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

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## Empirical Paper

**A multimethod assessment to study the relationship between rumination and gender differences**AGATA ANDO<sup>1</sup>  LUCIANO GIROMINI,  FRANCESCA ALES and ALESSANDRO ZENNARO*Department of Psychology, University of Turin, Italy*

Ando, A., Giromini, L., Ales, F. & Zennaro, A. (2020). A multimethod assessment to study the relationship between rumination and gender differences. *Scandinavian Journal of Psychology*.

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.

Agata Ando<sup>1</sup>, Department of Psychology, University of Turin, Via Verdi 10, 10124 Torino, TO, Italy. E-mail: agatamariaclaudia.ando@unito.it

## 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

1 previous diagnoses of depression or anxiety and considered  
2 rumination as a specific trait of these mental disorders.

### 3 *Rumination, physiological reactivity and vulnerability to stress*

4  
5 As mentioned before, rumination is defined as the most common  
6 impaired emotional regulation strategy and, therefore, as an  
7 emotional process related to a repetitive, undesired, and past-  
8 oriented negatively inclined thought; emotional dysregulation may  
9 dysfunctionally manage emotion-related physiological processes  
10 (e.g., reactivity of autonomic system, and difficulties in restoring the  
11 baseline condition or recovery) especially after experiencing a  
12 laboratory induced stress (e.g., Giromini, Ando', Morese, Ando',  
13 Morese, Salatino, Di Girolamo, Viglione, & Zennaro, 2016). In fact,  
14 recent evidence has suggested that rumination (considered as a form  
15 of emotional dysregulation) may be associated with exaggerated  
16 physiological changes relative to demands of the stressor (e.g.,  
17 Brosschot, Gerin, & Thayer, 2006; Stewart, Mazurka, Bond,  
18 Wynne-Edwards, & Harkness, 2013). Thayer and Lane (2000) have  
19 highlighted interactions between the ruminative thinking and vagal  
20 cardiac control – reflected by Heart Rate Variability (HRV)  
21 parameters – also suggesting a group of underlying neural networks  
22 involved in emotion–cognition relations. An important role plays the  
23 central autonomic network (CAN; Thayer, Hansen, Saus-Rose, &  
24 Johnsen, 2009) given that it is implicated in making visceromotor,  
25 neuroendocrine, and behavioral responses that are adaptive and  
26 flexible for coping various environmental demands (brain structures  
27 in the CAN are reciprocally related and connected allowing to  
28 involve additional structures that are necessary to provide specific  
29 behavioral changes; Thayer *et al.*, 2009; Thayer & Lane, 2000).  
30 HRV is a marker of cardiovascular reactivity and emotion regulation  
31 reflecting the degree to which cardiac activity can be modulated to  
32 meet changing situational demands (Reynard, Gevirtz, Berlow,  
33 Brown, & Boutelle, 2011). Some research (e.g., Aldao, Mennin, &  
34 McLaughlin, 2013; Key, Campbell, Bacon, & Gerin, 2008) has  
35 investigated, specifically, the relationship between rumination and  
36 HRV, moreover reporting contradictory results (Key *et al.*, 2008;  
37 Ottaviani, Shapiro, Davydov, Goldestein, & Millis, 2009). For  
38 example, Ottaviani *et al.* (2009) reported that rumination was  
39 associated to low HRV, while Key *et al.* (2008) showed that there  
40 was no relation between ruminative thoughts and HRV baseline.  
41 Aldao *et al.* (2013) examining differences in the functional  
42 characteristics of worry and rumination in relation to physiological  
43 markers of emotion regulation (i.e., HRV), found that worry was  
44 more associated with HRV across emotional contexts than  
45 rumination.

46  
47 The mechanism of ruminative thoughts involving repeated  
48 failures in stress management (Cole, Michel, & Teti, 1994) may  
49 be strongly associated with an overall arousal and, therefore, an  
50 increased cardiovascular reactivity (Brosschot & Thayer, 2003;  
51 Gerin, Davidson, Christenfeld, Goyal, & Schwartz, 2006) in  
52 response to a stressor (Obrist, Light, James, & Strogatz, 1987).  
53 The rumination arousal model described by Gerin and colleagues  
54 (2006) aimed to clarify the potential mechanisms through which  
55 ruminative thoughts might influence the cardiovascular recovery.  
56 This model explained that after administering a stress task, the  
57 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 vice-versa). 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). 5

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 Joormann & 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);

1 differently, positive reappraisal, problem-solving, and acceptance  
 2 were negatively related to psychopathologic features. Thoits  
 3 (1991) observed that women usually adopted both adaptive and  
 4 maladaptive coping strategies than men did. Tamres, Janicki, and  
 5 Helgeson (2002) noted that women reported more use of coping  
 6 strategies because they were experiencing higher stress than men.  
 7 The authors suggested that gender differences in coping strategies  
 8 could be the result of gender differences in the stressor appraisal;  
 9 in fact, they found that women used the coping strategy more  
 10 than men only in those circumstances in which they evaluated the  
 11 stressor as more massive than men did. Rogier, Garofalo, and  
 12 Velotti (2019) reported the presence of the use of cognitive  
 13 reappraisal and expressive suppression in women; also, the  
 14 authors tested interaction effects between reappraisal and  
 15 suppression strategies on psychopathological diseases and  
 16 aggression measures, founding significant interaction effects  
 17 among men and only on aggressive measures. A limitation shared  
 18 by the most part of previous studies was not to investigate  
 19 whether there were gender differences in adaptive or maladaptive  
 20 strategies and their relationships with the psychopathology  
 21 (Nolen-Hoeksema & Aldao, 2011).

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

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

40 A meta-analysis by Johnson and Whisman (2013) reporting  
 41 results in line with those obtained by another previous study  
 42 (Rood, Roelofs, Bögels, Nolen-Hoeksema, & Schouten, 2009)  
 43 found significant differences in rumination between boys and girls  
 44 in childhood and adolescence, leading to the conclusion that girls  
 45 would be more likely to ruminate than boys. Overall, most of the  
 46 literature on rumination reports that women use rumination more  
 47 frequently than men (thus increasing their depressive symptoms)  
 48 (Johnson & Whisman, 2013; Nolen-Hoeksema, Morrow, &  
 49 Fredrickson, 1993; Thayer, Newman, & McClain, 1994) and that  
 50 the ruminative thinking is associated to self-perception (Conway,  
 51 Csank, Holm, & Blake, 2000; McEvoy, Mahoney, & Moulds,  
 52 2010; Nolen-Hoeksema & Morrow, 1991), physiological  
 53 responses (Brosschot *et al.*, 2006; Stewart *et al.*, 2013), and  
 54 cognitive biases (Lyubomirsky & Tkach, 2003; Lyubomirsky &  
 55 Nolen-Hoeksema, 1995; Nolen-Hoeksema, 2000).

56 Based on some findings reported above, we can conceptualize  
 57 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 years<sup>1</sup> ( $M = 22.57$ ;  $SD = 3.30$ ). 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.

### 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, 2017). The DERS-16 is comprised of 16 of the 36 original items, and yields five of the six original scales' scores, that is, *Non-acceptance*, *Goals*, *Impulse*, *Strategies*, and *Clarity*. Items in the Non-acceptance 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<sup>2</sup>;** Trapnell & Campbell, 1999). This is a 24-item self-report measure of self-consciousness, divided along the dimensions of positively motivated reflection<sup>3</sup> (*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 inter-item 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<sup>4</sup>, RRQ<sup>5</sup> 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

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.<sup>6</sup> 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 (between-subject 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 RMSSD 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 condition<sup>7</sup> 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*  $\eta^2 = 0.010$ ]<sup>8,9</sup> (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	$F(2,68)$	$p$	Partial $\eta^2$
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 [ $t(66) = -1.86; p = 0.067; d = 0.44; t(66) = -1.18, p = 0.242, d = 0.285; t(66) = -1.04, p = 0.301, d = 0.254; t(66) = -.53, p = 0.598, d = 0.129; t(66) = -.60, p = 0.546; d = 0.014; t(66) = -.28, p = 0.784; d = 0.077$ ]<sup>10</sup>.

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 sizes<sup>11</sup> 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 ( $r = 0.521, p = 0.003$ ), 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 self-reported 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  $2 \times 2$  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 self-reports, 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 non-accepting 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 non-acceptance, DERS goals, and DERS clarity).



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

Condition	Condition	Mean differences	Std. error	95% Confidence Interval for Mean	
				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*

Gender	Condition	Mean	Std. error	95% Confidence Interval for Mean	
				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	M	SD
Rumination Scale	32	56	44.45	5.88
Reflection Scale	31	58	46.97	6.85
<b>M (n = 30)</b>				
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	M	SD	Rumination Scale r	Reflection Scale r
<b>F (n = 38)</b>				
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
<b>M (n = 30)</b>				
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	0.465*	-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

Table 6. Descriptive Statistics and Correlations with combined Stroop variables to RRQ ( $n = 68$ )

Combined Stroop Variables	<i>M</i>	<i>SD</i>	Rumination Scale <i>r</i>	Reflection Scale <i>r</i>
<b>F</b> ( $n = 38$ )				
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
<b>M</b> ( $n = 30$ )				
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

\* $p < 0.05$ ;\*\* $p < 0.01$ .

(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 i; (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, self-report 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).

#### 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 & Thayer, 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

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

<sup>2</sup> 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).

<sup>3</sup> 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).

<sup>4</sup> 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]

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

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

<sup>7</sup> As mentioned before, participants were exposed to a standard three-phase, 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.

<sup>8</sup> The main effect of gender was statically significant.

<sup>9</sup> Partial  $\eta^2$  effect size: 0.01 (small); 0.06 (medium); > 0.14 (large).

<sup>10</sup> Cohen's  $d$  effect size: 0.20 (small); 0.50 (medium); 0.80 (large).

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

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