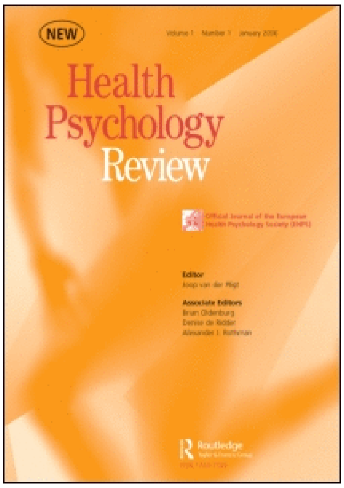

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Impulsive versus reflective influences on health behavior: a theoretical framework and empirical review

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Impulsive versus reflective influences on health behavior: a theoretical framework and empirical review

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Often, health behavior seems to be governed not only by reasoned attitudes and goal-directed behavior but also by impulsive influences. The notion of a conflict between reflective and impulsive processing which is incorporated in prominent dual-system accounts (e.g., Metcalfe & Mischel, 1999; Strack & Deutsch, 2004) may yield important benefits for the understanding and prediction of health-related behavior. In this article, we suggest a basic framework for the prediction of health-related behavior which combines (a) reflective influences (as measured via self-report), (b) impulsive influences (as measured via implicit measures), and (c) situational or dispositional moderators that shift the weight between reflective and impulsive influences. The practical utility of such a framework is demonstrated by drawing on recent evidence from several areas of health psychology such as eating, drinking, drug abuse, and sexual behavior. Implications for the understanding of health behavior and applied health interventions are discussed.

Keywords: impulse; self-control; health behavior; temptation; restraint; dual-systems theories

Impulsive versus reflective influences on health behavior: a theoretical framework and empirical review

> I have no self-control when it comes to eating snacks. I'll start off watching a movie with a bag of potato chips and think to myself, *one bag should last the entire movie … I'll pace myself, and eat one chip at a time every three minutes and finish the bag with the closing credits.* Everything starts off fine. I am the very model of patience and sophistication. But there's this point, maybe half-way through the bag, where an uncontrollable change comes over me. Suddenly, I'm like the Tasmanian Devil on crack. I can't get those chips into my mouth fast enough. I start breaking my own rules, eating them two or three at a time, inverting the bag, tearing it to pieces to get the final crumbs of salty goodness into me, licking my fingers, and feeling like a winner after discovering lost reservoirs of chip crumbs in the folds of my shirt. Then the previews end, and I'm left without anything to eat during the movie.

As captured nicely in this short passage from the internet article "potato chips" by Daniel Isaac (2008), people time and again experience that sticking to a preconceived plan may fail in the heat of temptation: Some end up eating or drinking more than they admit is good for them, some consume toxic substances, and some embark on sexual adventures with unknown risks. Pleasurable as they are for the moment, such behaviors often lead to negative health outcomes in the long run, ranging from regret the next day to premature

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death. For instance, recent statistics have shown that among the leading causes of death in Western societies are heart disease, cancer, and stroke (e.g., Taylor, 2003), with approximately half of the current death rate stemming from preventable causes such as a poor diet, smoking, drinking, or physical inactivity (Brannon & Feist, 2000). These data indicate the great need for health psychologists to develop and test models that help to explain when and why people are likely to engage in unhealthy behaviors. Such models may then form the basis of health initiatives and interventions aimed at preventing illness and promoting good health.

In this article, we argue that many health-related problems can be framed in terms of a conflict between immediate impulses on the one hand and reasoned attitudes and standards to restrain behavior on the other (e.g., Baumeister & Heatherton, 1996; Carver, 2005). For instance, the tempting dessert, drink, cigarette, drug, or one-night stand all allure by their pleasurable aspects. At the same time, people often harbor the conviction that these temptations should be resisted. In other words, in the typical *temptation* scenario, there exists a conflict between a positively valenced impulse and standards to refrain from acting on the impulse. Likewise, there are also scenarios, referred to as *heroism* scenarios, in which an impulse may carry a negative hedonic value by signaling uneasiness, harm, or danger to the organism and this negative impulse has to be overcome ("heroically") for a greater good such as health (see Trope & Fishbach, 2000). For example, picture a person that has to resist the impulse to jump off the dentist's chair in order to undergo a necessary medical treatment. Whether we deal with the temptation or the heroism scenario, both cases share the same underlying structure of a conflict between an impulse and the call for self-control to overcome the impulse in the way implied by one's reasoned attitudes or restraint standards.

The present article is an attempt to integrate the domain of health-related conflicts with recent dual-system models of impulse versus self-control (e.g., Epstein, 1990; Metcalfe & Mischel, 1999; Strack & Deutsch, 2004) and to review recent empirical evidence illustrating the usefulness of such an approach. Specifically, we will argue that integrative models of health behavior should not only specify the kinds of psychological constructs that relate to the self-control aspect (e.g., reasoned attitudes, behavioral intentions, restraint standards) but also psychological constructs that relate to the hedonic, impulsive influences on everyday health behaviors. We will suggest that a more balanced approach should consider the two sides of the self-control conflict equally, both in terms of theoretical integration and empirical assessment (see also Hofmann, Friese, & Strack, in press). This framework proposes that *impulsive* versus *reflective* influences may both determine health behavior, albeit to different degrees depending on a variety of situational or dispositional boundary conditions. We will present recent empirical evidence that demonstrates the utility of an integrative approach to the prediction of health behavior. Finally, we will discuss theoretical and practical implications with regard to the explanation and intervention of health-related outcomes.

Self-control and health behaviors

In the last three decades or so, health psychology has made considerable progress towards understanding the determinants of health behavior. The field has received much initial stimulation by the application of theories from social psychology and related disciplines, such as cognitive dissonance theory (Festinger, 1957), reactance theory (Brehm, 1966), self-efficacy theory (Bandura, 1977), social-cognitive theory

(Bandura, 1986; Bandura, 2001), the theory of reasoned action (Fishbein & Ajzen, 1975) and its update, the theory of planned behavior (Ajzen, 1991). Since then, the field further-developed elaborate theories that are specifically concerned with health-related decisions and behavior, such as protection motivation theory (Rogers, 1983) or the health-belief model (Janz & Becker, 1984), and more stage-oriented approaches (e.g., Prochaska, DiClemente, & Norcross, 1992; Schwarzer, 1992; Weinstein & Sandman, 1992). One common element of these models is the assumption that health behavior is the result of cognitive appraisal processes of the (a) expectancy and value of potential health threats and (b) possible coping responses. From these appraisal processes, a behavioral decision to reduce the health threat may be formed. Importantly, these decisions and the resulting goal-directed behavior are typically seen as reasoned, conscious, and intentional acts that require a person's volitional control or *willpower* in order to be effective.

That willpower is indeed needed for effective self-regulation in many health-related domains has been amply demonstrated by Baumeister and colleague's research program on *ego depletion* (e.g., Baumeister & Heatherton, 1996; Baumeister, Heatherton, & Tice, 1994). Specifically, Baumeister and colleagues showed that self-regulatory resources are crucially limited. The exertion of self-control seems to deplete these resources which replenish only after some time has elapsed (e.g., Baumeister, Bratslavsky, Muraven, & Tice, 1998; Vohs & Heatherton, 2000). For instance, individuals whose self-regulatory resources were depleted after engaging in an initial self-control task ate more unhealthy food (Vohs & Heatherton, 2000), drank more alcohol (Muraven, Collins, & Neinhaus, 2002), and engaged in less restrained sexual behavior (Gailliot & Baumeister, 2006) than participants who were not depleted. Next to ego depletion, a variety of other situational circumstances that disrupt the normal self-regulation of health behavior have been identified, such as cognitive load (e.g., Boon, Stroebe, Shut, & Ijntema, 2002; Shiv & Fedorikhin, 1999; Ward & Mann, 2000), emotional distress (Herman, Polivy, Lank, & Heatherton, 1987), or alcohol intoxication (e.g., Bushman & Cooper, 1990; Fillmore & Vogel-Sprott, 2006; for a review, see Hull & Bond, 1986). Note that in addition to acute alcohol effects, there is also emerging evidence for long-term negative effects on self-regulatory capacity as a consequence of alcohol or drug abuse during adolescence (see Wiers et al., 2007, for a model).

In a related vein, personality and individual differences research has identified traits that are particularly relevant for the self-control of health behavior. Bogg and Roberts (2004), for instance, showed that conscientiousness-related traits were negatively correlated with a host of risky health behaviors (such as excessive alcohol use, unhealthy eating, tobacco use, or risky sex) and positively correlated with beneficial health behaviors (such as exercising). Tangney, Baumeister, and Boone (2004) found that trait self-control, defined as a chronic tendency ''to override or inhibit undesired behavioral tendencies (such as impulses) and to refrain from acting on them'', was negatively related to undesirable health problems such as eating disorders, substance abuse, and other psychological disorders such as depression. In turn, impulsivity, that is, the generalized tendency to act without deliberation, has been found to be positively associated with problematic health behavior (e.g., Granö, Virtanen, Vaherta, Elovainio, & Kivimäki, 2004; Verdejo-Garcia, Lawrence, & Clark, 2008; Waldeck & Miller, 1997). These individual differences in impulsivity have been proposed to be based on a behavioral approach or behavioral activation system (Carver & White, 1994; Gray, 1982).

Scarce evidence for impulsive influences

Taken together, past models and research on the connection between self-control and health behavior have primarily focused on (a) models illuminating the determinants and processes by which individuals take *reasoned action* to engage in health-relevant behavior, (b) the capacity for self-control and the conditions and strategies affecting it, and (c) relevant personality correlates related to the successful regulation of health-related behavior. Somewhat surprisingly, however, the determinants and processes by which *impulses* (as opposed to general impulsivity) exert an influence on health behavior have received much less attention. To define more clearly what exactly we mean when talking of impulses, we would like to outline three defining features: First, impulses are specific rather than unspecific (Baumeister & Heatherton, 1996), arising when global motivations (e.g., thirst or hunger) meet specific activating stimuli in the environment (e.g., a cool beer or the smell of French fries, respectively). In contrast, the trait of *impulsivity* refers to a chronic and general tendency to act on impulses. Second, an impulse typically possesses a strong incentive value consisting of a primitive *hedonic* component (e.g., Loewenstein, 1996). Third, an impulse typically includes a *behavioral* tendency to act, often an urge to approach or consume the temptation at hand.[1]

In this article, we argue that a more complete model of health-related behavior in tempting situations should additionally integrate and specify impulsive influences on behavior. There are a number of reasons, why impulsive influences should gain more attention: First, although most of the models mentioned above make very clear assumptions about the determinants of health-related decisions and behavior, the appraisal and feasibility checks involved in such models are part of processes of higher-order mental reasoning and intending (e.g., Bagozzi, 1992; Gibbons, Gerrard, & Lane, 2003; Strack & Deutsch, 2004). It is plausible, however, to assume—and a more detailed analysis and empirical demonstration will follow shortly—that the processes by which tempting stimuli trigger impulsive behavioral tendencies are fundamentally different from the processes involved in reasoned action and goal pursuit (e.g., Metcalfe & Mischel, 1999; Strack & Deutsch, 2004).

Second, even though the capacity for self-control and its associated boundary conditions have been thoroughly researched (e.g., Baumeister, Bratslavsky, Muraven, Tice, & Baumeister, 1999; Muraven & Baumeister, 2000), these studies typically yield only indirect evidence for the differential impact of impulsive vs. reflective influences on behavior. For instance, a stronger influence of impulses on health-related behavior under certain conditions (e.g., alcohol consumption; ego depletion; load) has been typically *inferred* either from the observation of group differences in behavioral outcomes (e.g., drunk people behaved more aggressively than sober ones, so they must have acted more strongly on impulse), or from the breakdown of the behavior-regulating effect of restraint standards (e.g., Baumeister, Gailliot, De Wall, & Oaten, 2006). A more direct approach may demonstrate that impulsive precursors in fact unfold a stronger influence on behavior under such conditions (while at the same time the behavioral impact of reflective precursors is reduced).

Third, even though personality correlates of trait self-control and impulsivity point to important differences in the general capacity to instigate or maintain healthy behaviors, such findings (a) are often mute about the underlying processes that determine regulatory success or failure and (b) are usually not sensitive for the situational fluctuations that health-related behavior appears to be subject to. Thus, the personality approach may best be complemented by a process-oriented approach that spells out in more detail when and why individual health behavior is determined by impulsive or reflective influences, respectively.

A dual-systems framework of impulsive versus reflective influences on health behavior

Dual-system models (e.g., Epstein, 1990; Metcalfe & Mischel, 1999; Sloman, 1996; Smith & DeCoster, 2000; Strack & Deutsch, 2004; Wiers et al., 2007) appear to be well-suited as frameworks that integrate both reflective and impulsive influences on health behavior. These models share the assumption that structurally different systems of information processing underlie the production of impulsive versus reasoned forms of behavior. Some authors have also proposed that distinct brain areas underlie these systems (e.g., Bechara, Noel, & Crone, 2006; Lieberman, in press). All of these models can be harnessed to derive concrete predictions about what kind of influence may prevail under what kind of circumstances. For the following theoretical analysis, we chose the prominent reflective-impulsive model (RIM; Strack & Deutsch, 2004) as an example to spell out the dual-systems perspective and the predictions derived from it in sufficient detail. In so doing, we focus on the concepts, structural features, and measurement assumptions that we think are key for the prediction of health behavior from a dual-systems perspective; this analysis will provide the basis for the subsequent empirical review of studies in which these predictions were tested directly.

Impulsive influences on health behavior

From the perspective of the RIM (Strack & Deutsch, 2004), impulses are assumed to be triggered in the *impulsive system* from the activation of associative clusters in long-term memory in close interaction with perceptual stimulus input. These associative clusters have been created or strengthened by temporal or spatial co-activation of external stimuli, affective reactions, and associated behavioral tendencies, thus reflecting the learning history of the organism. For instance, repeated experience with potato chips may lead to the formation of an associative cluster that connects the concept of potato chips, positive hedonic affect generated by the organism, and the behavioral schema that has led to the positive affect (putting the chips into one's mouth). Once formed, such associative clusters can be reactivated quickly by perceptual input in close interaction with internal triggering conditions such as hunger, thirst, or other inner states of homoeostatic dysregulation (Aarts, Dijksterhuis, & De Vries, 2001; Ferguson & Bargh, 2004; Strack & Deutsch, 2004). From a functional perspective, these associative clusters "prepare" the organism to evaluate and respond to the environment quickly in accordance with one's needs and previous learning experiences (e.g., Seibt, Häfner, & Deutsch, 2007). Assume in our example, that the person sees another bag of potato chips at a party and he or she is not satiated. In this case, the corresponding associative cluster may become reactivated and automatically trigger an impulse consisting of (a) a positive hedonic value attributed to the potato chips and (b) a corresponding behavioral schema to approach and consume the object of desire (e.g., Chen & Bargh, 1999; Neumann, Hülsenbeck, & Seibt, 2004; Seibt et al., 2007).

The associative clusters just described are assumed to form gradually over time. Moreover, associative processes are generally assumed to be independent of conscious awareness and of one's personal endorsement of an association as true or false (Gawronski & Bodenhausen, 2006). Most importantly, impulsive processes of behavior determination are assumed to operate in an effortless manner (Strack & Deutsch, 2004). In other words, impulses are assumed to activate associated behavioral schemas in the motor cortex of the brain no matter whether cognitive resources are momentarily available or not.

How can impulses be properly assessed? As suggested by dual-systems models (e.g., Metcalfe & Mischel, 1999; Strack & Deutsch, 2004), a good measure of impulse should tap into the associative structure that generates *hedonic* or *behavioral* reactions triggered upon stimulus encounter. Because the generation of impulses is assumed to occur in the absence of conscious control, impulse assessment should also minimize interference from consciously controlled processing. Moreover, impulse assessment should be sensitive enough to capture situational variations in impulse strength due to changes in bodily need states.

We argue that procedures from the new wave of implicit measurement tools such as the Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998), the Affect Misattribution Procedure (Payne, Cheng, Govorun, & Stewart, 2005) and a variety of memory association measures (Stacy, 1997; Stacy, Ames, & Grenard, 2006) may fulfill these requirements and thus serve as good proxies of impulse (for detailed descriptions and discussions, see De Houwer, 2006; Fazio & Olson, 2003; Petty, Fazio, & Briñol, 2008; Wittenbrink & Schwarz, 2007). Many applications of these measures have been designed to tap into *automatic affective reactions* with regard to a specific stimulus of interest, also referred to as "implicit" attitudes (e.g., Marsh, Johnson, & Scott-Sheldon, 2001; Payne, Govorun, & Arbuckle, 2008; Payne, McClernon, & Dobbins, 2007; Wiers, van Woerden, Smulders, & de Jong, 2002). Typically, such measures assess the degree of compatibility or incompatibility of reactions toward the stimulus of interest and reactions towards positively and negatively valenced stimuli (e.g., De Houwer, 2006). These measurement tools may be particularly suited to tap into the *hedonic* component of an impulse. Alternatively, some measures have been proposed that may be used in order to tap into the *behavioral* component of an impulse. Typically, such measures are geared towards assessing *approach-avoidance reactions* toward the temptation of interest (Field, Mogg, & Bradley, 2005; Hofmann, Friese, & Gschwendner, in press; Mogg, Bradley, Field, & De Houwer, 2003; Neumann et al., 2004; Seibt et al., 2007).

Responses on implicit measures are comparatively difficult to control unless the person is explicitly instructed on how to do this (e.g., Asendorpf, Banse, & Mücke, 2002; Egloff & Schmukle, 2002; Fiedler & Bluemke, 2005; Steffens, 2004). Furthermore, implicit measures have been shown to be sensitive to bodily need states such as deprivation or craving (e.g., Field et al., 2005; Hofmann et al., in press; e.g., Seibt et al., 2007). This indicates that these measures appear to be sensitive enough to capture meaningful state influences on impulse strength over and above stable (trait) sources of variance (e.g., Schmukle & Egloff, 2004).

Reflective influences on health behavior

Most uninhibited impulses interfere with long-term goals or generate interpersonal conflict at some point (Bogg & Roberts, 2004; Carver, 2005; Freud, 1930; Tangney et al., 2004). For this reason, self-control is among the key competencies of everyday functioning. Taking a dual-systems perspective (e.g., Strack & Deutsch, 2004), the *reflective system* can be seen as the mental faculty that has evolved in order to serve this purposes (Strack & Deutsch, 2004). Specifically, the reflective system employs higher-order mental operations which provide a fairly large and flexible degree of control over decisions and actions. These operations include executive functions such as making reasoned judgments and evaluations, putting together strategic action plans for goal-pursuit, and inhibiting or overriding prepotent responses (e.g., impulses or habits). They are achieved through relatively slow controlled processes based on symbolic representations and operations (Smith & DeCoster, 2000; Strack & Deutsch, 2004).

How does the reflective system bring about behavior? The RIM assumes that the reflective system generates behavioral decisions which in turn activate corresponding behavioral schemas in the motor cortex (Strack & Deutsch, 2004). For instance, if a discrepancy between restraint standards and the actual situation is detected, a behavioral decision to inhibit or to override the unwanted behavior may be formed. Such a behavioral decision then leads to the activation of corresponding behavioral schemas (Strack & Deutsch, 2004).

However, the judgmental and behavioral flexibility provided by the reflective system has a severe disadvantage: That is, the cognitive resources available for reflective operations are assumed to be subject to situational or dispositional limitations (Evans, in press; Fazio & Towels-Schwen, 1999; Vohs, 2006). If cognitive resources are situationally or chronically reduced, individuals may (a) fail to detect discrepancies between a given restraint goal and the actual state (see Carver & Scheier, 1981) and/or (b) fail to inhibit or override impulsive influences violating these standards.

How should constructs from the reflective system be measured? According to a dual-systems perspective (Smith & DeCoster, 2000; Strack & Deutsch, 2004), the symbolic contents in the reflective system form the basis of conscious experiences that can be communicated to others. For this reason, explicit measures of verbal self-reports are appropriate for tapping into reflective precursors of health behavior such as reasoned attitudes, restraint standards, behavioral intentions, and other cognitive constructs associated with conscious goal-pursuit (e.g., self-efficacy). In sum, a dual-systems framework on health-related behavior regulation implies that different measurement strategies should be employed in order to tap into the impulsive and reflective components of behavior determination.

Conflicts between the impulsive and the reflective system

Often, the behavioral implications instigated in the impulsive system may be compatible with reasoned action. For instance, following the impulse to drink a glass of water when being thirsty typically does not imply a self-control conflict (unless the situation necessitates the rationing of drinking water). For many health-related behaviors, however, there are circumstances in which the behavioral implications of the two systems are incompatible (Metcalfe & Mischel, 1999; Strack & Deutsch, 2004). For example, a dieter who is being invited for a high-caloric milkshake may experience a strong impulse toward the tempting object, but at the same time be motivated to restrain his or her caloric intake. Which of the two forces will win the upper hand eventually? The RIM suggests a parsimonious answer by assuming that both systems access a common final mechanism for overt behavior execution: the activation of behavioral schemas (e.g., Strack & Deutsch, 2004). Specifically, which behavioral schema wins out over the other will depend on the relative strength of activation for competing schemas (see also Norman & Shallice, 1986) which have received their input from the impulsive and reflective system, respectively.[2] Most importantly, because the two systems follow differential operating characteristics, certain situational and dispositional *boundary conditions* may shift the potential for schema activation in favor of one of the two systems (e.g., Strack & Deutsch, 2004). For instance, situational factors related to the availability of control resources such as ego depletion, cognitive load, or alcohol intoxication should selectively impair the reflective system by undermining its ability to symbolically represent attitudes or restraint standards and to monitor ongoing behavior in accordance with those representations. The same applies when an individual's stock of control capacity is dispositionally low. In these cases, the reflective system may fail to activate the inhibitory (e.g., "do *not* accept the offer") or overriding ("e.g., "ask for a glass of water instead") behavioral schemas necessary for effective self-regulation. As a consequence, impulse-triggered behavioral schemas are more likely to exert an influence on overt behavior under these conditions. Under conditions of sufficient available control resources, in contrast, we assume that the reflective system typically gets the upper hand, unless additional factors such as mood or low motivation to control undermine the use of these resources in the service of self-regulation.

Implications for the prediction of health-related behavior

As the present dual-systems analysis suggests, health-related outcomes may often result from the interplay between impulsive and reflective processes and their boundary conditions. Probably the most valuable insight from such an analysis is that individuals may not only differ in their reasoned attitudes or their personal standards to restraint potentially problematic behavior; They are also likely to differ in their impulsive reactions toward tempting stimuli (due to genetic endowment, differences in learning history and current need states). Such differences in impulse may relate to actual health behavior in a meaningful way and should therefore be incorporated as meaningful predictors into models of health behavior.

Taken together, our analysis suggests that the predictive validity of health behavior models may be enhanced if such models include (a) reflective and (b) impulsive precursors, and if they specify (c) situational and dispositional boundaries that may shift the weight towards one or the other type of precursor (see Figure 1). Depending on the specific circumstances individuals find themselves in, health-related behaviors may be better predicted by reflective precursors (reasoned attitudes; restraint standards) or by impulsive precursors (automatic affective reactions; automatic behavioral tendencies of approach/avoidance). The combined consideration of the above three factors may enable a more precise prediction of health-related behavior than when each of these factors is studied in isolation. For instance, under conditions of low control resources, automatic affective

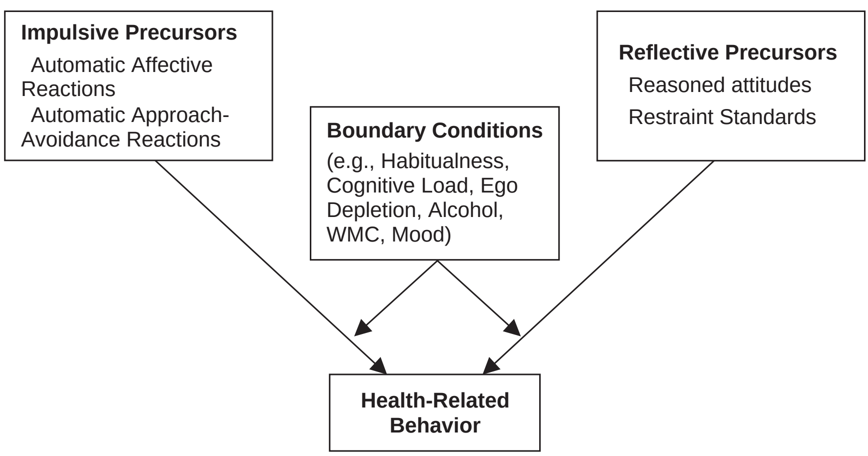

Figure 1. A framework for the prediction of health behavior by impulsive versus reflective precursors and associated boundary conditions (moderators).

reactions toward tempting stimuli should exert a stronger influence on health behavior than under conditions of full resource availability. In a complementary manner, the impact of reasoned attitudes or restraint standards should be stronger under full resources and wane with increasing processing strain on reflective operations.

Similarities and differences to related models

Social reaction model

The idea that health behavior is not solely the result of reasoned processes of premediation and planning has led to extensions of reasoned action approaches. Arguably the most prominent modification is Gibbons and colleagues' (Gibbons, Gerrard, Blanton, & Russell, 1998; Gibbons et al., 2003) extension of the theory of reasoned behavior into the *social reaction model* of health risk behavior. The model was in part inspired by inconsistencies between individuals' intentions to engage in health-related behavior and later actual behavior as well as by the observation that expectancy value theories predict behavioral *self-reports* better than actual observations of behavior (see Armitage & Conner, 2001, for a recent meta-analysis; Gibbons et al., 2003). One potential explanation for these discrepancies is that models of reasoned behavior may be less effective at explaining irrational or impulsive behaviors. In order to increase the predictive validity of such models, the social reaction model incorporates an additional direct predictor of health risk behavior over and above behavioral intention, called *behavioral willingness*. The assessment of behavioral willingness is different from that of a behavioral intention in that individuals are asked to think about a risk-conducive situation (e.g., sexual temptation) and to indicate whether he or she might perform the risky behavior in question (e.g., having sex without condoms) under some circumstances, even if he or she originally intended not to engage in it (see Gibbons et al., 2003, for an in-depth discussion).

The social reaction model is similar to a dual-systems conception in that it explicitly acknowledges that health behavior is often not as planned as implied by theories of reasoned action but rather driven by affect-laden, persuasive features given by the circumstances. The most important difference to the present framework is that, from a theoretical point of view, the assessment of behavioral willingness via self-report does not preclude a *conscious consideration* of risk opportunities and social norms under those imagined circumstances (Gibbons et al., 2003). This problem is empirically reflected in the typically quite substantial correlation between self-reported behavioral willingness and behavioral intention (Gibbons et al., 1998). In contrast, the present framework attempts to incorporate and indirectly assess the non-cognitive, impulsive processes that underlie the experience of hedonic appeal in tempting situations and that are not mediated by intentions (Strack & Deutsch, 2004).

Goal conflict model

A second related model that has been recently proposed in the domain of eating behavior is the *goal conflict model* by Stroebe and colleagues (Stroebe, 2002; Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008). The model is concerned with the question why dieting often fails among people motivated to restrain their food intake (restrained eaters). According to the model, the eating behavior of restrained eaters is characterized by a conflict between two incompatible goals: the (hedonic) goal of eating enjoyment and the (control) goal to regulate one's weight. In order to effectively regulate weight, restrained eaters have to shield the weight control goal from interference by inhibiting or devaluating the goal of eating enjoyment. However, palatable food stimuli from the environment have a strong positive incentive value for restrained eaters (e.g., Fedoroff, Polivy, & Herman, 1997; Jansen & van den Hout, 1991). To the extent that "hot" thoughts (Metcalfe & Mischel, 1999) about the pleasurable aspects of palatable food are triggered by external or imagined stimulus exposure, the enjoyment goal may become dominant and inhibit the eating control goal (e.g., Papies, Stroebe, & Aarts, 2007; Shah, Friedman, & Kruglanski, 2002).

The goal conflict model of eating behavior can in principle be extended to other health behaviors in which people face a conflict between tempting stimuli and their restraint goals. This model and the present dual-systems framework share many properties such as (a) the explicit consideration of external stimulus influences on self-regulatory success and (b) the assumption of an incompatibility between the behavioral tendencies implied by the hedonic qualities of the temptation and the goal to control weight, respectively. The two frameworks differ in that the goal conflict model assumes an operational symmetry between the processes underlying eating and dieting because both behaviors are viewed as subject to the very same processes and mechanisms of regulatory goal pursuit (e.g., Kruglanski, 1996). As a consequence of this equal status of both influences, the goal conflict model needs additional assumptions in order to explain why a particular goal (e.g., weight control) is typically more focal than the other goal and why this goal is more strongly compromised by a particular factor (such as resource depletion). In contrast, the present framework is based on the assumption of an operational *asymmetry* between the impulsive processes that are assumed to underlie short-term hedonic behaviors on the one hand and the higher-order, capacity-consuming processes of reasoned action and long-term goal pursuit on the other (Metcalfe & Mischel, 1999; Strack & Deutsch, 2004; see also Loewenstein & O'Donoghue, 2004, for a similar view from a behavioral economics perspective).

Empirical evidence for impulsive versus reflective influences on health behavior

In the following we will review research from our own and other labs in which the proposed general framework (see Figure 1) has been applied to the prediction of health-related behavior. In order to qualify for inclusion, studies in health-related domains such as eating behavior, drinking behavior, drug abuse, or sexual interest behavior had to include at least three things: First, an individual differences measure of impulsive precursors of behavior such as automatic affective reactions. Preferably, but not necessarily, the study also included an individual differences measure of reflective processing such as reasoned attitudes or restraint standards. Second, studies were eligible if they included a health-related behavioral measure, ideally in the form of observed behavior in a laboratory or a field setting, or—somewhat less ideally—in the form of a retrospective behavioral self-report (which may suffer from validity threats due to, for instance, social desirability concerns). Third, a study had to include a situational or dispositional moderator that was expected to shift the relative impact of impulsive/reflective precursors on behavior. Note that the focus of these studies was not on whether a given situational influence (such as cognitive load, ego depletion, or alcohol) or a given personality dimension (such as trait self-control) increases or reduces self-regulatory success as ample research has already established that this is the case (e.g., Baumeister et al., 1998; Bogg & Roberts, 2004, 2004e.g., Hull & Slone, 2004; Lattimore & Maxwell, 2004; Tangney et al., 2004; Ward & Mann, 2000); Rather, the focus of the research reviewed below was to go one step further and investigate directly whether these factors *moderate* the relative weight of impulsive versus reflective precursors on behavior determination as the dual-systems approach suggests.

Moderators were arranged into three broad categories along which the present review will be organized: (a) moderators pertaining to the *availability of control resources* (e.g., cognitive load, working memory capacity), (b) moderators such as mood or affective focus that presumably affect the *reliance on impulses* as "guides" for behavior (even in the presence of sufficient capacity for control), and (c) moderators pertaining to the *motivation* to control one's behavior.

Availability of control resources

As stated above, dual system models assume that reflective operations draw on available cognitive resources in order to enable reasoned action or planful behavior. Thus, under normal circumstances, reasoned attitudes or standards to restrain behavior should be fairly good predictors of health-related behavior. Under reduced capacity, however, reflective processing may break down and impulsive processing should gain more weight on behavior determination (Strack & Deutsch, 2004). A number of recent studies tested these predictions directly with regard to health-related behaviors. In these studies control capacity was either manipulated situationally (e.g., via cognitive load, ego depletion, or alcohol manipulations) or assessed dispositionally (e.g., trait self-control, or via working memory capacity).

Cognitive load

A study by Friese and colleagues (Friese, Hofmann, & Wänke, in press, Study 1) investigated the moderator role of cognitive load in the context of food choice between fruit or chocolate. Participants performed an IAT (Greenwald et al., 1998) assessing automatic affective reactions with regard to fruit stimuli as compared to chocolate stimuli. Then they self-reported their reasoned attitudes before engaging in a fruit-chocolate choice task. Importantly, half of the participants performed the food choice task with nearly full cognitive capacity, keeping in mind a one-digit number whereas the other half was instructed to keep in mind an eight-digit number (Gilbert & Hixon, 1991). Results showed that the IAT predicted choice behavior well for participants under cognitive load, but not for those with full cognitive capacity. The opposite pattern emerged for the predictive validity of reasoned attitudes. These results indicate that people under cognitive load follow their impulses more strongly when making health-related choices.

Ego depletion

In their influential model of self-regulation, Baumeister and colleagues assumed that the ability to self-control relies on a limited resource (e.g., Baumeister et al., 1998; Muraven & Baumeister, 2000). Any exertion of self-control depletes this resource, leading to a reduction in people's capacity at self-control. A number of studies has already established that ego depletion reduces the impact of restraint standards on health-related outcomes (Baumeister et al., 2006, for a review; Gailliot & Baumeister, 2006; Muraven et al., 2002; Vohs & Heatherton, 2000). However, only recently did researchers also include measures of impulsive precursors in order to more directly examine the complementary hypothesis that ego depletion may increase the influence of impulsive precursors on health-related behavior.

In a first test of these predictions (Hofmann, Rauch, & Gawronski, 2007), candy consumption in a test and rate task was primarily predicted by automatic affective reactions as measured with a Single Category-IAT (SC-IAT; Karpinski & Steinman, 2006) for participants who were depleted of self-regulatory resources but not in non-depleted control participants. In contrast, candy consumption was effectively regulated in accordance with dietary restraint standards (i.e., higher restraint led to less candy intake) in control participants. This pattern of findings was replicated in a second study on potato chips consumption which employed reasoned attitudes rather than restraint standards as reflective precursors (Friese et al., in press, Study 2). Comparable results were also obtained in a study on chocolate consumption when thoughts about death (e.g., Gailliot, Schmeichel, & Baumeister, 2006; Greenberg, Solomon, & Pyszczynski, 1997) were used as a manipulation of self-regulatory resources (Friese & Hofmann, in press).

Even though reasoned attitudes and restraint standards are assumed to rely on reflective processes, both constructs are distinct because restraint standards are not necessarily evaluative in nature. For instance, it is possible to like beer but at the same time harbor strong standards that one should refrain from drinking (too much of) it. In a fourth study in the domain of drinking behavior we therefore investigated whether the behavioral impact of reasoned attitudes and restraint standards is independently moderated by ego depletion (Friese et al., in press, Study 3). Again, automatic affective reactions predicted beer consumption only for depleted participants, replicating previous findings (see also Ostafin, Marlatt, & Greenwald, 2008). Interestingly, ego depletion decreased both the influence of reasoned attitudes and drinking restraint standards (Collins & Lapp, 1992) as predictors of beer consumption. These results, in summary, strongly support the view that ego depletion increases the impact of impulses on health-related behaviors while at the same time hampering the impact of reflective determinants such as reasoned attitudes or restraint standards.

Alcohol consumption

As everyday experience contests, alcohol impairs the ability to inhibit or override prepotent responses (e.g., Easdon & Vogel-Sprott, 2000). These findings are congruent with the basic tenet of alcohol myopia theory (Steele & Josephs, 1990) according to which alcohol narrows the perceptual focus down to only salient and proximal cues in the environment.[3] As a consequence, more abstract concepts such as goals and standards may lose impact. This analysis leads to the prediction that alcohol may act as another important moderator of the influence of impulsive versus reflective processes on health-related behavior.

The alcohol hypothesis was tested in a study on eating behavior (Hofmann & Friese, in press). At the beginning of the study, female participants completed a number of screening questionnaires including a measure of dietary restraint standards (Stunkard & Messick, 1985; Pudel & Westenhöfer, 1989). Subsequently, automatic affective reactions toward candy were assessed with a SC-IAT (Karpinski & Steinman, 2006). Participants then engaged in two different product tests. In the first product test, they consumed a drink that either consisted of orange juice with vodka (alcohol condition) or solely orange juice (control condition). An intermediate filler task gave the alcohol dose time to unfold its impact before participants tasted and rated candy in a second product test. As expected, candy consumption was reliably predicted by automatic affective reactions for participants in the alcohol condition, but not in the control condition. Conversely, dietary restraint standards were quite ineffective in participants who had consumed alcohol but regulated candy consumption effectively for sober participants. These results clearly indicate that alcohol consumption fosters the influence of impulses on eating behavior.

Trait self-control

Next to the situational manipulations reviewed thus far, the capacity for control varies also dispositionally (e.g., Bogg & Roberts, 2004; Tangney et al., 2004). For instance, according to the definition of trait self-control, individuals low in trait self-control are more likely to act on impulse as a consequence of their failure to inhibit or override prepotent action tendencies (Tangney et al., 2004). In one study investigating this hypothesis (Friese & Hofmann, 2008, Study 1), participants completed the self-control scale (Tangney et al., 2004) in a first session. In a second session, a SC-IAT (Karpinski & Steinman, 2006) measured automatic reactions toward potato chips. As expected, the SC-IAT predicted consumption behavior in a taste-and-rate task better for participants low rather than high in trait self-control.

Working memory capacity

A second dispositional construct that may be particularly relevant for the study of self-control is working memory capacity (Baddeley & Hitch, 1974; Barrett, Tugade, & Engle, 2004). Individuals high in working memory capacity are assumed to be more successful in enacting goal-directed processing and in shielding their goals from interference, such as the kind that stems from impulsive processing (Barrett et al., 2004). Therefore, reflective precursors of behavior should predict behavior better for individuals high rather than low in working memory capacity. The opposite should hold for impulsive precursors.

Recent research strongly supports this assumption (Grenard et al., in press; Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008; Thush et al., 2008; Wiers, Beckers, Houben, & Hofmann, 2008). For instance, one representative study (Hofmann et al., 2008, Study 1) was concerned with sexual interest behavior. Male heterosexuals were brought into a tempting situation by letting them watch on the computer a series of erotic slides of sexually highly attractive women. Importantly, the 'burden of responsibility' for the time spent looking at the slides was imposed on the participants, since they were given time to view each picture until they felt comfortable to answer a couple of subsequent questions about it (e.g., "How much would you like to talk to this woman?"). As expected, previously assessed automatic affective reactions toward erotic stimuli predicted the viewing time of the erotic stimuli (relative to arts control pictures) for low WMC individuals, but not for high WMC individuals. The opposite pattern emerged for a self-report measure of reasoned attitudes.

Comparable results were obtained when this approach was applied to alcohol and cigarette use in high risk adolescents in the US and The Netherlands (Grenard et al., in press; Thush et al., 2008), aggressive behavior after alcohol intake in men (Wiers, Beckers et al., 2008), and eating behavior in the laboratory (Hofmann et al., 2008, Study 2). A major strength of these studies, considered jointly, is that they demonstrate a very consistent picture, across different measures for WMC and across different measures of appetitive impulse (varieties of IAT and open ended memory association measures in Grenard et al., in press). Taken together, converging evidence points to the importance of individual differences in WMC for the maintenance and shielding of health related beliefs and standards against interfering impulsive influences (for a discussion, see Hofmann et al., 2008).

Reliance on impulsive processing

Next to situational and dispositional constraints on the capacity for control, a number of boundary conditions may increase people's reliance on impulsive processing without associated changes in the capacity for control (e.g., Epstein, 1994; Friese, Hofmann, & Schmitt, in press; Smith & DeCoster, 2000). For instance, mood effects on information processing can occur *independently* of variations in capacity or motivation (e.g., Bless, 2001; Bless et al., 1996). In a similar vein, factors such as a high habitualness of the behavior in question or an internal focus on inner affective reactions may increase the likelihood that impulsive processes shape overt health behavior without associated changes in the capacity/motivation for control.

Habitualness of behavior

Many health-related behaviors have a strong habitual component. The more a behavior becomes habituated, the less controlled it gets (e.g., Smith & DeCoster, 2000; Verplanken & Aarts, 1999). High habitualness implies less effort on behavior regulation since one can rely on impulsive processing instead. Consequently, impulses should better predict health-related behavior for participants whose behavior has become strongly habituated over time. Two recent studies by Conner and colleagues in the eating domain (Conner, Perugini, O'Gorman, Ayres, & Prestwich, 2007) are in line with this prediction. In this research, a self-report measure of habitualness (Verplanken & Orbell, 2003) regarding eating sweets was employed as a moderator. In Study 1, an Extrinsic Affective Simon Task (De Houwer, 2003) predicted self-reported eating behavior better for participants with higher habitualness in eating sweets than for participants scoring low in habitualness. In a second study, an IAT (Greenwald et al., 1998) assessing the relative preference of chocolate (as compared to fruits) predicted self-reported sweet consumption better for participants who reported consuming sweets habitually than for participants who reported low habitualness (without controlling for habitualness in fruit consumption). In a similar vein, the IAT predicted the relative preference of chocolate over fruit in a choice task better for highly habitual sweet consumers.

It should be noted that the role of compulsive habit-like processes may be different in the realm of addictive behaviors compared with other health-related behaviors such as food consumption. There is little dispute about the importance of hedonic processes in the early phases of addiction, but current neurobiological models differ with respect to the processes that are central to the escalation of substance use and misuse into dependence (Everitt & Robbins, 2005; Koob & Le Moal, 2005; Robinson & Berridge, 2003). Everitt and Robbins (2005) argue that compulsive habits are the main characteristic to differentiate (mis)use from dependence, Koob and Le Moal (2005) mention negative reinforcement processes in this regard, and Robinson and Berridge (1993, 2003) sensitized "wanting" which is dissociated from hedonic "liking". The impulsive processes central in our dual-process view of health behaviors are the same as those in early phases of addictive behaviors (i.e., hedonically "hot" reactions that are relatively automatic, see Wiers et al., 2007), but we acknowledge that in later phases of addiction, more hedonically neutral habitual responses may come into play as well. Consequently, dissociations between the predictive validity of measures tapping into automatic affective reactions to the drug stimulus (i.e., hedonic liking) as compared to measures of approach-avoidance reactions (i.e., wanting) may be expected in later phases of addiction.

Mood

Individuals in a positive mood engage in more shallow information processing than individuals in a negative mood. Specifically, individuals in a positive mood may rely more heavily on their associative network in information processing (e.g., Bolte, Goschke, & Kuhl, 2003; Isen, Johnson, Mertz, & Robinson, 1985). Drawing on these findings it can be hypothesized that impulses should influence health-related behavior better for individuals in a positive mood than for individuals in a negative mood.

Hermsen, Holland, and van Knippenberg (2006) investigated this hypothesis in three studies related to health-behavior. In one study (Hermsen et al., 2006, Study 3), automatic affective reactions as measured with a personalized variant of the IAT (see Olson & Fazio, 2004) predicted the choice between an apple and a candy bar in a preference-consistent direction for participants in a positive mood, but not for participants in a negative mood. Hermsen et al. (2006), Study 4) replicated this effect and also showed that, conversely, reasoned attitudes are a better predictor of choice for participants in a negative rather than positive mood.

Mood effects were also investigated with regard to blood donation (Hermsen et al., 2006, Study 2). Note that the case of blood donation fits the introductory definition of a heroism scenario in which potentially negative impulses (disgust, danger of being hurt) have to be overcome for a greater good. It was found that automatic affective reactions toward blood donation predicted how much information participants provided on a form asking for their interest in becoming a blood donor for participants in a positive but not in a negative mood. Conversely, reasoned attitudes of donating blood predicted the degree of information provided for participants in a negative but not in a positive mood.

Affective focus

When people focus on their affective reactions to target objects, impulsive processes may gain the upper hand in influencing behavior (e.g., Bruyneel, Dewitte, Vohs, & Warlop, 2006; Metcalfe & Mischel, 1999; Wilson & Schooler, 1991). One study tested this assumption by situationally manipulating the accessibility of participants' affective or cognitive reactions to target objects (Scarabis, Florack, & Gosejohann, 2006). Participants were confronted with (the by now well-known) choice between a chocolate and a piece of fruit. They were instructed either to think about which option would make their mouth water more (affective focus condition) or to analyze their choice and to list several arguments for their preferred option (cognitive focus condition). In line with the above reasoning, an IAT (Greenwald et al., 1998) assessing automatic affective reactions relating to fruit and chocolate predicted choice behavior better for participants in the affective focus than in the cognitive focus condition, indicating that affectively focused participants relied more strongly on their immediate affective reactions. Importantly, participants in both conditions spent an equal amount of time on concentrated thinking about affective or cognitive aspects, respectively, and their cognitive resources were not manipulated. Hence, both groups most likely did not differ in their motivation or capacity to control. Rather, the focus manipulation may have had a direct effect on the reliance on impulsive precursors as "guides" for behavior.

Further support for the role of affective reliance comes from research on *emotional eating*, which refers to the tendency to rely on affective signals as cues for food intake (Prestwich, Ayres, Perugini, & Conner, 2006). In two studies, automatic affective reactions toward chocolate (measured with an IAT) predicted chocolate consumption during the week following the experiment as assessed with a self-report diary significantly better for participants scoring high on the emotional eating sub-scale of the DEBQ (Van Strien, Frijters, Bergers, & Defares, 1986). In contrast, reasoned attitudes of chocolate were a better predictor of chocolate consumption for low emotional eaters (Prestwich et al., 2006, Study 2). This pattern of findings indicates that the eating behavior of emotional eaters is more strongly determined by their reliance on impulsive, hedonic reactions toward tempting food.

Motivation

A final factor that is repeatedly mentioned in the context of dual-process or dual-system models is the *motivation* to control behavior (Fazio, 1990); Strack & Deutsch, 2004; Wiers et al., 2007). However, there is a striking paucity of research investigating motivation as a potential moderator of the impulse-behavior and reflection-behavior relationship in the health domain (for evidence in the domain of prejudice, see Fazio, Jackson, Dunton, & Williams, 1995). The only study we are aware of in the context of health is a recent study by Thush, Wiers, Moerbeek and colleagues (in press). They investigated the impact of a single session motivational interview on implicit and explicit alcohol-related cognitions and prospective alcohol use and found no evidence for a moderator effect of motivation. This is clearly an area that should be further investigated.

Conclusions and implications

The present article was centered on the idea that many health-related problems may be framed in terms of a conflict between immediate impulses and self-regulated action. On the background of a dual-systems perspective (e.g., Metcalfe & Mischel, 1999; Strack & Deutsch, 2004) we have argued that, on the one hand, *impulsive* influences on health behavior operate according to associative, affective representations that mediate between stimulus input and motor schemas of approach or avoidance. On the other hand, *reflective* influences on health behavior are assumed to operate via an effortful process by which behavior is regulated in accordance with reasoned attitudes and standards to restrain behavior. The structural difference between impulsive and reflective processing leads to a number of predictions regarding the boundary situations and the types of individuals for which impulsive influences on health-related behaviors may prevail over reflective influences and vice versa. Employing implicit measures as proxies for impulse, a number of recent studies reviewed above has begun to investigate these moderator hypotheses with strongly supportive results.[4]

The idea that health behavior is determined by more than just reflective processing is not new (e.g., Baumeister et al., 1994; Gibbons et al., 1998; Kiviniemi, Voss-Humke, & Seifert, 2007; Loewenstein, 1996; Tiffany, 1990). Nevertheless, there have been few attempts to theoretically and methodologically integrate impulsive precursors such as automatic affective reactions or approach-avoidance tendencies into predictive models of health-related behavior. Rather, previous research and theory building in the health domain has primarily provided a fine-grained analysis of the "reflective" part of this equation, that is, the kinds of variables and processes involved in expectancy and value assessments as precursors for reasoned action (e.g., Fishbein & Ajzen, 1975; Janz & Becker, 1984) or in the appraisal of health threats and coping possibilities (e.g., Rogers, 1983).

The purpose of this article is not to question the rich and fruitful insights provided by these models. Instead, the suggested framework is an attempt to *complement* reasoned action and goal-pursuit frameworks by integrating impulsive processes into an overarching model. Because the focus is on integration, our framework is coarser (in terms of the number of predictor variables) than previous models of reasoned behavior determination. Its primary utility at this point may derive from its heuristic value: First and foremost, the framework may direct health researchers' attention more strongly on impulsive influences on health-related behaviors and encourage them to routinely incorporate measures of impulse into their predictive models. Such an approach may yield a more precise prediction of health-related behaviors than when reflective precursors are used as the sole class of predictor variables.

To illustrate this point, in many of the studies reviewed above, reflective precursors such as reasoned attitudes or restraint standards tended to be good predictors of behavior under those circumstances that have been proposed to be conducive to reflective processing. In other words, those individuals with particularly positive reasoned attitudes toward the temptation at hand or those with particularly low restraint standards showed relatively higher degrees of unhealthy behaviors. Correspondingly, the behavioral impact of impulsive influences was negligible in those cases. However, the presented research investigated a number of "risky" circumstances such as cognitive load, ego depletion, alcohol consumption, low trait self-control, low working memory capacity, or high habitualness in which the picture was the other way around: Under these circumstances, reasoned attitudes or restraint standards bore surprisingly little relationship with self-regulatory behavior. Rather, individual differences in *impulse* were the primary determinants such that participants with strong impulses toward the temptation at hand exhibited relatively higher degrees of unhealthy behaviors. As many challenging situations in people's everyday life arguably belong to the latter class of "risky" circumstances, the importance of impulses for everyday health behavior may be somewhat underestimated. By incorporating and specifying the impulsive, "irrational" side of human information processing (next to the "rational" side), models of health behavior may significantly gain in their theoretical and practical range.

Avenues for future research

Our review of the current literature allows identifying a number of avenues for future research into the dynamics of impulsive versus reflective health behavior. First, whereas factors pertaining to the availability of control resources have become well-researched as moderators of predictive validity, future research should consider more strongly the role of *control motivation* as a potential moderator of impulsive influences. Control motivation may vary situationally, for instance as a function of perceived personal accountability or anonymity for a given health-related behavior of interest. In a similar vein, individuals may differ in the degree to which they are motivated to bring their health behavior in line with their reasoned attitudes or goal standards (e.g., Cialdini, Trost, & Newsom, 1995). Control motivation may also vary as a function of perceived goal pursuit of the relevant self-control goal and other variables related to the dynamics underlying goal pursuit. For instance, control motivation may decline if people (falsely) think that great progress toward the self-control goal has already been made, leading to a stronger indulgence in immediate, short term gratifications (Fischbach & Dhar, 2005).

It should be noted that there are different predictions about how control motivation may interact with control resources in determining behavior. One possibility holds that high levels of control motivation may become more important as control resources are fully available rather than situationally or dispositionally reduced because both motivation and resources need to be present for successful self-control. Another possibility holds that high motivation may compensate for the detrimental effects of reduced control resources because individuals may recruit any left-over resources for reflective processing if they are highly motivated. When motivation is low, however, people may be inclined to "conserve" their remaining resources "for later" rather then using them up for the self-control task at hand (Muraven, Shmueli, & Burkley, 2006).

A second avenue that should receive more attention relates to the assumed fine-tuning between impulsive processing and hedonic need states. On the one hand, recent research (Seibt et al., 2007) has shown that need states appear to increase the strength of automatic affective reactions toward those objects that are instrumental in satisfying the need (see also related work from the addiction domain by Ingjaldson, Thayer, and Laberg [2003] demonstrating need state effects on automatic biophysiological responses such as hear rate and salivation). However, there is no research to date showing that increased bodily need states also lead to a stronger impact of automatic affective reactions on need-congruent behavior. An increased impulse-behavior link can be expected if one assumes that the impulsive system may take precedence of need satisfaction, thus curtailing or bypassing the reflective system's operations. For instance, under high food deprivation, impulses may predict consummatory behavior even in circumstances under which reflective processing suggests refraining from consumption (e.g., when the food is known to contain an unhealthy additive).

A third exciting avenue for basic research is to relate the present framework with research on automatic goal pursuit (e.g., Bargh, Gollwitzer, Lee-Chai, Barndollar, & Troetschel, 2001) or implicit self-control (e.g., Fishbach, Friedman, & Kruglanski, 2003). This research indicates the existence of automatized forms of self-regulation such as an automatic link between a tempting stimulus and an overriding restraint goal (Fishbach et al., 2003) or an automatic link between critical situational cues and concrete goal-directed responses (implementation intentions; e.g., Achtziger & Gollwitzer, 2008; Gollwitzer & Sheeran, 2006; Webb & Sheeran, 2007). These findings raise the question of how such automatic forms of self-control may complement intentional and effortful forms of health behavior regulation. For instance, can implicit self-control fully compensate for low WMC because self-control is delegated to relatively effortless and unintentional behavioral routines?

Implications for health interventions

The present analysis also has implications for treatments targeted to improve people's health behavior in tempting situations. Specifically, such treatments may be most effective if they simultaneously attempt to (a) change people's reasoned attitudes, beliefs, and control standards (e.g., through processes of cognitive restructuring, health-education, or persuasion), (b) create situational and dispositional circumstances that are conducive for effective self-regulation of health goals (e.g., by increasing self-monitoring, self-efficiency, coping skills, control capacity or control motivation), and, *in addition*, (c) change impulsive influences on behavior.

Common health interventions have primarily focused on changing health-related cognitions (Miller & Rollnick, 2002; Puska, 1985; Wolburg, Hovland, & Hopson, 1999) and/or creating circumstances that strengthen people's ability to deal with problematic situations (Marlatt & Gordon, 1985; Miller & Rollnick, 2002; Monti & Rohsenow, 1999; Oaten & Cheng, 2006). Even though most of these sketched approaches can be regarded as effective to some extent, however, there is clearly room for improvement—as indicated, for instance, by the high rates of relapse in the treatment of eating disorders or substance abuse (e.g., Irvin, Bowers, Dunn, & Wang, 1999; Keel, Dorer, Franko, Jackson, & Herzog, 2005; Sayette, 2004).

From a dual-systems perspective, health interventions may be particularly effective if they not only target the contents of the reflective system and facilitate the operating conditions of the reflective system, but also attempt to tackle the impulsive roots of behavior determination. If impulsive processes are indeed crucial predictors of health behavior in many everyday high-risk situations, treatments geared at changing impulsive processes directly may be a worthwhile endeavor. Specifically, impulsive reactions toward tempting stimuli may be changed at various stages of behavior determination such as (a) automatic attentional biases, (b) automatic affective reactions, (c) or automatic approach-tendencies. Addressing attentional biases, pioneering work has attempted to retrain attentional biases in heavy drinkers (e.g., Field et al., 2007). And some promising first results have even been obtained in alcoholic patients in a clinical setting (Fadardi & Cox, 2007; Schoenmakers et al., 2008). Addressing automatic affective reactions, first research has begun to use evaluative conditioning procedures in order to change automatic affective reactions toward tempting stimuli (e.g., Dwyer, Jarratt, & Dick, 2007; Lascelles, Field, & Davey, 2003).

Finally, Wiers and colleagues (Wiers, Rinck, Kordts, Houben, & Strack, 2008) set out to change the *behavioral* component of impulses in heavy drinkers by reducing the degree of approach motivation triggered by the impulsive processing of alcohol stimuli. Specifically, Wiers et al. (2008) developed a re-training version of an approach-avoidance task in which one subgroup of heavy drinkers was trained to avoid alcohol-related pictures by pushing a joystick away from themselves (re-training condition) while the other subgroup was trained to approach the alcohol pictures. Results showed reduced automatic approach tendencies for alcohol and less actual beer consumption in a test-and-rate task among successfully re-trained drinkers (as compared to the heavy drinkers trained to approach the alcohol). Even though it is too early to evaluate the general and long-term effectiveness of the above techniques, impulse-oriented interventions clearly offer exciting new possibilities for the treatment of problematic health behaviors.

Coda

In sum, a dual-systems perspective on health-related behavior as outlined in this article may enrich our theoretical understanding of the factors underlying behavior determination and increase the precision of predictive models of health-related behavior. Such an approach may eventually lead to refined health interventions that also address the impulsive springs of behavior. Of course, human life would be less pleasurable without our propensity to act impulsively: An over-controlled life can be even psychologically and physically damaging (e.g., Polivy, 1998). But then again, too much impulsive consumption is not good for one's health either. Establishing a healthy balance between impulse and restraint is one of the fundamental and ever recurring challenges of human existence, and, for as long as we live, the tug-of-war within the mind will never end.

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Notes

1. Correspondingly, in the heroism scenario, the hedonic component is negative and the activated behavioral tendency is an avoidance reaction.
2. Specifically, in their model of willed and automatic control of behavior, Norman and Shallice (1986) further distinguish between two ways in which a winner may be determined: First, by the mere competition of activation potential among incompatible schemas. This type of conflict resolution may function quite automatically and effortlessly. Second, a (controlled) mechanism of selective attention may be recruited whose function is to "bias" schema selection by inhibiting one of the competing schemas and by providing extra activation for the other. We assume that it is particularly the latter type of mechanism that is in charge of inhibiting and overriding prepotent impulsive action tendencies in the service of self-regulatory goals and that this mechanism can be sapped by a lack of control resources. Also, only the latter mechanisms may be accompanied by a full-fledged conscious experience of internal conflict. Finally, this mechanism also allows for the possibility that, in order to achieve certain goals, control may actually be directed at bolstering the impulsive rather than the reflective response (e.g., when boosting one's aggressive responses in order to win a football match).
3. In most circumstances, the salient features will have to do with the processing of the immediate temptation of interest (resulting in short-sighted, impulsive behavior) rather than to long-term standards, unless these standards are made especially salient (e.g., MacDonald, Fong, Zanna, & Martineau, 2000).
4. We believe that the implicit measures that have been employed in the studies reviewed have encouraging properties that justify their use as proxies of impulse. This does not mean, however, that implicit measures are a silver bullet to impulse assessment, as the degree of internal validity of these measures is still a subject of great debate (e.g., Conrey, Sherman, Gawronski, Hugenberg, & Groom, 2005; Mierke & Klauer, 2003). Nevertheless, the amount of incremental validity provided by these measures is reassuring and their continued application will most likely lead to their further improvement.

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