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Meta-analytic evidence for ambivalence resolution as a key process in effortless self-control

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ABSTRACT

Self-control is a central construct in understanding human behavior and wellbeing, and has a significant impact on outcomes in several areas such as health, wellbeing, academic performance, and interpersonal relationships. However, underlying mechanisms of self-control, and particularly effortless self-control, remain underexposed. Recent work using mouse tracking techniques has shed new light on these issues and found that self-control is related to ambivalence associated with self-control dilemmas, both in magnitude and resolution. Using a meta-analytical approach, the current research examines whether these initial findings, suggesting that the resolution of ambivalent conflicts is a key ingredient of effortless self-control, are robust. Combining two studies from Gillebaart, Schneider, & De Ridder (2016), and five novel studies, we examined whether self-control influenced the magnitude of ambivalence conflicts (magnitude hypothesis) and the process of its resolution (process hypothesis). Self-reports of objective and subjective ambivalence conflicts were combined with a mouse tracking paradigm to tap into these different aspects. Our analyses replicate previous findings and showed a robust small to medium large effect: Higher self-control was associated with less self-reported conflict, faster conflict resolution, and earlier moment of maximum conflict. Notably, on an implicit level, conflicts emerged in equal magnitude regardless of self-control level. Extending previous work, self-control did not only play a role in food-related dilemmas but also in resolving conflict with regards to different societal topics. These results support the notion of ambivalent conflict resolution as an underlying mechanism of effortless self-control and contribute to a new perspective of self-control going beyond effort and inhibition.

1. Introduction

Self-control is a central construct in understanding human behavior and wellbeing. It is the ability to override undesired impulses and initiate desired behavior in the face of temptations. Self-control helps people strive for, and achieve their long-term goals when conflicts between these long-term goals and short-term, often hedonic goals arise (De Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Fujita, 2011; Gillebaart, Schneider, & De Ridder, 2016). It is the force that helps people resist watching another episode of Game of Thrones after having watched five already, or leave behind a warm bed to get up and start the day. Beyond such examples, higher self-control has been related to better quality outcomes in domains as diverse as health (Moffitt et al., 2011), wellbeing (Cheung, Gillebaart, Kroese, & De Ridder, 2014; Hofmann, Luhmann, Fisher, Vohs, & Baumeister, 2014), economic decision-making (Baumeister, 2002), and interpersonal

relationships (Tangney, Baumeister, & Boone, 2004). Reflecting this centrality, research on self-control is at the core of many domains in science, such as psychology, economics, and health and wellbeing.

Despite the widespread attention given to self-control across disciplines, relatively little is known about *how* self-control works. Traditionally, work on self-control has focused mainly on the inhibitory component of self-control (e.g., Hofmann, Friese, & Strack, 2009; Metcalfe & Mischel, 1999; Muraven & Baumeister, 2000). From this view, in the example above, the key aspect would be that the individual is able to inhibit the desire to watch more TV. The theoretical approaches emphasizing the inhibitory component of self-control in general assume that exerting self-control takes effort, and therefore makes individuals prone to failure due to fatigue or depletion in subsequent self-control efforts (Baumeister & Heatherton, 1996; Muraven & Baumeister, 2000). Although this approach has yielded a large body of research examining under what conditions self-control fails, it is

relatively silent on which mechanisms support *successful* self-control.

1.1. Successful self-control

Addressing this gap in self-control research, scholars have begun to turn their attention to the components underlying successful self-control. One of the most central insights from this new approach came from a meta-analysis on self-control, that showed that people high in self-control actually do not exert too much effortful self-control to begin with (De Ridder et al., 2012). Strikingly, in contrast to what research focusing on inhibition and self-control failure so far suggested, there seemed to be such a thing as effortless self-control (Gillebaart & de Ridder, 2015). Specifically, research has identified the role of habits (Adriaanse, Kroese, Gillebaart, & De Ridder, 2014; Galla & Duckworth, 2015), and the early regulation and resolution of ambivalent response conflict (i.e., competing behavioral tendencies) as essential components of effortless self-control. This insight has led to a new perspective on self-control that incorporates the idea that successful self-control relies in part on successfully resolving self-control conflicts, for instance the dilemma between wanting to watch both more and less TV (De Ridder, Kroese, & Gillebaart, 2018; Fujita, 2011; Gillebaart, 2018; Gillebaart et al., 2016). Whereas the resolution of self-control conflicts is important for both effortful and effortless self-control, adaptive conflict resolution (e.g., smaller experienced conflicts, or faster resolution) may be especially important for effortless pathways to self-control success. Providing support for this, recent work has indeed shown that the magnitude of conflicts, and the process of conflict resolution can be considered core components of effortless self-control (Gillebaart et al., 2016). In this paper we set out to replicate this finding, using a meta-analytical approach.

1.2. Self-control and conflict resolution

Many self-control dilemmas constitute a conflict between the positive and negative aspects of a certain behavior. For instance, in the example above, continuous TV watching is positive because it is relaxing and gratifying, while negative because this time could also be used to make progress towards long-term goals (e.g., studying, learning healthy recipes), leading people to feel conflicted about such behaviors. Although intuitively, self-control is often conceptualized as deciding between two different options, such as a cookie and an apple, real-life self-control dilemmas are actually quite often experienced towards a single topic or behavior, for instance having a piece of cake, or not having that piece of cake. Ambivalent conflict arises because these temptations at the same time activate both short term gratification, accompanied by positive evaluations, as well as the long term goals against which the temptation works, which results in negative feelings (Fishbach, Friedman, & Kruglanski, 2003).

Indeed, many of the topics that are at the core of self-control research, such as smoking, exercise, unhealthy food, and alcohol have all been shown to elicit ambivalence (Conner & Sparks, 2002; Prochaska & Velicer, 1997; Schneider et al., 2013; Schneider et al., 2015; Schneider & Schwarz, 2017; Sherman, Rose, Koch, Presson, & Chassin, 2003; Sparks, Conner, James, Shepherd, & Povey, 2001; van Harreveld et al., 2015b; van Harreveld, Nohlen, & Schneider, 2015a). The resolution of such ambivalent conflicts is central to effortless self-control, and eventually, self-control success.

Effortless self-control can potentially work through two conflict resolution mechanisms. First, people high in self-control may simply experience less ambivalent conflict in response to self-control dilemmas. This is the *magnitude* hypothesis: higher self-control is related to the experience of less conflict. Second, people high in self-control may be faster to resolve conflict when it does emerge, the *process* hypothesis. A recent paper (Gillebaart et al., 2016) found first evidence for these hypotheses. People higher in self-control reported less ambivalence towards different healthy and unhealthy food items, providing

support for the magnitude hypothesis. To further examine the magnitude and process hypotheses, the authors used mouse tracking techniques that allow for a temporal examination of the evolution of conflict resolution in real time. In line with the process hypothesis, higher self-control was related to faster resolution of participants' ambivalence towards healthy and unhealthy foods. Interestingly, the magnitude hypothesis was not supported on this implicit level, with conflicts emerging in equal size for different levels of self-control. These findings lay the first stones in the empirical foundation of the notion of effortless self-control by identifying the resolution of conflict as a mechanism for successful self-control.

Here we aim to replicate these findings. Thus, although these results provide support for a novel perspective on self-control success, additional data is necessary to examine their robustness and get a more precise estimate of the effect size. Furthermore, going beyond food related dilemmas, we examine whether self-control can support conflict resolution in other domains.

2. Method

We report meta-analyses of seven studies that have been conducted in our research team on the relationship between self-control and ambivalent conflict resolution. This approach shifts the focus away from *p*-values of individual studies, towards the overall effect size across all studies and allows for small effects to be detected that might not be found in individual studies. Overall, this approach allows us to draw more reliable conclusions than we could draw on the basis of individual studies. For all studies, all measures, manipulations, and exclusions are reported when applicable. All material, data, and analyses scripts can be found here: http://osf.io/tsg4f/.

2.1. Sample

A total of 995 individuals (685 females, 302 males, 8 other/not indicated) participated in seven studies. Their mean age was 24.36 (*SD* = 7.12). Sample size was determined by the number of participants in the included studies. It was not increased after preliminary data analyses. For a description of the sample and materials of each individual study, see Table 1. Details for the two studies from Gillebaart et al. (2016) can be found in that paper, while details from unpublished studies are reported in the Supplemental Materials (Appendix A).

2.2. Self-control

Self-control was measured by the Brief Self-Control Scale (Tangney et al., 2004) in the original English, German (Bertrams & Dickhäuser, 2009) and Dutch (translated by the research team). The self-control scale consists of 13 statements relating to different self-control aspects. An example item is: 'People would say that I have iron self-discipline', answered on a scale from 1 (not at all typically like me) to 5 (very much typically like me). Of the 13 items, 9 are reverse coded. An average score between 1 (low) and 5 (high) indicates level of self-control.

2.3. Ambivalence measures

Ambivalence was assessed in two different ways. First, we measured the structural conflict between positive and negative evaluations, often referred to as *objective ambivalence*. Participants were asked to indicate for each stimulus how positive [negative] they thought each stimulus was on two separate unipolar scales ranging from not at all positive [negative] to very positive [negative] (for range of each scale, see Table 1). Objective ambivalence was then computed according to the following equation: $[(P + N)/2] - |P - N|$ (Thompson, Zanna, & Griffin, 1995), where P and N refer to the positive and negative evaluation, respectively.

We also assessed participants' experience of conflict using a measure

Table 1

Overview of the studies included in the meta-analyses.

Study information			Design and material		Measures		
Index	Study	N	Design	Stimuli	Objective ambivalence[a]	Subjective ambivalence	Mouse-tracking[b]
Study A	Schneider & Mattes (submitted)	247	2 levels (valence: ambivalent vs. univalent) within-subjects	Topics	10-Point scale	10-Point scale, 1 = "completely one-sided reactions", 10 = "completely mixed reactions", item: mixed	MD, MD time, RT
Study B	Gillebaart et al. (2016), Study 2	109	2 levels (type of food: healthy vs. unhealthy) within-subjects	Food	4-Point scale	5-Point scale, 1 = "not at all conflicted", 5 = "very much conflicted", item: conflicted	MD, MD time, RT
Study C	Schneider (2017), unpublished	100	2 (valence: ambivalent vs. univalent) × 2 (presentation mode: picture vs. word) within-subjects	Food	10-Point scale	10-Point scale, 1 = "no conflicting thoughts and feelings at all", 10 = "maximally conflicting thoughts and feelings", item: conflicted	MD, MD time, RT
Study D	Schneider (2017), unpublished	100	2 (valence: ambivalent vs. univalent) × 2 (presentation mode: colored vs. black-and-white picture) within-subjects	Food	10-Point scale	10-point scale, 1 = "no conflicting thoughts and feelings at all", 10 = "maximally conflicting thoughts and feelings", item: conflicted	MD, MD time, RT
Study E	Hohnsbehn (2017), unpublished	154	2 levels (valence: ambivalent vs. univalent) within-subjects	Topics	10-Point scale	10-Point scale, 1 = "do not agree at all", 10 = "completely agree", item: conflicted	MD, MD time, RT
Study F	Gillebaart et al. (2016), Study 1	146	2 levels (type of food: healthy vs. unhealthy) within-subjects	Food	4-Point scale	5-Point scale, 1 = "not at all", 10 = "maximally", items: conflicted, mixed, indecisive	–
Study G	Hohnsbehn (2017), unpublished	152	2 levels (valence: ambivalent vs. univalent) within-subjects	Topics	10-Point scale	10-point scale, 1 = "do not agree at all", 10 = "completely agree", items: conflicted, mixed, indecisive	–

[a] The scale ends were labelled "not at all positive/negative" and "very positive/negative" in all studies.
[b] MD: Maximum Deviation; MD time: Maximum Deviation Time; RT: Response Time.

of *subjective ambivalence*. In each study, we presented participants with an adjusted version of the subjective ambivalence scale (Priester & Petty, 1996). This scale consists of 3 items that assess how conflicted, mixed, and indecisive participants are, resulting in an average subjective ambivalence score. In some studies, we opted to only use a subset of these items (see Table 1 for an overview of which item was used in each study).

2.4. Mouse tracking

In five of seven studies, we used mouse tracking to examine the temporal dynamics of ambivalent conflict resolution with a paradigm successfully used in previous studies. Below we describe the general procedure, which was the same for each study. At the beginning of each trial, participants clicked "start" at the lower center of the computer screen. Subsequently, they were presented with a stimulus and asked to evaluate the stimulus as "positive" or "negative". Response buttons for each option were displayed in the upper left or right corner of the screen. Participants could indicate their response by clicking on each one of these buttons.

On each trial, the *x* and *y* coordinates of the mouse trajectory was recorded with a sampling rate of approximately 70 Hz. For all studies, the recording of the trajectory and the computation of the mouse tracking parameters were done in the *MouseTracker* software package (Freeman & Ambady, 2010). Degree of conflict was assessed by calculating the deviation of the trial's trajectory from a straight line to the

chosen response option, also known as *Maximum Deviation (MD)*. Additionally, we assessed *Maximum Deviation Time (MD Time)*, which is the temporal point at which the conflict (MD) is the largest, before subsiding again. We also recorded response times (see also Table 1).

2.5. Meta-analyses

The meta-analyses were conducted in the statistical software R (R Core Team, 2013) using a random effects model with restricted maximum likelihood estimation implemented in the *metafor* package (Viechtbauer, 2010). In a first step, we computed the correlations between self-control and the ambivalence measures for each study. The ambivalence measures were collapsed across experimental conditions within each study since we were only interested in the relationship between self-control and the overall level of the ambivalence measures between participants. Moreover, earlier studies did not find a difference in the strength of the relationship between self-control and ambivalence measures between ambivalent/unhealthy and univalent/healthy stimuli (e.g. Gillebaart et al., 2016). Next, we applied the inverse-variance method to weigh and aggregate the Fisher-*z*-transformed correlation coefficients across individual studies. Finally, we transformed the aggregated effect size and the corresponding limits of the confidence interval back to *r* to facilitate interpretation.

For exploratory purposes, we also conducted moderator analyses to investigate whether the type of stimuli (food items vs. topics) had an influence on the magnitude of the effect size. For this we dummy coded

the stimulus type factor (0 = food items, 1 = topics) and performed a meta-regression as implemented in the *metafor* package (Viechtbauer, 2010).

3. Results

Before submitting the data to the meta-analyses, we excluded trials that were faster than 300 ms. Next, we excluded trials that were three standard deviations above or below the participant's mean RT. This step of the outlier exclusion was performed separately for each participant because we were ultimately interested in the correlation between self-control and ambivalence, which is computed on the participants' level. In total, across all studies, 1.18% of trials (206 out of 17,528) were excluded from analyses. While the meta-analyses were performed on Fisher-z-transformed correlations, here, we report the correlations transformed back to r for the sake of interpretation. The same applies to the confidence intervals.

3.1. Magnitude hypothesis

The analyses revealed a negative correlation between self-control and ratings of objective ambivalence, $r = -0.14, z = -2.90, p = .004$, 95% CI $[-0.24, -0.05]$, and self-control and ratings of subjective ambivalence, $r = -0.18, z = -4.50, p < .001$, 95% CI $[-0.25, -0.10]$. Higher levels of self-control were associated with lower ambivalence (see Fig. 1). This constitutes a replication of the findings reported in Gillebaart et al. (2016) and support for the magnitude hypothesis that states that higher self-control is related to less conflict. The correlation between self-control and Maximum Deviation was not significant, $r = 0.04, z = 0.64, p = .524$, 95% CI $[-0.09, 0.17]$ (see Fig. 1).

3.2. Process hypothesis

The analyses showed a negative correlation between self-control and response time, $r = -0.11, z = -2.88, p = .004$, 95% CI $[-0.19, -0.04]$ (see Fig. 2), which means that the higher participants were in self-control, the faster they resolved their ambivalence. This confirms earlier findings (Gillebaart et al., 2016) and supports the process hypotheses. Notably, also as found in previous studies, there was a negative correlation between self-control and maximum deviation time, $r = -0.10, z = -2.28, p = .022$, 95% CI $[-0.18, -0.01]$, which means that the higher participants were in self-control, the earlier they reached the point of maximum deviation after which conflict subsided, suggesting a more efficient resolution of conflict (see Fig. 2).

3.3. Moderator analyses

As Fig. 1 shows, the correlation between self-control and maximum deviation differed across the individual studies. For Studies A and E (which featured topics as stimuli), the correlation was negative, for the other studies (which featured food items as stimuli), it was positive. This hints at heterogeneity in the effect sizes (i.e., the correlation coefficients). Indeed, the Q-test for heterogeneity (Hedges & Olkin, 1985) revealed significant differences between the individual correlation coefficients, $Q(df = 4) = 10.94, p = .027$, suggesting that the variance of effect sizes cannot solely be accounted for by sampling error and thus pointing at the existence of moderators. To examine this, we conducted a moderator analysis to see whether there was a systematic difference between the different studies and we tested whether the stimulus type (food stimuli vs. topic stimuli) could account for (part of) the variance in the correlation coefficients for the correlation between self-control and maximum deviation. Indeed, we found that for topics, the correlation coefficient ($r = -0.09$, 95% CI $[-0.19, 0.01]$) was significantly smaller than for food items ($r = 0.15$, 95% CI $[0.03, 0.25]$), $\beta = -0.24, z = -3.08, p = .002$. This indicates that for foods,

the higher participants were in self-control, the larger the maximum deviation they displayed, which was not in line with the magnitude hypothesis. Conversely for topics, the higher participants were in self-control, the smaller the maximum deviation they displayed. Note however, that for topic stimuli, the confidence interval around the correlation coefficient included zero, suggesting that is no statistically significant relationship.

Furthermore, the Q-test for heterogeneity also revealed a significant difference between the correlation coefficients between self-control and objective ambivalence, $Q(df = 6) = 13.83, p = .032$. The moderator analysis showed that the correlation for food items ($r = -0.24$, 95% CI $[-0.33, -0.15]$) was significantly smaller than for topics ($r = -0.03$, 95% CI $[-0.12, 0.05]$), $\beta = 0.22, z = 3.33, p < .001$. This means that the higher participants were in self-control, the lower their levels of objective ambivalence. This relationship was stronger for food stimuli than for topic stimuli. For topics, again, the confidence interval around the correlation coefficient included zero, which suggests that for this stimulus type, the relationship might not reach statistical significance. For all other measures the Q-test for heterogeneity did not show statistically significant results.

3.4. Exploratory analyses

3.4.1. Independence of magnitude and process hypothesis

We repeated the main analyses using semi-partial correlations between self-control and the ambivalence measures. To this end, we controlled for the process measures (response time, maximum deviation time) when testing the magnitude hypothesis, and we controlled for the magnitude measures (objective ambivalence, subjective ambivalence, maximum deviation) when testing the process hypothesis (for a complete report of the analyses and results, see the Supplementary Material). This allowed us to examine whether two independent mechanisms are associated with self-control. Indeed, we found the same pattern of results as presented above when analyzing the semi-partial correlations, albeit with slightly smaller effect sizes. For maximum deviation time, the effect was marginal. However, the fact that the analyses yielded almost the same results for semi-partial correlations suggests that self-control is indeed associated with two independent mechanisms as described in the magnitude and process hypotheses.

3.4.2. Self-control subscales

To investigate whether the effects we found for self-control were driven by one of the subscales of the Brief Self-Control Scale (Maloney, Grawitch, & Barber, 2012), namely impulsivity and restraint, we repeated the analyses for these two facets of self-control. The pattern of results for the two facets was nearly identical to the pattern of results for self-control, indicating that the effects we found for self-control were not driven specifically by either the impulsivity subscale and the restraint subscale (for a complete report of the analyses and results, see the Supplementary Material).

4. General discussion

4.1. Summary of results

The results of our meta-analytic analyses replicate the findings by Gillebaart et al. (2016) and demonstrate a robust small to medium effect size. Individuals with higher levels of self-control resolve conflicts faster than those with lower levels of self-control, potentially due to a more efficient resolution process indicated by an earlier peak of the conflict. As in the original findings, on an implicit level, conflicts do not differ in size as a function of self-control (although exploratory analyses suggest a moderating influence of stimulus type), but self-reports show that people with higher self-control experience less conflict. Taken together, the results demonstrate that the notion of conflict resolution as an underlying mechanism of self-control success seems to be a robust
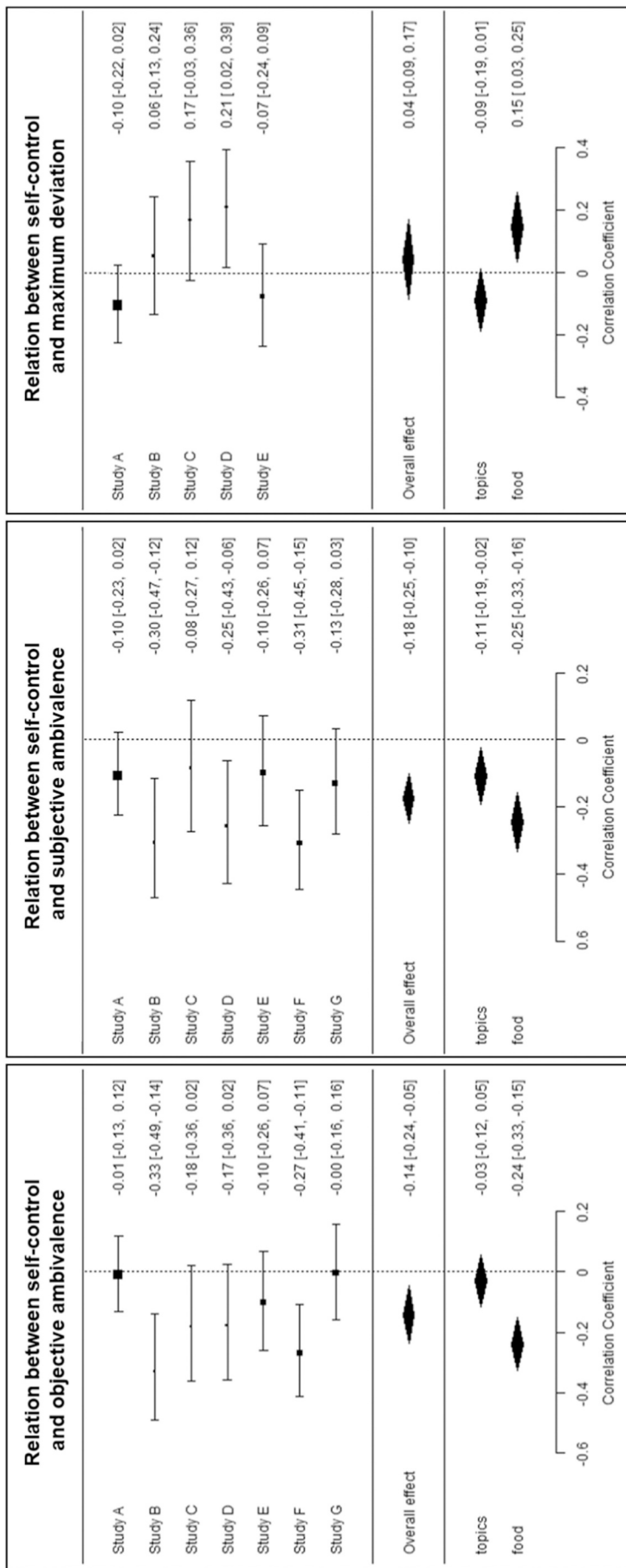
Fig. 1. Relation between self-control and objective ambivalence, subjective ambivalence, and maximum deviation. The squares represent the effect sizes of the individual studies with their respective 95% confidence intervals. The size of the square indicates the weight with which the effect size enters the overall effect size. The diamonds represent the overall effect size across all studies, and across studies using food and topic stimuli respectively. The width of the diamonds represents the 95% confidence interval.
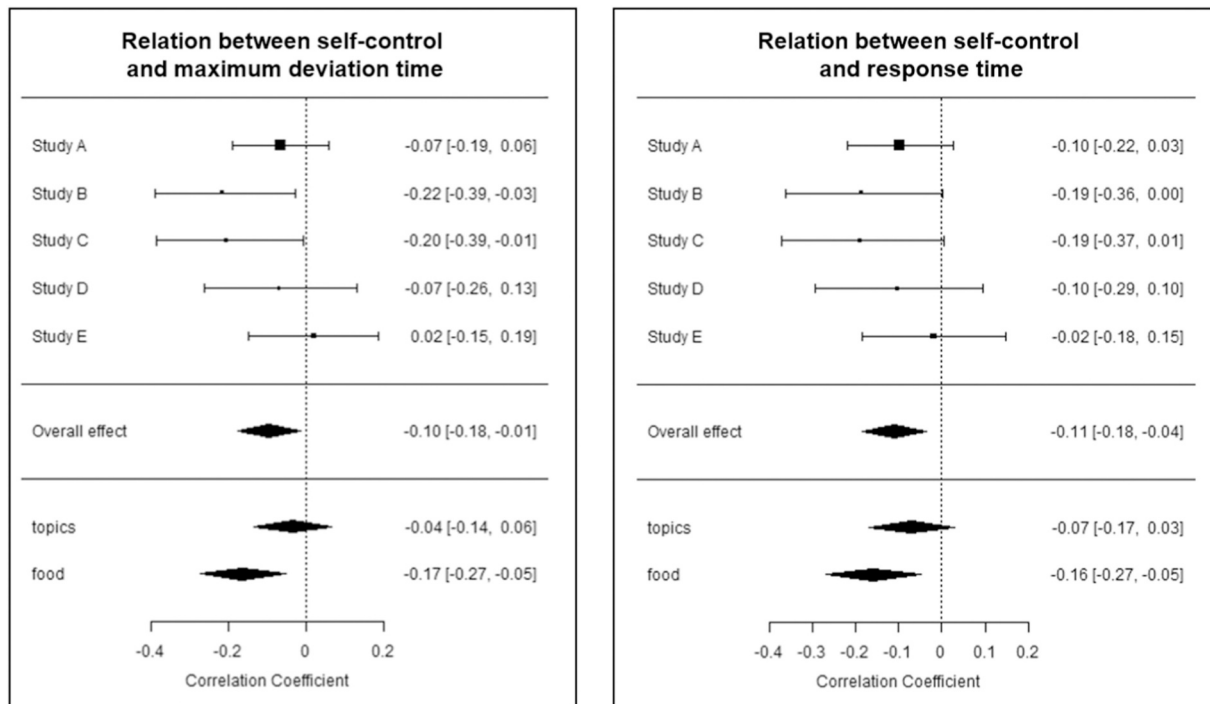
Fig. 2. Relation between self-control and maximum deviation time, and response time. The squares represent the effect sizes of the individual studies with their respective 95% confidence intervals. The size of the square indicates the weight with which the effect size enters the overall effect size. The diamonds represent the overall effect size across all studies, and across studies using food and topic stimuli respectively. The width of the diamonds represents the 95% confidence interval.

one.

Results furthermore demonstrate the importance of combining implicit and explicit measures when assessing ambivalence resolution as a self-control process. Specifically, when looking at the magnitude hypothesis, implicit and explicit measures diverge. This is in line with findings by Gillebaart et al. (2016), and supports the notion that whereas the explicit measure may gauge the outcome of the ambivalence resolution process, implicit measures may be better able to capture the ambivalence resolution process while it is occurring. As people with higher trait self-control tend to be faster to resolve ambivalence, their self-reported experience of this ambivalence may be smaller, whereas the size of conflict can be similar at the beginning of the process.

Our findings fall in line with recent developments in the field of self-control, by supporting a framework focusing on self-control success, its underlying processes, and the notion that these processes may be effortless rather than effortful (De Ridder et al., 2018; Gillebaart & de Ridder, 2015). Moving away from the classic conceptualization of self-control as solely being effortful and focused on inhibition, studies have shown that self-control is linked to automatic behaviors (Adriaanse et al., 2014; De Ridder et al., 2012; Galla & Duckworth, 2015), and have integrated initiatory in addition to inhibitory self-control behaviors (De Ridder et al., 2012). Moreover, effortless and situational strategies have been proposed as pathways to self-control success (Duckworth, Gendler, & Gross, 2016; Ent, Baumeister, & Tice, 2015).

Although advancing the field, these new angles on self-control have also sparked theoretical and terminological debate on what we mean when we talk about self-control. Recently, a suggestion was made to resolve this debate by operationally defining self-control as '…everything that one does to steer one's behavior toward the desired end state' (Gillebaart, 2018). This operational definition allows for distinguishing self-control from the broader concept of self-regulation (defined as the broader set of skills that allows for formulating and setting goals and standards), while at the same time allowing for novel notions of how self-control may work to be integrated. The process of resolving conflict is evidently of importance in self-control, as illustrated by the current

findings, and indeed falls under the operational definition as something that constitutes a change or adjustment in behavior (defined broadly) that makes it more likely form someone to reach their long-term goal (i.e., desired end state).

4.2. Strengths and limitations

The current paper replicates earlier findings (Gillebaart et al., 2016) and shows that the association between self-control and ambivalent conflict resolution is small, but robust. The meta-analytic approach allowed for demonstrating this across studies and stimuli, going beyond single studies of which some were and some were not able to reach significance levels for these associations. The current paper adds not only to a growing body of work that supports a new way of thinking about self-control, but also connects self-control more directly to ambivalence, opening up new research questions in the latter. Indeed, the examination of the relationship between ambivalence and self-control is an emerging field in research on self-control, mixed emotions, and attitudes, that has begun to attract attention over various domains (for instance Berrios, Totterdell, & Kellett, 2018).

The methodology of combining self-report measures of ambivalence and self-control with process tracking measures such as mouse tracking has shown that great tools can lead to theoretical advance. In this case, previous work using this methodology laid bare an interplay between self-reported ambivalent conflict, conflict activation, and resolution (Gillebaart et al., 2016; Schneider et al., 2015). The use of this methodology has shown that individual differences in self-control already exert influence at the conflict activation and resolution phase, potentially leading to downstream self-reported differences.

Another strength of the current research is the conceptualization and operationalization of self-control as a stable personality trait rather than a situational state. Although research has repeatedly shown that it is exactly this personality trait that predicts numerous outcomes in several domains such as health, wellbeing, interpersonal relationships, and academic performance (De Ridder et al., 2012; Duckworth & Seligman, 2005; Tangney et al., 2004), research into the underpinnings

of self-control is often focused on state self-control, a situationally induced, highly malleable form of self-control. By studying self-control in its naturally occurring form, we are able to draw conclusions that have more potential in terms of predictive power, and ecological validity.

We also acknowledge some limitations with regards to the current work. One limitation of the current work is that we examine correlations, and thus cannot make strong claims about causality. However, the nature of the concepts that we examine does hint at what a possible causal direction could be. Specifically, because in our studies we examined self-control as an individual difference, we assume this construct to be rather stable. Ambivalence on the other hand, was elicited in the moment, by the stimuli presented to participants. As such, it makes sense to assume an influence of the more stable construct over the manipulated construct. That is, it is likely that self-control exerted an influence on ambivalence and its resolution, rather than the other way around. Nevertheless, these data cannot support any conclusive claims about the causal direction.

4.3. Future directions

The current work supports previous work that showed the relationship between self-control and the resolution of conflict. It seems likely that this process of conflict resolution functions as a mediator for the effect of self-control on outcomes established in the literature, such as Body Mass Index (Duckworth, Tsukayama, & Geier, 2010) and eating behavior (Adriaanse et al., 2014). However, the current work did not include any behavioral measure of self-control success. An intriguing avenue for future research is to understand whether and how process tracking measures relate to these real life outcomes. For instance, measuring spontaneous conflict towards different foods might be related to weight loss or adherence to exercise programs over time. This approach may also be used in measuring the effect of self-control training intervention to assess at what level such intervention exerts its influence. Furthermore, an important question remaining pertains to the automaticity of the conflict resolution. For instance, does the temporal conflict resolution change with the strength of different habits? Combining habit learning and mouse tracking measures can give insight into what makes self-control more or less effortless.

A new perspective on self-control, building on a broader operational definition, allows for including novel developments in the field that show that automatic processes (e.g., habits) and ambivalence resolution, as well as situational strategies, all play a role in self-control success. Additionally, it creates potential for new empirical questions that will elucidate the underlying mechanisms of this seminal human trait that we call self-control. By meta-analytically supporting first studies into the resolution of ambivalent conflicts as a function of self-control level, the results contribute to this new frontier of self-control research.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jesp.2019.103846.

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