Self-control conflict in the eating domain

A cognitive, affective, and behavioral perspective

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CHAPTER 1

General Introduction

Life is full of situations in which I want to do A, but think I should better do B. For example, I sometimes feel the desire for a cigarette (A), even though I know smoking is bad for me and I should therefore resist (B). Other times, I think I should go to the sports class (B), but to be honest, I would rather sit on a sunny terrace enjoying a cool glass of wine (A). Maybe the most commonly used and recognizable example of such a situation is, however, when I want to order the much more hedonically pleasing pizza (A), even though I know that taking one of the salads would be the much healthier and therefore better choice (B). Of course, we all have our own A's and B's. But what is the same for everybody is that the two are often mutually exclusive and therefore in direct conflict with each other. I can either smoke that cigarette or not, go to the sports class or sit on the terrace, order the pizza or the salad, but I cannot do both at the same time (well, I could technically order the pizza *and* the salad, but I usually order only one main course). The social-psychological literature refers to those situations in which an immediate impulse, or desire (A) collides with a more distal higher-order goal (B) as 'self-control conflicts'– because it requires self-control (i.e., effortful inhibition of the impulse; Milyavskaya & Inzlicht, in press) in order to solve the conflict in favor of the higher-order goal (Baumeister, 2002). Self-control conflicts turn desires into temptations (i.e., something you want but should not do; see Hofmann, Baumeister, Förster, & Vohs, 2012), and are at the heart of the self-control process, given that without such a conflict no self-control would be necessary (e.g., if I did not have the goal of healthy eating, nothing would hold me back from ordering the pizza).

It is striking that although the literature acknowledges the central role of conflict in offsetting self-control processes, not much is known about its characteristics and consequences. As a recent study suggests, almost half of all desires (46.7%) we experience on a daily basis are conflicted (Hofmann et al., 2012). This finding further underlines the importance of studying self-control conflicts more systematically, a goal which I pursued in the present dissertation. In doing so, I incorporated different theoretical and methodological perspectives, all of which are related to the broader concept of conflict. In fact, outside the self-control literature conflicts have been studied much more thoroughly. Cognitive psychology has, for example, a longstanding tradition and interest in studying response conflicts (i.e., the simultaneous activation of two incompatible response tendencies), and the general finding is that conflicts mobilize control efforts (e.g., Botvinick, Braver, Barch, Carter, & Cohen, 2001). Classic social psychological research, and research within many other domains, however, stresses that conflicts (e.g., response conflicts,

attitudinal conflicts, decisional conflicts) are experienced as aversive (e.g., Festinger, 1964). This highlights the double-edged nature of conflict: On the one hand conflict seems to energize and trigger control, whereas on the other hand conflict is being experienced as aversive.

The present dissertation built on those insights from different research traditions and applied them to the study of self-control. More specifically, in the first line of research I zoomed in on the potential benefits of self-control conflict and employed a paradigm from cognitive psychology to test the interplay between conflict-triggered control and motivational processes. In the second line of research, I studied the potential affective costs of self-control conflict by using a decisional conflict paradigm. In the last line of research, I applied a popular cognitive bias modification paradigm in order to test whether self-control conflict strength can be modified.

Most of the research that will be reported in the present dissertation will look at self-control processes in the domain of eating behavior. This focus was specifically chosen because eating behavior is notoriously difficult to control (see the rising prevalence of overweight and obesity; Ng et al., 2014), often experienced as conflicting (Hofmann et al., 2012), and in case of overconsumption associated with lifestyle related health problems (World Health Organization, 2015). Nonetheless, the main conclusions of this dissertation are probably not specific to the eating domain but may also apply to other domains of self-control (e.g., academic achievement). In what follows I will first elaborate on the concept of self-control conflict, before I will provide the theoretical backgrounds guiding each line of research.

Perspectives on Self-control Conflict
The notion that people experience conflicts between their immediate desires and higher-order goals has been around for many centuries. Take, for example, the Bible (5th to 4th century BC), which opens with an iconic and highly moralized illustration of self-control conflict by telling the story of Eve who, against better knowledge, gives in to the temptation to eat from the forbidden tree and thereby causes the 'fall of mankind'. Around the same time, Aristotle also observed in his book Nicomachean Ethics (350 BC) that people not always act according to their higher-order goals (i.e., reason), but that their behavior is often determined by desires which might even be conflicting with their goals. In Greek philosophy, enacting a desire despite knowing better has been referred to as 'akrasia', or the lack of self-control. This early understanding of behavior resulting from different, potentially conflicting, sources has significantly

influenced the evolution of psychology. The prime example of a relatively more modern description of self-control conflicts comes from Freud and his tripartite model of the human psyche (1922/1949), in which he distinguishes between the id (representing people's needs and desires), the super-ego (representing culturally shaped goals) and the ego (balancing the two). Again, the power of impulses or desires and their potential conflict with higher-order goals was seen as central to the dynamic unfolding of behavior.

In contemporary psychology behavior is still often conceptualized as the outcome of a balance between a more impulsive, hedonically charged component, and a more reflective, reasoned component (Baumeister & Heatherton, 1996; Metcalfe & Mischel, 1999; Smith & DeCoster, 2000; Strack & Deutsch, 2004). One of the more prominent so-called dual-process models in psychology is the Reflective Impulsive Model (RIM; Strack & Deutsch, 2004). The RIM differentiates between two types of processes coordinating behavior regulation. On the one hand, a relatively fast and effortless *impulsive* process, which is triggered as a result of (cognitive, affective, or motivational) associations with, for example, cues in the environment (e.g., you see the tasty food and you are instantly inclined to approach it). On the other hand, a relatively slow and effortful *reflective* process, which is triggered as a result of a decision process in which different aspects of the situation and the self (e.g., goals, expectations) are integrated. Both processes can operate in parallel and usually work together in concert. There are situations, however, in which both processes are conflicting because they trigger incompatible responses. This conflict can either be between two incompatible reflective, two incompatible impulsive, or between a reflective and an impulsive process. This latter type of conflict represents what is typically referred to as a self-control conflict. To illustrate, for a dieter who wants to lower his or her calorie intake, seeing a tasty chocolate cake might evoke an immediate approach impulse which is in direct conflict with his or her weight-loss goal.

Impulses can encompass relatively 'cool', overlearned stimulus-response associations (i.e., habits), or relatively 'hot', motivationally charged hedonic goals (i.e., desires). Both types of impulses exert an early and strong influence on response selection, which is then to be modified or inhibited in case it conflicts with a higher-order goal. The probably most basic description of a self-control conflict is, therefore, that of a conflict between two incompatible behavioral response tendencies (cf. Botvinick et al., 2001). Relating this behavioral response conflict perspective to our dieter's dilemma suggests that a) unless a choice has to be made between, for example, a healthy or unhealthy

food option, self-control conflict is not experienced, and b) that once a choice has been made the response conflict is solved and the self-control episode is terminated.

Given that everyday self-control conflicts typically entail a conflict between a desire and a higher-order goal (see Hofmann et al., 2012), it seems appropriate to not only reduce them to response conflicts but to also conceptualize them as more complex goal conflicts (Fishbach & Shah, 2006; Stroebe, van Koningsbruggen, Papies, & Aarts, 2012; Trope & Fishbach, 2000). As I have argued above, desires are hedonic goals which are one type of impulse, as they represent fast motivational responses to external (e.g., seeing tasty food) or internal (e.g., hunger, craving) cues. As such they are characterized by the mobilization of behavior geared towards immediate gratification and are therefore often prioritized at the expense of long-term goals. They are different to the more 'cool' impulses (i.e., habits), however, in the sense that once a (hedonic) goal is activated it remains accessible until fulfilled (see Förster, Liberman, & Friedman, 2007; Zeigarnik, 1927). In the context of self-control conflicts, this suggests that even if choosing the long-term over the hedonic goal (i.e., the healthy over the unhealthy food option) can solve a conflict on the behavioral response level, the conflict experience might linger because the hedonic goal remains accessible. To summarize, a self-control conflict usually entails a 'hot' desire (vs. 'cool' habit) and represents therefore not only a response conflict but also a goal conflict. As a consequence, conflict resolution and subsequent processing may be subject to the dynamics of goal pursuit.

The Role of Self-control Conflict in Triggering Self-control

The RIM (Strack & Deutsch, 2004) has been helpful in conceptualizing the processes underlying human behavior, and helped understand why and when people find it difficult to pursue their long-term goals when facing temptations (Hofmann, Friese, & Wiers, 2008). Specifically, the RIM proposed that the resolution of self-control conflict depends on the relative strength between the (e.g., hedonic) impulse and the (e.g., weight-loss) goal. Impulses are more likely to dominate behavior regulation if they are strong (e.g., when hungry), and/or if reflective processes are too weak to prevent the impulsive behavior from being executed (e.g., when tired, low motivation). Accordingly, self-control has been defined as the capacity for 'effortful inhibition of an immediately gratifying behavior or impulse' (Milyavskaya & Inzlicht, in press, para. 2), and

is always then needed when this impulse is in conflict with, and therefore jeopardizing the attainment of, another important goal.

Despite that central role of conflict in self-control (Baumeister, 2002; Carver & Scheier, 2002; Myrseth & Fishbach, 2009), only a few recent studies have actually measured conflict directly, or systematically studied its relationship to self-control outcomes (i.e., giving in vs. resisting temptation) and other variables implied in the self-control process (e.g., Grund, Schmid, & Fries, 2015; Milyavskaya, Inzlicht, Hope, & Koestner, 2015). One recent experience sampling study, for example, tracked participants' self-control behavior and their (self-reported) experience of conflict strength on a daily basis (Hofmann et al., 2012). Their results showed that people vary in the degree to which they experience self-control conflict, and more importantly, that variations in conflict strength predicted participants' engagement in self-control strategies and self-control success (e.g., the more conflict the more resistance and success).

This control enhancing aptitude of conflict has been hypothesized in several models of behavior regulation (e.g., Carver & Scheier, 2002; Inzlicht, Bartholow, & Hirsch, 2015). It has been argued that conflicts act as 'alarm signals' informing the system that goal-attainment is currently obstructed and that something needs to be done in order to get back on track. As a consequence, attention is directed to the source of conflict and resources are mobilized in order to deal with and eventually solve the conflict, so that goal-pursuit can be resumed. This reasoning also corresponds to research on cognitive control, which has reliably demonstrated that people upregulate cognitive control upon experiencing response conflict (e.g., enhanced target-focus in a Stroop task; Botvinick et al., 2001). Interestingly, both lines of research propose that the mechanism underlying conflict-triggered control is affective in nature. More specifically, there is ample evidence from a variety of different literatures showing that conflict is experienced as negative and aversive (e.g., Dreisbach & Fischer, 2012a; Festinger, 1964; Inzlicht et al., 2015). They suggest that the occurrence of conflict (e.g., between response tendencies, goals, evaluations etc.) gives rise to phasic negative affect which is proportional to conflict strength. This negative conflict signal then motivates the organism to mobilize resources in order to return to a state of comfort.

From the above I conclude that people often encounter self-control conflicts, and that those conflicts trigger control efforts which help bring behavior in line with higher-order goals. Besides those clear benefits, self-control conflicts might also be associated with negative affect and therefore come at an experiential cost. The costs could be especially large when one fails

to solve the conflict, which might be the case given that self-control conflicts usually involve two goals. That is because unfulfilled (i.e., non-enacted goals) goals linger and may thus maintain the negative affective conflict state. Finally, though conflicts may aid self-control many people still often fail to resist temptations. One way of improving the attainment of higher-order goals might, therefore, be to reduce conflict strength. Below, I will elaborate more on those core ideas, incorporating different literatures and trying to relate them to the study of self-control. While doing so I will also raise the questions that guided the empirical work of the present dissertation.

Conflict-triggered Control over Temptations
The literature on cognitive control has a long tradition in studying conflicts and their effects on behavior (see Berlyne, 1960; Botvinick et al., 2001). Broadly speaking, cognitive control refers to the ability to dynamically adapt to current situational demands. It is therefore necessary for successfully dealing with conflicts and thus closely related to the concept of self-control. In that literature, conflicts are usually operationalized as response conflicts which arise in distractor-interference tasks, such as the Stroop task (Stroop, 1935) or the flanker task (Eriksen & Eriksen, 1974). In a typical Stroop task, participants are presented with color words (e.g., "BLUE") that are printed in either the same color (i.e., blue) or another color (e.g., red). Participants have to indicate the color in which the word is printed and to ignore the automatic, or overlearned, reading of the word. The general finding is that people are slower to respond to trials in which the word meaning is in conflict with the print color (i.e., incongruent trial), compared to when there is no conflict (i.e., congruent trial). According to the conflict monitoring model (Botvinick et al., 2001), this response delay, or so-called *congruency effect*, reflects the mobilization of control needed to solve the conflict in favor of the task-goal. Explaining how those control adjustments occur, the model proposes an evaluative system (the conflict monitoring system) which is constantly scanning the environment for instances of conflict (interferences of active response schemata). Once such a conflict is detected, through activation in the anterior cingulate cortex (ACC), a signal is transmitted to higher control areas (lateral prefrontal cortex) that adjusts and gears current task-processing towards solving the conflict.

But conflict-triggered control is not limited to the duration of one Stroop or flanker trial. There are many studies demonstrating that conflict-triggered control, once mobilized, stays high for some time biasing attention and performance on the next trial towards task-relevant features (for an

overview see Egner, 2007). This 'carry-over' effect is termed *conflict adaptation*, and implies that performance following incongruent (vs. congruent) trials is relatively more influenced by target information and relatively less influenced by non-target information. As a consequence, the congruency effect on the current trial is reduced if the previous trial was incongruent rather than congruent (Gratton, Coles, & Donchin, 1992). How exactly task-relevant processing is reinforced by the conflict signal is not entirely clear yet. Most accounts, however, emphasize that conflict acts as a learning signal. Either as an (affective) avoidance learning signal motivating people to solve the present and prevent any further conflict (Dreisbach & Fischer, 2012a), or as an arousal based learning signal strengthening currently active task representations (Verguts & Notebaert, 2008). Independent of which exact process takes place, all accounts predict that there is more top-down control after conflict (vs. no conflict), so that when entering the following situation control processes are relatively better prepared to deal with conflict. The conflict adaptation paradigm therefore lends itself very well for studying the influence of varying degrees of control over, for example, conflicting impulses.

Most previous research on conflict-triggered control adjustments (i.e., conflict adaptation) has studied the effectiveness in dealing with 'cool' habitual impulses (e.g., automatic word reading in a Stroop task). As argued above, more complex self-control conflicts, however, often entail 'hot' motivational impulses. Think back to the dieter who is tempted by the hedonically pleasing chocolate cake, or to my personal desire to smoke a cigarette. [1] One goal of this present dissertation was therefore to use the conflict adaptation paradigm to test whether conflict-triggered control adjustments operate equally well in the presence of motivationally charged distractors – cues of motivational relevance that are preferentially processed and might thus interfere with target processing (cf. temptations, see Question #1).

There are some lines of research which have studied the interaction between conflict-triggered control adjustments and motivational processing (Braem, Verguts, Roggeman, & Notebaert, 2012; van Steenbergen, Band, & Hommel, 2009), but none of them have tested the mechanism's effectiveness when in direct competition with motivational processing, as is the case in self-control conflicts. On the one hand, conflict-triggered control adjustments are especially geared towards processing task-relevant (i.e., target) information, so conflict adaptation might be protected in the presence of even motivational

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[1] A cigarette would actually be quite nice right now.

distractors. On the other hand, because motivational distractors are especially difficult to disengage from (Anderson, Laurent, & Yantis, 2011; Vuilleumier & Huang, 2009), they might consume some of the mobilized resources which would result in a reduction of the conflict adaptation effect (Padmala, Bauer, & Pessoa, 2011; Pessoa, 2009). Investigating the effectiveness of conflict-triggered control adjustments in the presence of motivational distractors would clearly enrich the literature on conflict adaptation, because it would test one of its most ecological boundary conditions. More importantly though, it would also enrich the literature on self-control, since it provides a highly experimentally controlled test of the core processes implied in self-control.

> **Question #1**   (see Figure 1.1 Panel A)
>
> Conflict triggers control adjustments which bring subsequent behavior in line with task-goals. Does this conflict-triggered control mechanism also operate in the presence of motivationally charged distractors (cf. temptations)?

Conflict as Negative Experience

Existing work on self-control conflict has primarily focused on which of the conflicting components is most likely to determine the behavioral outcome (giving in vs. resisting; e.g., Hofmann et al., 2008). Those behavioral outcomes have in turn been used to predict people's affective and emotional reactions. Accordingly, giving in to temptation has been related to elevated feelings of guilt, whereas resisting temptation to feelings of pride (e.g., Giner-Sorolla, 2001; Hofmann, Kotabe, & Luhmann, 2013). What has been largely neglected until recently is that self-control conflict itself might be an affective, or emotional, experience that can vary in intensity (Inzlicht et al., 2015; cf. Berrios, Totterdell, & Kellett, 2015; Grund et al., 2015). This is quite likely given that many other forms of conflicts (e.g., response and attitudinal conflict) are associated with negative affect and a general sense of discomfort (Dreisbach & Fischer, 2012a; Emmons & King, 1988; Festinger, 1964; Gawronski, 2012; Tversky & Shafir, 1992; van Harreveld, Rutjens, Rotteveel, Nordgren, & van der Pligt, 2009). Importantly, if self-control conflicts were also accompanied by negative affect, that could have consequences on how people feel about exerting self-control, and possibly also on how they evaluate their self-control outcomes. Moreover, given that self-control conflicts typically entail two competing goals (rather than just behavioral responses), which tend to remain accessible until fulfilled,

it is possible that conflict and its associated negativity lingers even after a choice has been made. Studying these affective consequences is therefore important not only because it provides a more dynamic perspective on the experience of exerting self-control, but also because of their potentially profound effects on the likelihood of engaging in future self-control (see Hofmann & Fisher, 2012).

The evidence for the link between conflicts and negativity spans from low level response conflicts (as experienced in Stroop tasks) to more complex decisional conflicts. To illustrate, Dreisbach and Fischer (2012a) found that priming participants with response conflict (i.e., incongruent Stroop stimulus) facilitated subsequent responding to negative targets in an affective priming task (see also Fritz & Dreisbach, 2013). Moving up to more complex, real-life instances of conflict, research on decisional conflict showed that being conflicted about different choice options is associated with feelings of negativity and difficulty. This in turn can reduce people's overall choice satisfaction, presumably because the non-chosen alternative remained attractive (Carmon, Wertenbroch, & Zeelenberg, 2003; van Harreveld et al., 2009).

Although conflicts might be experienced as negative, it has also been suggested that the successful resolution of conflict can release positivity (Festinger, 1964; Inzlicht et al., 2015). Again, the supporting evidence for this claim varies from studies on solving response conflicts, to solving conflicts involving higher-order goals. For example, a line of studies by Schouppe and colleagues (2015) showed that correctly responding to incongruent (vs. congruent) Stroop trials facilitated responding to positive targets in an affective priming task (see also Satterthwaite et al., 2012). Research on more complex goal pursuit has also shown that people assign higher value to outcomes that were achieved through investing high (vs. low) effort (Aronson & Mills, 1959). Also, goal achievement feels more rewarding when it required overcoming difficulty (a proxy of conflict), probably through mechanisms of effort justification (Festinger, 1964; Higgins, 2006, but see also Zentall, 2010). Together those findings suggest that even if conflicts feel negative, they can release a proportional amount of positivity once they are successfully solved.

Applying this literature to self-control conflicts, self-control conflicts may also be experienced as negative, whereas their successful resolution as positive. For example, the dieter who faces a conflict between chocolate cake and the healthier fruit salad might experience negative affect while making the choice, but this negativity could convert into positivity once he/she chooses to act in line with the long-term goal. This corresponds to research showing that people report increased levels of pride after resisting temptations, which in turn

predicts future self-control success (Hofmann & Fisher, 2012; Hofmann et al., 2013). However, there is also evidence that people can feel more regret after resisting (as well as giving in to) temptations, which suggests that acting in line with the goal is not always or automatically perceived as a successful solution to the conflict (Hofmann et al., 2013; Kivetz & Keinan, 2006). In fact, this finding supports the goal-perspective on self-control conflicts, according to which people could remain conflicted even after the choice has been made, because the unfulfilled goal remains accessible.

In summary, previous research suggests that conflicts are associated with negativity, whereas their successful resolution can trigger positivity. The second goal of the present dissertation was, therefore, to provide a first test of the affective and emotional consequences of experiencing varying amounts of self-control conflict during real-life self-control decision making (e.g., making a choice between a healthy or unhealthy meal, see Question #2). Moreover, I also studied when self-control conflicts are most (vs. least) likely to be perceived as successfully resolved. Such an investigation would provide a significant contribution to the current theoretical debate on the emotional foundations of self-control (see Inzlicht et al., 2015), but it might also shed light on the circumstances in which resisting temptations might or might not be conducive to sustained self-control.

Question(s) #2   (see Figure 1.1 Panel B)

What are the affective and emotional consequences of experiencing self-control conflict? And do those consequences depend on whether or not the conflict is perceived to be solved?

Decreasing Conflict Strength

Self-control is notoriously difficult because it entails solving a conflict between an immediately gratifying impulse and a higher-order goal. Even though I have argued that conflict may be beneficial for exerting self-control, the odds of acting in line with one's higher-order goals should be highest in the absence of conflict (temptations). To illustrate, a person with a health goal who does not have a desire for the unhealthy food option is naturally more likely to make a healthy food choice. Accordingly, it has been argued that attaining higher-order (e.g., health) goals does not necessarily require the effortful inhibition of impulses. It can also be achieved through strategies which prevent conflicts from arising in the first place (Adriaanse, Kroese, Gillebaart, & De Ridder, 2014;

Hofmann & Kotabe, 2012). Therefore, one way of improving health behavior might be through reducing conflict strength. From a dual-process perspective, this can either be achieved through strengthening the higher-order goal (i.e., targeting reflective processes), or through decreasing the hedonic or motivational 'pull' of the impulse (i.e., targeting impulsive processes; for an overview see Wiers, Becker, Holland, & Lejuez, 2015).

The first approach is based on the idea that goals, intentions, and attitudes are important determinants of people's behavior (e.g., Ajzen & Fishbein, 1980; Locke & Latham, 2002). Research on goal-pursuit has shown that people are more likely to exert goal-directed behavior if the respective goal is important, accessible and commitment is high (e.g., Gollwitzer, 1990). However, as recent reviews suggest, many interventions building on that idea do not seem to be effective in changing (health) behavior. This is the case for broad societal interventions (e.g., providing health information on products; Campos, Doxey, & Hammond, 2011; Dumanovsky et al., 2011), as well as for more individualized interventions (e.g., increasing self-efficacy, changing attitudes; Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Webb & Sheeran, 2006). One reason for why interventions targeting reflective processes might not be as effective is because the influence of impulsive processes on behavior can remain quite strong. So even if people are relatively better prepared to bring their behavior in line with their goals, they might still encounter temptations that potentially jeopardize self-control success.

The second approach aims at reducing the strength of the impulse. This is based on the idea that most of our behavior is determined by fast, conditioned responses to motivationally salient cues in the environment. For example, in the eating domain there is evidence that people who struggle with their weight (i.e., are overweight or obese) have an approach bias to high caloric food (Brignell, Griffiths, Bradley, & Mogg, 2009; Kemps & Tiggemann, 2015; Veenstra & de Jong, 2010). This implies that in situations in which high caloric food is available, they are immediately inclined to approach it, which ultimately leads to higher consumption. Interventions targeting the impulsive system are therefore geared towards 'unlearning' those conditioned responses. Over the past decade there has been a surge of studies testing different ways of achieving this aim. For example, training participants to inhibit responding to high caloric food stimuli has proven successful in reducing not only liking for high caloric foods, but also energy intake and even weight (e.g., Houben & Jansen, 2011; Lawrence et al., 2015; Veling, Aarts, & Papies, 2011; Veling, van Koningsbruggen, Aarts, & Stroebe, 2014).

Yet another paradigm that aims at reducing impulse strength is the approach avoidance training. In the approach avoidance training, participants repeatedly make avoidance movements to critical stimuli (e.g., palatable but unhealthy foods) and approach movements to control stimuli (e.g., healthy foods). The aim of the approach avoidance training is to reduce the approach bias or to even turn it into an avoidance bias. This prediction has received support from several domains (e.g., Kawakami, Phills, Steele, & Dovidio, 2007; but see van Dessel, De Houwer, & Gast, 2016), and it seems that approach avoidance training is especially promising in the area of alcohol dependence (Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011; Wiers, Rinck, Kordts, Houben, & Strack, 2010). More specifically, participants who followed one session of approach avoidance training (i.e., repeatedly avoiding vs. approaching pictures of alcohol vs. soft-drink beverages) showed reduced implicit liking for alcohol and alcohol consumption directly afterwards compared to a control condition (Wiers et al., 2010). Importantly, this effect was replicated with multiple training sessions in a clinical sample, where it was also found that training reduced relapse rates (Eberl et al., 2013; Wiers et al., 2011).

To date, there is no conclusive evidence yet for whether the approach avoidance training would also be effective in the eating domain. Some initial supportive evidence exists (see Fishbach & Shah, 2006; Kemps, Tiggemann, Martin, & Elliott, 2013) but their findings are qualified by methodological constraints (e.g., small sample size, direct instructions to approach healthy and avoid unhealthy foods).[2] More research is, therefore, needed to investigate whether the approach avoidance training is indeed successful at reducing impulse strength and thereby improving eating behavior (see Question #3). The added advantage of paradigms targeting impulsive (vs. reflective) processes is that they are easy to administer (e.g., online), they allow more flexibility regarding when and where participants complete the session, and they are relatively economical.

Question #3   (see Figure 1.1 Panel C)

Does the approach avoidance training succeed in reducing impulse strength, and thereby help bring eating behavior in line with high-order (health) goals?

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[2] Since the publication of Chapter 4 there have been two additional papers published studying the effectiveness of approach avoidance training in the eating domain. Those are discussed in the General Discussion.

Overview of Empirical Chapters

Goal of Present Dissertation
The overarching goal of the present dissertation was to shed more light on the concept of self-control conflict, and thereby uncover its potential benefits as well as costs for the self-control process. To this end, I incorporated theory and methodology from cognitive, social, and health psychology. This is reflected in each chapter, where I adopted a different perspective on self-control conflicts to derive novel, empirical questions. Chapters can therefore be read independently, but note that terminology can occasionally differ between the Chapters and the General Introduction/Discussion. A final goal was to be transparent about the empirical evidence presented in each chapter. Additional unreported studies which were conducted testing the same core design are, therefore, mentioned in footnotes (total n = 2; see footnote 7 and 10).

Chapter 2
The goal of Chapter 2 was to study the interplay between conflict-triggered control adjustments and motivational processes. More specifically, I was interested in the effectiveness of top-down control in facilitating the disengagement from motivational distractors, which are cues that you want to process but which might be detrimental to goal-attainment (cf. temptations). To test this, I used the conflict adaptation paradigm which allows predicting when in a (Stroop) task participants have more versus less cognitive control resources available. On some of the trials motivationally charged distractors were inserted, so that I could test whether control triggered in a previous trial prevailed in the presence of a motivational distractor. Based on the existing literature I proposed two competing hypotheses. On the one hand, conflict triggers top-down control which biases subsequent performance in task-relevant ways (i.e., enhanced target processing; Botvinick et al., 2001). Any distractor information, may it be neutral or motivationally charged, will consequently have less influence and thus interfere less with task performance. Accordingly, conflict adaptation should be protected in the presence of motivational distractors. On the other hand, motivationally charged distractors have a reputation for catching as well as holding attention (Anderson, Laurent, & Yantis, 2011; Vuilleumier & Huang, 2009). If that was the case, motivationally charged distractors should be processed despite increased control levels and therefore interfere with task performance, undermining the conflict adaptation mechanism (see Padmala et al., 2011). Those hypotheses were pitted against

each other in four experimental studies. In all reported studies motivational distractors represented monetary reward and loss cues. An additional study using a similar paradigm but food reward cues is reported in Supplementary Materials 1 (SM1).

Chapter 3

The goal of Chapter 3 was to investigate the affective experience of varying degrees of self-control conflict, and how that is related to people's emotional reactions to their self-control choices (giving in vs. resisting a food temptation). According to the literature, different kinds of conflicts have been consistently associated with increased negative affect and discomfort (e.g., Dreisbach & Fischer, 2012a; Festinger, 1964). However, there are also several lines of research showing that once they are successfully solved, conflicts can increase positivity (Inzlicht et al., 2015; Schouppe et al., 2015). Interestingly, not much is known about whether this also applies to self-control conflicts. I therefore conducted four studies (and re-analyzed one existing experience sampling data set by Hofmann et al., 2012) to test the affective, emotional and also behavioral consequences of experiencing self-control conflict during self-control decision making. More specifically, in all studies participants first made a food choice between a relatively more healthy and a relatively more unhealthy food option (e.g., salad vs. pizza). Then variations of self-control conflict strength (or choice difficulty, a proxy), levels of general affect, emotions and evaluations regarding their choice, and their future self-control behavior were assessed. I was particularly interested in whether conflict strength predicted those latter variables, whether this was dependent on the choice they made, and on whether or not participants appraised their choice as a successful solution of the self-control conflict.

Chapter 4

The goal of Chapter 4 was to test the effectiveness of the approach avoidance training in the eating domain. Previous research in the alcohol dependence domain suggests that the approach avoidance training, a training in which participants learn to associate tempting stimuli (e.g., alcoholic beverages) with avoidance movements and control stimuli (e.g., soft drinks) with approach movements, can lead to reduced approach impulses and liking of those temptations, and to improvements in the regulation of the targeted behavior (e.g., reduced alcohol consumption; Wiers et al., 2010, 2011). But does this also apply to eating behavior? To bring this to a test, I conducted three experimental

studies in which one session of approach avoidance training (training vs. sham training) was administered to a group of healthy-weight students. More specifically, the training group avoided the majority of all high caloric food pictures and approached the majority of all low caloric food pictures, whereas the sham training group approached and avoided equal amounts of high and low caloric food pictures. I measured participants' change in response bias, their liking for high caloric food, and their actual eating behavior following the training. Moreover, I conducted an additional multi-session intervention study that was administered online and open to a broader public (see Supplementary Material 2, SM2). In that final study I also tracked changes in participants' perceived difficulty with which they resist temptations (a proxy of conflict).
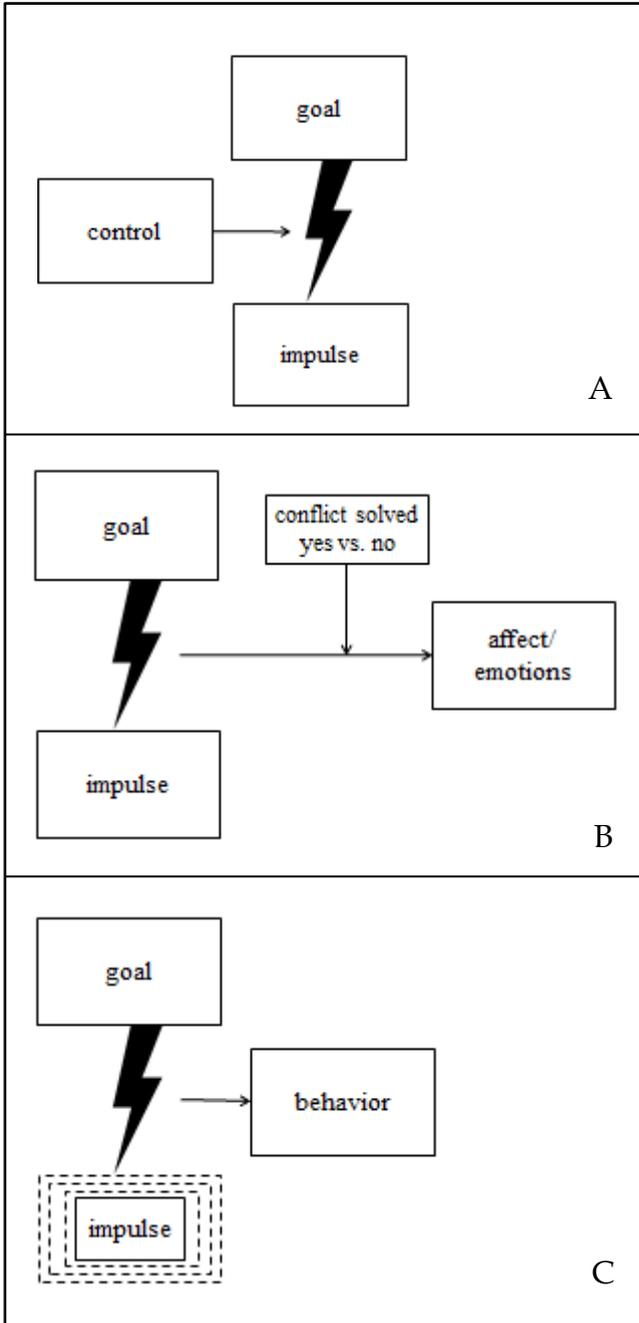
Figure 1.1 Panel A shows a schematic representation of the first line of studies (Chapter 2), in which I investigated whether momentary increases in control facilitate goal-congruent behavior (i.e., task performance) in the presence of a motivationally charged distractor (i.e., impulse). Panel B represents the second line of studies (Chapter 3), in which I investigated the affective and emotional consequences of conflict strength during decision making. I was also interested in whether those consequences depended on whether the conflict was successfully solved or not. Panel C refers to the last line of research (Chapter 4) in which I investigated whether reducing impulse strength of palatable but unhealthy foods through administering the approach avoidance training can improve eating behavior.