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Empirical Paper

A multimethod assessment to study the relationship between rumination and gender differences

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Rumination is described as the propensity of responding to distress by repetitively and passively focusing on one's negative emotions, and failures, and their consequences (Nolen-Hoeksema, 1991, 1998). Therefore, given that rumination is characterized especially by difficulties in managing and controlling negative emotional states, it is considered as the most common (impaired) emotional regulation strategy, and can be defined as an emotional process related to a repetitive, undesired, and past-oriented negatively inclined thought (Compare, Zarbo, Shonin, Van Gordon, & Marconi, 2014; Smith & Alloy, 2009). Recent evidence suggested that because of problems related to monitoring of negative states, rumination may be associated with exaggerated physiological reactivity relative to demands from the environment, and to some difficulties in attentional control abilities. The current study aimed at deepening our understanding of the role that a maladaptive emotional regulation strategy - such as rumination - might play in physiological response changes and in engaging dysfunctional attentional strategies. We used a multimethod assessment including self-reports (i.e., Rumination and Reflection Questionnaire, and Difficulties in Emotion Regulation Scale), physiological measures, (i.e., Heart Rate Variability recording), and attention tasks (i.e., Stroop Task) in order to examine the multiple aspects of rumination across genders. Sixty-eight individuals (30 males and 38 females) were administered DERS -16, RRQ and, soon after them, the Stroop task. Immediately after completing the Stroop task (T1), participants were exposed to a three-phase, baseline-stress-recovery experimental paradigm while their heart rate variability (HRV) was recorded. After completing the experimental paradigm, Stroop stimuli were presented for the second time (T2), in order to examine possible intra-individual differences between the two performances in the Stroop task. Our findings showed that rumination was higher in females than in males, but in men it appeared to be strongly associated with an overall impaired emotional regulation. However, no gender differences in rumination and emotion dysregulation were found when inspecting physiological data. The current study aims to contribute towards a better understanding which emotion regulation strategies and which physiological mechanisms are associated with rumination.

Key words: Attention, emotional dysregulation, gender, heart rate variability, rumination, vulnerability to stress.

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INTRODUCTION

Rumination represents focused, repetitive thought revolving around past mistakes and failures (see Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Watkins, 2008); it is described as the process of responding to distress by repetitively and passively focusing on one's symptoms and their possible causes and consequences (Nolen-Hoeksema, 1991, 1998). Several previous studies have shown that the tendency to ruminate is a relatively a stable trait and that rumination consists in a cognitive and behavioral expression of neuroticism (Just & Alloy, 1997; Knowles, Tai, Christensen & Bentall, 2005; Nolen-Hoeksema & Morrow, 1993; Nolen-Hoeksema & Davis, 1999; Nolen-Hoeksema, Parker, & Larson, 1994; Roberts, Gilboa, & Gotlib, 1998; Trapnell & Campbell, 1999). Rumination is psychologically distinct from reflection; in fact, reflection provides a summary conception of self-attentiveness motivated by the curiosity, and it is considered as a functional thinking associated to the capacity to learn from the experience alleviating impacts of psychological distress (Colvin, Block, & Funder, 1995; Trapnell & Campbell, 1999). While rumination may be conceived as a dysfunctional emotion regulation strategy, reflection is rather a psychological resource.

Previous literature suggests that rumination can be divided in three main classes of theories which are not mutually exclusive and which try to define the main deficits underlying rumination (van Vugt, van der Velde, & ESM-MERGE Investigators, 2018): (1) the first class proposes that the rumination occurs when people's attention is directed more to the information with a negative valence (Whitmer & Gotlib, 2013); (2) the second class focuses on failures in disengaging from some information (especially when such information is negative and self-focused) as primary deficit underlying rumination (Whitmer & Banich, 2007, 2010); and (3) the third class of theories focuses on those specific negative themes occurring in the repetitive thinking rather than on control processes such as attention and inhibition (Cramer, van Borkulo, Giltay, van der Maas, Kendler, Scheffer, & Borsboom, 2016).

Ruminative thoughts have a central role in the onset and maintenance of multiple forms of psychopathology such as depression, anxiety, eating disorders, and substance abuse problems (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Specifically, during the experience of internalizing symptoms, ruminative thinking seems to occur and interfere with effective coping mechanisms and active problem-solving (Donaldson & Lam, 2004; Jose & Weir, 2013; Lyubomirsky & Nolen-Hoeksema, 1993). Consequently, rumination may not only lead to a stronger and longer period of negative mood (Nolen-Hoeksema, 1991), but it may also end up maintaining the stress that started the negative mood and perhaps even generating new experiences of stress. However, the most part of experimental studies on rumination examined exclusively individuals with current or previous diagnoses of depression or anxiety and considered rumination as a specific trait of these mental disorders.

Rumination, physiological reactivity and vulnerability to stress

As mentioned before, rumination is defined as the most common impaired emotional regulation strategy and, therefore, as an emotional process related to a repetitive, undesired, and pastoriented negatively inclined thought; emotional dysregulation may dysfunctionally manage emotion-related physiological processes (e.g., reactivity of autonomic system, and difficulties in restoring the baseline condition or recovery) especially after experiencing a laboratory induced stress (e.g., Giromini, Ando', Morese, Ando', Morese, Salatino, Di Girolamo, Viglione, & Zennaro, 2016). In fact, recent evidence has suggested that rumination (considered as a form of emotional dysregulation) may be associated with exaggerated physiological changes relative to demands of the stressor (e.g., Brosschot, Gerin, & Thayer, 2006; Stewart, Mazurka, Bond, Wynne-Edwards, & Harkness, 2013). Thayer and Lane (2000) have highlighted interactions between the ruminative thinking and vagal cardiac control - reflected by Heart Rate Variability (HRV) parameters - also suggesting a group of underlying neural networks involved in emotion-cognition relations. An important role plays the central autonomic network (CAN; Thayer, Hansen, Saus-Rose, & Johnsen, 2009) given that it is implicated in making visceromotor, neuroendocrine, and behavioral responses that are adaptive and flexible for coping various environmental demands (brain structures in the CAN are reciprocally related and connected allowing to involve additional structures that are necessary to provide specific behavioral changes; Thayer et al., 2009; Thayer & Lane, 2000). HRV is a marker of cardiovascular reactivity and emotion regulation reflecting the degree to which cardiac activity can be modulated to meet changing situational demands (Reynard, Gevirtz, Berlow, Brown, & Boutelle, 2011). Some research (e.g., Aldao, Mennin, & McLaughlin, 2013; Key, Campbell, Bacon, & Gerin, 2008) has investigated, specifically, the relationship between rumination and HRV, moreover reporting contradictory results (Key et al., 2008; Ottaviani, Shapiro, Davydov, Goldestein, & Millis, 2009). For example, Ottaviani et al. (2009) reported that rumination was associated to low HRV, while Key et al. (2008) showed that there was no relation between ruminative thoughts and HRV baseline. Aldao et al. (2013) examining differences in the functional characteristics of worry and rumination in relation to physiological markers of emotion regulation (i.e., HRV), found that worry was more associated with HRV across emotional contexts than rumination.

The mechanism of ruminative thoughts involving repeated failures in stress management (Cole, Michel, & Teti, 1994) may be strongly associated with an overall arousal and, therefore, an increased cardiovascular reactivity (Brosschot & Thayer, 2003; Gerin, Davidson, Christenfeld, Goyal, & Schwartz, 2006) in response to a stressor (Obrist, Light, James, & Strogatz, 1987). The rumination arousal model described by Gerin and colleagues (2006) aimed to clarify the potential mechanisms through which ruminative thoughts might influence the cardiovascular recovery. This model explained that after administering a stress task, the cognition can lead to experience some negative emotions (e.g., sadness or anxiety), and these negative emotions can increase sympathetic arousal prolonging negative emotions (and viceversa). Differently, other studies reported that the cardiovascular recovery was relatively faster for unemotional tasks compared to emotional tasks (e.g., mental arithmetic with harassment; Bunn, Manor, Wells, Catanzarito, Kincer, & Eschbach, 2017; Linden, Earle, Gerin, & Christenfeld, 1997).

Overall, these aforementioned previous studies reported some ambiguous and contradictory results related to the role that rumination may play in physiological reactivity.

Ruminative thinking and attentional control ability

Rumination has also been associated to attentional biases and overall involuntary engagement strategies linked with more depressive and anxiety symptoms. In fact, coping strategies (both adaptive and maladaptive) may lead to attentional biases at both conscious and below conscious awareness levels; importantly, rumination may strongly impair attention abilities, for example during those tasks requiring efforts in allocating correctly the selective attention (Luecken, Tartaro, & Appelhans, 2004). Previous studies (Lyubomirsky & Tkach, 2003; Lyubomirsky & Nolen-Hoeksema, 1995; Nolen-Hoeksema, 2000) explained that rumination may include a poor concentration and problem-solving failures; in fact, rumination may interfere with problem-solving and task performance and its harmful effects stem from self-focused attention that is negative and judgmental (Rude, Maestas, & Neff, 2004).

Several experimental studies focusing on mental operations related to the attentional control ability identified three separable cognitive functions, which were, however, associated with one another: monitoring and updating of working memory representations, inhibition, and mental set shifting (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). Among these mental operations, those most frequently associated to depression and rumination are inhibition and set shifting; inhibition refers to the ability to effectively hamper the processing of previously relevant or irrelevant distracting information; set shifting function regards to the ability to shift back and forth between multiple tasks and mental operations (e.g., Monsell, 1996). In particular, attention and perception of negative stimuli in dysphoric/clinically depressed individuals with the ruminative thinking seem to be linked with the difficulty in disengaging intrusive thoughts and attention from negative stimuli (e.g., see Joormannn & D'Avanzato, 2010, for a review). Therefore, findings of set shifting involved difficulties in disengaging from depressive cognitions, resulting in repetitive, maladaptive thought patterns (Davis & Nolen-Hoeksema, 2000; Levens, Muhtadie, & Gotlib, 2009). Some studies described a link between rumination in adults and poorer performance on neutral cognitive tasks including switching and mental flexibility (Altamirano, Miyake, & Whitmer, 2010; Davis & Nolen-Hoeksema, 2000; Levens et al., 2009; Whitmer & Banich, 2007).

Gender differences in rumination

People use specific strategies to monitor their emotions, and such strategies may be adaptive or maladaptive (such as rumination; see reviews in Gross & Thompson, 2007). A recent meta-analysis showed that rumination and suppression were correlated with greater symptoms of several disorders (Aldao *et al.*, 2010);

21<mark>6</mark>

32⁷

54<mark>8</mark>

differently, positive reappraisal, problem-solving, and acceptance were negatively related to psychopathologic features. Thoits (1991) observed that women usually adopted both adaptive and maladaptive coping strategies than men did. Tamres, Janicki, and Helgeson (2002) noted that women reported more use of coping strategies because they were experiencing higher stress than men. The authors suggested that gender differences in coping strategies could be the result of gender differences in the stressor appraisal; in fact, they found that women used the coping strategy more than men only in those circumstances in which they evaluated the stressor as more massive than men did. Rogier, Garofalo, and Velotti (2019) reported the presence of the use of cognitive reappraisal and expressive suppression in women; also, the authors tested interaction effects between reappraisal and suppression strategies on psychopathological diseases and aggression measures, founding significant interaction effects among men and only on aggressive measures. A limitation shared by the most part of previous studies was not to investigate whether there were gender differences in adaptive or maladaptive strategies and their relationships with the psychopathology (Nolen-Hoeksema & Aldao, 2011).

Focusing on rumination as a maladaptive coping strategy, we observed ambiguous findings reported by some previous studies on gender differences in rumination. The response styles theory (RST; Nolen-Hoeksema, 1987, 1991), suggested that women were characterized by greater tendency to ruminate on their depressive symptoms and distress than men, leading to greater rates of depression in women; it has been reported that women tended to perceive social events and emotional experiences as more severe and uncontrollable than men, and they often believed they were responsible (of those experiences) which might exacerbate ruminative thoughts (Nolen-Hoeksema & Jackson, 2001).

Hankin (2009), and Hyde, Mezulis, and Abramson (2008) suggested that ruminative thinking interplayed with stressful life events to trigger depression, and this interaction might be stronger for women than men. Also, it has been observed that, traumatic events in women might exacerbate more rumination than men because several experiences were not discussed with others (Shors & Millon, 2016).

A meta-analysis by Johnson and Whisman (2013) reporting results in line with those obtained by another previous study (Rood, Roelofs, Bögels, Nolen-Hoeksema, & Schouten, 2009) found significant differences in rumination between boys and girls in childhood and adolescence, leading to the conclusion that girls would be more likely to ruminate than boys. Overall, most of the literature on rumination reports that women use rumination more frequently than men (thus increasing their depressive symptoms) (Johnson & Whisman, 2013; Nolen-Hoeksema, Morrow, & Fredrickson, 1993; Thayer, Newman, & McClain, 1994) and that the ruminative thinking is associated to self-perception (Conway, Csank, Holm, & Blake, 2000; McEvoy, Mahoney, & Moulds, 2010; Nolen-Hoeksema & Morrow, 1991), physiological responses (Brosschot et al., 2006; Stewart et al., 2013), and cognitive biases (Lyubomirsky & Tkach, 2003; Lyubomirsky & Nolen-Hoeksema, 1995; Nolen-Hoeksema, 2000).

Based on some findings reported above, we can conceptualize rumination as a stable trait of personality with specific dysfunctional features (*diagnostic autonomy*) that we can find in different psychological problems. Furthermore, rumination is shared with its cognitive and behavioral processes by several mental disorders (*trans-diagnostic factor characteristic;* e.g., Dudely, Kuyken, & Padesky, 2011), such as depression and anxiety.

Nowadays: (1) no studies have investigated rumination as a dis-adaptive psychological construct from different points of view (e.g., as a form of emotion dysregulation, and as a form of exaggerate physiological arousal when experiencing stress) by using multimethod assessment; (2) no studies have examined whether there would be any differences in the rumination construct between males and females and whether and at what level (i.e., emotional, physiological, attentional level) rumination would manifest differently in these two groups. Therefore, the main goal of the current study was: (1) to examine those components of the rumination construct that may occur in physiological arousal, emotion dysregulation, and attention biases; (2) to investigate rumination in women and men. We used a multimethod assessment including self-reports, physiological measures, and attention tasks in order to enhance our understanding of the multiple aspects of rumination. We expected that ruminative thoughts would associate, in both genders, with low HRV, attention biases, and emotional dysregulation.

METHOD

Participants

Seventy-one right-handed healthy participants ranging in age from 18 to 40 years were recruited from the Departments of Psychology at the University of ***, (Italy) via an online recruitment system. Prospective participants were screened for exclusion criteria (no history of neurological or psychiatric illness, no smoking) and inclusion criteria (minimum of 18 years of age). Three individuals were excluded from the study due to missing data during the physiological parameters recording. The final sample comprised 68 individuals (30 males and 38 females), ranging in age from 18 to 34 years¹ (M = 22.57; SD = 3.30). Participants gave their written informed consent to participate in this study, which was previously approved by the Institutional Review Board of the University of ***, Italy.

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Measures

Difficulties in emotion regulation scale (DERS; Gratz & Roemer, 2004). The Difficulties in Emotion Regulation Scales is a 36-item self-report questionnaire comprising six subscales developed to detect multiple aspects of emotion dysregulation: (1) non-acceptance of emotional responses (*Non-acceptance*); (2) difficulties in engaging in goal-directed behavior (*Goals*); (3) impulse control difficulties (*Impulse*); (4) lack of emotional awareness (*Awareness*); (5) limited access to emotion regulation strategies (*Strategies*); and (6) Lack of emotional clarity (*Clarity*). Recently, Giromini, Ales, de Campora, Zennaro, and Pignolo (2017) provided equations to calculate age and gender adjusted T-scores, so that clinicians would easily interpret the resultant T-transformed, DERS scores, which have a mean of 50 and standard deviation of 10.

The DERS was adapted for use with Italian populations by Giromini, Velotti, de Campora, Bonalume, and Zavattini (2012). In this study, however, we used a briefer version of it (DERS-16; Bjureberg, Ljótsson, Tull, Hedman, Sahlin, & Lundh, 2016), which in recent research has demonstrated superior psychometric properties compared to the original version (Miguel, Giromini, Colombaroli, Zuanazzi, & Zennaro, 2107). The DERS-16 is comprised of 16 of the 36 original items, and yields five of the six original scales' scores, that is, *Nonacceptance, Goals, Impulse, Strategies*, and *Clarity*. Items in the Nonacceptance scale reflect unwillingness to accept certain emotional

responses (e.g., "When I'm upset, I feel ashamed with myself for feeling that way"); the Goals scale comprises items that gather difficulties in engaging goal-directed cognition and behavior when distressed (e.g., "When I'm upset, I have difficulty getting work done"); the Impulse scale includes items that reflect the difficulty in regulating behavior and distress (e.g., "When I'm upset, I become out of control"); items in the Strategies scale express a lacking access to strategies for feeling better when distressed (e.g., "When I'm upset, I believe there is nothing I can do to make myself feel better"); the Clarity scale includes items able to gather the presence of emotional clarity (e.g., "I have difficulty making sense out of my feelings"). Awareness was not included in DERS-16 because of its dubious validity and reliability (Bardeen, Fergus, & Orcutt, 2012). In Bjureberg *et al.*'s (2016) study, Cronbach's alphas values ranged from 0.92 to 0.95.

Rumination & reflection questionnaire $(RRQ^2; Trapnell \& Campbell, 1999)$. This is a 24-item self-report measure of self-consciousness, divided along the dimensions of positively motivated reflection³ (*Reflection*) and negatively motivated rumination (*Rumination*). Items related to Reflection focus on self-attentiveness motivated by curiosity or epistemic interest in the self (e.g., "My attitudes and feelings about things fascinate me", or "I love analyzing why I do things"); items related to Rumination reflect self-attentiveness motivated by perceived threats, losses, or injustices to the self (e.g., "My attention is often focused on aspect of myself I wish I stop thinking about", or "Often I'm playing back over in my mind how I acted in a past situation"). Items are rated on a five-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Alpha estimates of reliability exceeded 0.90, and the mean interitem correlation exceeded 0.40 for both scales.

For the current study, we used the Italian version adapted by Giromini, Brusadelli, Di Noto, Grasso, and Lang (2015).

Stroop task (for a review, see MacLeod, 1991). This is defined as the difference in color-naming performance between congruent (the word naming its color such as *red* in red, with the former signifying the word and the latter the color) and incongruent (word and color conflict, such as *red* in green) stimuli. The Stroop task is considered to measure sustained selective attention, cognitive flexibility, and processing speed (in fact the reaction time and number of mistakes should increase with fatigue and/or inattention to the task). In our study, we examined the following Stroop variables which are considered the most informative about the level of performance the subject experiences (Williams, Mathews, & MacLeod, 1996): the *reaction time* (in milliseconds), the number of *correct responses*, the number of *errors*, and the number of *omissions*. Stroop stimuli were presented using *Presentation* Software.

Procedures

Initially, participants were met in a quiet room in order to ensure exclusion/exclusion criteria and to obtain written consent. Subsequently, they were administered DERS -16^4 , RRQ⁵ and soon after the Stroop task. Immediately after completing the Stroop task (T1), participants were exposed to a three-phase, baseline-stress-recovery experimental paradigm while their heart rate variability (HRV) was recorded. Specifically, during baseline, they were asked to rest quietly for 7 min. Immediately after this 7 min period, a 3 min stress-inducing task was initiated (stress); this task involved a performance of serial subtraction, namely, the Mental Arithmetic Task (Dickerson & Kemeny, 2004) accompanied by discouraging feedback (sometimes called "harassment") from the experimenter (e.g., "Stop a second - remember to go as fast as you possibly can. Okay, keep going"). This method of inducing stress and anxiety has been widely used in previous social psychophysiological studies (e.g., Earle, Linden, & Weinberg, 1999; Giromini et al., 2016; Kirschbaum, Prüssner, Stone, Federenko, Gaab, & Lintz, 1995), and debriefing after the experiment revealed that none of the participants could tell that these interruptions were staged, and all were feeling angry, frustrated, and/or stressed. Finally, immediately after the stress-inducing task, a 7 min recovery period, in which participants were asked again to 12

rest quietly, was follow. After completing the experimental paradigm, Stroop stimuli were presented for the second time (T2), in order to examine possible intra-individual differences between the two performances in the Stroop task. We chose to adopt a laboratory induced stress in order to enhance negative emotions able to facilitate the mental rumination; indeed, people who perceive negative emotions states because of stressful conditions may report more rumination, which in turn may lead to increases in negative emotions (e.g., Du, Huang, & Xu, 2018; Smith & Alloy, 2009). We created combined Stroop variables (labeled as combined variables) which were calculated subtracting all Stroop variables (i.e., total time, correct responses, errors, omissions) at T1 (before the stress) from T2 (after the stress) in order to evaluate differences in the performance across the two times. Specifically, to investigate some possible effects of stressors on the learning ability, we subtracted from T2 those variables related to T1, in order to evaluate the overall ability to recover after the induced stress (i.e., T2-T1).

HRV measures. HRV measures are derived by estimating the variation among a set of temporally ordered interbeat intervals. In the current study, we decided to focus only on time-domain indices that quantify the amount of variability in measurements of the interbeat interval (IBI), which is the time period between successive heartbeats: standard deviation (SDNN), root mean square of successive differences, (rMSSD), and heart rate (HR); as reported in literature (Reynard, 2011; Shaffer & Ginsberg, 2017; Task Force, 1996), high baseline RMSSD and SDNN values – reflecting primarily vagal influences and a restricted sympathetic activity – are considered as marker of self-regulation.⁶ HRV parameters were recorded by a polygraph (PhysioAmp GP-8e Hardware and GP-8 Physio App Software) with a laptop computer. The GP-8e is a biofeedback system able of measuring a signal up to 100 Hz.

Data analysis

As mentioned above, we expected that ruminative thoughts would associate, in both genders, with low RMSSD and SDNN (i.e., two heart rate variability time-domain indices) with high numbers of errors in the Stroop task (i.e., the task we used for assessing attention problems), and with high scores on DERS (i.e., the tool able to detect the emotional dysregulation). To test these hypotheses, we first computed a mixed ANOVA to test the effects of the laboratory induced stress on HR frequency (within-subject factor), in women versus men (betweensubject factor). Next, we compared the levels of rumination and emotional dysregulation in women versus men via a series of t-tests, and examined the relationship of rumination to RMMSD and SDNN, DERS, and Stroop performance, in both genders, via correlational analyses. Finally, when we tested a 2×2 mixed ANCOVA with Stroop task performance at T1 versus T2 as the within-participants factor (condition) and gender as the between-groups factor, with RRQ and DERS-16 scores as covariates.

RESULTS

The heart rate frequency (HR) was affected by the stress condition⁷ supporting that the stress-inducing task produced similar levels of stress in both genders [F (1,66) = 79.44; p = 0.001; *Partial* $\eta^2 = 0.546$)]; the interaction effect was not statistically significant [(F (1,66) = 0.69; p = 0.504 *Partial* $\eta^2 = 0.010$)]^{8,9} (see Tables 1–3). Scores on Rumination and DERS *Non-acceptance, Strategies* and *Total* scales were respectively, significantly higher in females than in males [t (66) = -2.39; p = 0.020, d = 0.575; t (63.52) = -2.63, p = -0.011, d = 0.628; t (66) = -2.56, p = 0.013, d = 0.634; t (66) = -2.37, p = 0.021, d = 0.578]. Differently, we did not observe statistically significant differences between the two groups in *Reflection* scale, *DERS Goals, Impulse and Clarity scales,* and

Table 1. Heart rate frequency (HR) by gender and condition (n = 68)

Gender & Condition	F (2,68)	р	Partial η^2
Condition	79.44	< 0.001	0.546
Gender	4.41	0.039	0.063
Condition * Gender	0.69	0.504	0.010

Note: Condition = Baseline, Stress, Recovery; Gender = Female group and Male group.

RMSSD and *SDNN* [*t* (66) = -1.86; *p* = 0.067; *d* = 0.44; *t* (66) = -1.18, *p* = 0.242, *d* = 0.285; *t* (66) = -1.04, *p* = 0.301, *d* = 0.254; *t* (66) = -.53, *p* = 0.598, *d* = 0.129; *t* (66) = -.60, *p* = 0.546; *d* = 0.014; *t* (66) = -.28, *p* = 0.784; *d* = 0.077)]¹⁰.

In Tables 4 and 5, we summarized descriptive statistics of RRQ, and correlations of DERS, RMSSD, and SDNN to the Rumination scale; correlations with a medium to large effect sizes¹¹ were found in both male and female groups; specifically, in the female group the Rumination scale significantly correlated to DERS Strategies (r = 0.481; p = 0.002) and DERS Total (r = 0.391; p = 0.015) scales, and produced a negative correlation with a medium effect size with SDNN (r = -0.285; p = 0.083). Interestingly, DERS Clarity and Reflection scale produced a negative significant statistically correlation (r = -0.395; p = 0.014) and, surprisingly, DERS Impulse scale correlated positively to Reflection (r = 0.362, p = 0.026).

Within the male group, the Rumination scale significantly correlated to the DERS Non-acceptance (r = 0.368; p = 0.045), Goals (r = 521, p = 0.003), Strategies (r = 0.437; p = 0.016), Clarity (r = 0.465; p = 0.010), and Total (r = 0.546; p = 0.002) scales.

In the female group, a statistically significant and marginally statistically significant correlations, both with a medium effect size, were obtained between the Rumination scale with combined correct responses and combined errors (r = -0.341; p = 0.036; r = 0.302; p = 0.065; see Table 6). Both in women and in men, we observed a non-significant correlation with a low-to-medium effect size between the Stroop - combined total time and the Rumination scale (i.e., r = 0.203 for females, r = 0.230 for males). Noteworthy, when controlling for the levels of selfreported trait measures of rumination and emotional dysregulation, men and women did not differ from each other on Stroop task performance differences from T1 to T2. Indeed, when we tested a 2×2 mixed ANCOVA with Stroop task performance at T1 versus T2 as the within-participants factor (condition) and gender (group) as the between-groups factor, with RRQ and DERS-16 scores as covariates, the interaction effect between gender and condition was not statistically significant, F(1, 66) = 0.693, p = 0.408. In fact, the only statistically significant result obtained from this ANCOVA consisted of a significant main effect for condition, indicating that the performance at T2 was notably faster than that at T1, F(1, 66) = 14.091, p < 0.001.

DISCUSSION

The current study investigated rumination as a dis-adaptive psychological construct from different points of view: as a form of emotion dysregulation (e.g., Nolen-Hoeksema & Morrow, 1991), as a form of exaggerate physiological arousal when experiencing stress (e.g., Conner-Smith, Compas, Wadsworth, Thomsen, & Saltzman, 2000), and as a form of lacking attention abilities (e.g., Carver, 1979). Below we reported our findings related to rumination construct that may arise from behavioral and psychophysiological alterations, both in males and females.

Rumination and emotion dysregulation

In line with some previous research (e.g., Ciesla, Reilly, Dickson, Emanuel, & Updegraff, 2012; Masedo & Esteve, 2007; Mennin & Fresco, 2013; Mitmansgruber, Beck, Höfer, & Schüßler, 2009; Wegner, Schneider, Carter, & White, 1987), as reported by selfreports, females seemed to be characterized by higher levels of rumination than males, showing (apparently) limited overall ability in managing their emotions, especially those considered as negative.

In fact, scores on the Rumination Scale and DERS scales (i.e., DERS Total, Non-acceptance and Strategies) were respectively, significantly higher in the female group than in the male group, while we did not observe differences in Reflection scale although women showed the tendency to be more introspective/reflective than men did. Indeed, women seemed to not accept negative emotions and, thus, they were more likely to ruminate, that could perpetuate negative emotions: the latter can only be hypothesized because we have not found a statistically significant correlation in women between rumination and the non-acceptance scale but it is worthy, however, that such correlation was characterized by a medium effect size. Also, we may observe in women statistically significant correlations with rumination to an overall emotional dysregulation (i.e., DERS Total), and to a lack of access to strategies for feeling better (i.e., DERS strategies).

Interestingly, focusing on findings reported by the male group, ruminative thinking was strongly associated to all DERS scales: in fact, all correlations between rumination and emotional dysregulation were statistically significant, or with a medium to large effect size. Therefore, we can suppose that when experiencing negative emotions, men were characterized by nonaccepting reactions to one's distress, difficulties remaining in control of one's behavior, poor ability to regulate emotions effectively and limited clarity of their emotions. Generally, we may assume that rumination in men was more associated with the non-acceptance of negative emotions, and it seemed to occur especially when failures and associated negative emotions were not completely accepted; differently women seemed to be less tolerant in experiencing negative emotions to which, however, they do not respond (inevitably) passively through the use of rumination (possibly they react with agitation or active coping (e.g., Rogier et al., 2017).

Overall, there was a positive correlation between DERS total and rumination for both women and men, although stronger in men. However, in women this relationship seemed to be mainly confined to when they express a lack of access to strategies for managing stress and feeling better, while in men it involved additional areas of emotion dysregulation (i.e., DERS nonacceptance, DERS goals, and DERS clarity). 14

Table 2. Pairwise comparisons for condition (n = 68)

				95% Confidence In	terval for Mean
Condition	Condition	Mean differences	Std. error	Lower bound	Upper bound
(Ln) HR Baseline	(Ln) HR Stress	-0.183*	0.017	-0.225	-0.140
	(Ln) HR Recovery	0.008	0.010	-0.015	0.032
(Ln) HR Stress	(Ln) HR Baseline	0.183	0.017	0.140	0.225
	(Ln) HR Recovery	0.191*	0.015	0.154	0.229
(Ln) HR Recovery	(Ln) HR Stress	-0.008	0.010	-0.032	0.015
· · · ·	(Ln) HR Baseline	-0.191*	0.015	-0.229	-0.154

Notes: Conditions = Baseline, Stress, Recovery. Ln = HR data were transformed in natural logarithm (see Nuan et al., 2010; Task Force of The European Society of Cardiology & The North American Society of Pacing & Electrophysiology, 1996). *p < 0.05;

***p* < 0.01.

Table 3. *HR values in females* (n = 38) *and in males* (n = 30) *during the three conditions*

				95% Co Interval Mean	onfidence for
Gender	Condition	Mean	Std. error	Lower bound	Upper bound
Females	(Ln) HR Baseline	4.418	0.031	4.356	4.480
	(Ln) HR Stress	4.604	0.032	4.541	4.668
	(Ln) HR Recovery	4.403	0.026	4.351	4.455
Males	(Ln) HR Baseline	4.327	0.035	4.257	4.398
	(Ln) HR Stress	4.506	0.036	4.435	4.577
	(Ln) HR Recovery	4.323	0.029	4.265	4.381

Table 4. Descriptive Statistics of RRQ (n = 68)

RRQ	Maximum	Minimum	М	SD
Rumination Scale	32	56	44.45	5.88
Reflection Scale	31	58	46.97	6.85
$\mathbf{M} (n = 30)$			2	
Rumination Scale	24	53	40.70	7.10
Reflection Scale	26	57	43.51	8.45

Rumination and physiological reactivity

Furthermore, it was noteworthy that gender differences in rumination and emotion dysregulation did not emerge from physiological data (i.e., RMSSD and SDNN baseline-values); in fact, the two groups showed similar physiological pathways. A possible explanation for this last finding may be that women perceived and described themselves – through self-reports – as more vulnerable to stress and worried but did not appear to be characterized by massive sympathetic reactivity and excessive arousal, if compared to men.

Rumination and attentional bias

In females ruminative thinking was strongly correlated to poor performance in the Stroop task; females reported several errors and few correct responses. In women rumination seemed to be Table 5. Descriptive Statistics and Correlations with DERS and HRV to RRQ (n = 68)

DERS scales & HRV indices	М	SD	Rumination Scale <i>r</i>	Reflection Scale r
$\overline{\mathbf{F}(n=38)}$				
Total	38.76	9.71	0.391*	0.133
Non-acceptance	7.42	3.01	0.262	0.149
Goals	8.94	2.64	0.115	-0.048
Impulse	6.55	2.79	0.281	0.362*
Strategies	11.44	4.11	0.481**	0.148
Clarity	4.39	1.65	-0.037	-0.395*
(Ln) RMSSD (Baseline)	3.56	0.35	-0.049	-0.175
(Ln) SDNN (Baseline)	4.02	0.04	-0.285	-0.021
$\mathbf{M} (n = 30)$				
Total	33.03	10.10	0.546**	0.023
Non-acceptance	5.83	1.93	0.368*	-0.044
Goals	8.13	3.03	0.521**	-0.097
Impulse	5.83	2.86	0.307	0.071
Strategies	9.06	3.35	0.437*	0.079
Clarity	4.16	1.89	465*	-0.237
(Ln) RMSSD (Baseline)	3.50	0.45	0.040	0.084
(Ln) SDNN (Baseline)	3.99	0.37	0.109	0.130

p < 0.05; p < 0.01.

linked to several failures in the Stroop task (showing an impaired "learning process" as reported in differences between the Stroop at T2 and Stroop at T1). However, both in women and in men, we not observed significant associations between the Stroop combined total time and Rumination.

It is worthy that we observed a lack of a gender effect in the ANCOVA on Stroop task performance. We try to assume that this latter result may be related to the possible lack of statistical power required to detect the gender effect given the relatively small sample size.

CONCLUSION

Summarizing, as reported by literature, it is widely believed that men and women differ in their emotional responding (McRae, Ochsner, Mauss, Gabrieli, & Gross, 2008); women are with affective disorders up to twice as frequently as men **p < 0.01.

Table 6.	Descriptive	Statistics and	Correlations	with	combined	Stroop	variables	to RRQ	(n =	68
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Combined Stroop			Rumination Scale	Reflection
Variables	M	SD	r	Scale r
$\mathbf{F}\left(n=38\right)$				
Combined Total Time (msec)	-242057.23	151043.17	0.203	0.025
Combined Correct responses	1.71	4.13	-0.341*	-0.208
Combined Errors	-0.36	2.63	0.302	0.094
Omitted responses combined	-0.97	1.96	0.109	0.275
$\mathbf{M} (n = 30)$				
Combined Total Time (msec)	-236224.33	193862.30	0.230	-0.034
Combined Correct responses	2.23	3.92	0.185	-0.200
Combined Errors	-1.44	3.58	-0.134	0.115
Omitted responses combined	-0.76	1.07	0.123	0.176

(Gater, Tansella, Korten, Tiemen, & Mavreas, 1998;), they are up to three times more likely than men to develop a major depressive disorder in response to a stressful event (Maciejewski, Prigerson, & Mazure, 2001) and show a greater number of severe depressive symptoms than men (Young, Fogg, Scheftner, Keller, & Fawcett, 1990). Women seem to have greater lifetime prevalence of social and specific phobias, anxiety disorders, and comorbid depression and anxiety (Gorman, 2006), and therefore, it could be essential to understand at what level women and men differ in regulating their emotions since many affective disorders are characterized by failures of emotion regulation and many of the empirically validated treatments for these disorders involve training in emotion regulation in general. Specifically, the current study examined if there would be any differences in this multifaceted (ruminative) construct between males and females and whether and at what level (i.e., emotional, physiological, attentive level) it would be manifest differently in the two groups.

The fact that women more often have "social-emotional roles" (e.g., with regard to child care, and being in romantic relations) may imply their tendency to report themselves (so as described by self-reports) like those who experience more intensely and frequently some negative emotions (Fischer, 1993). Also, women are more characterized by stress-related problems due to the role (and its difficulties) they may hold in this modern society. In females the effects of perceived stress on cognitive functioning was probably expressed by a worse performance in the Stroop task if compared to males. But all this does not mean that they are actually characterized by more emotional dysregulation than males: in self-reports, women seemed to describe themselves as more overwhelmed by negative emotions (that they should have managed) perceiving a poor control ability (e.g., "When I am upset, I become out of control" [item 4 on DERS strategy scale]; "When I am upset, I feel like I am weak" [item 4 on DERS non-acceptance scale; "I spend a great deal of time thinking back over my embarrassing or disappointing moments" [item 12 on RRQ rumination scale). Our opinion, therefore, is that the difference between men and women may appear as more pronounced when studies examined the perception of emotions by using only self-report tools.

By using a multimethod assessment, it was possible to observe that women were not characterized by a higher arousal than men and, therefore, the state of *agitation/psycho-physical stress* seemed to be not occurred.

A limitation of previous studies is related to the fact that they did not include a multimethod assessment for examining together psychophysiological correlates, cognitive biases, and emotion regulation strategies associated to the rumination); previous studies on gender differences in rumination included information obtained exclusively by self-report ì; (i.e., Ruminative Responses Scale, Nolen-Hoeksema & Morrow, 1991; Rumination on Sadness Scale, Blake, 2000; Repetitive thinking Questionnaire, McEvoy et al., 2010;) and, thus, related to the conscious awareness/self-schema only (although, in the current study, selfreport measures were able to detect nuanced gender differences in the relationship between rumination and emotion dysregulation that the physiological measures were not able to detect dysregulation). Also, it is worthy that the multimethod approach we used to study rumination from different point of views it is also consistent with the approach of Research Domain Criteria (RDoC) as a research network with the aim of integrating data from different study lines/approaches in order to thoroughly understand the basic dimensions of the psychological functioning underlying the full spectrum of human behaviors (from normal to pathological).

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Final consideration and clinical implications

Observing the findings obtained by the current study, we may therefore formulate important considerations on different depressive or anxious components according to a continuum/ spectrum approach. Some personality disorders or syndromes occur along a continuum starting from "normal" passes through a neurotic and borderline level, up to a level of functioning characterized by serious impairments of the thought and obvious psychotic symptoms. Depression is a condition that can vary, in intensity, from mild to very severe. Individuals may be characterized by states of pervasive rumination resulting in repetition and the feelings of inadequacy raise anxiety, and anxiety interferes with solving the problem. In an attempt to exercise control over what they feel uncertain and about situations that cause anxiety (where the "failure" seems to have serious negative consequences), they find themselves paradoxically in conditions in which both anxiety and erroneous perception increase.

Rumination may assume different forms in women and men. For example, (in our study) in women the aspects related to the non-acceptance of emotions and irritability seem to be more present which also lead to a worse performance in tasks requiring attention and learning ability; differently, in men we find a ruminative and passive thought when negative emotions occur. Such information may be very important for orienting clinicians to a better treatment taking into account how, for example, the depressive-anxious spectrum (e.g., as characterized by massive rumination) can manifest differently in women and men.

Limitations

The most evident limit of our study is the small sample size (although other studies on similar topic included a (relatively) small sample, e.g., Verkuil, Brosschot, & Borkovec, Thaye & Marques, 2015 (n = 60; 41 women); Udo, Bates, Mun, Vaschillo, & Vaschillo, 2009 (n = 21; 16 women); Sollers & Thaier, 1997 (n = 64; 33 females); Giromini *et al.*, 2016; (n = 52; 42 women). Furthermore, this study did not investigate how the age might impact on the ruminative thinking; future studies including larger samples will also better investigate the role that age may play in monitoring emotions and especially the negative ones (e.g., it could be really interesting to examine levels of coping ability and rumination in age ranges).

COMPLIANCE WITH ETHICAL STANDARDS

The manuscript has not been published previously and is not, in whole or in part, under consideration for publication in another journal. No source of support is declared. The authors declare no conflict of interest.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The participants gave their written informed consent to participate in the study, which was approved by the Institutional Review Board of the University of ***, Italy, and for the publication of the current study.

DECLARATIONS OF INTEREST

None.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

NOTES

¹ Both groups did not differ by age [t (66) = 0.215; p = 0.830)].

 2 We chose to use the RRQ as a tool to evaluate rumination – the main construct we aimed to investigate – for the following reasons: (1) using RRQ it is possible to evaluate and distinguish rumination from reflection, and such distinction may have a great potential in terms of clinical implications; (2) the theoretical approach underlying the development of RRQ considers rumination as a form of self-focused attention which can presuppose difficulties in gathering external stimuli that may affect the ability to adapt to different circumstances (Trapnell & Campbell,1999; Nolen-Hoeksema *et al.*, 1994).

³ Reflection is considered as a functional thinking associated to the capacity to learn from the experience identifying key insights and reaching conclusions from which you can benefit in the future (Trapnell & Campbell, 1999).

⁴ Cronbach's alphas for Non-acceptance. = 0.881; Cronbach's alphas for Goals = 0.739; Cronbach's alphas for Impulse = 0.822; Cronbach's alphas for strategies = 0.903; Cronbach's alphas for Clarity = 0.820 [DERS-16]

⁵ Cronbach's alphas for Rumination Scale = 0.804; Cronbach's alphas for Reflection Scale = 0.871[RRQ]

⁶ Self-regulation is considered as the capacity to change or inhibit thoughts, emotions, impulses, or overt behaviors, (Baumeister, Heatherton and Tice, 1994).

⁷ As mentioned before, participants were exposed to a standard threephase, baseline-stress-recovery experimental paradigm while their heart rate frequency was recorded. The physiological data provided the objective support for effectiveness of our stress intervention.

⁸ The main effect of gender was statically significant.

⁹ Partial η^2 effect size: 0.01 (small); 0.06 (*medium*); > 0.14 (*large*).

¹⁰ Cohen's *d* effect size: 0.20 (small); 0.50 (*medium*); 0.80 (large).

¹¹ Effect sizes for Pearson correlation coefficient: 0.10 (small); 0.30 (medium); 0.50 (large).

REFERENCES

- Aldao, A., Mennin, D.S. & McLaughlin, K.A. (2013). Differentiating worry and rumination: Evidence from heart rate variability during spontaneous regulation. *Cognitive Therapy and Research*, 37, 613– 619.
- Aldao, A., Nolen-Hoeksema, S. & Schweizer, S. (2010). Emotionregulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review*, 30, 217–237.
- Altamirano, L.J., Miyake, A. & Whitmer, A.J. (2010). When mental inflexibility facilitates executive control. Beneficial side effects of ruminative tendencies on goal maintenance. *Psychological Science*, 21, 1377–1382.
- Bardeen, J.R., Fergus, T.A. & Orcutt, H.K. (2012). An examination of the latent structure of the Difficulties in Emotion Regulation Scale. *Journal of Psychopathology and Behavioral Assessment*, 34, 382–392.
- Baumeister, R.F., Heatherton, T.F., Tice, D.M. (1994). Losing control: How and why people fail at self-regulation. San Diego, CA: Academic Press.
- Bjureberg, J., Ljótsson, B., Tull, B.M., Hedman, E., Sahlin, H., Lundh, L.G. et al (2016). Development and validation of a brief version of the difficulties in emotion regulation scale: The DERS-16. Journal of Psychopathology and Behavioral Assessment, 38, 284–296.
- Brosschot, J.F., Gerin, W. & Thayer, J.F. (2006). The perseverative cognition hypothesis: A review of worry, prolonged stress-related physiological activation, and health. *Journal of Psychosomatic Research*, 60, 113–124.
- Brosschot, J.F. & Thayer, J.F. (2003). Heart rate response is longer after negative emotions than after positive emotions. *International Journal* of Psychophysiology, 50, 181–187.
- Bunn, J., Manor, J., Wells, E., Catanzarito, B., Kincer, B. & Eschbach, L.C. (2017). Physiological and emotional influence on heart rate recovery after submaximal exercise. *Journal of Human Sport and Exercise*, 12, 349–357.
- Carver, C.S. (1979). A cybernetic model of self-attention processes. Journal of Personality and Social Psychology, 37, 1186–1195.

- Ciesla, J.A., Reilly, L.C., Dickson, K.S., Emanuel, A.S. & Updegraff, J.A. (2012). Dispositional mindfulness moderates the effects of stress among adolescents: Rumination as a mediator. *Journal of Clinical Child & Adolescent Psychology*, 41, 760–770.
- Cole, P.M., Michel, M.K. & Teti, L.O. (1994). The Development of emotion regulation and dysregulation: A clinical perspective. *Monographs of the Society for Research in Child Development*, 59, 73–100.
- Colvin, C.R., Block, J. & Funder, D.C. (1995). Overly positive selfevaluations and personality: Negative implications for mental health. *Journal of Personality and Social Psychology*, 68, 1152–1162.
- Compare, A., Zarbo, C., Shonin, E., Van Gordon, W. & Marconi, C. (2014). Emotional regulation and depression: A potential mediator between heart and mind. *Cardiovascular Psychiatry and Neurology*, 2014, 1–10.
- Conner-Smith, J.K., Compas, B.E., Wadsworth, M.E., Thomsen, A.H. & Saltzman, H. (2000). Responses to stress in adolescence: Measurement of coping and involuntary stress responses. *Journal of Consulting and Clinical Psychology*, 68, 976–992.
- Conway, M., Csank, P.A., Holm, S.L. & Blake, C.K. (2000). On assessing individual differences in rumination on sadness. *Journal of Personality Assessment*, 75, 404–425.
- Cramer, A.O.J., van Borkulo, C.D., Giltay, E.J., van der Maas, H.L.J., Kendler, K.S., Scheffer, M. & Borsboom, D. (2016). Major depression as a complex dynamic system. *PLoS One*, *11*, e0167490.
- Davis, R.N. & Nolen-Hoeksema, S. (2000). Cognitive inflexibility among ruminators and nonruminators. *Cognitive Therapy and Research*, 24, 699–711.
- Donaldson, C. & Lam, D. (2004). Rumination, mood and social problem solving in major depression. *Psychological Medicine*, 34, 1309–1318.
- Du, J., Huang, J., An, Y. & Xu, W. (2018). The relationship between stress and negative emotion: The mediating role of rumination. *Clinical Research and Trials*, 4, 1–5.
- Dudely, R., Kuyken, W. & Padesky, C.A. (2011). Disorder specific and trans-diagnostic case conceptualization. *Clinical Psychology Review*, 31, 213–224.
- Earle, T.L., Linden, W. & Weinberg, J. (1999). Differential effects of harassment on cardiovascular and salivary cortisol stress reactivity and recovery in women and men. *Journal of Psychosomatic Research*, 46, 125–141.
- Fischer, A.H. (1993). Sex differences in emotionality: Fact or stereotype? *Feminism & Psychology*, 3, 303–318.
- Fischer, A.H., Kret, M.E. & Broekens, J. (2018). Gender differences in emotion perception and self-reported emotional intelligence: A test of the emotion sensitivity hypothesis. *PLoS One*, *13*, e0190712
- Gater, R., Tansella, M., Korten, A., Tiemen, B.G., Mavreas, V. *et al* (1998). Sex differences in the prevalence and detection of depressive and anxiety disorders in general health care settings: Report from the World Health Organization collaborative study on psychological problems in general health care. *Archives of General Psychiatry*, 55, 405–413.
- Gerin, W., Davidson, K.W., Christenfeld, N.J.S., Goyal, T. & Schwartz, J.E. (2006). The role of angry rumination and distraction in blood pressure recovery from emotional arousal. *Psychosomatic Medicine*, 68, 64–72.
- Giromini, L., Ales, F., de Campora, G., Zennaro, A. & Pignolo, C. (2017). Developing age and gender adjusted normative reference values for the Difficulties in Emotion Regulation Scale (DERS). *Journal of Psychopathology and Behavioral Assessment*, 39, 705–714.
- Giromini, L., Ando', A., Morese, R., Salatino, A., Di Girolamo, M., Viglione, D.J. & Zennaro, A. (2016). Rorschach Performance Assessment System (R-PAS) and vulnerability to stress: A preliminary study on electrodermal activity during stress. *Psychiatry Research*, 246, 166–172.
- Giromini, L., Brusadelli, E., Di Noto, B., Grasso, R. & Lang, M. (2015). Measuring psychological mindedness: validity, reliability, and relationship with psychopathology of an Italian version of the Balanced Index of Psychological Mindedness. *Psychoanalytic Psychotherapy*, 29, 70–87.

- Giromini, L., Velotti, P., de Campora, G., Bonalume, L. & Zavattini, G.C. (2012). Cultural adaptation of the difficulties in emotion regulation scale: Reliability and validity of an Italian version. *Journal of Clinical Psychology*, 68, 989–1007.
- Gorman, J.M. (2006). Gender differences in depression and response to psychotropic medication. *Gender Medicine*, 3, 93–109.
- Gratz, K.L. & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the Difficulties in Emotion Regulation Scale. Journal of Psychopathology and Behavioral Assessment, 26, 41–54.
- Gross, J.J. & Thompson, R.A. (2011). Emotion regulation: Conceptual foundations. In J.J. Gross (Ed.), *Handbook of emotion regulation*, New York: Guilford Press.

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- Hankin, B.L. (2009). Development of sex differences in depressive and co-occurring anxious symptoms during adolescence: Descriptive trajectories and potential explanations in a multiwave prospective study. *Journal of Clinical Child and Adolescent Psychology*, 38, 460– 472.
- Hyde, J.S., Mezulis, A.H. & Abramson, L.Y. (2008). The ABCs of depression: Integrating affective, biological, and cognitive models to explain the emergence of the gender difference in depression. *Psychological Review*, 115, 291–313.
- Johnson, D.P. & Whisman, M.A. (2013). Gender differences in rumination: A meta-analysis. *Personality and Individual Differences*, 55, 367–374.
- Joorman, J. & D'Avanzato, C. (2010). Emotion regulation in depression: Examining the role of cognitive processes. *Cognition and Emotion*, 24, 913–939.
- Jose, P.E. & Brown, I. (2007). When does the gender difference in rumination begin? Gender and age differences in the use of rumination by adolescents. *Journal of Youth and Adolescence*, 37, 180–192.
- Jose, P.E. & Weir, K.F. (2013). How is anxiety involved in the longitudinal relationship between brooding rumination and depressive symptoms in adolescents? *Journal of Youth and Adolescence*, 42, 1210–1222.
- Just, N. & Alloy, L.B. (1997). The response styles theory of depression: Tests and an extension of the theory. *Journal of Abnormal Psychology*, 106, 221–229.
- Key, B.L., Campbell, T.S., Bacon, S.L. & Gerin, W. (2008). The influence of trait and state rumination on cardiovascular recovery from a negative emotional stressor. *Journal of Behavioral Medicine*, 31, 237–248.
- Kirschbaum, C., Prüssner, J.C., Stone, A.A., Federenko, I., Gaab, J., Lintz, D. et al (1995). Persistent high cortisol responses to repeated psychological stress in a subpopulation of healthy men. *Psychosomatic Medicine*, 57, 468–474.
- Knowles, R., Tai, S., Christensen, I. & Bentall, R. (2010). Coping with depression and vulnerability to mania: A factor analytic study of the Nolen-Hoeksema (1991) Response Styles Questionnaire. *British Journal of Clinical Psychology*, 44, 99–112.
- Levens, S.M., Muhtadie, L. & Gotlib, I.H. (2009). Rumination and impaired resource allocation in depression. *Journal of Abnormal Psychology*, 118, 757–766.
- Linden, W., Earle, T.L., Gerin, W. & Christenfeld, N. (1997). Physiological stress reactivity and recovery: conceptual siblings separated at birth. *Journal of Psychosomatic Research*, 42, 117– 135.
- Luecken, L., Tartaro, J. & Appelhans, B. (2004). Strategic coping responses and attentional biases. *Cognitive Therapy and Research*, 28, 23–37.
- Lyubomirsky, S., Kasri, F. & Zehm, K. (2003). Dysphoric rumination impairs concentration on academic tasks. *Cognitive Therapy and Research*, 27, 309–330.
- Lyubomirsky, S. & Nolen-Hoeksema, S. (1993). Self-perpetuating properties of dysphoric rumination. *Journal of Personality and Social Psychology*, 65, 339–349.
- Lyubomirsky, S. & Nolen-Hoeksema, S. (1995). Effects of self-focused rumination on negative thinking and interpersonal problem solving. *Journal of Personality and Social Psychology*, 69, 176–190.

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- Maciejewski, P.K., Prigerson, H.G. & Mazure, C.M. (2001). Sex differences in event-related risk for major depression. *Psychological Medicine*, 31, 593–604.
- MacLeod, C.M. (1991). Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin*, *109*, 163–203.
- Martin, L. & Tesser, A. (1996). Some ruminative thoughts. In R.S. Wyer (Ed.), Advances in social cognition, 9 (pp. 1–48). Hillsdale, NJ: Lawrence Erlbaum.
- Masedo, A.I. & Esteve, M.R. (2007). Effects of suppression, acceptance and spontaneous coping on pain tolerance, pain intensity and distress. *Behaviour Research and Therapy*, 45, 199–209.
- McEvoy, P.M., Mahoney, A.J. & Moulds, M. (2010). Are worry, rumination, and post-event processing one and the same? Development of the Repetitive Thinking Questionnaire. *Journal of Anxiety Disorders*, 24, 509–519.
- McRae, K., Ochsner, K.N., Mauss, I.B., Gabrieli, J.J.D. & Gross, J.J. (2008). Gender differences in emotion regulation: An fMRI study of cognitive reappraisal. *Group Processes & Intergroup Relations*, 11, 143–162.
- Mennin, D.S. & Fresco, D.M. (2013). What, me worry and ruminate about DSM-5 and RDoC? The importance of targeting negative selfreferential processing. *Clinical Psychology: Science and Practice*, 20, 258–267.
- Miguel, F.K., Giromini, L., Colombaroli, M.S., Zuanazzi, A.C. & Zennaro, A. (2017). A Brazilian investigation of the 36- and 16-item difficulties in emotion regulation scales. *Journal of Clinical Psychology*, 73, 1146–1159.
- Mitmansgruber, H., Beck, T.N., Höfer, S. & Schüßler, G. (2009). When you don't like what you feel: Experiential avoidance, mindfulness and meta-emotion in emotion regulation. *Personality and Individual Differences*, 46, 448–453.
- Miyake, A., Friedman, N.P., Emerson, M.J., Witzki, A.H., Howerter, A. & Wager, T.D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, 41, 49–100.
- Monsell, S. (1996). Control of mental processes. In V. Bruce (Ed.), Unsolved mysteries of the mind: Tutorial essays in cognition (pp. 93– 148). Hove: Erlbaum.
- Nolen-Hoeksema, S. (1987). Sex differences in unipolar depression: Evidence and theory. *Psychological Bulletin*, 101, 259–282.
- Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology*, 100, 569–582.
- Nolen-Hoeksema, S. (1998). The other end of the continuum: The costs of rumination. *Psychological Inquiry*, 9, 216–219.
- Nolen-Hoeksema, S. (2000). The role of rumination in depressive disorders and mixed anxiety/depressive symptoms. *Journal of Abnormal Psychology*, 109, 504–511.
- Nolen-Hoeksema, S. & Davis, C.G. (1999). "Thanks for sharing that": Ruminators and their social support networks. *Journal of Personality* and Social Psychology, 77, 801–814.
- Nolen-Hoeksema, S. & Morrow, J. (1991). A prospective study of depression and posttraumatic stress symptoms after a natural disaster: The 1989 Loma Prieta Earthquake. *Journal of Personality and Social Psychology*, *61*, 115–121.
- Nolen-Hoeksema, S. & Morrow, J. (1993). Effects of rumination and distraction on naturally occurring depressed mood. *Cognition and Emotion*, 7, 561–570.
- Nolen-Hoeksema, S., Morrow, J. & Fredrickson, B.L. (1993). Response styles and the duration of episodes of depressed mood. *Journal of Abnormal Psychology*, 102, 20–28.
- Nolen-Hoeksema, S., Parker, L.E. & Larson, J. (1994). Ruminative coping with depressed mood following loss. *Journal of Personality and Social Psychology*, 67, 92–104.
- Nolen-Hoeksema, S., Wisco, B.E. & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science*, 3, 400–424.
- Obrist, P.A., Light, K.C., James, S.A. & Strogatz, D.S. (1987). Cardiovascular responses to stress: I. Measures of myocardial response and relationship to high resting systolic pressure and parental hypertension. *Psychophysiology*, 24, 65–78.

- Ottaviani, C., Shapiro, D., Davydov, D.M., Goldestein, I.B. & Millis, P.J. (2009). The autonomic phenotype of rumination. *International Journal* of Psychophysiology, 72, 267–275.
- Reynard, A., Gevirtz, R., Berlow, R., Brown, M. & Boutelle, K. (2011). Heart rate variability as a marker of self-regulation. *Applied Psychophysiology and Biofeedback*, 36, 209–215.
- Roberts, J.E., Gilboa, E. & Gotlib, I.H. (1998). Ruminative response style and vulnerability to episodes of dysphoria: Gender, neuroticism, and episode duration. *Cognitive Therapy and Research*, 22, 401–423.
- Rogier, G., Garofalo, C. & Velotti, P. (2019). Is emotional suppression always bad? A matter of flexibility and gender differences. *Current Psychology*, 38, 411–420.
- Rood, L., Roelofs, J., Bögels, S.M., Nolen-Hoeksema, S. & Schouten, E. (2009). The influence of emotion-focused rumination and distraction on depressive symptoms in non-clinical youth: A meta-analytic review. *Clinical Psychology Review*, 29, 607–616.
- Rude, S.S., Maestas, K.L. & Neff, K. (2004). Paying attention to distress: What's wrong with rumination? *Cognition and Emotion*, 21, 843–864.
- Shaffer, F. & Ginsberg, J.P. (2017). An overview of Heart Rate Variability metrics and norms. *Frontiers in Public Health*, 5, 1–17.
- Shors, T.J. & Millon, E.M. (2016). Sexual trauma and the female brain. Frontiers in Neuroendocrinology, 41, 87–98.
- Smith, J.M. & Alloy, L.B. (2009). A roadmap to rumination: A review of the definition, assessment, and conceptualization of this multifaceted construct. *Clinical Psychology Review*, 29, 116–128.
- Sollers, J. & Thaier, J.F. (1997). Effects of activity and gender on autonomic control of the heart and emotional processing. ProQuest Dissertations Publishing.
- Stewart, J.G., Mazurka, R., Bond, L., Wynne-Edwards, K.E. & Harkness, K.L. (2013). Rumination and impaired cortisol recovery following a social stressor in adolescent depression. *Journal of Abnormal Child Psychology*, 41, 1015–1026.
- Tamres, L.K., Janicki, D. & Helgeson, V.S. (2002). Sex differences in coping behavior: A meta-analytic review and an examination of relative coping. *Personality and Social Psychology Review*, 6, 2–30.
- Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (1996). Heart rate variability, Standards of measurement, physiological interpretation, and clinical use. *European Heart Journal*, *17*, 354–381.
- Thayer, J.F., Hansen, A.L., Saus-Rose, E. & Johnsen, B.H. (2009). Heart rate variability, prefrontal neural function and cognitive performance: The neurovisceral integration perspective on self-regulation, adaptation, and health. *Annals of Behavioral Medicine*, 37, 141–153.
- Thayer, J.F. & Lane, R.D. (2000). A model of neurovisceral integration in emotion regulation and dysregulation. *Journal of Affective Disorders*, 61, 201–216.
- Thayer, R.E., Newman, J.R. & McClain, T.M. (1994). Self-regulation of mood: Strategies for changing a bad mood, rising energy, and reducing tension. *Journal of Personality and Social Psychology*, 67, 910–925.
- Thoits, P.A. (1991). On merging identity theory and stress research. Social Psychology Quarterly, 54, 101–112.
- Trapnell, P.D. & Campbell, J.D. (1999). Private self-consciousness and the five-factor model of personality: Distinguishing rumination from reflection. *Journal of Personality and Social Psychology*, 76, 284–304.
- Udo, T., Bates, M.E., Mun, E.Y., Vaschillo, E.G. & Vaschillo, B. (2009). Gender differences in acute alcohol effects on self-regulation of arousal in response to emotional and alcohol-related picture cues. *Psychology of Addictive Behaviors*, 23, 196–204.
- van Vugt, M.K., van der Velde, M. & ESM-MERGE Investigators (2018). How does rumination impact cognition? A first mechanistic model. *Topics in Cognitive Science*, 10, 175–191.
- Verkuil, B., Brosschot, J.F., Marques, A.H., Kampschroer, K., Sternberg, E.M. & Thayer, J.F. *et al* (2015). Gender differences in the impact of daily sadness on 24-h heart rate variability. *Psychophysiology*, 52, 1682–1688.
- Watkins, E. (2004). Appraisals and strategies associated with rumination and worry. *Personality and Individual Differences*, 37, 679–694.
- Watkins, E. (2008). Constructive and unconstructive repetitive thought. *Psychological Bulletin*, 134, 163–206.

1 2 4 5 6 7 8 9	 Watkins, E. & Brown, R.G. (2002). Rumination and executive function in depression: An experimental study. <i>Journal of Neurology, Neurosurgery & Psychiatry</i>, 72, 400–402. Wegner, D.M., Schneider, D.J., Carter, S.R. & White, T.L. (1987). Paradoxical effects of thought suppression. <i>Journal of Personality and Social Psychology</i>, 53, 5–13. Whitmer, A.J. & Banich, M.T. (2007). Inhibition versus switching deficits in different forms of rumination. <i>Psychological Science</i>, 18, 546–553. Whitmer, A.J. & Banich, M.T. (2010). Trait rumination and inhibitory deficits in long-term memory. <i>Cognition and Emotion</i>, 24, 168–179. 	 Whitmer, A.J. & Gotlib, I.H. (rumination. <i>Psychological Bul</i> Williams, J.M.G., Mathews, A. Stroop task and psychopatholo Young, M.A., Fogg, L.F., Scheftr (1990). Sex differences in the varying the diagnostic criteria <i>Affective Disorders</i>, <i>18</i>, 187–1 Received 27 November 2019, acc
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- J.M.G., Mathews, A. & MacLeod, C. (1996). The emotional task and psychopathology. Psychological Bulletin, 120, 3-24.
- .A., Fogg, L.F., Scheftner, W.A., Keller, M.B. & Fawcett, J.A. Sex differences in the lifetime prevalence of depression: Does g the diagnostic criteria reduce the female/male ratio? Journal of ve Disorders, 18, 187–192.

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