

The role of depression and anxiety in developing true and false memories about past events

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Abstract: The present study aims to assess the interaction between depression and anxiety, on the one hand, and the emotional valence of a to-be-remembered material in determining true and false memories. A sample of 126 participants completed the study. For the assessment of the occurrence of true and false memories, a video memory paradigm was used. The participants completed scales for measuring depression and anxiety, then they watched two videos presenting a positive, respectively a negative life event. After watching the videos, the participants completed a recognition task, in order to assess both true and false memories. The results showed that more true memories were reported for negative event, by the participants with a low level of depression and anxiety. Moreover, both depression and anxiety interacted with the emotional content of the remembered material in determining true or false memories. The implications of the results are discussed.

Keywords: true memories, false memories, depression, anxiety, emotional content

Introduction

When trying to remember past events from our lives, we are prone to errors, given the reconstructive character of our memory. False memories are an example of such errors, representing memories of events that were never experienced (e.g. Loftus, 2005). These memories can be created through suggestion or imagination and can further create a distorted image of a person's reality (Moritz, Voigt, Arzola, & Otte, 2008; Zaragoza, Mitchell, Payment, & Drivdahl, 2011). Therefore, professionals from legal or clinical fields should be aware of the risks that particular techniques implies. Despite particular techniques based on suggestion and imagination, an important problem concerns the individual differences or predispositions that can affect the reliability of memories. Previous studies highlighted the role of persistent emotional states and emotional valence of the remembered experience in memory accuracy (Kensinger & Schacter, 2006; Nielson & Powless, 2007; Toffalini, Mirandola, Drabik, Melinder, & Cornoldi, 2014). In the present study, we focused on

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depression and anxiety, as stable emotional states. Thus, the overall aim of this study is to investigate how individual differences in terms of depression and anxiety and the emotional valence of an event interact in determining memory accuracy. For measuring memory accuracy, both true and false memories were assessed.

The role of emotional content of the to-be-remembered event in memory accuracy

Previous studies showed that the emotional valence of the to-be-remembered events has the potential to influence memory accuracy (Toffalini, Mirandola, Coli, & Cornoldi, 2015). According to socio-emotional selectivity theory, negative stimuli attract more attention because they contain more details and, therefore, a higher informational content (e.g., Carstensen & Mikels, 2005). Further, a greater attention to the details improves memory accuracy, by increasing the level of true memories and reducing false memories (Brainerd & Reyna, 2005; Brainerd, Reyna, & Ceci, 2008; Mirandola, Toffalini, Grassano, Cornoldi, & Melinder, 2014). However, concerning false memories, the evidence is mixed. Thus, contrary to the above mentioned point of view, other studies showed that negative emotional content of the to-be-remembered material increase false memory production (Dehon, Larøi, & Van der Linden, 2010). The Paradoxical Negative Emotion hypothesis tries to explain these mixed findings (Porter, Taylor, & ten Brinke, 2008). According to this theoretical approach, negative events, compared to positive events, lead to more accurate memories, but also can increase the vulnerability to false memories. This paradoxical effect can be explained based on the fact that our memory is simultaneous characterized by power and fragility. Moreover, it is considered that more attention paid to negative materials lead to a more processing time for different details. Further, the deep processing of information increase the number of true details recalled, but also facilitate the occurrence of processing errors, like false memories (Porter et al., 2008). However, despite this theoretical point of view, some individual characteristics can interact with the emotional valence of the to-be-remembered event, in order to determine the level of true or false memories. For example, it has been shown that stable emotional states, like depression and anxiety, can explain the differences in processing stimuli that are emotional in content (Leppanen, 2006). Because the persistent emotional states, unlike induced temporary emotional states, may affect memory through specific cognitive mechanism, they represent the focus of the present study.

The role of depression and anxiety

Previous studies showed that people in negative emotional states, like depression, present more item specific interpretation, which reduce false

memories (e.g., Brainerd et al., 2008; Howe, 2008). Contrary to this point of view, a large literature showed that a high level of depression cause different memory impairments, like overgeneralization in autobiographical memory and deficits in working memory (Drakeford, Edelstyn, Oyeboode, Srivastava, Calthorpe, & Mukherjee, 2010; Gotlib & Joormann, 2010; Joormann & Gotlib, 2008; Van Vreeswijk & De Wilde, 2004). The positive association between depression and false memories was also documented (Moritz et al., 2008; Zhu et al., 2010), although the lack of significant results concerning this relation can also be identified (Howe & Malone, 2011; Salthouse & Siedlecki, 2007). Therefore, there is not a clear picture concerning the relation between depression and memory accuracy.

Studies on the relation between anxiety and memory showed that this stable emotional state was associated with short-term memory effectiveness via increased arousal, although mixed findings were reported (for a meta-analysis, see Mitte, 2008). Thus, it was also considered that the preconscious attentional bias toward threatening stimuli specific to a high level of anxiety affect implicit memory (Mogg & Bradley, 2005; Tarsia, Power, & Sanavio, 2003). In additions, some studies document the association between anxiety and false memories (Zhu et al., 2010; Zoellner, Foa, Brigidi, & Przeworski, 2000), while other studied did not find a relation between these variables (Roberts, 2002; Yovel & Mineka, 2004).

The mixed findings concerning the relation between depression, anxiety, and memory accuracy can be partially explained by the emotional content of the remembered experience (Howe & Malone, 2011). The mood-congruent memory framework (Eich & Macaulay, 2000) sustain that people have a better recall for information congruent with one's mood (e.g., Brainerd et al., 2008; Howe, 2008). Most of the previous studies investigated this theoretical framework in relation with depression and confirmed the existence of a bias for information congruent with the present mood (for reviews see Mathews & MacLeod, 2005; Howe & Malone, 2011; Joormann, Teachman, & Gotlib, 2009; Toffalini et al., 2014; Yeh & Hua, 2009). The mood-congruent memory at person with a high level of anxiety has received comparatively little attention. Moreover, more of the previous studies investigated true recognition, not false memory (Wittekind, Terfehr, Otte, Jelinek, Hinkelmann, & Moritz, 2014). However, some studies showed that memories errors, like false memories, are particularly present for emotional information in individuals with depression (Howe & Malone, 2011; Moritz, Gläscher, & Brassens, 2005; Watkins & Brown, 2002). This bias was also found in individuals that only present a risk for depression, not an established diagnosis (Joormann, 2010; Krompinger & Simons, 2009). This distortion may be explained by a cognitive bias that imply difficulty in disengaging from negative material (Toffalini et al., 2014). An interesting results of the previous studies consists in the fact that the

susceptibility for false memories is higher not only for negative events, but also for positive events (Moritz et al., 2005; Yeh & Hua, 2009), although the role of depression and anxiety in the occurrence of false memories for positive events was rarely documented. Because previous findings are heterogeneous and did not clearly explained moderators for memory accuracy, further research is needed in this area (Wittekind et al., 2014).

In the present study, we investigated the relation between depression and anxiety, on the one hand, and true and false memories, related to emotional materials, on the other hand. Specifically, the aims of the present study are: 1) to investigate the relation between the emotional content of the to-be-remembered material and true and false memory; 2) to investigate the relation between stable emotional states, depression and anxiety, and true and false memory; 3) to assess the interaction between the emotional content of the to-be-remembered material and depression; 4) to assess the interaction between the emotional content of the to-be-remembered material and anxiety. Based on previous studies reported above, we expected that the participants will report more true memories and a low level of false memory for negative material, compared to positive material. Concerning the others aims, we cannot anticipate specific results, due to previous inconsistent findings. Moreover, the interaction between the above mentioned variables was not studied thus far.

Method

Participants and procedure

A sample of 134 undergraduate students participated at the current study, after signing an informed consent. Eight participants were excluded from the dataset because they failed to complete the tasks required by the study. The final sample consists of 126 participants (84.9% women). The age range between 18 and 34 (mean age of 21.14 years, $SD = 2.29$). After filling in the BDI-II, BAI, and then the films were shown, the participants were tested in six groups of about 20-23 participants for each group. The order of the videos' presentation was counterbalanced. At the end, the participants completed the recognition task and then they were debriefed. For their involvement in the research, all the participants received course credits.

Materials and measures

Video False Memory Paradigm

We used a false memory paradigm based on visual scenes, according to some previous research (Otgaar, Howe, Peters, Sauerland, & Raymaekers, 2013; Otgaar, Howe, Peters, Smeets, & Moritz, 2014; Peters, Engel, Hauschildt, Moritz, Jelinek, & Otgaar, 2012). Two videos different in terms of emotional valence were used to assess both false and true memories. They were chosen based on the following criteria: (1) themes are easy to identify; (2)

themes are universally familiar from human daily-life experience or other sources (e.g., media news, movies); (3) present detailed dynamic setting; and (4) are suitable for the emotional content. The negative event lasted 2 minute and 19 seconds and the positive event lasted 2 minutes and 10 seconds.

For selecting the two videos, a pilot study was conducted (described in Măirean, 2015). For positive condition, the video presents a party from a child birthday, with many peoples, both children and adults, having fun. For negative condition, the video represents a reportage about the consequences of a flood that followed an earthquake.

The recognition task was composed of 10 presented items for each video with a corresponding contextual cue from the specific video and 10 non-presented items for each video (40 items in total). The participants were asked to evaluate if the items (affirmations) are true or false, by choosing one answer from the following: *True/ False/ I am not sure or I do not remember*. These items were presented in a random order. Each item had a code consisting of a letter (that represent the initial of the videos' names) and a number (the number of the item). The participants were informed that the letter represents the video they should report to when responding to the item. For example, the first item was *A1. The child name is Matthew: True/ False/ I am not sure or I do not remember*.

The Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996) is a 21-item multiple-choice self-report inventory, used for measuring the severity of depression (e.g. Please pick out the one statement in each group that best describes the way you have been feeling during the past two weeks, including today: *Sadness*: I do not feel sad; I feel sad much of the time; I am sad all the time; I am so sad and unhappy that I can't stand it). The Cronbach Alpha in the present sample is .91.

Beck Anxiety Inventory (BAI; Beck & Steer, 1990) is a 21-item self-report questionnaire that lists symptoms of anxiety (e.g. Unable to relax). The respondent is asked to rate how much each symptom has bothered him/her in the past two weeks. The symptoms are rated on a four-point scale, ranging from "not at all" (0) to "severely" (3). In our sample, the instrument has a very good internal consistency ($\alpha = .86$).

Results

For each participant, three scores were computed: a score representing true memories (the total number of *True* answers for true statements and *False* answers for false statements, which represent a good memory for the videos' content) and two scores that reflect false memories, for related and for unrelated details (the total number of *True* answers for false statements).

Means and standard deviations for the groups we compared are presented in Table 1 and Table 2.

Table 1. Means for true recognition and false recognition as a function of depression and valence (SDs in parentheses)

	Low depression		High depression	
	Positive	Negative	Positive	Negative
True recognition	6.40 (0.20)	6.92 (0.17)	6.15 (0.21)	6.28 (0.18)
False recognition critical	1.29 (0.14)	1.35 (0.15)	1.33 (0.14)	1.44 (0.16)
False recognition unrelated	0.70 (0.12)	0.75 (0.12)	0.69 (0.12)	0.73 (0.12)

Table 2. Means for true recognition and false recognition as a function of anxiety and valence (SDs in parentheses)

	Low anxiety		High anxiety	
	Positive	Negative	Positive	Negative
True recognition	6.61 (0.19)	6.69 (0.19)	5.83 (0.22)	6.52 (0.23)
False recognition critical	1.33 (0.13)	1.29 (0.14)	1.31 (0.15)	0.92 (0.16)
False recognition unrelated	0.74 (0.11)	1.54 (0.11)	0.65 (0.13)	1.22 (0.12)

True Memory

The role of depression

We conducted a 2 (depression: low, high) \times 2 (valence: negative, positive) mixed ANOVA on the proportion of true recognition. We found a significant main effect of the event valence [$F(1,124) = 2.97, p = 0.047, \eta^2 \text{ partial} = .02$], more true memories being reported for the negative event ($M = 6.60$) than for the positive event ($M = 6.28$). The significant main effect of depression was also significant [$F(1,124) = 3.63, p = 0.049, \eta^2 \text{ partial} = .03$]. The participants with a low level of depression ($M = 6.66$) reported more true memories than the participants with a high level of depression ($M = 6.22$). A significant interaction also emerged [$F(1,124) = 1.07, p = 0.030$]. For the participants with a low level of depression, the level of true memories reported for negative event ($M = 6.92$) was higher than the level of true memories reported for positive event ($M = 6.41$) ($t(62) = -2.05; p = .045$). For the participants with a high level of depression, there were not significant differences between the level of true memories reported for negative event and that reported for the positive event ($t(62) = -0.46; p = .642$). Moreover, for negative event, the participants with a low level of depression ($M = 6.92$) reported more true memories than the

participants with a high level of depression ($M = 6.28$) ($t(124) = 2.14$; $p = .034$). For the positive event, the participants did not differ in their level of true memories based on the level of depression ($t(124) = 0.85$; $p = .395$). These results are presented in Figure 1.

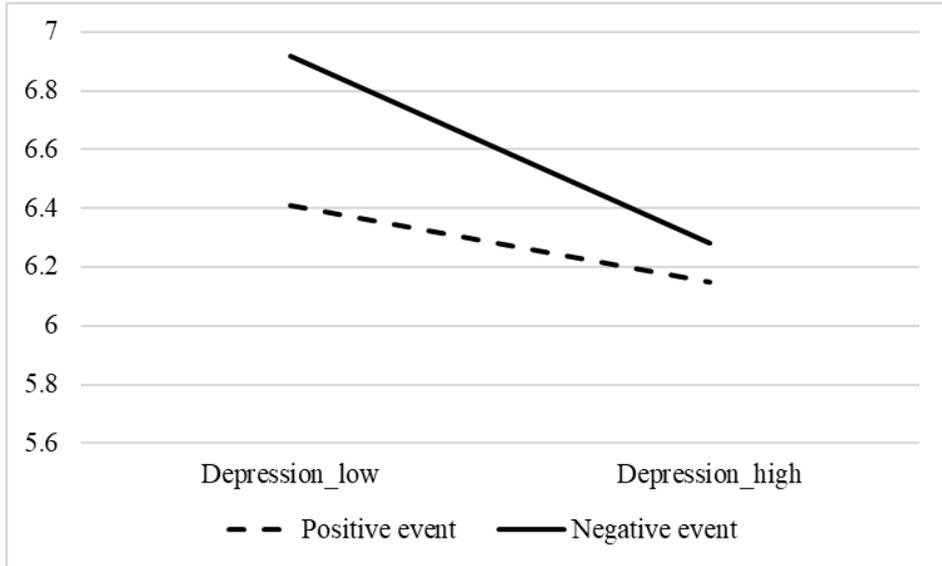


Figure 1. Presence of true memories as a function of depression and the event valence.

The role of anxiety

Further, we conducted a 2 (anxiety: low, high) \times 2 (valence: negative, positive) mixed ANOVA on the proportion of true recognition. We found a significant main effect of the event valence [$F(1,124) = 3.76$, $p = 0.050$, η^2 partial = .02]. Additional contrast tests showed that the participants reported more true memories for the negative event ($M = 6.58$) than for the positive event ($M = 6.22$). The significant main effect of anxiety was also significant [$F(1,124) = 4.57$, $p = 0.034$, η^2 partial = .03], more true memories being reported by the participants with a low level of anxiety ($M = 6.60$) than by the participants with a high level of anxiety ($M = 6.15$). A significant interaction also emerged [$F(1,124) = 2.45$, $p=0.013$]. Specifically, for the participants with a low level of anxiety, there are not significant differences concerning the level of true memories reported for positive and for negative event ($t(72) = -0.28$; $p = .774$). For the participants with a high level of anxiety, the level of true memories was significantly higher for negative event ($M = 6.52$) than for the positive event ($M = 5.83$) ($t(54) = -2.47$; $p = .017$). Moreover, for positive event, the participants with a low level of anxiety ($M = 6.61$) reported more true

memories than the participants with a high level of anxiety ($M = 5.83$) ($t(126) = 2.70$; $p = .008$). For the negative event, the participants did not differ in their level of true memories based on the level of anxiety ($t(126) = 0.52$; $p = .603$). These results are presented in Figure 2.

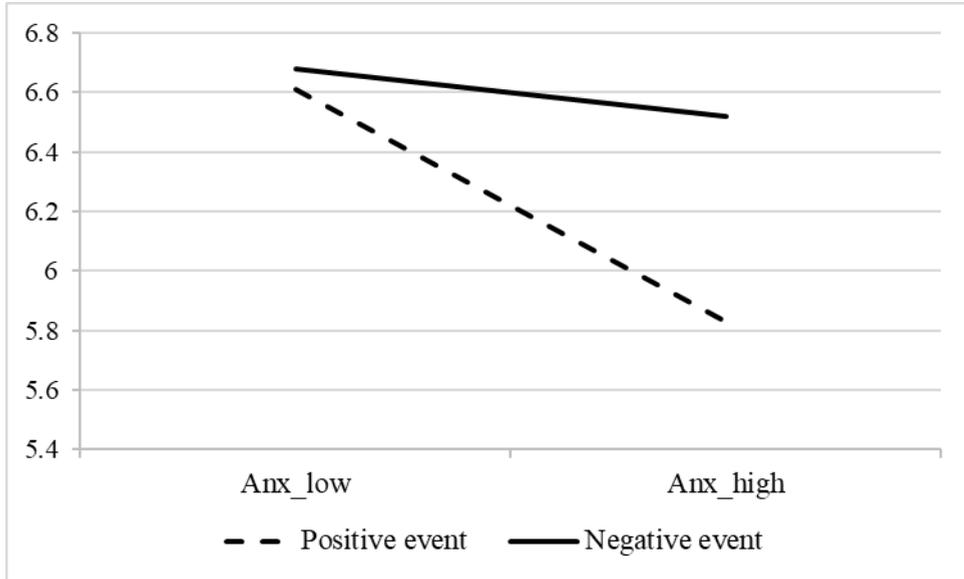


Figure 2. Presence of true memories as a function of anxiety and the event valence. Notes: Anx_low – low level of anxiety; Anx_high – high level of anxiety.

False Memory

The role of depression

A 2 (depression: low, high) \times 2 (valence: negative, positive) mixed ANOVA on the proportion of false recognition for the critical related items yielded a nonsignificant principal effects of the event valence [$F(1,124) = 2.29$, $p = .132$] and depression [$F(1,124) = 0.32$, $p = .570$]. The interaction effect is also nonsignificant [$F(1,124) = 1.14$, $p = 0.706$]. For unrelated false recognition, we found a significant main effect of the event valence [$F(1,124) = 57.51$, $p < .001$, η^2 partial = .32]. The negative event ($M = 1.40$) lead to a higher level of false memory than the positive event ($M = 0.67$). The principal effect of depression is nonsignificant [$F(1,124) = 1.11$, $p = .739$] and the interaction effect is also nonsignificant [$F(1,124) = 1.26$, $p = .988$].

The role of anxiety

A 2 (anxiety: low, high) \times 2 (valence: negative, positive) mixed ANOVA on the proportion of false recognition for the critical items yielded the

following results. The principal effects of the event valence [$F(1,126) = 2.89, p = .09$] and anxiety [$F(1,126) = 1.52, p = .219$] are nonsignificant. A significant interaction emerged [$F(1,126) = 1.88, p = .017$]. For the participants with a high level of anxiety, the high level of false memories was reported for the positive event ($M = 1.31$) than for the negative event ($M = 0.92$) ($t(53) = 2.50; p = .015$). For the participants with a low level of anxiety, there were not significant differences between the level of false memories reported for the positive event and that reported for the negative event ($t(71) = 0.22; p = .822$). The results are presented in Figure 3.

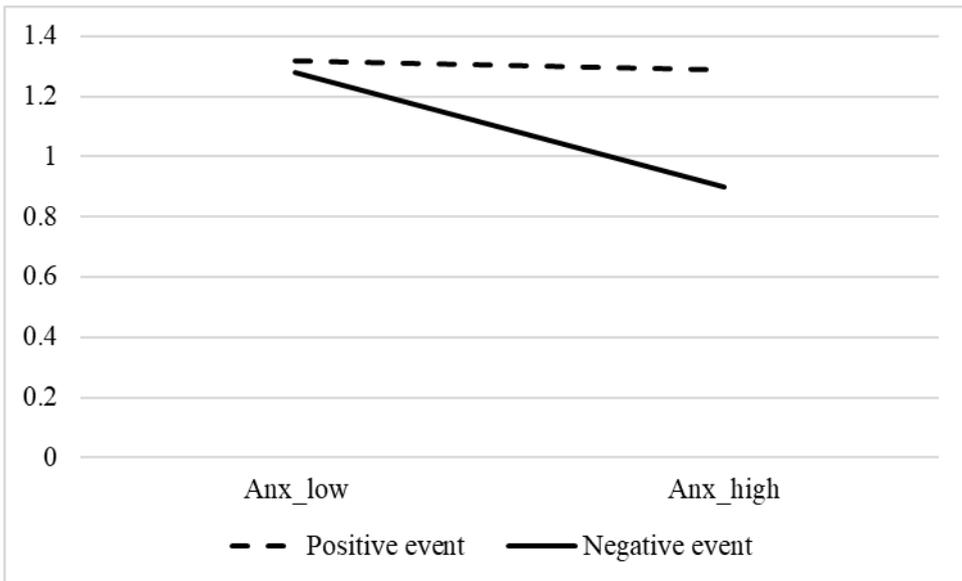


Figure 3. Presence of critical false memories as a function of anxiety and the event valence. Notes: Anx_low – low level of anxiety; Anx_high – high level of anxiety.

For unrelated false recognition, we found a significant main effect of the event valence [$F(1,124) = 46.30, p < .001, \eta^2 \text{ partial} = .27$]. Additional contrast tests showed that negative event ($M = 1.37$) lead to a higher level of false memory than the positive event ($M = 0.69$). The principal effect of anxiety is nonsignificant [$F(1,124) = 1.97, p = .163$] but a significant interaction emerged [$F(1,126) = 1.33, p = .025$]. Specifically, for the negative event, a high level of false memories was reported by the participants with a low level of anxiety ($M = 1.54$) than by the participants with a high level of anxiety ($M = 1.22$) ($t(124) = 1.84; p = .048$). For the positive event, there were not significant differences

between the participants with a high and with a low level of anxiety ($t(124) = 0.26$; $p = .789$). The results are presented in Figure 4.

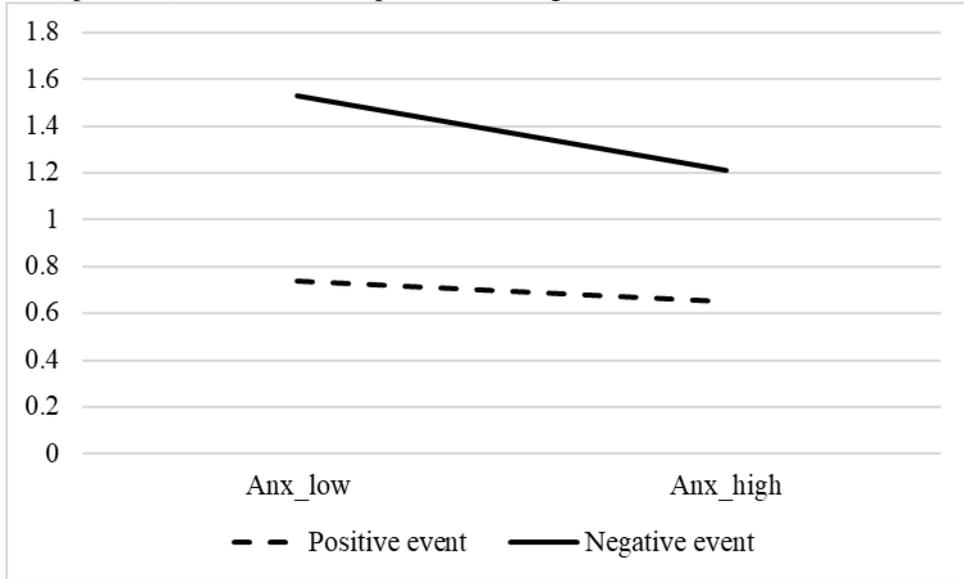


Figure 4. Presence of unrelated false memories as a function of anxiety and the event valence. Notes: Anx_low – low level of anxiety; Anx_high – high level of anxiety.

Discussion

The aim of the present study was to assess the relation between depression, anxiety, and memory accuracy for positive and negative life events. According to our hypothesis, the results showed that more true memories were reported for the negative event than for the positive event. This result confirmed the assumption of socio-emotional selectivity theory, according to which negative stimuli attract more attention and lead to a better memory accuracy (Carstensen & Mikels, 2005). However, contrary to the hypothesis, the negative event also leads to a higher level of unrelated false memory than the positive event. Thus, the results suggest that negative events improve memory accuracy but also lead to a high level of false memory. This paradox sustains the Paradoxical Negative Emotion hypothesis (Porter et al., 2008). Greater attention paid to negative life experiences makes them more active in our memory, and as a consequence more details can be remembered, but also more memory errors can occur. This pattern of results was also obtained in previous studies (Dehon et al., 2010). Because negative life experiences are more common for legal settings, the professionals from this field should be aware of the risks that remembering

these kind of experiences implies. This fact is particularly important because false memories can direct the decision process in a wrong direction.

The literature on memory accuracy in depression and anxiety is plagued by large inconsistencies, with several studies reporting a processing advantage for persons with a high level of depression and anxiety and others failing to do so (Brainer et al., 2008; Drakeford et al., 2010). Our results sustain one possible association between depression, anxiety, and memory accuracy. Specifically, the results showed that more true memories were reported by the participants with a low level of depression and anxiety, than by the participants with a high level of depression and anxiety. Concerning false memory, there are not significant differences in their level based on the level of depression or anxiety. Further, both depression and anxiety interact with the emotional content of the to-be-remembered material in determining memory accuracy.

The interaction between depression and emotional valence of the to-be-remembered event showed that the level of true memories reported for negative event was higher than the level of true memories reported for positive event only for the participants with a low level of depression. The interaction effect between depression and emotional valence of the to-be-remembered event on false memory is nonsignificant. The lack of significant results in relation with false memories can be explained by some variables that were not considered in the present study, like the personal salience of the material or the type of material being activated in memory. For example, Moritz et al. (2008) found that false memories in depression has been reported especially when the material was judged as personally salient. Moreover, Howe and Malone (2011) found that false memories in persons with depression are more susceptible for depression relevant materials. Thus, the negative valence may not be sufficient to elicit false memories in person with depression.

The interaction between anxiety and emotional valence of the to-be-remembered event showed that the level of true memories was significantly higher for negative event than for the positive event, for the participants with a high level of anxiety. The high level of arousal that characterize a person with a high level with anxiety may determine her to focus more attention on particular details and, therefore, to report more true memories (Mitte, 2008).

Concerning critical false memory, for the participants with a high level of anxiety, the high level of critical false memories was reported for the positive event than for the negative event. This results is consistent with the fact that positive event lead to a more superficial processing of information (Ruder & Bless, 2003) and to a high level of false memories. This is true only for person with a high level of anxiety, which can be explained by increased arousal manifested by these persons, especially for negative materials. When the level of anxiety is low, there were not significant differences between the level of false memories reported for the positive event and that reported for the negative

event. Therefore, the emotional valence of the remembered experience should be considered in relation with stable emotional states, like anxiety. For unrelated false recognition, the results showed that a high level of false memories for negative event was reported by the participants with a low level of anxiety than by the participants with a high level of anxiety. Other studies also found that the participants who scored low in anxiety had more false memories (Zhu et al., 2010), although the role of anxiety in relation with the emotional content of the remembered material was not studied before.

Several limitations of the present study should be noted. First, the sample is comprised by students and largely by females. Therefore, the generalizability of the results is limited to this population. Future studies should be realized on this focus, openly addressed to both males and females. Second, we only used a recognition test in this study. The use of recall vs. recognition tests should be considered in future studies in order to offer a complete picture about true and false memories. Third, other factors, like the personal salience of the material or the type of the material (e.g. traumatic) was not measured and should be considered in future studies.

To conclude, the findings suggest that participants present more veridical and false recognition for negative material and when they present a low level of depression and anxiety. Moreover, depression and anxiety interacted with the emotional valence of the remembered material in determining true or false memories. Given the limited number of studies investigating mood-congruent memory in depression and anxiety, we extended previous literature by studying this theoretical approach in relation with both negative and positive materials. Further, we extended previous results about mood-congruent memory distortions in depression and anxiety using an ecological video paradigm, which allowed to identify memory errors. This results can have implication both in clinical and in forensic context. If a client or an eyewitness is asked to report past events, their emotional states, especially depression and anxiety, should be assessed and considered when analyzing the testimony. Future research should also analyze more in depth the roles of depressive and anxious traits, in relation with other variables that can moderate their relation with memory accuracy.

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