impulsive processes than those low in trait self-control (Friese & Hofmann, 2009).

Several researchers have tried to improve trait self-control. To this end, participants were asked to brush their teeth or use the computer mouse with the

non-dominant hand, keep a good posture, avoid slang words, perform Stroop tasks, keep a financial diary, or adhere to study or exercise plans (Azor Hui et al., 2009; Gailliot, Plant, Butz, & Baumeister, 2007; Muraven, Baumeister, & Tice, 1999; Oaten & Cheng, 2006a, 2006b, 2007). In one program, participants engaged in a physical exercise program for several weeks (Oaten & Cheng, 2006a). Taking up and maintaining a physical exercise program requires self-control and many people planning to exercise regularly fail despite of their knowledge about the benefits of regular exercise (Karoly et al., 2005; Sullum, Clark, & King, 2000). Adhering to such a program should therefore drain the muscle in the short-term und train it in the long-term. To the extent that self-control in different spheres relies on the same resource, self-control improvements in diverse spheres should be observable after training the muscle. This hypothesis was impressively corroborated (Oaten & Cheng, 2006a). The longer participants were involved in the program, the fewer cigarettes they smoked and the less alcohol they drank. They also reported drinking less coffee, eating less junk food, spending less on impulse, and losing their temper less often. They ate healthier food, forsook the TV in favor of studying, and—our favorite item—they tended to wash their dishes immediately instead of leaving them in the sink. These results were corroborated by improved performance on a laboratory self-control task after an initial depletion of resources.

The generalization of the effects to manifold self-control outcomes that are unrelated to the training domain (i.e., physical exercise) carries the interesting implication that it may not be mandatory to design a self-control training regime targeting a specific domain with exercises in this potentially aversive and problem-laden domain. Instead, training self-control in a different sphere may prove beneficial for the target behaviors as well. Future research is needed to explore the exact psychological processes underlying these training effects, their stability, generalizability and the most efficient training techniques.

Executive Functions

When people exert self-control they often rely heavily on executive functions such as inhibition (i.e., stopping an already initiated action such as reaching for a glass of beer) or working memory updating (i.e., keeping goal-relevant information such as personal drinking standards active in working memory, shield this information from distractors such as impulses, and adapt it if necessary in the specific context; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). In many ways, executive functions can be regarded as the basic cognitive processes that only allow for successful self-control. Thus, a further way to strengthen the rider is to train his executive functions. A wealth of evidence points to the crucial role that executive functions play for self-control in general (e.g., Barrett, Tugade, & Engle, 2004; Hofmann, Friese, Schmeichel, Baddeley, 2011) and health-related behaviors such as eating (Hofmann, Friese, & Roefs, 2009), drinking (Lyvers, 2000; Whitney, Hinson, & Jameson, 2006), and physical exercise (Lambourne, 2006) in particular. Interestingly, the relationship between executive functions and self-controlled behavior may be bidirectional. A meta-analysis revealed that training programs of physical exercise for older adults, which require a certain degree of self-control to attend, improved executive functions (Colcombe & Kramer, 2003). It may be speculated that some of the effects that Oaten and Cheng (2006a) and others found in their interventions to build up self-control strength (see above) may have been mediated by improvements in executive functioning.

Based on recent findings that executive functions can be improved through practice (Jaeggi, Buschkuhl, Jonides, & Perrig, 2008; Karbach & Kray, 2009; Minear & Shah, 2008; Persson & Reuter-Lorenz, 2008; Verbruggen & Logan, 2008), researchers began to develop training programs of executive functions that are specifically targeted at improving health behavior. One program aimed at fostering response inhibition (Houben, Nederkoorn, Wiers, & Jansen, 2010). In this study, participants completed a Go/No-Go task. One group of participants always pressed a key when a beer stimulus appeared and had to inhibit any response when a water stimulus appeared (i.e., they pressed no key). This response assignment was reversed in the other condition. In a subsequent taste test of beer, participants in the beer/go–water/no-go condition on average drank significantly more than participants in the water/go–beer/no-go condition. This effect generalized to self-reported alcohol consumption in the following week. These results seem remarkable given that the Go/No-Go task consisted of only 80 trials. It remains for further research to investigate the psychological processes underlying this effect and if it was indeed mediated by increased inhibitory control. In the Houben et al. study, no general measure of inhibitory control was assessed after the manipulation. Thus, a general training of inhibitory control and the examination of its effects on different kinds of health behaviors remains a promising research enterprise.

Giving Direction to the Rider: Changing Contents of the Reflective System

Most of the established intervention programs fall into this category. The number of published programs is enormous. Comprehensive and systematic reviews exist for many health-behavior domains such as eating (e.g., Hardeman, Griffin, Johnston, Kinmonth, & Wareham 2000), drinking (e.g., Carey, Scott-Sheldon, Carey, & DeMartini, 2007; Tripodi, Bender, Litschge, & Vaughn, 2010), smoking (Baillie, Mattick, Hall, & Webster, 1994; Viswesvaran, & Schmidt, 1992), and physical exercise (e.g., Conn, Valentine, & Cooper, 2002; Müller-Riemenschneider, Reinhold, Nocon, & Willich, 2008).

Given the abundance and diversity of intervention programs, recent work attempted to systematize key behavioral determinants that interventions need to address in order to successfully change health behavior (Fishbein et al., 2001; Michie et al., 2005). Key determinants cover, among others, personal standards, knowledge, beliefs about one's capabilities and the consequences of one's behavior, intentions, and personal goals. From the perspective of the reflective–impulsive model, these constructs reside in the reflective system and are essential to give the rider direction on where to go. For example, a drinker will have difficulty regulating his intake without having established clear personal standards on the amount of drinks he should not exceed on a given drinking occasion. Other identified key determinants such as motivation and skills pertain to the preconditions that have to be met for the reflective system to operate successfully (see above).

While the number of agreed upon key determinants of behavioral change is limited, the number of intervention techniques to change these determinants is very large. In recognition of the complexity of the literature, Michie and colleagues recently developed a taxonomy of techniques designed to change behavioral determinants (Abraham & Michie, 2008; Michie, Johnston, Francis, Hardeman, &

Eccles, 2008). These techniques were derived from theories such as the theories of reasoned action and planned behavior (Ajzen, 1991; Fishbein & Ajzen, 1975), control theory (Carver & Scheier, 1998), social-cognitive theory (Bandura, 1997) and the information-motivation-behavioral skills model (Fisher & Fisher, 1992). The list of techniques includes, for example, providing information about the consequences of unhealthy behavior and the behavior–health link or the prompting of intention formation, goal setting and self-monitoring of behavior. Such a taxonomy is not only useful to get an overview of what has been done, it is also necessary to systematically determine the efficacy of different techniques to change determinants of behavior. Based on this taxonomy a recent meta-regression found the prompting of self-monitoring behavior to be the single most effective intervention technique for the promotion of both healthy eating and physical activity (Michie, Abraham, Whittington, McAteer, & Gupta, 2009). Interventions including a prompt for self-monitoring and at least one further technique based on control theory (e.g., prompt for specific goal setting; Carver & Scheier, 1982, 1998) were more effective than interventions not including these techniques.

Discussion

In this article we used the metaphor of a rider with an unclear sense of direction and deficient ability to control his wild horse to illustrate the nature of many self-control conflicts. We reviewed recent developments in research on interventions targeting all three components to improve health behavior. Specifically, we discussed: (i) research trying to change automatic associations, attentional biases, and approach–avoidance tendencies in a way that they foster healthy behavior; (ii) attempts to strengthen the ability to self-control by improving trait self-control and executive functioning; and (iii) recent taxonomic work to organize and systematize interventions aimed at changing reflective structures such as personal standards and attitudes.

The theoretical framework that we used to derive these three broad classes of interventions (Figure 1) is necessarily an oversimplification. It might be useful in organizing very diverse approaches to change health behavior in theoretically telling terms. On the downside, at least in a short review article, it comes at the cost of eliding important differences between the approaches within each class. For example, there is abundant and diverse research on intervention strategies to change structures in the reflective system. The taxonomic work by Michie and colleagues (Abraham & Michie, 2008; Michie et al., 2009) reduces this complexity to a great extent, but nevertheless many differences between the different strategies had to remain undiscussed in the present context.

Although we presented the three classes of intervention strategies as distinct approaches, some strategies may well impact on more than one of the components. For example, setting or clarifying personal standards may not only change the respective reflective structures, but also increase the motivation to adhere to them in an effort to avoid dissonance (Festinger, 1957). Also, more than one component may be involved in intervention strategies. For instance, implementation intentions (Gollwitzer, 1999) make use of reflective planning to automatize behavior and arrange for *less* reflective involvement in the crucial moments when self-control is demanded. Another case in point is the possibility that effortful reflective operations change the contents of the impulsive system by means of repeated mental imagery and reasoning (Hofmann, Deutsch, Lancaster, & Banaji, 2010).

Undoubtedly, while some interventions are reliably established, for others the research to date has done little more than setting the stage for future investigations. We noted open research questions at several points in the article and it is easy to think of more such as the relation between effortful self-control and implicit, automatized self-control (e.g., Fishbach & Shah, 2006), the empirical connections between different contents of the impulsive system and their relation to self-control behavior, or the incremental efficacy of recent interventions over and beyond established interventions (see Schoenmakers et al., 2010; Wiers et al., in press, for first evidence). We hope that the present overview will contribute to coming research endeavors so that in the future more people will be able to say that even wild horses can't drag them away from their goal to live a healthy life.

Notes

1. Although the horse is not meant to be a direct expression of Bargh's (1994) four horsemen of automaticity, impulsive processes are often less effortful, intentional, and controllable than reflective processes symbolized by the rider.
2. Beyond dual-system models, our framework is largely compatible with other approaches such as temporal self-regulation theory (TST; Hall & Fong, 2007) that also stresses the moderating role of self-control abilities for the link between reflective processes and behavior. One difference is that TST conceptualizes prepotent responses such as impulses also as such a moderator. Our framework understands impulses as a precursor of behavior the influence of which is moderated by—among others—the ability to self-control. In a series of studies, we did not find the reflective \times impulsive interactions predicted by TST (e.g., Hofmann et al., 2008). Future research will identify the strengths and shortcomings of both frameworks.

References

- Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. *Health Psychology, 27*, 379–387.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179–211.
- Attwood, A. S., O'Sullivan, H., Leonards, U., Mackintosh, B., & Munafò, M. R. (2008). Attentional bias training and cue reactivity in cigarette smokers. *Addiction, 103*, 1875–1882.
- Azor Hui, S., Wright, R. A., Stewart, C. C., Simmons, A., Eaton, B., & Nolte, E. R. (2009). Performance, cardiovascular, and health behavior effects of an inhibitory strength training intervention. *Motivation and Emotion, 33*, 419–434.
- Baillie, A. J., Mattick, R. P., Hall, W., & Webster, P. (1994). Meta-analytic review of the efficacy of smoking cessation interventions. *Drug and Alcohol Review, 13*, 157–170.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.
- Bargh, J. A. (1994). The four horsemen of automaticity: Awareness, efficiency, intention, and control in social cognition. In R. S. Wyer Jr., & T. K. Srull (Eds.), *Handbook of social cognition* (2nd ed., pp. 1–40). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Barrett, L. F., Tugade, M. M., & Engle, R. W. (2004). Individual differences in working memory capacity and dual-process theories of the mind. *Psychological Bulletin, 130*, 553–573.
- Baumeister, R. F., & Heatherton, T. F. (1996). Self-regulation failure: An overview. *Psychological Inquiry, 7*, 1–15.
- Baumeister, R. F., Schmeichel, B. J., & Vohs, K. D. (2007). Self-regulation and the executive function: The self as controlling agent. In A. W. Kruglanski & E. T. Higgins (Eds.), *Social psychology: Handbook of basic principles* (2nd ed., pp. 516–539). New York, NY: Guilford Press.

- Bluemke, M., Brand, R., Schweizer, G., & Kahlert, D. (2010). Exercise might be good for me, but I don't feel good about it: Do automatic associations predict exercise behavior? *Journal of Sport & Exercise Psychology*, *32*, 137–153.
- Carey, K. B., Scott-Sheldon, L. A. J., Carey, M. P., & DeMartini, K. S. (2007). Individual-level interventions to reduce college student drinking: A meta-analytic review. *Addictive Behaviors*, *32*, 2469–2494.
- Carver, C. S., & Scheier, M. F. (1982). Control theory: A useful conceptual framework for personality-social, clinical and health psychology. *Psychological Bulletin*, *92*, 111–135.
- Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior*. New York, NY: Cambridge University Press.
- Chen, M., & Bargh, J. A. (1999). Consequences of automatic evaluation: Immediate behavioral predispositions to approach or avoid the stimulus. *Personality and Social Psychology Bulletin*, *25*, 215–224.
- Colcombe, S., & Kramer, A. F. (2003). Fitness effects on the cognitive function of older adults: A meta-analytic study. *Psychological Science*, *14*, 125–130.
- Conn, V. S., Valentine, J. C., & Cooper, H. M. (2002). Interventions to increase physical activity among aging adults: A meta-analysis. *Annals of Behavioral Medicine*, *24*, 190–200.
- Cutler, R. B., & Fishbain, D. A. (2005). Are alcoholism treatments effective? The Project MATCH data. *BMC Public Health*, *5*, 75.
- De Houwer, J., Thomas, S., & Baeyens, F. (2001). Associative learning of likes and dislikes: A review of 25 years of research on human evaluative conditioning. *Psychological Bulletin*, *127*, 853–869.
- Domjan, M. (2003). *The principles of learning and behavior* (5th ed.). Belmont, CA: Thomson/Wadsworth.
- Ehrman, R. N., Robbins, S. J., Bromwell, M. A., Lankford, M. E., Monterosso, J. R., & O'Brien, C. P. (2002). Comparing attentional bias to smoking cues in current smokers, former smokers, and non-smokers using a dot-probe task. *Drug and Alcohol Dependence*, *67*, 185–191.
- Epstein, S. (1990). Cognitive-experiential self-theory. In L. A. Pervin (Ed.), *Handbook of personality: Theory and research* (pp. 165–192). New York, NY: Guilford Press.
- Fadardi, J. S., & Cox, W. M. (2009). Reversing the sequence: Reducing alcohol consumption by overcoming attentional bias. *Drug and Alcohol Dependence*, *101*, 137–145.
- Fazio, R. H., & Towels-Schwen, T. (1999). The MODE model of attitude-behavior processes. In S. Chaiken & Y. Trope (Eds.), *Dual-process theories in social psychology* (pp. 97–116). New York, NY: Guilford Press.
- Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford, CA: Stanford University.
- Field, M., & Cox, W. M. (2008). Attentional bias in addictive behaviors: A review of its development, causes, and consequences. *Drug and Alcohol Dependence*, *97*, 1–20.
- Field, M., Duka, T., Eastwood, B., Child, R., Santarcangelo, M., & Gayton, M. (2007). Experimental manipulation of attentional biases in heavy drinkers: Do the effects generalise? *Psychopharmacology*, *192*, 593–608.
- Field, M., Duka, T., Tyler, E., & Schoenmakers, T. (2009). Attentional bias modification in tobacco smokers. *Nicotine & Tobacco Research*, *11*, 812–822.
- Field, M., & Eastwood, B. (2005). Experimental manipulation of attentional bias increases the motivation to drink alcohol. *Psychopharmacology*, *183*, 350–357.
- Finkelstein, E., Fielbelkorn, I., & Wang, G. (2004). State-level estimates of annual medical expenditures attributable to obesity. *Obesity Research*, *12*, 18–24.
- 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.
- Fishbein, M., & Ajzen, I. (Eds.). (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, UK: Addison-Wesley.
- Fishbein, M., Triandis, H. C., Kanfer, F. H., Becker, M., Middlestadt, S. E., & Eichler, A. (2001). Factors influencing behaviour and behaviour change. In A. Baum, T. A. Revenson, & J. E. Singer (Eds.), *Handbook of health psychology* (pp. 3–17). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

- Fisher, J. D., & Fisher, W. A. (1992). Changing AIDS risk behavior. *Psychological Bulletin*, *111*, 455–474.
- Franken, I. H. A. (2003). Drug craving and addiction: Integrating psychological and neuropsychopharmacological approaches. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *27*, 563–579.
- Friese, M., Bargas-Avila, J., Hofmann, W., & Wiers, R. W. (2010). Here's looking at you, Bud: Alcohol-related memory structures predict eye movements for social drinkers with low executive control. *Social Psychological and Personality Science*, *1*, 143–151.
- Friese, M., & Hofmann, W. (2009). Control me or I will control you: Impulses, trait self-control, and the guidance of behavior. *Journal of Research in Personality*, *43*, 795–805.
- Friese, M., Hofmann, W., & Schmitt, M. (2008). When and why do implicit measures predict behavior? Empirical evidence for the moderating role of opportunity, motivation, and process reliance. *European Review of Social Psychology*, *19*, 285–338.
- Friese, M., Hofmann, W., & Wänke, M. (2008). When impulses take over: Moderated predictive validity of explicit and implicit attitude measures in predicting food choice and consumption behaviour. *British Journal of Social Psychology*, *47*, 397–419.
- Gailliot, M. T., & Baumeister, R. F. (2007). The physiology of willpower: Linking blood glucose to willpower. *Personality and Social Psychology Review*, *11*, 303–327.
- Gailliot, M. T., Plant, E. A., Butz, D. A., & Baumeister, R. F. (2007). Increasing self-regulatory strength can reduce the depleting effect of suppressing stereotypes. *Personality and Social Psychology Bulletin*, *33*, 281–294.
- Garner, D. M., & Wooley, S. C. (1991). Confronting the failure of behavioral and dietary treatments for obesity. *Clinical Psychology Review*, *11*, 729–780.
- Gibson, B. (2008). Can evaluative conditioning change attitudes toward mature brands? New evidence from the Implicit Association Test. *Journal of Consumer Research*, *35*, 178–188.
- Gollwitzer, P. M. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist*, *54*, 493–503.
- Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology*, *38*, 69–119.
- Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The Implicit Association Test. *Journal of Personality and Social Psychology*, *74*, 1464–1480.
- Hagger, M. S., Wood, C. W., Stiff, C., & Chatzisarantis, N. L. D. (2009). The strength model of self-regulation failure and health-related behaviour. *Health Psychology Review*, *3*, 208–238.
- Hagger, M. S., Wood, C. W., Stiff, C., & Chatzisarantis, N. L. D. (2010). Ego depletion and the strength model of self-control: A meta-analysis. *Psychological Bulletin*, *136*, 495–525.
- Hall, P. A., & Fong, G. T. (2007). Temporal self-regulation theory: A model for individual health behavior. *Health Psychology Review*, *1*, 6–52.
- Hardeman, W., Griffin, S., Johnston, M., Kinmonth, A. L., & Wareham, N. J. (2000). Interventions to prevent weight gain: A systematic review of psychological models and behaviour change methods. *International Journal of Obesity and Related Metabolic Disorders*, *24*, 131–143.
- Hofmann, W., De Houwer, J., Perugini, M., Baeyens, F., & Crombez, G. (2010). Evaluative conditioning in humans: A meta-analysis. *Psychological Bulletin*, *136*, 390–421.
- Hofmann, W., Deutsch, R., Lancaster, K., & Banaji, M. R. (2010). Cooling the heat of temptation: Mental self-control and the automatic evaluation of tempting stimuli. *European Journal of Social Psychology*, *40*, 17–25.
- Hofmann, W., Friese, M., & Roefs, A. (2009). Three ways to resist temptation: The independent contributions of executive attention, inhibitory control, and affect regulation on the impulse control of eating behavior. *Journal of Experimental Social Psychology*, *45*, 431–435.

- Hofmann, W., Friese, M., & Strack, F. (2009). Impulse and self-control from a dual-systems perspective. *Perspectives on Psychological Science*, 4, 162–176.
- Hofmann, W., Friese, M., & Wiers, R. W. (2008). Impulsive versus reflective influences on health behavior: A theoretical framework and empirical review. *Health Psychology Review*, 2, 111–137.
- Hofmann, W., Friese, M., Schmeichel, B. J., & Baddeley, A. D. (2011). Working memory and self-regulation. In K. D. Vohs & R. F. Baumeister (Eds.), *Handbook of self-regulation* (2nd ed., pp. 204–225). New York, NY: Guilford Press.
- Houben, K., Havermans, R. C., & Wiers, R. W. (2010). Learning to dislike alcohol: Conditioning negative implicit attitudes towards alcohol and its effect on drinking behavior. *Psychopharmacology*, 211, 79–86.
- Houben, K., Nederkoorn, C., Wiers, R. W., & Jansen, A. (2010). *Putting the brake on temptation: Decreasing alcohol-related affect and drinking behavior by training response inhibition*. Unpublished manuscript, Maastricht University, The Netherlands.
- Houben, K., Schoenmakers, T. M., & Wiers, R. W. (2010). I didn't feel like drinking but I don't know why: The effects of evaluative conditioning of alcohol-related attitudes, craving and behavior. *Addictive Behaviors*, 35, 1161–1163.
- Jaeggi, S. M., Buschkuhl, M., Jonides, J., & Perrig, W. J. (2008). Improving fluid intelligence with training on working memory. *Proceedings of the National Academy of Science*, 105, 6829–6833.
- Jeffery, R. W., Drewnowski, A., Epstein, L. H., Stunkard, A. J., Wilson, G. T., Wing, R. R., et al. (2000). Long-term maintenance of weight loss: Current status. *Health Psychology*, 19(Suppl.), 5–16.
- Karbach, J., & Kray, J. (2009). How useful is executive control training? Age differences in near and far transfer of task-switching training. *Developmental Science*, 12, 978–990.
- Karoly, P., Ruelman, L. S., Okun, M. A., Lutz, R. S., Newton, C., & Fairholme, C. (2005). Perceived self-regulation of exercise goals and interfering goals among regular and irregular exercisers: A life space analysis. *Psychology of Sport and Exercise*, 6, 427–442.
- Klein, S. B. & Mowrer, R. R. (1989). *Contemporary learning theories: Pavlovian conditioning and the status of traditional learning theory*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Lambourne, K. (2006). The relationship between working memory capacity and physical activity rates in young adults. *Journal of Sports Science and Medicine*, 5, 149–153.
- Lyvers, M. (2000). “Loss of control” in alcoholism and drug addiction: A neuroscientific interpretation. *Experimental and Clinical Pharmacology*, 8, 225–249.
- MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, 95, 15–20.
- Marissen, M. A. E., Franken, I. H. A., Waters, A. J., Blanken, P., van den Brink, W., & Hendriks, V. M. (2006). Attentional bias predicts heroin relapse following treatment. *Addiction*, 101, 1306–1312.
- Metcalfe, J., & Mischel, W. (1999). A hot/cool system analysis of delay of gratification: Dynamics of willpower. *Psychological Review*, 106, 3–19.
- Michie, S., Abraham, C., Whittington, C., McAteer, J., & Gupta, S. (2009). Effective techniques in healthy eating and physical activity interventions: A meta-regression. *Health Psychology*, 28, 690–701.
- Michie, S., Johnston, M., Abraham, C., Lawton, R., Parker, D., & Walker, A. (2005). Making psychological theory useful for implementing evidence based practice: A consensus approach. *Quality and Safety in Health Care*, 14, 26–33.
- Michie, S., Johnston, M., Francis, J., Hardeman, W., & Eccles, M. (2008). From theory to intervention: Mapping theoretically derived behavioural determinants to behaviour change techniques. *Applied Psychology: An International Review*, 57, 660–680.
- Minear, M., & Shah, P. (2008). Training and transfer effects in task switching. *Memory & Cognition*, 36, 1470–1483.

- Mitchell, C. J., De Houwer, J., & Lovibond, P. F. (2009). The propositional nature of human associative learning. *Behavioral and Brain Sciences*, *32*, 183–246.
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology*, *41*, 49–100.
- Mogg, K., Bradley, B. P., Hyare, H., & Lee, S. (1998). Selective attention to food-related stimuli in hunger: Are attentional biases specific to emotional and psychopathological states, or are they also found in normal drive states? *Behaviour Research and Therapy*, *36*, 227–237.
- Müller-Riemenschneider, F., Reinhold, T., Nocon, M., & Willich, S. N. (2008). Long-term effectiveness of interventions promoting physical activity: A systematic review. *Preventive Medicine*, *47*, 354–368.
- Muraven, M., & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin*, *126*, 247–259.
- Muraven, M., Baumeister, R. F., & Tice, D. M. (1999). Longitudinal improvement of self-regulation through practice: Building self-control strength through repeated exercise. *Journal of Social Psychology*, *139*, 446–457.
- Oaten, M., & Cheng, K. (2006a). Longitudinal gains in self-regulation from regular physical exercise. *British Journal of Health Psychology*, *11*, 717–733.
- Oaten, M., & Cheng, K. (2006b). Improved self-control: The benefits of a regular program of academic study. *Basic and Applied Social Psychology*, *28*, 1–16.
- Oaten, M., & Cheng, K. (2007). Improvements in self-control from financial monitoring. *Journal of Economic Psychology*, *28*, 487–501.
- Persson, J., & Reuter-Lorenz, P. A. (2008). Gaining control. Training executive function and far transfer of the ability to resolve interference. *Psychological Science*, *19*, 881–888.
- Robbins, S. J., & Ehrman, R. N. (2004). The role of attentional bias in substance abuse. *Behavioral and Cognitive Neuroscience Review*, *3*, 243–260.
- Robinson, T. E., & Berridge, K. C. (1993). The neural basis of drug craving: An incentive sensitization theory of addiction. *Brain Research Reviews*, *18*, 247–291.
- Schoenmakers, T. M., de Bruijn, M., Lux, I. F. M., Goertz, A. G., van Kerkhof, D. H. A. T., & Wiers, R. W. (2010). Clinical effectiveness of attentional bias modification training in abstinent alcoholic patients. *Drug and Alcohol Dependence*, *109*, 30–36.
- Schoenmakers, T., Wiers, R. W., Jones, B. T., Bruce, G., & Jansen, A. T. M. (2007). Attentional retraining decreases attentional bias in heavy drinkers without generalization. *Addiction*, *102*, 399–405.
- Smith, E. C., & DeCoster, J. (2000). Dual-process models in social and cognitive psychology: Conceptual integration and links to underlying memory systems. *Personality and Social Psychology Review*, *4*, 108–131.
- Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, *8*, 220–247.
- Sullum, J., Clark, M. M., & King, T. K. (2000). Predictors of exercise relapse in a college population. *Journal of American College Health*, *48*, 175–180.
- 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.
- Taylor, S. E. (2008). Current issues and new directions in psychology and health: Bringing basic and applied research together to address underlying mechanisms. *Psychology and Health*, *23*, 131–134.
- Tripodi, S. J., Bender, K., Litschge, C., & Vaughn, M. G. (2010). Interventions for reducing adolescent alcohol abuse: A meta-analytic review. *Archives of Pediatrics & Adolescent Medicine*, *164*, 85–91.
- Tyler, J. M., & Burns, K. C. (2008). After depletion: The replenishment of the self’s regulatory resources. *Self and Identity*, *7*, 305–321.

- van Gucht, D., Baeyens, F., Vansteenwegen, D., Hermans, D., & Beckers, T. (2010). Counterconditioning reduces cue-induced craving and actual cue-elicited consumption. *Emotion, 10*, 688–695.
- Verbruggen, F., & Logan, G. D. (2008). Automatic and controlled response inhibition: Associative learning in the Go/No-Go and Stop-Signal paradigms. *Journal of Experimental Psychology: General, 137*, 649–672.
- Viswesvaran, C., & Schmidt, F. L. (1992). A meta-analytic comparison of the effectiveness of smoking cessation methods. *Journal of Applied Psychology, 77*, 554–561.
- Vohs, K. D. (2006). Self-regulatory resources power the reflective system: Evidence from five domains. *Journal of Consumer Psychology, 16*, 215–221.
- Webb, T. L., & Sheeran, P. (2003). Can implementation intentions help to overcome ego-depletion? *Journal of Experimental Social Psychology, 39*, 279–286.
- Whitney, P., Hinson, J. M., & Jameson, T. L. (2006). From executive control to self-control: Predicting problem drinking among college students. *Applied Cognitive Psychology, 20*, 823–835.
- Wiers, R. W., Eberl, C., Rinck, M., Becker, E. S., & Lindenmeyer, J. (in press). Re-training automatic alcohol-approach tendencies in alcoholic patients increases abstinence. *Psychological Science*.
- Wiers, R. W., Rinck, M., Kordts, R., Houben, K., & Strack, F. (2010). Retraining automatic action-tendencies to approach alcohol in hazardous drinkers. *Addiction, 105*, 279–287.