



Reappraisal (but not distraction) is going to make you sweat: Physiological evidence for self-control effort

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ABSTRACT

Previous studies of emotion regulation suggested that *reappraisal* (construing an emotional event in non-emotional terms) has no cognitive or physiological consequences, but in all these studies, reappraisal was instructed ahead of an emotional situation. The authors' recent work, using behavioral indices, showed that inhibitory self-control resources are challenged when reappraisal starts late during an emotional situation relative to late instruction of *distraction* (diverting attention through producing neutral thoughts). The present study provides converging physiological evidence in showing that instructing to use reappraisal but not distraction late in a sadness inducing film involved increased skin conductance and decreased finger temperature. Both of these results are indicative of increased sympathetic activation that has been previously found to accompany inhibitory self-control effort.

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1. Introduction

Emotion regulation is an important cognitive skill that has substantial implications to one's interpersonal conduct, well being, coping and appropriate functioning in general (see Gross, 1998a, for a review). For this reason, people may be struggling with the question which emotion regulatory strategy would prove most useful in each context. However, providing an answer to such question may not be simple since the same strategy that was proven effective in one context may not be effective in another context.

In the present study we created one such context that poses a substantial challenge to the effectiveness of regulation strategies and as such is likely to involve physiological effort. Specifically, in the following sections we show that previous studies have established that reappraisal—construing an emotional situation in non-emotional terms—has no physiological or cognitive costs (see Gross, 2002; Richards, 2004, for reviews). However, in a recent behavioral study, we showed (Sheppes and Meiran, *in press*) that initiating reappraisal late during a sadness mood induction increased the regulatory challenge, and resulted in the expenditure of inhibitory self-control resources

relative to late distraction (diverting attention away from an emotional situation via producing neutral thoughts. e.g. Nolen-Hoeksema, 1991). In the present study, we sought to provide converging physiological evidence for the increased inhibitory self-control effort that we found for late initiated reappraisal but not for distraction.

1.1. Does reappraisal consume inhibitory self-control resources?

Two lines of evidence have established that reappraisal does not involve an expenditure of inhibitory self-control resources as reflected in behavioral and physiological measures. First, several behavioral studies were inspired by the ego depletion theory, which views self-control as a limited resource which gets depleted when one tries to *inhibit* competing behaviors, urges or desires (see Muraven and Baumeister, 2000, for review). According to this theory, the exertion of self-control appears to depend on a limited resource. Just as a muscle gets tired after performing an effortful action, an initial act of an inhibitory self-control task causes impairments (ego depletion) in the performance of a subsequent self-control task. Applying this logic, it was shown that initiating reappraisal did not result in ego depletion (e.g., Baumeister et al., 2007; Vohs and Schmeichel, 2003).

Second, another study showed that as opposed to the increased inhibitory-related sympathetic activation found in suppression of facial expressions, reappraisal showed a physiological response profile that was not different from that of a control condition (Gross, 1998b).

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The basic argument for reappraisal's lack of inhibitory self-control cost is based on Gross's (1998a) process model of emotion regulation. In that model, reappraisal is considered an antecedent focused emotion regulation strategy, which is initiated early, before emotional response tendencies are fully activated. Such an early initiation diverts the emotional trajectory before the emotional response is fully blown, and hence does not tax self-control resources.

Note that in all of these studies, reappraisal was indeed instructed very early during the emotion generative process (at the mood induction onset), making the inhibitory self-control challenge minimal. Indeed, we agree that in this case, reappraisal is what Gross (1998a, 2001) defines as "an antecedent focused strategy", changing the emotional trajectory early on and consequently at a minimum cost.

However, in a previous work, we showed that not all forms of reappraisal come free of charge. Specifically, we introduced a new form of emotion regulation defined as online regulation—the attempt to change an emotion which starts and continuously operates during an emotional situation (Sheppes and Meiran, 2007). In that study, we tested distraction and reappraisal in two manners. When we tested both strategies as antecedent (initiated at the mood induction onset) we replicated previous findings in showing that reappraisal and distraction were equally effective. However, initiating both strategies late (during the mood induction presumably after the emotion response has sufficiently evolved) revealed that reappraisal was less effective than distraction in down regulating the sad emotion.

In a following study, designed to test the behavioral origin of this effect, we adopted a classical ego depletion procedure. We found that initiating reappraisal late (relative to late distraction), resulted in an expenditure of self-control resources, as reflected in a subsequent increased Stroop interference effect (a task involving inhibition, Sheppes and Meiran, *in press*). We suggested that initiating reappraisal late in an emotional situation may pose a high inhibitory self-control challenge, because it requires overcoming a strong tendency of identifying with the emotional content which had a chance to be well established prior to the late strategy initiation.

Accordingly, applying reappraisal late involves using self-control resources as one has to stop and override the strong previous interpretation when transforming it to a neutral interpretation. By contrast, we showed that late distraction does not involve consuming self-control resources since it entails diverting attention away from the emotional situation and its contents by producing independent neutral contents. This feature of distraction was observed in memory decrements of the emotional situation once distraction was initiated; indicating reduced encoding of the emotional situation (Sheppes and Meiran, 2007, *in press*).

Notice that this inhibitory self-control effort that we found for reappraisal is relatively indirect because we examined the delayed effects of self-control effort (the depletion of self-control resources as seen in subsequent Stroop performance), but did not yet show evidence for self-control challenge as it occurs online. One of the most straightforward ways to examine online processes as they evolve is via physiological measures.

Several researchers argued that the cognitive effort that accompanies self-control demand in general and inhibition/suppression in particular is reflected in increased sympathetic activation, specifically in an increase in skin conductance level (SCL) and also to less extent in a decrease in finger temperature (FT). Below we provide a short review of this topic.

1.2. Inhibition, self-control effort and their relation to increased sympathetic activation

One of the early demonstrations of the relation between SCL and inhibitory self-control effort was obtained by Elliott et al. (1970). These authors found the increase in SCL to be a reliable measure that

positively correlated with increased inhibitory demand in the Stroop task. Two other studies have shown that SCL increased both when participants refrained from telling the truth in a guilty knowledge test (Pennebaker and Chew, 1985), and when participants avoided talking about personal and traumatic events (Pennebaker et al., 1987).

SCL was also measured in studies that examined the inhibitory processes occurring during the suppression of emotional thoughts (e.g., Wegner and Gold, 1995; Wegner et al., 1990). For example, Wegner and Gold (1995) investigated the effects of suppression of thoughts concerning a significant past romantic relationship. Participants had to either express or suppress thoughts regarding a desired past relationship (a high emotional difficult condition) or a no longer desired past relationship (a low emotional easy condition). Results for the expression and suppression groups in the desired relationship condition showed that those who were instructed to suppress their thought had indeed thought less about the desired past relationship but showed increased SCL relative to the group who were instructed to express their thoughts and feelings. Note that there were no SCL differences between express and suppress groups in the non-desired past relationship condition indicating that only taxing suppression results in SCL increase.

In addition, behavioral studies provide converging support for the interpretation that SCL rise observed in thought suppression may denote the expenditure of inhibitory self-control resources. Specifically, it was repeatedly shown that initiating thought suppression consumes self-control resources and leads to ego depletion (see Muraven and Baumeister, 2000, for a review).

Last, several studies measured the physiological profile of expressive suppression, defined as inhibiting ongoing emotion-expressive facial behavior (Gross, 1998b, 2002; Gross and Levenson, 1993, 1997). It was hypothesized that because suppression involves behavioral inhibition it should result in increased sympathetic activation as reflected in the physiological response. The results supported the hypothesis in showing higher SCL and lower FT in films inducing disgust (Gross, 1998b; Gross and Levenson, 1993) and sadness (Gross and Levenson, 1997).

Converging behavioral support for the interpretation that increased sympathetic activation may relate to the expenditure of inhibitory self-control resources in suppression comes from Inzlicht and Gutsell (2007) who have directly shown that expressive suppression depletes self-control resources. Specifically, suppressing one's emotions resulted in subsequent increased Stroop effect relative to a control condition. Last, note again that just like Wegner and Gold (1995), Gross and Levenson (1997) did not find an increase in sympathetic activation when participants suppressed their ongoing facial behavior to a non-emotional neutral film. This last finding indicates that increased sympathetic arousal in suppression is only observed when the inhibitory demand is strong.

1.3. The present study

In the present study, we set out to provide physiological evidence for the differential inhibitory self-control demands associated with online cognitive reappraisal and online distraction. We examined this issue under conditions that presumably challenge inhibitory self-control abilities. To that end, we measured physiological responses associated with the autonomic system while participants were watching a sadness inducing film. According to the online emotion regulation paradigm, participants were randomly assigned to conditions by receiving subtitles containing the core instructions at a late point during this film. This procedure enabled us to measure the strategies' response profiles before and after the strategy initiation. Reappraisal's profile was compared to a control condition in which participants were allowing their feelings to rise, and to late distraction which has not been shown to involve the expenditure of inhibitory self-control resources. Moreover, by showing that online distraction

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