Reliving Emotional Personal Memories: Affective Biases Linked to Personality and Sex-Related Differences

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Although available evidence suggests that the emotional valence and recollective properties of autobiographical memories (AMs) may be influenced by personality- and sex-related differences, overall these relationships remain poorly understood. The present study investigated these issues by comparing the effect of general personality traits (extraversion and neuroticism) and specific traits linked to emotion regulation (ER) strategies (reappraisal and suppression) on the retrieval of emotional AMs and on the associated postretrieval emotional states, in men and women. First, extraversion predicted recollection of positive AMs in both men and women, whereas neuroticism predicted the proportion of negative AMs in men and the frequency of rehearsing negative AMs in women. Second, reappraisal predicted positive AMs in men, and suppression predicted negative AMs in women. Third, while reliving of positive memories had an overall indirect effect on postretrieval positive mood through extraversion, reliving of negative AMs had a direct effect on postretrieval negative mood, which was linked to inefficient engagement of suppression in women. Our findings suggest that personality traits associated with positive affect predict recollection of positive AMs and maintenance of a positive mood, whereas personality traits associated with negative affect, along with differential engagement of habitual ER strategies in men and women, predict sex-related differences in the recollection and experiencing of negative AMs. These findings provide insight into the factors that influence affective biases in reliving AMs, and into their possible link to sex-related differences in the susceptibility to affective disorders.

Keywords: personal memories, individual variations, emotion control, mood and anxiety disorders, affective state

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Emotional personal experiences are typically better and more vividly remembered than nonemotional ones (e.g., Comblain, D'Argembeau, & Van der Linden, 2005; Schaefer & Philippot, 2005; Talarico, LaBar, & Rubin, 2004). Although evidence suggests that the emotional valence and recollective properties (e.g., vividness) of autobiographical memories (AMs) may be influenced by personality- and sex-related individual variations (e.g., D'Argembeau & Van der Linden, 2006; Piefke, Weiss, Markowitsch, & Fink, 2005; Rubin & Seigler, 2004), these relationships remain poorly understood. The present study investigated these issues by comparing the effect of general personality traits and traits specifically linked to emotion regulation (ER) on the retrieval of emotional AMs and their effect on subsequent emotional states in women and men. Investigation of these issues has relevance for understanding factors that may influence affective biases in retrieving AMs and their subsequent impact on emotional states, as well as in understanding their link to individual variation in the vulnerability to affective disorders.

Recollection of emotional personal events, such as a romantic evening or the birth of a child, are important to healthy cognitive and affective functioning (Markowitsch, 2008), because they provide us with a sense of self-identity and self-continuity, and guide our future goals (Addis & Tippett, 2008; Schacter & Addis, 2007). While positive affective biases in healthy behavior may enhance personal well-being by creating and maintaining a positive view of the self (e.g., D'Argembeau & Van der Linden, 2008; Davidson, 2004), negative affective biases may have detrimental effects on health by increasing susceptibility to affective disorders, such as depression and posttraumatic stress disorder (PTSD), which are often characterized by an exacerbated bias in retrieving and ruminating on negative memories (Bradley, Mogg, Millar, & White, 1995; Brewin, Hunter, Carroll, & Tata, 1996; Brewin, Reynolds, & Tata, 1999; Lemogne et al., 2006; Nolen-Hoeksema, 2000; Reynolds & Brewin, 1999; Rubin, 2005; Rubin, Berntsen, & Bohni, 2008; Watkins, Vache, Verney, Muller, & Mathews, 1996; Williams & Moulds, 2007).

An open question in the literature concerns the relationships between factors that may influence affective biases in retrieving AMs in healthy behavior, and their link to individual variation in the susceptibility to mood and anxiety disorders. Available evidence suggests that affective biases in memory may be related to individual variations in personality traits linked to general emotion processing, such as extraversion and neuroticism (Rubin et al., 2008; Young & Martin, 1981), and to sex-related differences (Davis, 1999; Seidlitz & Diener, 1998). Regarding the role of personality traits, on the one hand, there is evidence that factors associated with positive affect, such as extraversion (Costa & McCrae, 1980; John & Srivastava, 1999), are associated with the recollection of positive nonpersonal memories (Rusting, 1999), but investigation of the role of this trait in remembering positive personal memories is not conclusive (Mayo, 1983; Quoidbach, Hansenne, & Mottet, 2008). On the other hand, there is evidence that personality traits associated with negative affect, such as neuroticism, are linked to recollection of negative personal memories (Mayo, 1983; Ruiz-Caballero & Bermudez, 1995). Moreover, neuroticism has also been linked to vulnerability to affective disorders (Bienvenu et al., 2004), in that some of its subcomponents (i.e., depression and anxiety) map onto behavioral and cognitive characteristics associated with mood and anxiety disorders (Costa & McCrae, 1992).

Regarding the role of sex-related differences in AM retrieval and emotion processing, available evidence suggests that women recall more emotional AMs (Davis, 1999; Seidlitz & Diener, 1998), and that they are also more prone to develop affective disorders. It has been suggested that greater lifetime prevalence of mood and anxiety disorders in women (i.e., nearly two times higher than in men) (Kessler, 2003; Nolen-Hoeksema, 2001) may be related not only to variations in personality traits linked to a negative bias in general emotion processing, such as neuroticism (Goodwin & Gotlib, 2004), but also to specific traits linked to strategies of coping with stressful experiences (Matud, 2004; Nolen-Hoeksema, 2001; Thayer, Rossy, Ruiz-Padial, & Johnsen, 2003). However, a direct link between a negative affective bias in reliving emotional memories and sex-related differences in coping strategies has not been establish, although recent neuroimaging evidence points to sex-related differences in brain activity associated with emotion control/regulation (Domes et al., 2009; Mak, Hu, Zhang, Xiao, & Lee, 2009; McRae, Ochsner, Mauss, Gabrieli, & Gross, 2008).

The topic of emotion regulation (ER) has recently gained considerable interest (Gross, 2008; Ochsner & Gross, 2005; Ochsner & Gross, 2007), as the ability to cope adaptively with emotionally challenging situations is important for physical and mental health, and understanding its mechanisms has direct relevance to understanding and treating affective disorders. Indeed, dysfunctional emotion regulation (or affective dysregulation) is among the core symptoms in depression and anxiety disorders (e.g., Mayberg, 1997; Mayberg et al., 1999), and has been linked to a negative affective bias (see review by Banich et al., 2009) and to alterations in brain regions typically associated with cognitive control (Beauregard, Paquette, & Levesque, 2006; Fales et al., 2008; Johnstone, van Reekum, Urry, Kalin, & Davidson, 2007; Mayberg, 1997; Mayberg et al., 1999). Also, comparisons of various emotion regulation strategies, such as reappraisal and suppression,[1] in healthy participants suggest that these strategies are not equally effective (see review by Gross, 2008), and indicate an advantage of reappraisal (e.g., Eippert et al., 2007; Gross, 1998; Jackson, Malmstadt, Larson, & Davidson, 2000; Ochsner & Gross, 2005) over suppression (Gross & John, 2003). For instance, compared to individuals who use suppression more frequently in everyday life, individuals who habitually engage reappraisal experience lesser negative affect and fewer depressive symptoms (Gross & John, 2003). However, little is known about the relationship between ER strategies and the retrieval of affective AMs in healthy participants (but see Wisco & Nolen-Hoeksema, 2009), which could provide a link between emotion dysregulation and the negative affective bias in remembering and ruminating on AMs observed in depressed patients.

Collectively, although extant evidence suggests a link between AMs and both general and ER-specific personality traits (e.g., Rubin & Seigler, 2004; Wisco & Nolen-Hoeksema, 2009), the way their relationships may influence individual variations in affective biases in reliving AMs remains poorly understood. To some extent, incomplete understanding of these issues is due to limitations of previous research, including (i) the absence or separate investigation of the role of general personality traits versus ER-specific traits, and (ii) the absence of systematic examination of sex-related differences.

Another missing link concerns the relationship between recollection of AMs that vary in valence and the subsequent affective states. Although previous research suggests the existence of such relationships (Rusting, 1999), for both positive and negative AMs (Gillihan, Kessler, & Farah, 2007; Joormann & Siemer, 2004; Joormann, Siemer, & Gotlib, 2007; Lewis, Critchley, Smith, & Dolan, 2005; Matt, Vázquez, & Campbell, 1992), the role of individual differences in the impact of reexperiencing emotional AMs on postretrieval emotional states remains unclear. Investigation of these issues is important because in everyday life people remember memories that vary in valence, from positive to negative, and their mood after this mixture of memories will reflect the impact of the emotional valence with longer-lasting effects, which may be influenced by personality factors, such as the ability to use efficient emotion regulation strategies. For instance, in the healthy population, recollection of positive memories leads to positive postretrieval mood, and even has the potential to reverse the negative mood. In depression, however, and in other clinical conditions characterized by an impaired ability to regulate emotions, remembering positive memories, which may be as positive and specific as those of nondepressed people, cannot reverse a negative mood (Joormann, Siemer, & Gotlib, 2007). Yet, the role of personality and sex-related factors in influencing postretrieval mood following recollections of mixed-valenced memories is not well understood. Again, incomplete understanding of these issues is partially due to limitations of previous research, including (i) the absence of systematic assessments of postretrieval emotional states

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[1] Cognitive reappraisal involves attempts to change the meaning of stimuli/situations (by thinking for instance that the situation is not real), whereas expressive suppression involves attempts to decrease emotionally expressive behaviour (Gross, 2008). To examine the individual difference in the habitual use of reappraisal and suppression, Gross and John (2003) developed the so-called Emotion Regulation Questionnaire (ERQ; see Supplementary Material–Method for details).

relative to preretrieval states, and (ii) the absence of investigations assessing how the relationship between AMs and mood is influenced by personality and sex-related differences.

Therefore, the main goal of the present study was to address these limitations by investigating the role of personality- and sex-related differences in (1) the retrieval of affective AMs, and (2) the associated postretrieval emotional states. Personality traits linked to general emotion processing and traits specifically linked to emotion regulation were assessed in both women and men, and emotional states of the participants were assessed before and after retrieval of emotional AMs. Based on the available evidence, we made the following three predictions. First, we predicted valence-congruent relationships between personality traits and reliving affective AMs and the associated postretrieval affective states. Second, we predicted sex-related differences in general personality traits, the recollection of affective AMs, and their relationships, which would overall be consistent with a negative affective bias in women. Third, we predicted that sex-related differences would also be reflected in personality traits linked to emotion regulation strategies, possibly due to habitual engagement of less efficient coping strategies in women.

Method

Participants

Seventy-one young, healthy subjects participated in this study (38 women; age range: 18–34 years, $M = 21.27$ years; women and men did not differ in age, ($T_{(69)} = -1.56$, $p > .12$). Participants were recruited from the University of Alberta campus area, and were compensated with course credits or money ($10 per hour). All participants had English as first language. None of the participants were previously diagnosed with neurological, psychiatric, or personality disorders. The experimental protocol was approved by the University of Alberta Health Research Ethics Board, and all subjects provided written informed consent for participation.

Measures and Procedures

Emotional autobiographical events and personality traits were assessed individually in a quiet environment, using AM and personality questionnaires. Affective AMs were assessed using an autobiographical memory questionnaire (AMQ), which comprised a list of 115 verbal cues for distinct life events (e.g., "the birth of a family member," "being hospitalized"), resulted from a combination and extension of lists employed by other authors (Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002; Sharot, Riccardi, Raio, & Phelps, 2007). To assess phenomenological characteristics of each event, participants dated the memory and rated it on several Likert scales similar to those used by other studies (Addis, Moscovitch, Crawley, & McAndrews, 2004; Rubin, Schrauf, & Greenberg, 2003), including emotional valence (using a 7-point scale: $-3 = $ *very negative*, $0 = $ *neutral*, and $+3 = $ *very positive*), emotional intensity, personal significance, the amount of contextual details, the amount of visuo-perceptual details (i.e., vividness), and the frequency of retrieval (all of the latter using a 7-point scale: $1 = $ *not at all*, $7 = $ *extremely*) (for additional details, see Supplementary Material–Method; available online).

Individual variations in general personality traits were assessed using the Neuroticism-Extraversion-Openness Five-Factor Inventory (NEO-FFI) (Costa & McCrae, 1992). Because neuroticism and extraversion are most closely related to emotion processing (Hamann & Canli, 2004), we mainly focused on these two traits. However, relationships with the other three traits were also investigated as part of control analyses, to verify whether the observed relationships were specific to neuroticism and extraversion. The overall neuroticism score was decomposed into its three subscores (i.e., anxiety, depression, and self-reproach) (Saucier, 1998). Individual variations in specific ER-related personality traits were assessed using the Emotion Regulation Questionnaire (ERQ) (Gross & John, 2003), which assesses individual differences in the habitual use of cognitive reappraisal and expressive suppression. The impact of AM retrieval on subsequent emotional states was assessed by measuring the subjects' mood before and after the study, using the state scale of the Positive and Negative Affective Schedule (PANAS-S) (Watson, Clark, & Tellegen, 1988).

Data Analysis

Because the main interest was in affective AMs, in all analyses the focus was on the highly negative and highly positive memories (i.e., rated -3 and -2 and $+3$ and $+2$, respectively).[2] PANAS-S scores were missing in nine subjects due to technical problems, and hence analyses investigating the relationship between affective AMs and emotional states were performed on 62 subjects (31 females). Analyses performed to address our two main research questions are described in turn below.

Research Question 1: The Role of Personality- and Sex-Related Differences in the Retrieval of Affective AMs

To investigate the relationship between affective AMs and individual variations in general (extraversion vs. neuroticism) and specific emotion regulation-related (reappraisal vs. suppression) personality traits, different dimensions of the affective AMs were treated as separate dependent variables in a series of correlation and regression analyses. One set of analyses focused on the proportion of recalled emotional memories (i.e., overall proportion of positive AMs, overall proportion of negative AMs, and the relative proportion of positive vs. negative AMs, calculated by subtracting the percentage of negative and positive AMs from each other) (for additional details, see Supplementary Material–Method). Another set of analyses focused on the phenomenological characteristics of emotional memories (i.e., ratings for emotional intensity, personal significance, amount of contextual details, vividness, and frequency of rehearsal).

To examine sex-related differences, the following three main types of assessments were employed: *t* tests, moderation analyses (i.e., three-steps hierarchical regressions) (Cohen, Cohen, West, & Aiken, 2003; McFall, Geall, Fischer, Dolcos, & Dixon, 2010), and correlation analyses performed separately in women and men (see also Supplementary Material–Method).

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[2] To investigate the valence-related specificity of the relationships with affective memories, control analyses collapsing conditions over valence and comparisons with neutral memories were also employed.

Research Question 2: The Role of Personality- and Sex-Related Differences in the Relationship between Affective AMs and Emotional States

To investigate the relationships among personality factors, recollection of emotional AMs, and the associated postretrieval affective states, positive and negative mood states were considered separately in a series of correlation and regression analyses. To further examine the role of personality traits in the relationships between affective AMs and emotional states, regression-based mediator analyses were also employed (Preacher & Hayes, 2004). Finally, similar to the procedures described above, to examine the role of sex-related differences in the relationship between affective AMs and emotional states, three types of analyses were performed: t tests/ANOVAs, hierarchical regressions, and correlations. For all analyses, unless otherwise specified, two-tailed tests of significance were used.

Results

The results are reported according to our two main research questions and the predicted outcomes.

The Role of Personality- and Sex-Related Differences in the Retrieval of Affective AMs

Sex-independent effect of extraversion and sex-dependent effect of neuroticism on affective AMs. Confirming our first prediction, analyses focusing on the proportion of AMs revealed that extraversion was positively correlated with the overall ($R = 0.34$, $p < .01$) and relative ($R = 0.24$, $p < .05$) proportion of positive AMs (Table 1 and Figure 1A). In addition, these analyses also showed an opposite relationship for the neuroticism scores, namely in the self-reproach subscale (Figure 1A). Moderation analysis did not reveal a significant extraversion $\times$ sex interaction neither for the overall nor for the relative proportion of positive AMs (see Supplementary Table S1). No sex-related differences were identified in the comparisons of the average scores for the overall and relative proportion of positive AMs and extraversion (see Table 1).

Also consistent with our first prediction, analyses focusing on the proportion of negative AMs revealed that neuroticism (self-reproach subscore) was positively correlated with the overall ($R = 0.30$, $p < .02$) and relative ($R = 0.25$, $p < .04$) proportion of negative AMs (see Table 1). Consistent with sex-related differences in this effect, moderation analyses revealed a significant neuroticism (self-reproach) $\times$ sex interaction for the relative proportion of negative AMs (Block 3: $\Delta R^2 = 0.06$, $\Delta F = 4.96$, $p < .03$) (see also Supplementary Table S1). The within-sex group correlation analyses also revealed that neuroticism (particularly the self-reproach subscale) was only in men significantly related to the overall ($R = 0.44$, for men vs. $R = 0.10$, for women) and the relative ($R = 0.46$, for men vs. $R = 0.01$, for women) proportion of negative AMs (Figure 1B). Sex-related differences were also found in the comparison of the average scores for the proportion of negative AMs and neuroticism, with women remembering overall more negative AMs than men ($T_{(69)} = 2.11$, $p < .04$) and having higher neuroticism scores ($T_{(69)} = 1.78$, $p < .04$), particularly in the anxiety ($T_{(69)} = 1.99$, $p < .04$) and self-reproach ($T_{(69)} = 2.07$,

$p < .04$) subscales (see Table 1). It should be noted that control analyses performed on the proportion of neutral memories did not reveal significant correlations with extraversion ($R = -0.19$, $p = .11$) or with neuroticism ($R = 0.15$, $p = .21$). Also, analyses involving the other three NEO scales either did not reveal any significant correlations (e.g., consciousness subscale), or found very few relationships (i.e., between openness and agreeableness and the proportion of positive memories), which were not moderated by sex.

Analyses focusing on the relationships between general personality traits and the phenomenological characteristics of AMs revealed that extraversion predicted the intensity of negative AMs, whereas neuroticism (and the different subscales) predicted the frequency of rehearsal for both positive ($R = 0.38$, $p < .01$) and negative ($R = 0.45$, $p < .0001$) AMs (see Table 2). On the one hand, moderation analysis did not reveal a significant extraversion $\times$ sex interaction, although this relationship was statistically significant in men but not in women. On the other hand, moderation analysis revealed a significant neuroticism $\times$ sex interaction for both negative (Block 3: $\Delta R^2 = 0.08$, $\Delta F = 7.30$, $p < .01$) and positive AMs (Block 3: $\Delta R^2 = 0.04$, $\Delta F = 3.56$, $p < .03$), thus indicating that sex moderated the effect of neuroticism on frequency of rehearsal of affective AMs (see Supplementary Table S1 for additional statistical details). The within-sex group correlation analyses further revealed that neuroticism was only in women related to the frequency of rehearsal of both positive ($R = 0.55$, for women vs. $R = 0.10$, for men) and negative ($R = 0.70$, for women vs. $R = 0.07$, for men) AMs (see Figure 2). It is worth mentioning that, in general, the AMs ratings did not differ between men and women. There were no significant sex-related differences in the ratings of the phenomenological characteristics of the positive (emotional intensity: $T_{(69)} = 0.50$, $p > .62$; vividness: $T_{(69)} = 1.07$, $p > .29$; contextual details: $T_{(69)} = 0.97$, $p > .33$; personal significance: $T_{(69)} = 0.29$, $p > .77$; frequency of rehearsal: $T_{(69)} = 1.03$, $p > .31$) or negative AMs (emotional intensity: $T_{(69)} = 1.36$, $p > .18$; vividness: $T_{(69)} = 0.68$, $p > .50$; contextual details: $T_{(69)} = 0.75$, $p > .45$; personal significance: $T_{(69)} = 0.09$, $p > .93$; frequency of rehearsal: $T_{(69)} = 1.11$, $p > .27$).

In sum, these results show that extraversion predicts more positive AMs in both women and men, whereas neuroticism predicts the proportion of negative AMs in men and the frequency of rehearsal of affective AMs in women.

Differential sex-dependent effects of reappraisal versus suppression on affective AMs. Analyses focusing on the role of ER-related personality traits, as indexed by the ERQ scores, in the retrieval of affective AMs revealed opposing effects of reappraisal (ERQ-R) and suppression (ERQ-S) on positive memories, with the former showing a positive correlation ($R = 0.27$, $p < .03$) and the latter showing a negative correlation ($R = -0.21$, $p < .04$) (see Table 1). Moderation analyses revealed a significant reappraisal $\times$ sex interaction (Block 3: $\Delta R^2 = 0.06$, $\Delta F = 4.74$, $p < .03$), thus indicating that sex modulates the effect of reappraisal on retrieval of positive AMs (see Supplementary Table S1, for details). The within-sex group correlations further revealed that reappraisal was only in men significantly related to both the overall ($R = 0.44$, for men and $R = 0.13$, for women) and the relative ($R = 0.39$, for men and $R = -0.01$, for women) proportion of positive AMs (Figure 3A).

Analyses focusing on the role of ER-related personality traits on negative AMs revealed that suppression was related to the relative proportion of negative AMs ($R = 0.25$, $p < .04$), and within-sex

Table 1
Averages, Standard Deviations (SDs), and Correlations for Affective AMs (%) and Personality Measures

Variables	All (n = 71) Mean	SD	1	2	3	4	5	6	7	8	9	10
1. % Pos AMs	42.82	12.02	—									
2. % Pos-Neg AMs	19.13	13.17	†.8449**	—								
3. % Neg AMs	23.69	7.10	.1262	†−.4244**	—							
4. Extraversion	43.10	8.28	†.3443**	†.2410*	.1360	—						
5. Neuroticism	31.76	9.50	−.1419	§−.2277‡	.1820	†−.4060**	—					
6. N-Anx	8.92	3.08	−.0283	−.0754	.0919	‡−.2710*	†.8114**	—				
7. N-Depr	7.85	3.01	−.1952	−.1547	−.0436	†−.5775**	†.8251**	†.6439**	—			
8. N-SR	12.51	4.56	−.0999	§−.2527*	§.2994*	‡−.2447*	†.8760**	†.5342**	†.5652**	—		
9. ERQ-R	31.11	5.25	§.2661*	.1393	.1923	§.3060**	−.1432	.0077	−.1740	−.1474	—	
10. ERQ-S	14.01	4.96	†−.2126‡	‡−.2541*	.1114	†−.4433**	†.3254**	.1469	§.2984*	†.3609**	−.1475	—
	Women (n = 38)											
1. % Pos AMs	43.18	9.78	—									
2. % Pos-Neg AMs	17.87	11.63	.8063**	—								
3. % Neg AMs	25.31*	6.89	.0579	−.5438**	—							
4. Extraversion	43.92	7.49	.2978‡	.2395	.0183	—						
5. Neuroticism	33.61‡	10.05	−.0045	.0166	−.0344	−.4544**	—					
6. N-Anx	9.58‡	3.17	.0133	.0861	−.1265	−.3398*	.8776**	—				
7. N-Depr	8.13	3.16	−.0611	.0241	−.1275	−.5944**	.8915**	.8115**	—			
8. N-SR	13.53*	4.53	.0614	−.0082	.1010	−.3262*	.8713**	.5978**	.6303**	—		
9. ERQ-R	32.08‡	5.82	.1303	−.0143	.2089	.1204	−.0784	.0180	−.0579	−.0989	—	
10. ERQ-S	13.18	5.08	−.2232	−.3733*	.3134‡	−.4048*	.2923‡	.1075	.2380	.4187**	−.0270	—
	Men (n = 33)											
1. % Pos AMs	42.41	14.32	—									
2. % Pos-Neg AMs	20.57	14.79	.8856**	—								
3. % Neg AMs	21.83	6.98	.1757	−.3016‡	—							
4. Extraversion	42.15	9.12	.3745*	.2665	.2040	—						
5. Neuroticism	29.64	8.47	−.3016‡	−.4674**	.3717*	−.4414*	—					
6. N-Anx	8.15	2.83	−.0833	−.1966	.2456	−.2781	.6866**	—				
7. N-Depr	7.52	2.85	−.3316‡	−.3207*	−.0009	−.6096**	.7283**	.3966*	—			
8. N-SR	11.33	4.37	−.2565	−.4550**	.4379*	−.2395	.8725**	.3849*	.4672**	—		
9. ERQ-R	30.00	4.33	.4400*	.3948*	.0664	.5315**	−.4054*	−.1428	−.4454*	−.3814	—	
10. ERQ-S	14.97	4.72	−.2094	−.1933	−.0203	−.4708**	.5052**	.3232‡	.4423*	.4307*	−.2660	—

Note. Pos = Positive; Neg = Negative; AMs = Autobiographical Memories; N-Anx = Anxiety subscale from neuroticism; N-Depr = Depression subscale from neuroticism; N-SR = Self-Reproach subscale from neuroticism; ERQ-R = ERQ-Reappraisal; ERQ-S = ERQ-Suppression. † = Italic and underlined = results in both women and men; ‡ = Underlined = results driven by women; § = Italic = results driven by men.
* $p < .05$. ** $p < .01$ or 0.001. ‡ $p < .05$, one-tailed.

group correlations further revealed that suppression was only in women significantly related to the overall proportion of negative AMs (R = 0.31, for women vs. R = −0.02, for men) (Figure 3B) and to the relative proportion of negative AMs (R = 0.37, for women vs. R = 0.19, for men); this probably prevented identification of a significant effect at the level of all participants for the overall proportion of negative AMs (see Table 1). It is interesting to note that suppression was also positively related to neutral memory, but only in men. Namely, moderation analysis revealed a significant suppression × sex interaction (Block 3: $\Delta R^2 = 0.065$, $\Delta F = 5.24$, $p < .025$), thus indicating that sex modulates the effect of suppression on retrieval of neutral AMs. The within-sex group correlations further revealed that suppression was only in men significantly related to the proportion of neutral memories (R = 0.39, for men and R = −0.03, for women).[3] Sex-related differences were also found in the comparison of the average scores for the proportion of neutral AMs, with men remembering overall more neutral AMs than women ($T_{(69)} = 2.26$, $p < .03$).

Analyses focusing on the role of ER-related personality traits on the characteristics of the affective AMs revealed that reappraisal (ERQ-R) scores were also positively correlated with the overall amount of the visuo-perceptual details (i.e., vividness) and contextual details for both positive (R = 0.28, $p < .05$; R = 0.27, $p < .05$) and negative (R = 0.31, $p < .01$; R = .34, $p < .004$) AMs (see Table 2 and Supplementary Figure S1). Although moderation analysis did not reveal significant reappraisal × sex interactions, excepting a slight trend for the contextual details of negative AMs (see Supplementary Table S1), these relationships were statisti-

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[3] The moderation and within-group analysis also revealed that the neutral memories were negatively correlated to reappraisal only in men (Block 3: $\Delta R^2 = 0.053$, $\Delta F = 4.23$, $p < .044$ and R = −0.37 for men and R = −0.07 for women). No other significant correlations were found with neutral memories.
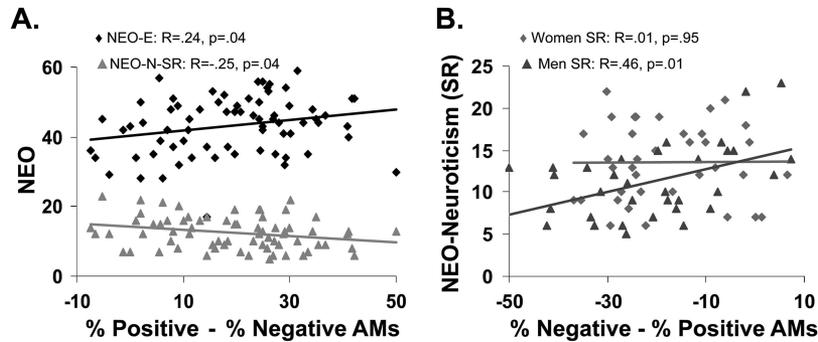
Figure 1. The role of extraversion and neuroticism in retrieving affective AMs. A. Remembering positive AMs correlates positively with Extraversion (NEO-E) and negatively with Neuroticism (Self-Reproach subscale; NEO-N-SR). B. Remembering negative AMs correlates positively with Neuroticism Self-Reproach (SR) subscale only in men.

cally significant only in women (see Table 2).[4] No sex-related differences were identified in the comparisons of the average scores for vividness, amount of contextual details (see Table 2), and the ERQ scores, although reappraisal scores tended to be higher in women than in men (see Table 1).

In sum, confirming our predictions, these results show that reappraisal predicts positive and neutral AMs in men, while suppression predicts negative AMs in women and neutral memories in men. Also, reappraisal predicted more vivid both positive and negative AMs only in women.

The Role of Personality- and Sex-Related Differences in the Relationship Between Affective AMs and Emotional States

Positive AMs predicted post retrieval positive mood through extraversion, whereas negative AMs directly predicted postretrieval negative mood. Consistent with our expectations, analyses focusing on the affective state also revealed valence-congruent relationships between recollection of affective AMs, and the associated postretrieval mood. While recollection of positive AMs indirectly predicted the postretrieval positive affective state via extraversion, recollection of negative AMs directly predicted the postretrieval negative affective state (see Figure 4 and Table 3). Moderation analysis did not reveal a significant extraversion × sex interaction or a significant negative AMs × sex interaction (see Supplementary Table S2). No sex-related differences were identified in the comparisons of the average scores for the postretrieval positive and negative affective states (see Table 3 and Supplementary Material–Results for further details about changes in affective states as a result of recollecting emotional AMs).

Differential effects of personality traits on negative mood in women and men. Analyses focusing on the role of general personality traits on postretrieval state revealed that extraversion was positively correlated with the positive postretrieval state (R = 0.36, $p < .01$) and neuroticism was positively correlated with the negative postretrieval state (R = 0.23, $p < .04$) (see Table 3). Moderation analysis did not reveal a significant extraversion × sex interaction or a significant neuroticism × sex interaction (see Supplementary Table S2). While

the relationship between extraversion and positive postretrieval state was significant in both women and men, the relationship between neuroticism and negative postretrieval state was statistically significant only in men. Analyses focusing on the role of specific ER-related personality traits on postretrieval state revealed that reappraisal was linked to positive postretrieval state (R = 27, $p < .04$), and moderation analysis did not reveal a significant reappraisal × sex interaction (see Supplementary Table S2). However, this relationship was statistically significant only in women (see Table 3). On the other hand, suppression was linked to negative postretrieval state, but only in women (R = 0.37, for women vs. R = 0.08 for men) (see Table 3 and Figure 5), which again, probably prevented identification of a significant effect at the level of the whole group.

To further elucidate the findings revealing a link between suppression and postretrieval negative mood in women, we performed additional analyses by separating female participants in high versus low suppressor subgroups, using a median split approach. Overall, these analyses provided evidence suggestive of inefficient use of suppression as a coping mechanism in women. First, these analyses revealed that women high in suppression tended to remember more negative versus positive AMs ($T_{(36)} = 1.76$, $p < .04$), and have lower extraversion ($T_{(36)} = 2.58$, $p < .01$) and higher neuroticism scores ($T_{(36)} = 1.77$, $p < .04$). Second, a 3-way ANOVA examining changes in positive versus negative states before and after AM recollection in high versus low suppressor women revealed a significant valence (positive vs. negative) × moment (pre vs. post) × suppression level (high vs. low) interaction ($F_{(1, 29)} = 4.19$, $p < .05$), which was due to greater reduction in postretrieval positive mood in high versus low suppressors ($p < .0001$ vs. $p < .02$).

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[4] The only significant correlations identified by the control analyses performed on the characteristics of neutral memories were between reappraisal scores and the amount of contextual (R = 0.37, $p = .002$) and visual (R = 0.35, $p = .004$) details. However, moderation analyses did not reveal significant reappraisal × sex interactions.

Table 2

Averages, Standard Deviations (SDs), and Correlations for Affective AMs' Characteristics and Personality Measures

AMs Charactreristics	All (n = 71)		Extraversion	Neuroticism	N-Anx	N-Depr	N-SR	ERQ-R	ERQ-S
	Mean	SD							
Pos Intensity	4.31	0.85	.0670	.1454	.0590	.0287	‡.2295‡	.1063	.0717
Pos Vividness	5.06	0.79	.1091	.0614	.1530	.0172	−.0072	‡.2841*	.0891
Pos Context Details	5.27	0.81	.1207	−.0243	−.0207	.0006	−.0491	‡.2684*	.1178
Pos Significance	4.14	0.89	.0720	.1551	.0697	.0165	†.2006‡	.0427	.1849
Pos Rehearsal	3.36	0.73	.0257	‡.3841**	‡.2649*	‡.2481*	‡.3985**	−.0489	.1801
Neg Intensity	5.16	0.78	§.2760*	.1108	.0676	−.0506	.1934	.1429	−.0682
Neg Vividness	4.97	0.88	.1148	.0583	.1131	.0187	−.0067	‡.3090*	.0376
Neg Context Details	5.13	0.81	.1736	.0167	.0851	.0211	−.0588	‡.3435**	.0388
Neg Significance	3.91	1.01	.0903	.1864	.0896	.0311	‡.2653*	.0770	.1237
Neg Rehearsal	3.44	0.83	.0247	‡.4518**	‡.3292**	‡.2821*	‡.4297**	−.0330	.0376
	Women (n = 38)								
Pos Intensity	4.36	0.91	−.0045	.2243	.1085	.1657	.2790‡	.0083	.2002
Pos Vividness	5.16	0.75	.0870	.0806	.2171	−.0006	.0553	.3156‡	.0301
Pos Context Details	5.36	0.84	.1906	−.0751	.0051	−.0788	−.0736	.3912*	.0069
Pos Significance	4.11	0.85	−.0261	.1804	.0777	.1053	.2480	−.1128	.1572
Pos Rehearsal	3.44	0.76	−.0824	.5470**	.5094**	.4630**	.4867**	−.2588	.2227
Neg Intensity	5.28	0.76	.2283	.1936	.1258	.0697	.2287	.0883	−.0317
Neg Vividness	5.03	0.80	.0447	.0625	.1840	−.0204	.0256	.3761*	−.0614
Neg Context Details	5.19	0.87	.3060‡	−.0455	.1050	−.0842	−.0934	.4910**	−.0923
Neg Significance	3.90	1.02	−.2068	.3088‡	.1955	.2788‡	.3226*	−.0715	.1038
Neg Rehearsal	3.55	0.83	−.2810‡	.6999**	.6363**	.6516**	.5657**	−.1719	.1833
	Men (n = 33)								
Pos Intensity	4.25	0.79	.1344	−.0030	−.0460	−.1878	.1442	.2551	−.0822
Pos Vividness	4.96	0.84	.1052	−.0188	.0260	.0097	−.1415	.2101	.2107
Pos Context Details	5.17	0.76	.0265	−.0127	−.1283	.0839	−.0893	.0140	.3294‡
Pos Significance	4.17	0.94	.1644	.1521	.0841	−.0783	.1815	.2835	.2105
Pos Rehearsal	3.26	0.69	.1132	.0992	−.1356	−.0804	.2455	.2407	.1859
Neg Intensity	5.03	0.78	.2984‡	−.0733	−.0894	−.2426	.0815	.1575	−.0501
Neg Vividness	4.89	0.98	.1551	.0210	.0076	.0427	−.0797	.2237	.1711
Neg Context Details	5.05	0.75	.0168	.0662	.0082	.1539	−.0696	.0535	.2696
Neg Significance	3.92	1.01	.3811*	.0331	−.0374	−.2877	.2196	.3235‡	.1491
Neg Rehearsal	3.33	0.81	.2938‡	.0715	−.1231	−.2242	.2262	.1134	−.0893

Note. Pos = Positive; Neg = Negative; N-Anx = Anxiety subscale from neuroticism; N-Depr = Depression subscale from neuroticism; N-SR = Self-Reproach subscale from neuroticism; ERQ-R = ERQ-Reappraisal, ERQ-S = ERQ-Suppression. † = Italic and underlined = results in both women and men; ‡ = Underlined = results driven by women; § = Italic = results driven by men.
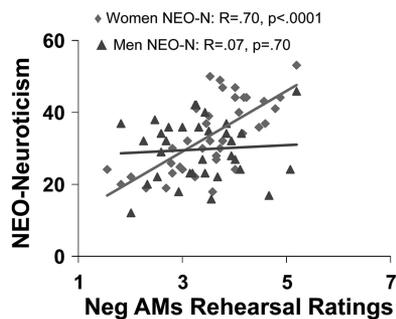* $p < .05$. ** $p < .01$ or 0.001. ‡ $p < .05$, one-tailed.

Figure 2. Neuroticism (NEO-N) predicts frequency of rehearsing negative AMs (Neg AMs) only in women.

In sum, these results show that positive AMs predict postretrieval positive affective state via a mediating effect of extraversion, whereas negative AMs directly predict negative postretrieval affective state, which is related to inefficient engagement of suppression in women.

Discussion

The present study yielded three main findings that shed light on the role of personality- and sex-related differences in the recollection of emotional personal memories and the associated postretrieval emotional states. First, we found that extraversion predicted positive AMs in both women and men, while neuroticism predicted the frequency of rehearsal of affective AMs in women and the proportion of negative AMs in men. Second, reappraisal and suppression had different sex-dependent effects on the proportion of positive versus negative AMs, with reappraisal being related to positive AMs in men and suppression
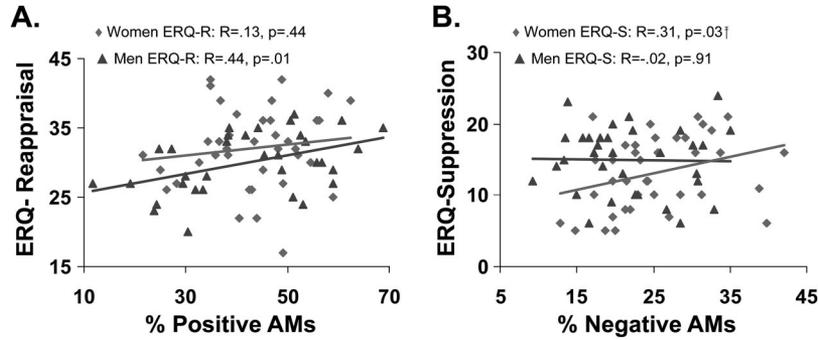
Figure 3. Differential sex-dependent effects of reappraisal versus suppression on affective AMs. A. Reappraisal (ERQ-R) predicts retrieval of positive AMs only in men, while B. Suppression (ERQ-S) predicts retrieval of negative AMs only in women. $p < .05$, one-tailed.

with negative AMs in women. Third, positive AMs predicted positive postretrieval state through a mediating effect of extraversion, while negative AMs directly predicted negative postretrieval state, which was also associated with suppression in women. These findings will be discussed in turn below, in the context of the main questions of the study.

The Role of Personality- and Sex-Related Differences in the Retrieval of Affective AMs

The finding that extraversion predicted retrieval of positive AMs in both women and men is consistent with evidence that people high in extraversion tend to be more oriented toward positive and rewarding experiences. For instance, highly extraverted people report more positive affect while watching funny films (Gross, Sutton, & Ketelaar, 1998; Morrone, Depue, Scherer, & White, 2000), and are more likely to imagine themselves in

happy events (Larsen & Ketelaar, 1991), which is consistent with an overall positive mindset.

Extending these results, our findings provide initial evidence that extraversion, typically associated with being assertive and experiencing excitement and positive affect (Costa & McCrae, 1980; Gross et al., 1998), also contributes to remembering more positive personal experiences and to maintaining a positive state (as also discussed below). This was possible as a result of addressing limitations of previous investigations that tended to use much fewer memories (e.g., 6), and relatively smaller subject samples ($N < 40$) (e.g., Quoidbach et al., 2008), and to focus more extensively on the role of negative experiences in mental health (Diener, Suh, Lucas, & Smith, 1999). Thus, the present findings linking positive personality traits to reliving positive memories provide further support to the notion that positive thinking and orientation toward positive experiences promote mental well-being
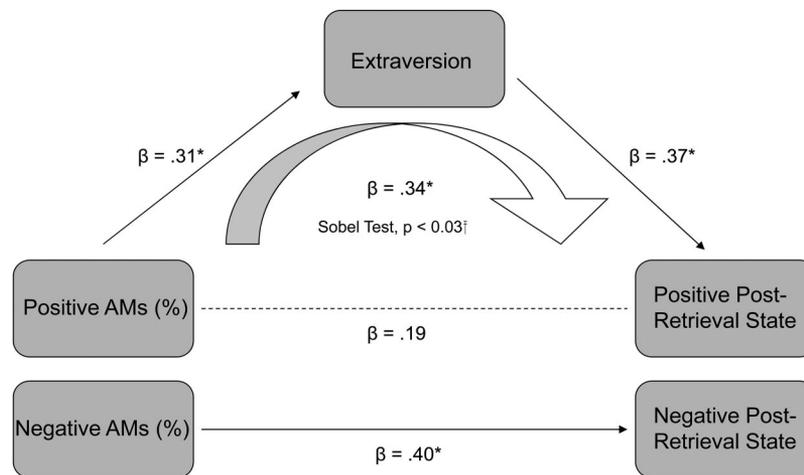

Figure 4. The impact of retrieval of affective AMs on the subsequent affective state. Extraversion mediates the effects of positive AMs recollection on positive postretrieval state in the absence of a direct relationship[1] between positive AMs and positive postretrieval state (dotted lines). By contrast, recollection of negative AMs directly predicts the negative postretrieval state. *Note:* [1] Investigation of possible indirect effects of AMs on postretrieval affective state, in the absence of a direct effect between AMs and postretrieval mood, is justified by previous validations of this approach (Hayes, 2009; Mathieu & Taylor, 2006). * $p < .05$ or $p < .01$, significant at one-tailed test.

Table 3

Averages, Standard Deviations (SDs), and Correlations for Postretrieval Affective States, Affective AMs (%) and Personality Measures

Post-Retrieval State	All (n = 62)		% Pos AMs	% Pos-Neg AMs	% Neg AMs	Extraversion	Neuroticism	N-Anx	N-Depr	N-SR	ERQ-R	ERQ-S
	Mean	SD										
PANAS-S Positive	24.65	7.27	.1915	.1531	.0496	†*.3570***	‡−**.3070***	‡−**.3302***	‡−**.2259**†	†−**.2520***	‡**.2683***	‡−**.2132***
PANAS-S Negative	12.58	3.36	−.0628	‡−**.2636***	†*.3973****	**.0570**	§*.2262*†	§*.2245*†	**.0104**	§*.2483*†	−**.1846**	.2028
	Women (n = 31)											
	Mean	SD										
PANAS-S Positive	24.06	7.96	.2641	.2477	−.0328	.4467*	−.3400†	−.3877*	−.2985†	−.2011	.3610*	−.2844
PANAS-S Negative	12.10	2.37	−.1814	−.4284*	.4708***	−.0871	.2380	.2133	.1919	.2341	−.1675	.3679*
	Men (n = 31)											
	Mean	SD										
PANAS-S Positive	25.23	6.60	.1611	.0724	.1795	.3102†	−.2371	−.2406	−.1079	−.2903	.1589	−.1694
PANAS-S Negative	13.06	4.11	−.0082	−.2131	.4422*	.1491	.3260†	.3408†	−.0770	.3647*	−.1938	.0752

Note. Pos = Positive; Neg = Negative; AMs = Autobiographical Memories; N-Anx = Anxiety subscale from neuroticism; N-Depr = Depression subscale from neuroticism; N-SR = Self-Reproach subscale from neuroticism; ERQ-R = ERQ-Reappraisal; ERQ-S = ERQ-Suppression. † = Italic and underlined = results in both women and men; ‡ = Underlined = results driven by women; § = Italic = results driven by men.

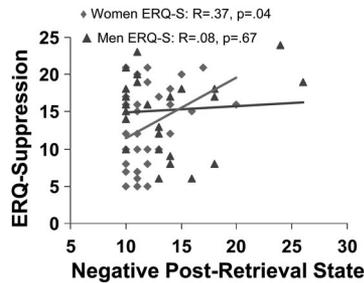* $p < .05.$ ** $p < .01$ or $0.001.$ ‡ $p < .05$, one-tailed.

Figure 5. Suppression (ERQ-S) predicts negative postretrieval state only in women.

(Davidson, 2004; Davidson, Jackson, & Kalin, 2000). These findings may also provide insight into identification of therapeutic approaches in affective disorders, focused on reversing negative affective biases (Diener & Seligman, 2002; Fredrickson, 2001, 2004; MacLeod & Moore, 2000).

On the other hand, the finding that neuroticism predicted negative memories is consistent with evidence generally linking neuroticism with the experience of negative emotions (Costa & McCrae, 1980; Costa & McCrae, 1992), and with sex-related differences in processing negative emotions (Thomsen, Mehlsen, Viidik, & Zachariae, 2005). The fact that neuroticism predicted the frequency of AM rehearsal in our female participants is consistent with evidence that women are more likely to ruminate on negative experiences (Nolen-Hoeksema, Larson, & Grayson, 1999). It is unclear, however, why neuroticism was linked to the proportion of negative AMs only in men, despite the fact that our female participants had overall greater neuroticism scores and remembered more negative AMs. This unexpected finding highlights the importance of considering that the same personality factor may have different consequences in men and women, and this matter requires further investigation in studies specifically focusing on sex-related differences, in contrast to most of the existing studies of neuroticism (e.g., Martin, Ward, & Clark, 1983; Mayo, 1983). The relationships with neuroticism should be systematically investigated not only in women, but also in men, especially in studies with larger samples.

Turning to our second main finding, the fact that reappraisal predicted recollection of more positive AMs is consistent with evidence that people who make more frequent use of reappraisal as a coping strategy also tend to experience more positive and less negative emotions (Gross & John, 2003). The fact that this effect was observed only in men suggests that men with high reappraisal scores may be more systematically using positive past experiences to reappraise negative experiences when dealing with stressful situations, which in turn may lead to easier access of positive AMs. This relationship between reappraisal and retrieval of positive AMs in men is somehow surprising, given that overall women tended to have slightly higher reappraisal scores; instead, a similar relationship was found in women between suppression and retrieval of negative AMs. Together, these findings extend the evidence that men and women differ not only in terms of general emotional reactivity but also in the engagement of emotion regulation strategies (Mak et al., 2009; Matud, 2004; Nolen-Hoeksema, 2001; Thayer et al., 2003) linked to the retrieval of emotional memories.

These findings also highlight the importance of investigating the differential impact of personality factors on AM recollection in men and women, which may not necessarily be directly related to differences in the actual scores for personality traits. For instance, although men did not have higher scores for neuroticism, those who did also remembered more negative memories, but this relationship was not identified in women (who overall had higher neuroticism scores). Similarly, although women had slightly higher scores in reappraisal (a more effective ER strategy), this did not result in remembering fewer negative memories. It should be noted that these sex-related differences in the relationships between personality traits and AM retrieval were identified in the absence of differences in the way women and men rated the retrieved information, which rules out the possibility that the effects on memory retrieval per se were contaminated by differential biases in evaluating and rating affective retrieved information.

The Role of Personality- and Sex-Related Differences in the Relationship Between Affective AMs and Emotional States

The third main finding of the present study was that positive AMs predicted positive postretrieval mood through a mediating effect of extraversion, while negative AMs directly predicted negative postretrieval mood; the latter was also related to suppression in women. Overall, these findings are consistent with evidence showing valence-congruent relationships between remembering of nonpersonal memory and mood (Rusting, 1999). In addition, the mediating role of extraversion emphasizes a role of this personality trait not only in (re)experiencing positive personal memories, as discussed earlier, but also in maintaining a positive postretrieval mood. It is interesting that our results showed that extraversion also mediated the positive effect of preretrieval mood on the retrieval of positive AMs (see Supplementary Figure S2). By contrast, remembering negative memories directly predicted negative mood after recollection, which points to a stronger impact of reliving negative AMs on subsequent negative affective states. Specifically, unlike retrieval of positive memories, which influences positive mood via extraversion, remembering negative memories is a sufficient condition to induce negative mood. Consistent with this idea, there was an overall pre- to post- retrieval reduction in the positive mood (see Supplementary Material–Results), despite the fact that overall participants remembered more positive memories.

The finding that suppression predicted postretrieval negative mood in our female participants, along with the fact that suppression also predicted recollection of negative AMs in women, is consistent with the suggestions that women may regulate their negative emotions less effectively (Mak et al., 2009), possibly by engaging less efficient emotion regulation strategies (i.e., suppression) (Gross & John, 2003). On the one hand, these findings may be interpreted in line with the theory of *ironic mental control*, which proposes that in people with high negative affect (such as depression and anxiety), attempts to suppress negative emotions may in fact lead to paradoxical increases in such feeling (Wegner, Erber, & Zanakos, 1993; Wegner, Wenzlaff, & Kozak, 2004). For instance, Dalgleish, Yiend, Schweizer, and Dunn (2009) found that when asked to suppress their feeling about distressing memories, people with high negative affect exhibited increased negative

emotions (see also Neufeind, Dritschel, Astell, & MacLeod, 2009). In contrast to women, men high in suppression seem to remember more neutral memories suggesting that, in men, suppression may be more efficient than previously documented. This finding points again to the importance of the differential impact of the personality factors in men and women, and future studies should compare the effects of these and other emotion regulations strategies, such as psychological distancing, on remembering real-life events in men and women.

These findings suggest that engaging suppression as a habitual coping strategy in women is inefficient and it may come at a cost, as it leads to overall increased retrieval of negative AMs and postretrieval negative affect. This interpretation is supported by the findings that high suppressor women remembered relatively more negative AMs compared to positive AMs, had higher neuroticism and lower extraversion scores, and greater reduction of positive affect following AM retrieval. This interpretation provides further support to the evidence that negative affective biases are linked to the habitual use of suppression (Gross & John, 2003), which may be related to enhanced susceptibility to depression in women (Kessler, 2003; Nolen-Hoeksema, 2001). By contrast, using reappraisal may be a helpful and efficient strategy, since our results also revealed that reappraisal is linked to positive emotional postretrieval state in women.

Overall, the present findings are consistent with the existence of sex-related differences in the direction of a negative affective bias in retrieving and experiencing AMs in women (see Figure 6, for a summary of findings). Namely, the combination of personality traits associated with negative affect (neuroticism) linked to increased rehearsal of affective memories and inefficient use of emotion regulation strategies (suppression), associated with the recollection of negative memories and the associated postretrieval negative mood. Nevertheless, the idea that these findings from healthy participants may establish a direct link to the evidence of

increased susceptibility to depression and anxiety in women (Kessler, 2003; Nolen-Hoeksema, 2001) needs further validation (e.g., from studies involving samples of participants that vary from nonclinical to subclinical and clinically diagnosed patients).

Summary and Conclusions

In sum, our findings provide initial evidence about the combined role of personality- and sex-related factors in experiencing affective autobiographical memories and the associated postretrieval affective states. The present study demonstrates that extraversion predicts recollection of positive personal memories and contributes to the maintenance of a positive mood in both sexes, whereas neuroticism predicts different aspects of memories in men and women. Our study also provides evidence that different emotion regulation strategies have dissociable effects on positive versus negative personal memories in men and women, with reappraisal being related to positive memories in men, while suppression being related to negative memories in women. Moreover, our findings also reveal that compared to men, healthy women reexperience more negative memories, and that suppression also predicts negative postretrieval mood in this group. Collectively, the present findings provide insight into the factors that contribute to a negative affective bias in healthy women in reliving personal memories, and suggest a possible link to increased susceptibility to affective disorders. Namely, the combination of personality traits associated with negative affect (neuroticism) linked to increased rehearsal of affective memories and inefficient use of emotion regulation strategies (suppression), associated with the recollection of negative memories and the associated postretrieval negative mood. To our knowledge, this is the first study revealing such relationships by concomitantly investigating the role of personality and sex-related differences in the recollection of emotional personal memories. The present findings have relevance for therapeu-
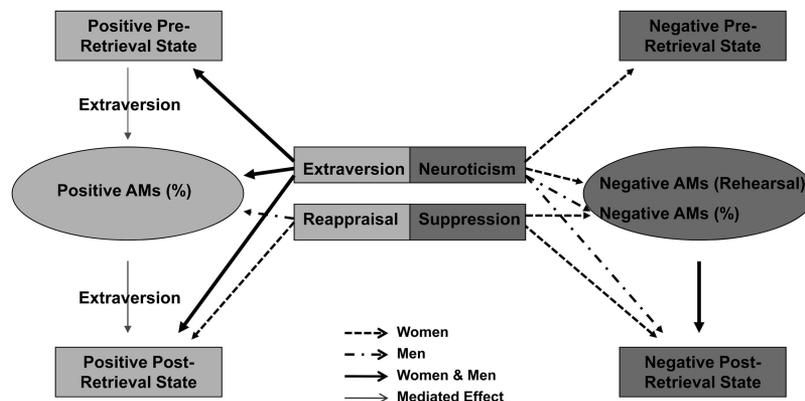

Figure 6. Summary of the main findings: sex-related differences consistent with a negative affective bias in women, in reliving emotional AMs and the associated emotional states. Extraversion predicts retrieval of positive memories and associated mood in both women and men (black arrows), while neuroticism has differential predicting value in women and men. Reappraisal predicts recollection of positive AMs only in men, but positive postretrieval state in women, whereas suppression predicts recollection of negative AMs and negative postretrieval mood only in women. Note that unlike the effect of recollecting negative AMs on negative postretrieval state, which is direct (illustrated by the black thick arrow on the right side of the diagram), the effect of positive preretrieval state on recollecting positive AMs and their subsequent effect on the positive postretrieval state are indirect, mediated by extraversion (illustrated by the gray thin arrows on the left side of the diagram); see also Figure 4 above and supplemental Figure S2.

tic intervention (e.g., training in positive thinking and/or training to reappraise) in patients with affective disorders, who tend to focus on negative personal experiences and thus maintain a negative affective state.

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Supplementary Material - Method

Measures

The Autobiographical Memory Questionnaire (AMQ). The main purpose of including a large number of cues was to address the limitations of previous studies which used a very small number of AMs (e.g., from 2 to 20) (see Mayo, 1983; Ruiz-Caballero & Bermudez, 1995; Wisco & Nolen-Hoeksema, 2010). For each cue in the list, participants were asked to remember a specific memory from their lives that occurred in a specific place and time, and that happened only once. They were instructed that the memories could be from any point in their lives, and that they must be accompanied by recollection of being personally involved rather than hearing about them from others. Examples were provided to make sure that the instructions were well understood. Concerning the ratings of AMs, in contrast to previous studies where ratings were recorded from independent coders rather than from the study participants (e.g., Wisco & Nolen-Hoeksema, 2010), we favored a method where the ratings were reported by the participants themselves, and hence reflected more accurately their subjective experiences.

The Neuroticism- Extraversion-Openness Five-Factor Inventory (NEO-FFI). NEO is a 60-item self-report questionnaire that assesses the five main domains of personality: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. Examples of neuroticism and extraversion items include 'I am seldom sad or depressed' and 'I laugh easily', respectively. Participants rated each item on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The purpose of decomposing the neuroticism score into its 3 sub-scores was to investigate whether any of these facets is driving the overall effects of the neuroticism score (see also Chapman, 2007).

The Emotion Regulation Questionnaire (ERQ). The ERQ is a 10-item self-report questionnaire composed of a 6-item reappraisal subscale (e.g., 'I control my emotions by changing the way I think about the situation I am in') and a 4-item suppression subscale (e.g., 'I control my emotions by not expressing them'). Participants rated each item on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

The Positive and Negative Affective Schedule (PANAS-S). PANAS-S is a widely-used measure of current

mood state composed by a list of 20 adjective descriptors of 10 positive (e.g., 'interested', 'enthusiastic')

and 10 negative (e.g., 'irritable', 'upset') affects. Items are rated on a 5-point scale (1 = very slightly or

not at all, 5 = extremely), according to how participants presently feel.

Data Analyses

It should be noted that we adopted the term of *overall proportion* of positive / negative AMs to

designate the % of positive and negative AMs, calculated for each participant relative to the total number

of AMs recalled. We also used the term *relative proportion* of positive / negative AMs to designate the %

of positive and negative AMs relative to each other (i.e., calculated by subtracting the % of positive and

negative AMs from each other: i.e., % Positive AMs minus % of Negative AMs and vice versa). While

overall proportion is separately indexing the proportion of positive and negative AMs, the relative

proportion is indexing a more direct comparison of the proportion of positive and negative AMs.

T tests and ANOVAs were used to investigate sex-related differences in personality factors,

affective AMs (across-groups) and emotional states, before and after AMs retrieval (within and across-

groups). Hierarchical regression analyses (Cohen, Cohen, West, & Aiken, 2003; McFall, Geall, Fischer,

Dolcos, & Dixon, 2010), investigating whether sex moderates the relationship between personality

measures and affective AMs , involved three-steps hierarchical regressions (moderation analyses). Each

step corresponded to the entry of single variables (i.e., Step 1: personality measures; Step 2: sex; and Step

3: personality measures x sex interaction term. Correlation analyses were performed separately in women

and men, to further investigate the relationship between personality measures and affective AMs, with a

focus on examining potential relationships that may be present only in one sex group or may go in

opposite directions women or men, and hence possibly precluding their identification with whole-group

analyses.

Regression-based mediator analyses (Preacher & Hayes, 2004) sought to identify: (a) independent

variables predicting dependent variables, (b) independent variables predicting mediator(s), and (c)

independent variables and the potential mediator(s) considered together to predict the dependent variables. Investigations of the role of personality- and sex-related differences in the relationship between affective AMs and emotional states also considered emotional states recorded before recollection of AMs. Depending on whether the impact of *pre-retrieval* emotional state on AMs, or the impact of AMs on the *post-retrieval* emotional states were tested, positive and negative AMs were either the dependent or the independent variable, respectively. Specifically, to determine whether the effect of the *pre* emotional state (independent variable) on the recollection of affective AMs (dependent variable) is mediated by personality traits (the mediator), and whether the effect of the affective memories (independent variable in this case) on the *post* emotional state (dependent variable) is mediated by personality traits (the mediator), unstandartised regression coefficients and the corresponding standard errors for the regressions b and c above were tested using the Sobel test (Preacher & Hayes, 2004). Finally, to control for sex-related differences in the mediation-based analyses, the sex factor was kept constant (i.e., entered in the first step of each regression analysis).

Supplementary Material - Results

For each of the research questions, we report a table presenting the results from the three-step multiple regression analyses (i.e., moderation analyses), which were significant at least in the first step.

1. The Role of Personality- and Sex-Related Differences in the Retrieval of Affective AMs

Table S1: Hierarchical Multiple Regressions Examining the Moderation Effect of Sex on the Relationship between Personality Factors and Affective AMs. Summary of the results from the three-step hierarchical regression analyses investigating the relationship between each personality factor and affective AMs, for both the proportion of affective AMs and their characteristics.

Extraversion	% Pos AMs			% Pos-Neg AMs			Intensity Neg AMs		
	β	ΔR2	ΔF	β	ΔR2	ΔF	β	ΔR2	ΔF
Block 1	0.34	0.12	9.28**	0.24	0.06	4.25*	0.28	0.08	5.69*
Block 2	0.01	0.00	0.00	0.13	0.02	1.24	-0.14	0.02	1.34
Block 3	0.37	0.01	0.35	0.10	0.00	0.03	0.06	0.00	0.01

Neuroticism	% Neg-Pos AMs			Rehearsal Pos/Neg AMs		
	β	ΔR2	ΔF	β	ΔR2	ΔF
Block 1	-0.23	0.05	3.77†	0.38 / 0.45	0.15 / 0.20	11.94** / 17.70**
Block 2	-0.06	0.00	0.23	-0.04 / -0.04	0.00 / 0.00	0.15 / 0.13
Block 3	1.01	0.08	6.35*	-0.73 / -0.99	0.04 / 0.08	3.56† / 7.30**

N- Anx	Rehearsal Pos/Neg AMs		
	β	ΔR2	ΔF
Block 1	0.26 / 0.33	0.07 / 0.11	5.21* / 8.39**
Block 2	-0.07 / -0.06	0.00 / 0.00	0.29 / 0.26
Block 3	-0.97 / -1.11	0.10 /0.13	7.99** / 11.55**

N- Depr	Rehearsal Pos/Neg AMs		
	β	ΔR2	ΔF
Block 1	0.26 / 0.28	0.06 / 0.08	4.53* / 5.96*
Block 2	-0.10 / -0.11	0.01 / 0.01	0.70 / 0.82
Block 3	-0.76 / -1.21	0.07 / 0.18	5.52* / 16.31**

N-SR	% Neg-Pos AMs			% Neg AMs			Intensity Pos AMs			Pers Sign Neg AMs			Rehearsal Pos/Neg AMs		
	β	ΔR2	ΔF	β	ΔR2	ΔF	β	ΔR2	ΔF	β	ΔR2	ΔF	β	ΔR2	ΔF
Block 1	0.25	0.06	4.70*	0.29	0.09	6.80*	0.23	0.05	3.84†	0.26	0.07	5.22*	0.40 / 0.43	0.16 / 0.18	13.03** / 15.62**
Block 2	-0.05	0.00	0.14	-0.18	0.03	2.48	-0.01	0.00	0.00	0.08	0.01	0.44	-0.03 / -0.03	0.00 / 0.00	0.06 / 0.08
Block 3	0.74	0.06	4.96*	0.5	0.03	2.25	-0.23	0.01	0.43	-0.14	0.00	0.17	-0.38 / -0.48	0.02 / 0.3	1.40 / 2.31

ERQ-R	% Pos AMs			Vividness Pos/Neg AMs			Context Pos/Neg AMs		
	β	ΔR2	ΔF	β	ΔR2	ΔF	β	ΔR2	ΔF
Block 1	0.27	0.07	5.26*	0.28 / 0.31	0.08 / 0.09	6.06* / 7.28**	0.27 / 0.34	0.07 / 0.12	5.36* / 9.23**
Block 2	0.02	0.00	0.03	-0.07 / -0.02	0.01 / 0.00	0.39 / 0.33	-0.07 / -0.02	0.00 / 0.00	0.31 / 0.04
Block 3	1.58	0.06	4.74*	-0.00 / -0.02	0.00 / 0.00	0.00 / 0.00	-1.03 / -1.25	0.03 / 0.04	1.96 / 2.83†

ERQ-S	% Pos AMs			% Neg-Pos AMs		
	β	ΔR2	ΔF	β	ΔR2	ΔF
Block 1	-0.21	0.05	3.27†	0.25	0.07	4.76*
Block 2	0.01	0.00	0.00	-0.15	0.02	1.71
Block 3	-0.14	0.00	0.12	-0.15	0.00	0.15

Note. Pos = Positive, Neg = Negative, AMs = Autobiographical Memories, N-Anx = Anxiety sub-scale from neuroticism, N-Depr = Depression sub-scale from neuroticism, N-SR = Self-Reproach sub-scale from neuroticism, ERQ-R = ERQ-Reappraisal, ERQ-S = ERQ-Suppression, Pers Sign = Personal Significance, Context = Contextual Details. * $p < 0.05$, ** $p < 0.01$ or 0.001, † $p < 0.05$, one-tailed.
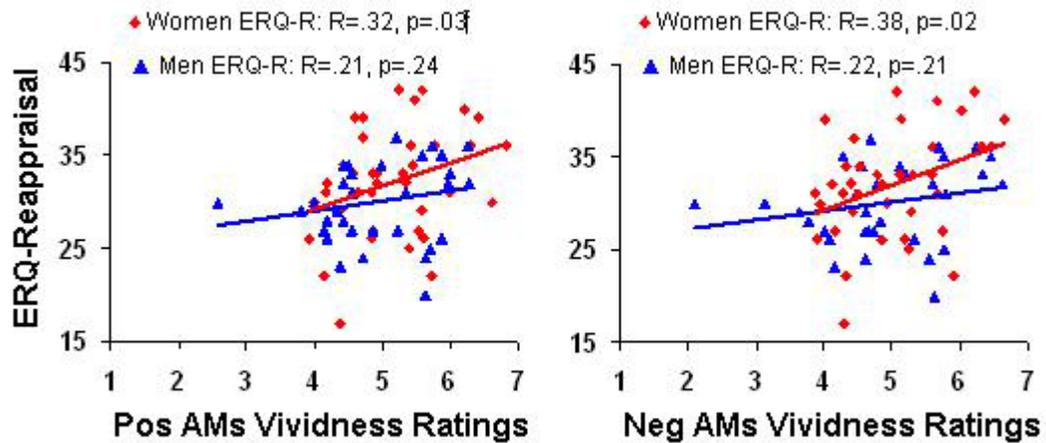
Figure S1. Reappraisal (ERQ-R) Predicts the Vividness of Positive (Pos) and Negative (Neg) AMs in Women only. [†] Significant at one-tailed test

2. The Role of Personality- and Sex-Related Differences in the Relationship between Affective AMs and Emotional States

Table S2: Hierarchical Multiple Regressions Examining the Moderation Effect of Sex on the Relationship among Personality Factors, Affective AMs, and Affective States. Summary of the results from the three-step hierarchical regression analyses according to the valence of the affective state: A. Findings from analyses investigating the relationship between positive pre- and post-retrieval affective states and personality traits associated with positive affect. B. Findings from analyses investigating the relationship between the negative pre- and post-retrieval affective states and personality traits and memory associated with negative affect.

A.	Pre-Retrieval Positive State			Post-Retrieval Positive State		
	β	Δ R2	Δ F	β	Δ R2	Δ F
Extraversion						
Block 1	0.47	0.22	17.19**	0.36	0.13	8.76**
Block 2	0.09	0.01	0.65	0.12	0.01	0.98
Block 3	0.30	0.00	0.24	-0.79	0.02	1.47
ERQ-R						
Block 1	0.25	0.06	3.91†	0.27	0.07	4.66*
Block 2	0.08	0.01	0.39	0.12	0.02	0.96
Block 3	-0.32	0.00	0.17	-0.50	0.01	0.43
B.	**Pre-Retrieval Negative State**			**Post-Retrieval Negative State**		
	β	Δ R2	Δ F	β	Δ R2	Δ F
Neuroticm						
Block 1	0.34	0.12	7.95*	0.23	0.05	3.23†
Block 2	-0.04	0.00	0.10	0.22	0.04	2.83†
Block 3	-0.10	0.00	0.05	0.48	0.02	1.20
N- Anxiety						
Block 1	0.32	0.10	7.00*	0.22	0.05	3.18†
Block 2	-0.03	0.00	0.06	0.23	0.05	3.15†
Block 3	-0.26	0.01	0.44	0.43	0.02	1.24
N-Self-Reproach						
Block 1	0.30	0.09	5.99*	0.25	0.06	3.94†
Block 2	-0.04	0.00	0.11	0.23	0.05	3.26†
Block 3	0.04	0.00	0.01	0.43	0.02	1.43
% Negative AMs						
Block 1				0.40	0.16	11.25**
Block 2				0.24	0.06	4.10*
Block 3				0.29	0.01	0.48
% Neg-Pos AMs						
Block 1				-0.26	0.07	4.48*
Block 2				0.16	0.03	1.67
Block 3				-0.15	0.00	0.27

Note. Pos = Positive, Neg = Negative, AMs = Autobiographical Memories, N-Anx = Anxiety sub-scale from neuroticism, N-Depr = Depression sub-scale from neuroticism, N-SR = Self-Reproach sub-scale from neuroticism, ERQ-R = ERQ-Reappraisal. * $p < 0.05$, ** $p < 0.01$ or 0.001, † $p < 0.05$, one-tailed.

Relationships among Personality Factors, Recollection of Affective AMs and Pre-Retrieval Emotional States

Analyses focusing on the impact of pre-retrieval emotional state on recollection of affective AMs, revealed that extraversion also had a mediating effect on the relationship between positive *pre*-retrieval state and the proportion of positive AMs (see Figure S2); negative *pre*-retrieval state did not affect the proportion of negative AMs ($R = 0.19$, $p > 0.14$) (see Table S3).
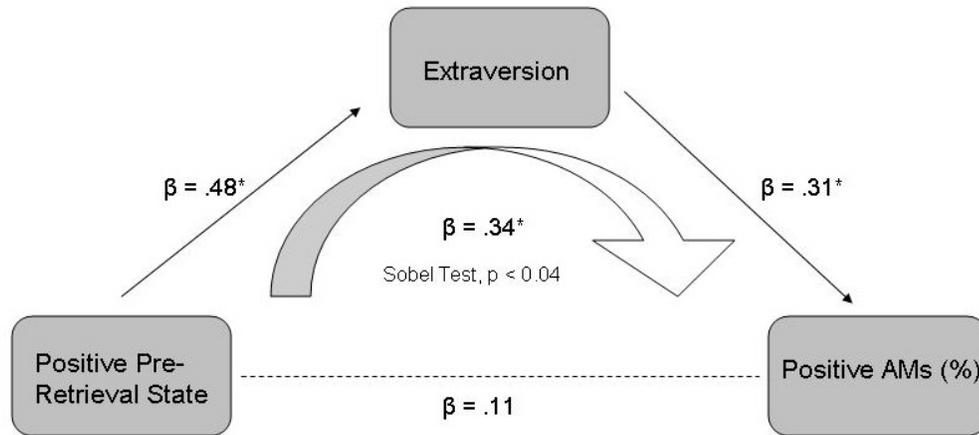
Figure S2. Extraversion Mediates the Relationships between Positive Pre-Retrieval State and Recollection of Positive AMs. * p < 0.05 or p < 0.01.

Table S3. Averages, Standard Deviations (SDs), and Correlations among the Pre-Retrieval Affective States, Affective AMs, and Personality Traits.

Pre-Retrieval State	All (n = 62)		% Pos AMs	% Pos-Neg AMs	% Neg AMs	Extraversion	Neuroticism	N-Anx	N-Depr	N-SR	ERQ-R	ERQ-S
	Mean	SD										
PANAS-S Positive	28.97	6.43	.1083	.0461	.1063	.4719**	-.2374	-.2185	-.3173**	-.1350	.2475*	-.1382
PANAS-S Negative	13.92	4.12	-.0698	-.1629	.1894	.0363	.3421**	.3232*	.1932	.3012*	-.2296	.1726
	Women (n = 31)											
	Mean	SD										
PANAS-S Positive	28.71	6.37	.2081	.1510	.0507	.3662*	-.2545	-.3072	-.2653	-.0987	.3428	-.0168
PANAS-S Negative	14.42	3.86	-.1651	-.1587	.0271	-.0459	.3990*	.4164*	.4074*	.2934	-.1867	.2205
	Men (n = 31)											
	Mean	SD										
PANAS-S Positive	29.23	6.59	.0531	-.0303	.1758	.5704**	-.2152	-.1249	-.3724*	-.1597	.1512	-.2892
PANAS-S Negative	13.42	4.37	-.0282	-.1578	.2815	.0723	.2533	.2006	-.0450	.2704	-.3458	.1868

Note. Pos = Positive, Neg = Negative, AMs = Autobiographical Memories, N-Anx = Anxiety sub-scale from neuroticism, N-Depr = Depression sub-scale from neuroticism, N-SR = Self-Reproach sub-scale from neuroticism, ERQ-R = ERQ-Reappraisal, ERQ-S = ERQ-Suppression. Purple italic and underlined = results in both women and men, Red underlined = results driven by women, Blue italic = results driven by men. * p < 0.05, ** p < 0.01 or 0.001, † p < 0.05, one-tailed.

Analyses focusing on the relationship between personality traits and *pre*-retrieval emotional states revealed that extraversion was positively correlated with the positive *pre*-retrieval state (R = 0.47, p < 0.001) and neuroticism was also positively correlated with the negative *pre*-retrieval state (R = 0.34, p < 0.01) (see Table S3). While moderation analysis did not revealed a significant neuroticism

x sex interaction (see Table S2), within-sex group correlations revealed that the depression sub-score of neuroticism was significantly correlated with the negative pre-retrieval state only in women ($R = 0.41$ for women vs. $R = -0.05$ for men) (see Figure S3), which probably prevented identification of significant effects at the level of the whole group.
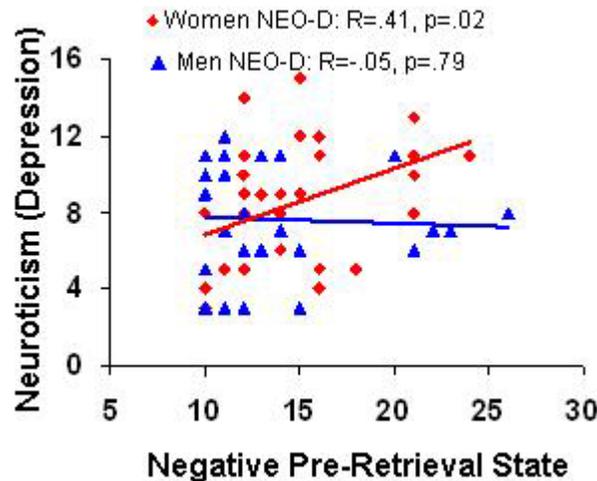

Figure S3. Depression Sub-Score of Neuroticism (NEO-D) Predicts Negative Pre-Retrieval State only in Women.

Post-Retrieval Changes in Positive and Negative Mood

A 3-way ANOVA examining changes in positive vs. negative states before and after AM recollection in women and men did not revealed a significant valence (positive vs. negative) x moment (pre vs. post) x sex (women vs. men) interaction ($F_{(1, 60)} = 0.49$, $p > 0.48$). However, they revealed a significant valence (positive vs. negative) x moment (pre vs. post) interaction ($F_{(1, 60)} = 10.07$, $p < 0.01$), which was due to a greater reduction in positive post-retrieval mood than in the negative post-retrieval mood ($p < 0.0001$ vs. $p < 0.05$).

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