



## The impact of angry rumination on anger-primed cognitive control



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### ABSTRACT

**Background and Objectives:** Recent research suggests that angry rumination augments aggressive behavior by depleting self-control resources. Yet, few studies have been conducted to empirically support this proposal. In the present study, we therefore sought to investigate the effects of angry rumination, relative to distraction, on self-reported anger and a behavioral indicator of self-control.

**Methods:** Seventy-two participants recalled and imagined an anger-inducing autobiographical memory and were instructed to engage in either angry rumination ( $n = 37$ ) or distraction ( $n = 35$ ). Following these emotion regulation instructions, participants performed an affective Go/NoGo task in order to assess behavioral self-control along with several questionnaires to assess anger related constructs.

**Results:** As expected, results revealed that angry rumination augmented anger, whereas anger decreased in the distraction condition. Contrary to predictions, we found no differences between both groups in performance on the affective Go/NoGo task.

**Limitations:** A potential limitation is we instructed our participants on how to regulate their emotions rather than letting angry rumination occur spontaneously.

**Conclusions:** The findings indicate that whereas angry rumination results in heightened anger, it does not seem to result in lower self-control as measured with a behavioral task that requires cognitive control. More research is needed to test the boundary conditions regarding the role of self-control in understanding rumination-induced aggression.

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### 1. Introduction

People differ in how they deal with provoking situations. These differences can to a certain degree be explained by individual differences in cognitive processes. For instance, whereas some individuals easily distract themselves from a provoking event and move on, others keep dwelling and mentally rehearsing upon the provocation and fantasize on how to get back. This dwelling and revenge planning process is known as angry rumination (Sukhodolsky, Golub, & Cromwell, 2001). More narrowly defined, angry rumination refers to “perseverative thinking about a personally meaningful anger-inducing event” (Denson, 2013, p. 1). Angry rumination is typically initiated when there is a discrepancy between one's desired goal and one's actual state (Martin & Tesser,

1996), especially when there is a lack of perceived control over the discrepancy (Wänke & Schmid, 1996). Angry rumination is often considered to be a key factor in explaining trait anger and aggression and can easily be incorporated in the main theories explaining dispositional anger and aggressive behavior (Denson, 2013; Denson, DeWall, & Finkel, 2012; Wilkowski, Robinson, & Troop-Gordon, 2010). Numerous studies have shown that people who ruminate on anger maintain or intensify their angry feelings (Bushman, 2002; Denson, Moulds, & Grisham, 2012; Ray, Wilhelm, & Gross, 2008; Rusting & Nolen-Hoeksema, 1998). Moreover, ample research has shown that both state and trait angry rumination facilitate aggressive behavior (Anestis, Anestis, Selby, & Joiner, 2009; Bushman, 2002; Collins & Bell, 1997; Denson, Pedersen, Friese, Hahm, & Roberts, 2011; Pedersen et al., 2011), including displaced aggression towards innocent victims after a seemingly minor anger-provoking event (Bushman, Bonacci, Pedersen, Vasquez, & Miller, 2005; Denson et al., 2011). Conversely, distracting oneself from ruminating (Konecni, 1974) or distancing

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oneself during ruminating (Mischkowski, Kross, & Bushman, 2012) decreases anger, aggressive thoughts, and aggressive behavior.

Another cognitive factor that takes a central role in main theories on trait anger and reactive aggression is self-control (Denson, DeWall et al., 2012; Denson, 2013; Wilkowski et al., 2010). Self-control refers to “the capacity for altering one’s own responses, especially to bring them into line with standards such as ideals, values, morals, and social expectations, and to support the pursuit of long-term goals” (Baumeister, Vohs, & Tice, 2007, p. 1). A concept closely related to self-control is cognitive control, given that exerting self-control requires cognitive control. Cognitive control refers to the ability to flexibly, voluntarily, and adaptively coordinate behavior in the service of goal-directed behavior, and is underlain by several distinct, but interacting, components, including working memory, attentional control, response inhibition, and error-processing (Luna, Garver, Urban, Lazar, & Sweeney, 2004). Self-control can be both regarded as a temperament based trait (i.e. the capacity to control one’s impulses across time and situations) or as a capacity-limited commodity that can become depleted after repeated use (Baumeister et al., 2007). Both state and trait self-control deficits have been repeatedly related to aggression (DeWall, Baumeister, Stillman, & Gailliot, 2007; Stucke & Baumeister, 2006; Tice & Baumeister, 1993; Wilkowski & Robinson, 2008; Wilkowski et al., 2010). Furthermore, patients with deficits in brain regions related to cognitive control, such as the inferior frontal cortex, often lack the ability to override their angry impulses and more often show aggressive behavior (Blair, 2012; Davidson, 2000; Siever, 2008). Adding further support to the causal relation between self-control and aggression, recent studies have shown that enhancing self-control reduces aggressive behavior (Denson, 2015; Wilkowski, Crowe, & Ferguson, 2015). In sum, both angry rumination and self-control deficits can be considered to be important cognitive risk-factors for anger and aggression.

Several lines of research provide indirect evidence that angry rumination and self-control may be related. Using self-report White and Turner (2014) showed that effortful control, a concept closely related to cognitive control, mediated the association between angry rumination and reactive aggression. Moreover, a recent study that used both self-report and behavioral tasks found that a disposition towards angry rumination was associated with deficient inhibition of related but at that time irrelevant information in long term memory (Whitmer & Banich, 2010). Another study conducted by Whitmer and Banich (2007) failed to find an association between a tendency towards rumination on anger and deficient inhibition in working memory, but did find angry rumination to be associated with difficulties switching to a new task set. Finally, evidence from neuroimaging research shows that higher levels of self-reported angry rumination were associated with heightened activity in regions related to cognitive control, including the (ventro) lateral prefrontal cortex, the dorsal medial prefrontal cortex, and the dorsal anterior cingulate cortex (Denson, Pedersen, Ronquillo, & Nandy, 2009; Ray et al., 2005).

Aside from these empirical studies suggesting that angry rumination and self-control may be related, several researchers have theorized that high self-control mitigates angry rumination (Denson, 2013; Finkel, 2007; Wilkowski & Robinson, 2008, 2010). Interestingly, Denson further proposes that angry rumination may lead to the loss of self-control and subsequent aggression by depleting self-control resources (also see Denson, DeWall et al., 2012; Denson, 2009; DeWall et al., 2007). More specifically, he posits that stopping angry rumination is challenging and depletes self-control resources as it requires individuals to down-regulate the intensity of their anger, to inhibit their angry thoughts, and to inhibit aggressive urges (Denson, 2013; Denson et al., 2011).

Note that this account is based on ego depletion models of self-regulation (Baumeister et al., 2007), in which angry rumination is proposed to consume self-regulatory resources subsequently contributing to self-control failures, such as aggression “in the same manner as refraining from eating a tempting donut” (Denson, 2009; p. 236). In order to answer this “causal question”, experimental studies are needed. To our knowledge, the only direct investigation of the impact of angry rumination on self-control is a series of studies by Denson, Pedersen, Friese, Hahm, and Roberts (2011). In one study, these researchers showed that inducing angry rumination following provocation resulted in higher aggression and lower self-control (as measured via self-report) compared to distraction (2011; study 2), and that the reduction in self-control mediated the association between angry rumination and aggressive behavior. Moreover, another study (2011; study 4) found indirect support by demonstrating that glucose, which supposedly replenishes the ability to exercise self-control (Gailliot et al., 2007), improved performance on a Stroop task relative to placebo following angry rumination but not following distraction.

Our main goal was to extend knowledge on the impact of angry rumination on self-control. In order to do so, we sought to investigate the effects of angry rumination on anger and using a behavioral indicator of a cognitive aspect of self-control. More specifically, we investigated whether angry rumination influenced experienced anger and performance on an anger-primed Go/NoGo task. An affective Go/NoGo task has been repeatedly used as a measure of response inhibition (e.g., Luijten, Littel, & Franken, 2011; Maurer et al., 2015; Munro et al., 2007), which is considered to be an important aspect of both cognitive control (e.g., Luna et al., 2004) and self-control (Muraven & Baumeister, 2000). Based on the work of Denson et al. (2011), we expected lower inhibitory control following angry rumination relative to distraction as evidenced by more commission errors on the Go/NoGo task.<sup>1</sup>

## 2. Materials and methods

### 2.1. Participants

Seventy-three undergraduate psychology students took part in our study in return for course credits or a financial compensation of 10 euros. We randomly assigned the participants to one of two experimental conditions (angry rumination vs distraction), such that approximately equal numbers of men and women were assigned to each condition. One participant was not able to come up with an autobiographical event in which he became very angry and was therefore excluded from our data analyses, leaving a total of 72 participants. Thirty-seven participants (28 women [75.7%];  $M$  age = 19.97,  $SD$  = 1.95) were in the angry rumination condition, and 35 participants (26 women [74.3%];  $M$  age = 20.46,  $SD$  = 2.20) were in the distraction condition. The study was conducted according to the rules of the helsinki declaration on informed consent and confidentiality (World Medical Association, 2001) and all procedures were carried out with adequate understanding and written informed consent of the participants.

### 2.2. Materials and procedure

All participants were tested individually. Upon arrival at the laboratory, participants received general instructions regarding the experiment. Participants were then seated behind the computer

<sup>1</sup> Although hypotheses were derived from the study of Denson et al. (2011), the current study was not intended as a conceptual replication.

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