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Effects of Trait Self-Control on Response Conflict About Healthy and Unhealthy Food

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Abstract

Self-control leads to positive life outcomes, but it is poorly understood. While previous research has focused on self-control failure, self-control success remains unexplored. The current studies aim to shed more light on the mechanisms of self-control by focusing on the resolution of response conflict as a key component in self-control success. Trait self-control was measured, and participants reported on the magnitude of response conflict they experienced about healthy and unhealthy foods in Study 1 ($N = 146$; $M_{age} = 33.03$; 59 females, 83 males, 4 unknown). The response conflict process was assessed in Study 2 ($N = 118$; $M_{age} = 21.45$; 68 females, 41 males, 9 unknown). Outcomes showed that self-reported evaluative response conflict about food items was smaller for people high in trait self-control. Study 2 revealed that higher trait self-control predicted faster resolution of self-control conflict, and an earlier peak of the response conflict. Taken together, these results provide insight into what makes people with high trait self-control successful, namely, how they handle response conflict. Implications for self-control theories and future directions are discussed.

People's ability to inhibit their impulses and initiate behaviors that lead to long-term goal fulfillment is of utmost importance in health, well-being, academia, careers, and relationships (De Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Tangney, Baumeister, & Boone, 2004). Self-control, defined as "the ability to override or change one's inner responses, as well as to interrupt undesired behavioral tendencies (such as impulses) and refrain from acting on them" (Hofmann, Luhmann, Fisher, Vohs, & Baumeister, 2014, p.1), is what makes us study instead of lie on the sofa, helps us choose an apple over chocolate, and keeps us from cheating on our loved ones. As such, understanding the mechanisms of self-control is not only of great scientific value, but also of invaluable societal and personal importance.

Although ample research has focused on self-control over the past two decades, one aspect of self-control remains relatively unexplored: Most self-control research focuses on how and why people *fail* at self-control, but self-control *success* has been an empirical blind spot. Although scholars agree that self-control is pivotal in many aspects of human adaptation (De Ridder et al., 2012; Mischel, Cantor, & Feldman, 1996; Rothbaum, Weisz, & Snyder, 1982; Tangney et al., 2004; Vohs & Baumeister, 2004), they also agree that self-control is difficult and exhausting, and that people have a limited resource for exerting self-control (Baumeister, 2002; Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, Vohs, & Tice, 2007; Vohs & Heatherton, 2000). This means that it is not only difficult to resist temptations like having a dessert in a restaurant, but also that doing so weakens our ability to exert self-control in subsequent instances, such as going to bed at an appropriate time after returning home from the restaurant, instead of watching another *Game of Thrones* episode (Baumeister, Heatherton, & Tice, 1994, Baumeister et al., 1998; Baumeister, Gailliot, & Tice, 2009; Baumeister & Heatherton, 1996; Hagger, Wood, Stiff, & Chatzisarantis, 2010; Muraven & Baumeister, 2000).

This perspective is dominated by the conceptualization of self-control as effortful inhibition of impulses, and its inevitable conclusion would be that self-control success is rare. However,

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such a perspective seems at odds with the fact that most people are actually quite successful in the self-control-related areas of health and well-being behavior, academic and work success, and interpersonal relationships, implying that people's self-control successes are at least as equally prevalent as self-control failures (Gillebaart & De Ridder, 2015). Thus, there must be more to self-control besides the effortful inhibition of impulses. A better understanding of what constitutes self-control success would not only foster insight into the concept of self-control, but would also aid the development of interventions for improving self-control. To start filling this gap in the literature, the current research will focus on dynamics of response conflict as a key component in self-control.

Trait Self-Control and Self-Control Success

Although self-control ability can fluctuate over time (state self-control), it is also considered a part of personality that is stable within one individual. It is actually this trait, rather than state self-control, that predicts behavioral outcomes such as health and well-being (De Ridder et al., 2012; Mischel et al., 1996; Tangney et al., 2004). Trait self-control therefore forms a natural avenue for investigating successful self-control. People who benefit from high trait self-control are by definition able to exert self-control at more than one subsequent moment in time. However, how successful self-control is achieved remains unclear. For instance, although high trait self-control is related to a number of positive life outcomes (Tangney et al., 2004) and predictive of self-control behavior (Schmeichel & Zell, 2007), there is also preliminary evidence suggesting that people with high trait self-control are actually worse at resolving tempting situations due to the fact that they tend to avoid potential self-control dilemmas to begin with (Imhoff, Schmidt, & Gerstenberg, 2014). As such, the mechanics of trait self-control remain at least controversial.

An inherent part of self-control is coping with the competing behavioral tendencies that are central to self-control dilemmas (Carver, 2005; Fishbach & Shen, 2014; Friese, Hofmann, & Wiers, 2011; Hofmann, Friese, & Strack, 2009; Myrseth & Fishbach, 2009; Strack & Deutsch, 2004). For instance, when people encounter a cake, their initial response may be both positive (tasty), making them want to approach the cake and eat it, as well as negative (fattening), making them want to avoid the cake. Such opposing evaluations give rise to a response conflict, of which the magnitude increases with the strength of the competing impulses. Because ultimately only one response can be given, one of the competing tendencies needs to be inhibited to reduce its interference with the final response (e.g., Logan, 1980; Stroop, 1935). Conceivably, this is more effortful when the competing tendencies are both strong, compared to weak (e.g., Bargh, Chaiken, Govender, & Pratto, 1992), making response conflicts of a larger magnitude harder to resolve.

The observations that people with high trait self-control are more successful at achieving their long-term goals (Tangney et al., 2004), and have more adaptive habits for doing so (De Ridder et al., 2012; Adriaanse, Kroese, Gillebaart, & De Ridder, 2014), suggest that these people are able to successfully overcome their response conflicts by inhibiting the impulse to engage in behavior that is nonconducive to their goals, possibly by making use of automatized strategies, like habits. This would suggest that when confronted with temptations, individuals high in trait self-control have response conflicts that unfold and are resolved differently compared to individuals low in self-control. Such a finding would further our understanding of the success of high self-control people. So far, however, the differences in dealing with response conflicts between individuals high and low trait control have not been systematically addressed. Thus, the aim of the current research is to investigate whether and how response conflict differs as a function of trait self-control.

Current Studies

In two studies, we investigated the associations between trait self-control and response conflict regulation. Differences in the regulation of response conflict between people high and low in trait self-control can lie in the *magnitude* of the response conflict, or in how the *process* of the response conflict evolves from emergence to resolution. The magnitude of the response conflict is important because a larger response conflict would be harder to solve (Bargh et al., 1992; MacLeod, 1991), requiring more self-control and reducing chances of self-control success. Thus, smaller response conflicts for people high in trait self-control would grant them the possibility to overcome this conflict relatively easily. Indeed, initial findings from self-report diary studies demonstrated that the magnitude of desire for temptation is generally lower for people with high trait self-control (Hofmann, Baumeister, Förster, & Vohs, 2012), which implies a smaller response conflict. However, direct evidence on the effect of trait self-control on the extent of response conflict is hitherto still absent.

Trait self-control could also be associated with differences in the response conflict *process*, which refers to the temporal unfolding of the response conflict. One way by which people high in trait self-control might successfully exert self-control is by more efficient down-regulation of emerging response conflict (Gillebaart & De Ridder, 2015). The finding that people with high trait self-control self-report less desire for temptations (Hofmann et al., 2012) may in fact reflect better or faster down-regulation of response conflict stemming from these temptations, rather than a smaller response conflict from the beginning. The emerging self-control conflict for people high and low in trait self-control may actually be similar, but the end result may differ due to regulation strategies taking place between the start of the response conflict and reporting on it.

Response conflict magnitude and process can be assessed several ways. First, because response conflict is the product of

the strength and similarity of opposing evaluations, it can be calculated from self-reported positive and negative evaluations about the object or situation (e.g., Thompson, Zanna, & Griffin, 1995). Second, because response conflict is accompanied by the subjective experience of conflict, it can also be assessed directly by simply asking people the degree to which they feel conflicted (cf. Priester & Petty, 1996). However, the response conflict that people can self-report represents only *the outcome* of the response conflict. Between emergence and outcome, there is the process of identification and possibly partial resolution of the response conflict (Myrseth & Fishbach, 2009). People often do not have access to these processes to the extent that they can truthfully report on them (e.g., Schwarz, 1999), so more subtle measures are required to assess the response conflict process. In the current studies, we employed self-report questionnaires of response conflict magnitude as well as an implicit measure of response conflict magnitude and process based on ongoing motor movements that serve as a proxy for response conflict (Freeman & Ambady, 2010; Wojnowicz, Ferguson, Dale, & Spivey, 2009).

To evoke response conflict, participants were presented with pictures of food in both studies. It is important to note that response conflict is not restricted to unhealthy food items only. Indeed, the self-control dilemma unhealthy foods represent is quite obvious: There is a long-term goal of health and well-being, and although unhealthy foods are often hedonically pleasing, they are not conducive to the long-term goal (Baumeister et al., 1998; Myrseth & Fishbach, 2009). However, healthy food items can trigger response conflict just as well because healthy foods may serve the long-term goal (e.g., health), but not the short-term goal (e.g., pleasure). In other words, healthy foods are often not considered to be tasty (Raghunathan, Naylor, & Hoyer, 2006), making them unattractive in the short run. Thus, we would expect response conflict to potentially occur for both types of foods, albeit possibly to a smaller extent for healthy foods.

In the first study, we measured trait self-control and explored response conflict magnitude through self-reports on response conflict about the healthy and unhealthy food items. In the second study, trait self-control was again measured, and both response conflict magnitude and process were assessed as it was unfolding. These two studies combined offer new insight into how people high in trait self-control differ from people low in self-control when it comes to response conflict resolution. We present two hypotheses. First, the magnitude hypothesis held that higher trait self-control would be associated with smaller response conflict magnitude for both healthy and unhealthy food items, as reflected by both self-reported response conflict ratings about healthy and unhealthy food items (Study 1) and the implicit assessment of response conflict magnitude in trials in which response conflict is overcome or yielded to (Study 2). Second, the process hypothesis entails that trait self-control would be associated with differences in the response conflict process. More specifically, it was predicted that higher trait self-control would be associated with a faster resolution of the response conflict by categorizing healthy foods as positive and unhealthy foods as negative, which would be indicated by lower response times in a response conflict task (Study 2).

Because we did not have a previous study to rely on for power analyses, in Study 1 we recruited an online sample large enough to detect medium to small effects in our experimental design. For Study 2, the number of participants was determined by scheduled lab time available to the experimenter, but with a set minimum of 100 participants, which again would be enough to detect medium to small effects in our within-subjects design.

STUDY 1: SELF-CONTROL AND SELF-REPORTED RESPONSE CONFLICT MAGNITUDE

In this study, the association between trait self-control and the magnitude of response conflict was assessed. Two aspects of conflict were considered: the *objective* conflict between responses and the degree to which people *experience* conflict. Objective conflict refers to the strength of the positive as well as the negative evaluations with regard to the food item, and the extent to which both are polarized and incongruent (Kaplan, 1972; Thompson et al., 1995). It is important to note that high objective conflict, however, does not always have to translate to high experienced conflict (Priester & Petty, 1996), which refers to actual feelings of "conflictedness." Therefore, both aspects of conflict were taken into account.

Method

Participants and Design. One hundred sixty-five participants were recruited through Mechanical Turk (https://www.mturk.com), an online crowdsourcing platform. Participants had done at least 500 studies before, had been approved at least 97% of the time for those studies (meaning they were rewarded for these studies), and were located in the United States. Participants were rewarded $0.35 for completing the 10–15 minute study. Data from 19 participants were removed due to unfinished surveys or missing/invalid responses, leaving a final sample of 146 participants.

Mean age of the remaining participants was 33.03 years (SD = 10.30 years), ranging from 19 to 63. Of the participants, 59 were female, 83 were male, and 4 participants chose not to disclose their gender. Participants were informed about the purpose of the study and indicated that they consented to participation in the study before starting.

The design of the study consisted of trait self-control being measured as a continuous variable and type of food depicted on the stimulus pictures being manipulated on two levels (healthy vs. unhealthy) within participants.

Materials. Participants were presented with 11 pictures of food, with four depicting unhealthy, attractive foods, such as cheesecake and french fries, and seven depicting healthy foods,

such as vegetables and bread.[1] Pictures were selected from a validated set of stimuli (Van Dillen, Papies, & Hofmann, 2013). Additional piloting in a separate but similar sample ($N = 35$) showed that the unhealthy stimuli ($M = 1.75$, $SD = .51$) were considered to be less healthy than the healthy stimuli ($M = 4.13$, $SD = .32$), $t(34) = 27.92$, $p < .001$, $d = 9.58$, 95% CI [2.21, 2.56]. Presentation order of the food items was randomized.

Trait self-control was assessed via the Brief Self-Control Scale (Tangney et al., 2004), consisting of 13 statements. Participants indicated how much each statement reflected how they typically are on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*very much*). Of these items, nine were reverse coded. When recoded and averaged, a higher score reflects higher trait self-control. A sample item reads, "People would say that I have iron self-discipline." The trait self-control scale proved reliable, with a Cronbach's alpha of .93.

We used two self-report-based measures that assessed people's conflict magnitude. First, because the magnitude of conflict is the result of opposing evaluations and their relative strength, we measured participants' negative (irrespective of positive) and positive (irrespective of negative) evaluations of each food item (Kaplan, 1972). The items read as follows: "*How positive (or negative) are your thoughts about the pictured food?* Please rate each statement based solely on your positive (or negative) thoughts, while ignoring or setting aside for the moment any negative (or positive) thoughts you may have about the pictured food." Ratings were given on a 4-point Likert scale ranging from *Not at all positive (or negative)* to *Very positive (or negative)*. Separate ratings were then subjected to the following formula $((P + N)/2) - | P - N |$ (cf. Thompson et al., 1995), where P refers to the positive evaluation and N to the negative evaluation. As such, this formula takes into account both the degree to which the evaluations are in opposing directions as well as their relative strength, constituting our measure of the magnitude of *objective* conflict between the opposing evaluations. For ease of interpretation, we added 1.5 to each score so that all scores were a positive integer. Thus, participants' scores could range from 1 to 5.5, with higher scores indicating more objective conflict.

Second, we measured the degree to which people actually *experienced* conflict with regard to the food item. To assess this, we adapted a validated scale that takes into account the affective, behavioral, and cognitive aspect of this experience (Priester & Petty, 1996). For each food item, participants were asked how conflicted, mixed, and indecisive they felt on 5-point Likert scales ranging from 1 (*not at all*) to 5 (*maximally*; Cronbach's $\alpha = .97$). A sample item is "Towards the pictured food, I feel . . . No conflict at all/Maximum conflict." Participants' experienced conflict could range from 1 to 5, with higher scores indicating more conflict.

Procedure. When starting the study, participants were first presented with a screen informing them about the study and asking them to consent to participation. Following this, participants were informed that they were going to be presented with several pictures of food and that they were to rate these foods on the rating scales given. Then the 11 stimuli were presented to them in a random order, one by one, accompanied by the self-report measures of conflict. Each item was rated in terms of objective and experienced conflict before continuing to the next item. Afterward, participants were informed they were to answer a set of questions about themselves, before starting on the Brief Self-Control Scale. After finishing this scale, participants were asked about their age, gender, education, and language level, and they were thanked for their participation. Rewards were paid out the same day as participation.

Results

Mean trait self-control was 3.41 ($SD = .66$). Paired t-tests showed that overall, objective response conflict was higher for unhealthy foods ($M = 2.35$, $SD = .89$) than for healthy ($M = 2.04$, $SD = .63$) foods, $t(145) = 4.83$, $p < .001$, $d = .80$, 95% CI [.18, .43], as was experienced response conflict ($M = 1.97$, $SD = .82$ vs. $M = 1.49$, $SD = .57$), $t(145) = 8.07$, $p < .001$, $d = 1.34$, 95% CI [.36, .59]. Unhealthy foods also fostered more polarized evaluations: Participants had stronger positive evaluations about unhealthy foods ($M = 2.89$, $SD = .69$) than about healthy foods ($M = 2.73$, $SD = .57$), $t(145) = -2.31$, $p = .022$, $d = .38$, 95% CI [–.29, –.02]. They also had stronger negative evaluations about unhealthy foods ($M = 1.92$, $SD = .75$) than about healthy foods ($M = 1.60$, $SD = .55$), $t(145) = -5.27$, $p < .001$, $d = .88$, 95% CI [–.44, –.20]. Objective and experienced conflict were significantly positively correlated for healthy foods, $r = .82$, $p < .001$, as well as unhealthy foods, $r = .74$, $p < .001$.

Regression analyses were performed to test the magnitude hypothesis.[2] In line with the first hypothesis, trait self-control significantly predicted objective conflict about healthy foods, $\beta = –.26$, $t = -3.24$, $p = .001$, 95% CI [–.40, –.10], as well as unhealthy foods, $\beta = –.23$, $t = -2.90$, $p = .004$, 95% CI [–.53, –.10], with more self-control predicting less conflict. Trait self-control also predicted experienced conflict for healthy foods, $\beta = –.26$, $t = -3.24$, $p = .001$, 95% CI [–.36, –.09], as well as unhealthy foods, $\beta = –.27$, $t = -3.36$, $p = .001$, 95% CI [–.53, –.14], with higher self-control predicting lower experienced conflict in both cases, which was additional support for the magnitude hypothesis.

Discussion

The hypothesis that the magnitude of response conflict would be smaller for people with high trait self-control was supported: Higher trait self-control predicted smaller self-reported response conflicts about both unhealthy and healthy food items. Findings from Study 1 suggest that the successful self-control exerted by people with high trait self-control may be due to differences in response conflict, and specifically response conflict magnitude. A smaller response conflict would be easier to resolve, and people with high trait self-control may thus be less susceptible to

self-control failure simply because their response conflicts are smaller. However, self-report measures as used in Study 1 only offer insight into the *outcome* of the response conflict, and they do not reveal what happens from encountering the self-control dilemma to the explicit reporting of the magnitude of the response conflict. Importantly, the response conflict *process* might explain the smaller *magnitude* of response conflict that people with high self-control experience. Therefore, in Study 2, we take a closer look at the response conflict process.

STUDY 2: SELF-CONTROL AND RESPONSE CONFLICT PROCESS

Study 1 focused on trait self-control and the magnitude of response conflict, assessed by self-reports. Study 2 aimed to extend these findings by assessing the process of response conflict as well as assessing magnitude on a more implicit level, by measuring motor movements that reflect response conflict as a function of self-control level. To do so, participants were given a computerized evaluation task in which they categorized healthy and unhealthy food items as positive or negative by moving the computer mouse to one of two response buttons (i.e., positive and negative) in the upper corners of the computer screen. By measuring the trajectory of the computer mouse from the bottom of the screen to the response option, the response conflict between positive and negative for healthy and unhealthy foods can be assessed (Freeman & Ambady, 2010; Wojnowicz et al., 2009). This response conflict is operationalized by the "pull" of the nonselected response option. A perfect nonconflicted response would look like a straight line from the stimulus to the selected response option. A curve of this trajectory away from this straight line, toward the nonselected response option, reflects the degree of the response conflict when the participant feels attracted to the nonselected response option, as well as to the selected response option. Thus, by analyzing the curvature of the mouse trajectories in the categorization task as a function of trait self-control, the magnitude and process of response conflict can be investigated.

Method

Participants. One hundred twenty-two participants (university students) participated in exchange for €3 or course credit. Accidental double entries were excluded from further analyses since their unique contribution could not be determined, resulting in a final sample of 118 participants (68 females, 41 males, 9 unknown). Participants had a mean age of 21.45 years ($SD = 2.65$ years) and a mean body mass index (BMI) of 21.87 ($SD = 2.50$). Participants were informed about the study and indicated that they consented to participation in the study before starting.

Materials. Twenty validated food pictures from Van Dillen et al. (2013) were used as stimuli. The stimuli set was increased compared to Study 1 to improve the power of the study. Of these pictures, nine depicted unhealthy foods like chocolate and chips, and 11 depicted healthy foods like apples and grapes. Trait self-control was measured with the Brief Self-Control Scale (Tangney et al., 2004; Cronbach's $\alpha = .86$; see Study 1 Materials section for details). Additionally, participants' feeling of hunger was assessed prior to the computer portion of the experiment using a single question: "How hungry are you at the moment?" Answers were given on a 5-point scale ranging from 1 (*not hungry*) to 7 (very hungry).

To assess response conflict process and magnitude, participants categorized the 20 food items as negative or positive using the computer mouse. Following five practice trials, participants categorized each food item as negative (left upper corner of the screen) or positive (right upper corner of the screen) by dragging the cursor from the center bottom of the screen to one of the two upper corners of the screen. In a second block, response categories were reversed to positive (left upper corner of the screen) or negative (right upper corner of the screen), and the 20 food items were again categorized. During the categorization task, Mouse Tracker software (Freeman & Ambady, 2010) recorded participants' mouse movements traveling toward the potential responses on the screen. Previous work has shown that mouse trajectories are sensitive to conflict in response to healthy and unhealthy food items (Schneider et al., 2015). To ensure trajectories were capturing participants' actual, ongoing response conflict, participants were encouraged to begin initiating movement early. A message appeared encouraging faster response if the initiation time exceeded 750 milliseconds (Freeman & Ambady, 2011): "It is important to start moving your mouse sooner, even if you are not (entirely) sure of your answer!"

Streaming x and y coordinates of the mouse were recorded with a sampling rate of 70 Hz. Prior to analysis, all trajectories were rescaled into a standard coordinate space (top left: [1, 1.5]; bottom right: [1, 0]). For comparison, all trajectories were horizontally remapped to the alternative option. Time normalization was conducted to control for the different lengths of each recorded trajectory. This resulted in trajectories each containing 101 time-steps and each time-step having a corresponding x and y coordinate.

To assess response conflict magnitude and process, we extracted the following indices from the mouse trajectory data. To quantify magnitude of response conflict, we used both "area under the curve" and "maximum deviation." The area under the curve refers to the geometric area between the actual mouse trajectory and the ideal trajectory: a straight line from the target stimulus to the response. Maximum deviation refers to the largest deviation between the actual trajectory and the ideal trajectory. Area under the curve and maximum deviation both illustrate the spatial attraction of the alternative answer option, and they can thus be interpreted as proxies for the *magnitude* of the response conflict.

Furthermore, to gain insight into the *process* of the response conflict, three reaction time variables are extracted: initiation time, response time, and time of maximum deviation. Initiation

time refers to the time it takes for the participant to start moving his or her mouse once the target stimulus appears on the screen. Response time refers to the time it takes for the participant to move the mouse from the target to the response option, and time of maximum deviation refers to the point in time when the actual trajectory deviates maximally from the ideal trajectory. Finally, mouse-tracking software also records xflips and yflips, which refer to the number of direction reversals along the *x*- and *y*-axis, respectively. Since these are not related to the magnitude or process per se, they are not taken into account in the analyses (for an in-depth discussion of Mouse Tracker data, see Freeman & Ambady, 2010).

On an explicit level, *objective* response conflict was measured as in Study 1 (see Study 1 Materials section for details). *Experienced* conflict for each food item was assessed by a single item: "Concerning the pictured food, I feel. . .." Answers were given on a 5-point scale ranging from 1 (*not at all conflicted*) to 5 (*very much conflicted*). The mean score of all unhealthy food items was used as the indicator of experienced conflict toward unhealthy foods. The mean score of all healthy food items was used as the indicator of experienced conflict toward healthy foods. Overall, higher scores indicated more experienced conflict.

Procedure. Upon arrival in the lab, participants filled out the Brief Self-Control Scale and answered the diet and hunger questions. Following the questionnaire portion, participants directed their attention toward the computer screen, where the categorization task was introduced and started. When the participant was finished with the categorization task, he or she was automatically redirected to an online questionnaire on experienced conflict and objective conflict. Finally, participants filled in their demographics, were thanked for participation, and collected their pay or course credit.

Results

Mean trait self-control was 4.70 ($SD = 1.04$). Paired *t*-tests showed that objective response conflict was higher for unhealthy ($M = 2.83$, $SD = .70$) as compared to healthy ($M = 1.99$, $SD = .41$) food items, $t(108) = 11.31$, $p < .001$, $d = 2.18$, 95% CI [.68, .98]. Experienced conflict was also higher for unhealthy ($M = 2.46$, $SD = .86$) compared to healthy food items ($M = 1.52$, $SD = .52$), $t(108) = 11.49$, $p < .001$, $d = 2.21$, 95% CI [.78, 1.11], mirroring findings from Study 1, as well as previous findings (Schneider et al., 2015). Objective and experienced conflict were significantly positively correlated for healthy foods, $r = .29$, $p = .002$, as well as for unhealthy foods, $r = .56$, $p < .001$.[3] For all four relevant Mouse Tracker outcome variables (area under the curve, maximum deviation, response time, and time of maximum deviation), there was no significant difference between the healthy and unhealthy items (all *p*s > .16).

To test the magnitude hypothesis, regression analyses were conducted with trait self-control as a predictor and the explicit conflict ratings as dependent variables. Trait self-control significantly predicted objective conflict for unhealthy, $\beta = -.24$, $t = -2.51$, $p = .013$, 95% CI [–.29, –.03], as well as healthy food items, $\beta = -.22$, $t = -2.28$, $p = .025$, 95% CI [–.16, –.01]. For both food types, higher trait self-control predicted lower objective conflict, which was in line with the magnitude hypothesis. Also in line with this hypothesis, self-control significantly predicted experienced conflict. Results showed that higher trait self-control was associated with less experienced conflict with unhealthy, $\beta = -.27$, $t = -2.89$, $p = .005$, 95% CI [–.38, –.07], as well as healthy food items, $\beta = -.22$, $t = -2.36$, $p = .020$, 95% CI [–.21, –.02].

The primary aim of this study was to gain insight into the process of overcoming evaluative conflict as a function of self-control. Therefore, we aggregated all trials in which healthy foods were categorized as positive, or in which unhealthy foods were categorized as negative, to obtain an average for trials in which conflict was *overcome*. Trials in which healthy foods were categorized as negative, and trials in which unhealthy foods were categorized as positive, were aggregated into *yield* trials. Area under the curve did not differ for overcome versus yield trials, $t(101) = .04$, $p = .969$, $d = .01$, 95% CI [–.13, .14], nor did maximum deviation, $t(101) = .14$, $p = .89$, $d = .03$, 95% CI [–.05, .05], indicating that these trials yielded conflict of comparable magnitude. However, participants were faster in trials in which conflict was overcome compared to those in which they yielded, $t(101) = -2.91$, $p = .005$, $d = .58$, 95% CI [–179.95, −33.94], and the point of maximum deviation was earlier in time, $t(101) = -2.47$, $p = .02$, $d = .49$, 95% CI [–109.58, −11.85].

To test the hypotheses on self-control and response conflict magnitude, a set of regression analyses was conducted with trait self-control as a predictor and the Mouse Tracker outcome variables for overcome and yield trials as dependent variables.[4] First, trait self-control did not predict area under the curve for overcome, $\beta = .06$, $t = .57$, $p = .57$, 95% CI [–.06, .11], or yield trials, $\beta = .01$, $t = -.13$, $p = .90$, 95% CI [–.13, .12]. Trait self-control could also not predict maximum deviation for overcome, $\beta = .04$, $t = .42$, $p = .68$, 95% CI [–.03, .04], or yield trials ($\beta = -.03$, $t = -.28$, $p = .78$, 95% CI [–.06, .05]. These findings imply that the magnitude of response conflicts in general did not differ as a function of self-control, which was not in line with the magnitude hypothesis.

However, self-control did influence how conflict unfolded over time. More specifically, and in line with the process hypothesis, trait self-control significantly predicted response time for trials in which participants overcame conflict, ($\beta = -.21$, $t = -2.18$, $p = .031$, 95% CI [–127.76, −6.18], meaning that higher trait self-control was associated with faster positive categorization of healthy stimuli and faster negative categorization of unhealthy stimuli. Time of maximum deviation for overcome trials was also significantly predicted by trait self-control, $\beta = -.22$, $t = -2.33$, $p = .022$, 95% CI [–81.46, −6.61], with higher trait self-control predicting earlier occurrence of

maximum conflict. For yield trials in which healthy stimuli were categorized as negative, and unhealthy stimuli as positive, trait self-control did not predict response time, $\beta = -.14$, $t = -1.45$, $p = .15$, 95% CI [–148.76, 23.32] or time of maximum deviation, $\beta = -.16$, $t = -1.63$, $p = .11$, 95% CI [–96.39, 9.52].

Discussion

Findings from Study 2 provide information on the association between trait self-control and response conflict process, as well as a more detailed picture of trait self-control and response conflict magnitude. Self-report results on response conflict magnitude replicate and strengthen findings from Study 1. Higher trait self-control in Study 2 was associated with less objective as well as experienced self-reported conflict, for healthy as well as unhealthy stimuli, which was in line with the magnitude hypothesis. It was also hypothesized that trait self-control would predict differences in magnitude in the mouse trajectory measure. However, mouse trajectory variables reflecting magnitude (area under the curve, time of maximum deviation) did not differ as a function of trait self-control level. This apparent incongruence may be due to the fact that the explicit self-reports of response conflict reflect the *outcome* of the response conflict, whereas the implicit measure captures response conflict *prior* to this outcome while it is unfolding and being resolved. Therefore, they need not be congruent.

Additionally, the response conflict process was assessed by the computer mouse trajectory reaction time variables in the categorization task. People with higher trait self-control overcame the response conflict faster than people with lower trait self-control, which was in line with our process hypothesis. Interestingly, people with higher trait self-control reached a maximum amount of conflict in the overcome trials at an earlier point in the process than people with lower trait self-control. This implies that people with high trait self-control were quicker to identify response conflict, and subsequently solve it, when they overcame these conflicts. Trait self-control did not affect reaction time outcomes for trials in which they "yielded" by categorizing healthy stimuli as negative, and unhealthy stimuli as positive.

GENERAL DISCUSSION

In two studies, we investigated how trait self-control predicted magnitude and process of response conflict. Results from Study 1 showed that people with high trait self-control reported smaller experienced as well as objective conflicts about healthy as well as unhealthy food items. In Study 2, results from the self-reports also indicated that people with high trait self-control reported less objective as well as experienced conflicts for healthy and unhealthy foods, which was in line with findings from Study 1 as well as the hypotheses. Summarizing, these results demonstrate that higher trait self-control is associated with lower explicitly experienced levels of response conflict, in line with the magnitude hypothesis.

Study 2 assessed the effect of trait self-control on the response conflict process from emergence to resolution, including magnitude, for overcome response conflicts as well as conflicts in which participants yielded to an undesirable categorization of healthy foods as negative, and unhealthy foods as negative. Interestingly, trait self-control did not predict differences in the *magnitude* of response conflict in terms of motor movements during the categorization task, which was not in line with the magnitude hypothesis. This may intuitively seem at odds with the self-report findings on smaller response conflict in higher trait self-control in Study 1 and Study 2, but whereas the mouse trajectories reflect the magnitude of the response conflict while it is unfolding, the self-reports only give insight into the *outcome* of that process. In line with the process hypothesis that people with high trait self-control would be quicker to resolve response conflict, higher trait self-control was associated with lower response times in overcome trials, indicating a quicker resolution of the conflict. Thus, these findings combined may mean that although the emerging response conflict is similar in magnitude for people with high and low trait self-control, people with high trait self-control reach a resolution of this conflict sooner, leading to lower self-reported outcome levels of response conflict with higher trait self-control.

From the combined study results, it can be concluded that although a similar magnitude of conflict is evoked by food items in people with high and low trait self-control, people with higher trait self-control solve these response conflicts faster than people with lower trait self-control. The eventually experienced response conflicts are, presumably as a result from this faster resolution, smaller for people with high trait self-control as compared to people with low trait self-control. This holds for healthy as well as unhealthy foods. Unhealthy foods are the usual suspects when talking about self-control dilemmas and response conflict: They are a prime candidate for the conflict between a long-term goal (health) and a short-term goal (enjoyment). As such, one may wonder why there are also differences in response conflict about healthy foods as a function of self-control. However, healthy items can elicit response conflict in the sense that a healthy food item may serve the long-term goal, but not the short-term goal. It may be healthy, but not tasty, or at least not as tasty as the unhealthy options (Raghunathan et al., 2006). This would foster a response conflict, albeit smaller than response conflict about an unhealthy item, as shown by the results of both studies.

Results from Study 2 also suggest by which process people with high trait self-control may reach a faster resolution of response conflict. The finding that higher trait self-control was associated with an earlier time of maximum deviation in overcome response conflict trials (referring to the maximal magnitude of the conflict) could suggest that the quicker resolution of response conflict is due to the quicker *identification* of conflict. Identification of conflict is a necessity when handling response conflict (Myrseth & Fishbach, 2009; Redden & Haws, 2013). The quicker one identifies the conflict, and thus recognizes the need for self-control action, the quicker one would be able to

resolve the conflict. Interestingly, the finding that the actual maximum magnitude of response conflict did not differ as a function of self-control implies that it is not a matter of early intervention before the response conflict grows too big to overcome, but rather may be a matter of efficient down-regulation strategies. Of course, these suggestions need to be corroborated by further research before they can be confirmed.

FUTURE DIRECTIONS

Our findings are in line with the notion of counteractive control. Counteractive control theory posits that temptations, and the response conflicts that arise from these temptations, may actually enable self-control by activating the long-term goal that becomes jeopardized, thereby also activating desirable behavior (Fishbach & Trope, 2005; Kroese, Evers, & De Ridder, 2009; Myrseth, Fishbach, & Trope, 2009; Trope & Fishbach, 2000). In this theory, the response conflict can function as a kind of "alarm bell" for people to activate their long-term goals, since they are at risk of being threatened. In order to use this alarm bell, response conflict needs to be identified first. Thus, counteractive control may take place especially in the early stages of response conflict, when identifying the temptation and the conflict it causes (Myrseth & Fishbach, 2009). Combining our findings on the process of response conflict with the ideas from counteractive control theory, it may be the case that the "alarm bell effect" is stronger in people who are high in trait self-control. This could be because of the earlier occurrence of maximum response conflict ringing the alarm bell, or in the other direction, with the alarm bell leading to a quicker occurrence of maximum response conflict. Future research could investigate this suggestion in order to develop further insight into the different aspects of the response conflict process in people with high and low trait self-control.

The findings reported in this article support the recent developments in the field of self-control processes. Whereas the classic definition of self-control is based on effortful inhibition, and research on self-control traditionally focuses on self-control failure, this perspective seems to be in need of an extension. For instance, recent research has shown that trait self-control actually seems to be associated more with automatic rather than deliberate behaviors (De Ridder et al., 2012), suggesting that people high in trait self-control are in fact good at automatizing behaviors in line with their long-term goals (Adriaanse et al., 2014; Baumeister & Alquist, 2009). The inhibition of impulsive behaviors may in fact be just one way of exerting self-control and reaching long-term goals among many other ways (De Ridder, De Boer, Lugtig, Bakker, & Van Hooft, 2011; Fujita, 2011).

The current research is in line with recent suggestions that there is more to high trait self-control than being good at effortfully resisting temptation (Gillebaart & De Ridder, 2015). People with high trait self-control may benefit from smart, less effortful strategies when facing self-control dilemmas, such as habits and scripts (see also Baumeister & Tierney, 2011), and findings from the current studies may offer some first suggestions for what these strategies may look like, and highlight one way by which people with high trait self-control may be more successful.

Self-control success is not only dependent on the inhibition of "bad" behavior, but is also defined as the initiation of "good" behavior (De Boer, Van Hooft, & Bakker, 2011; De Ridder et al., 2011). The finding that people with high trait self-control report less response conflict about "bad" as well as "good" foods reflects this nicely: Overcoming a response conflict about unhealthy foods would mean refraining from eating them, whereas overcoming a response conflict about healthy foods would mean initiating consumption. These may thus be two different pathways by which people high in trait self-control would be more successful in exerting self-control and subsequently leading healthier lives.

STRENGTHS AND LIMITATIONS

The current research benefits from a two-study setup that assesses response conflict on an outcome as well as a process level, employing explicit and implicit measures. Although it is insightful and interesting to have people self-report on how they experience self-control dilemmas, the added implicit process measure bypasses problems that arise with social desirability and lack of introspective capacity into these kinds of processes. Moreover, the results from implicit measures provide information about the underlying processes that lead to the self-report-based findings, which reflect outcomes rather than processes. Another strength of the current studies is the perspective on self-control as a personality trait. Although there is also a situational component to the construct (state self-control), trait self-control has vast predictive power on all kinds of life outcomes, such as health, well-being, relationship satisfaction, and academic and career success (De Ridder et al., 2012; Hoffman et al., 2013; Tangney et al., 2004). Studying this "natural" type of self-control allows for more ecologically valid conclusions that are more likely to hold outside of laboratory settings.

Of course, the setup of these two studies also carries some limitations that lead us to interpret the findings and conclusions with care. One limitation is caused by the fact that trait self-control is measured via a self-report questionnaire. Although this is an often used and well-validated measure for trait self-control (Duckworth & Kern, 2011; Tangney et al., 2004), predictive of behaviors indicating willpower (Schmeichel & Zell, 2007), future studies on self-control may benefit from an additional behavioral measure to distinguish between the level of self-control that people think and/or report they have, and the actual level of self-control they display. Furthermore, due to this measure rather than manipulation of self-control, causality of the associations between self-control and response conflict cannot be determined. Finally, future studies may want to add a

measure of consumption to get at the behavioral outcome of the response conflict process.

CONCLUSIONS

The current research demonstrated that trait self-control is associated with the way people handle response conflict, a core component of self-control dilemmas. Whereas much research has focused on self-control failure and situational fluctuations of self-control capacity (Baumeister et al., 1994, 1998, 2009; Baumeister & Heatherton, 1996; Hagger, Wood, Stiff, & Chatzisarantis, 2010; Inzlicht & Schmeichel, 2012; Muraven & Baumeister, 2000), this research aimed to gain understanding of the underpinnings of trait self-control and self-control success. Investigating the self-control strategies that people with high trait self-control employ in the face of response conflicts can teach us about successful routes to self-control, a promising avenue for not only self-control theory, but also interventions and training for people who struggle with self-control in their daily lives. By exploring this relatively unknown side of self-control, we further our understanding of this invaluable human capacity and are building a possible framework for future self-control interventions.

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Notes

1. Initial stimuli consisted of three categories (healthy, neutral, and unhealthy), two of which (healthy and neutral) were merged into one category (healthy) after piloting.
2. Confidence intervals are reported on unstandardized regression coefficients (B).
3. On average, participants expressed mild hunger prior to the experiment ($M = 3.73$, $SD = 1.57$). Hunger level was not associated with any of the outcome measures and was therefore not considered further in the main analyses.
4. For all regression analyses, confidence intervals are reported for unstandardized coefficients (B).

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