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False memory for positive and negative life events. The role of mental imagery

Cornelia Măirean[1]

[1]*Alexandru Ioan Cuza University of Iasi*

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A false memory appears when a person recalls memories of events that did not actually happen to him or her. The present study focused on situational and personal determinants of spontaneous false memories. Specifically, we aimed to investigate the role of emotional valence of an event, as well as the individual differences in mental imagery in evocation false memory. Three videos in which related details were not shown but were presented during a recognition task were used to induce spontaneous false memories. The three videos are different in terms of valence, reflecting positive, negative and neutral events. A scale for measuring mental imagery was also used. A sample of 132 participants completed the study. The results showed that the positive event lead to a higher level of false memory than the negative event. Moreover, the participants differ in their susceptibility to false memories based on the level of imagery, but the interaction between the emotional valence of the event and mental imagery is not significant. The results are discussed from the perspective of their legal and clinical implications.

Keywords: false memory, true memory, emotional valence, imagery

Address of correspondence: Cornelia Măirean, Alexandru Ioan Cuza University of Iasi, Faculty of Psychology and Education Sciences, Psychology Department, Toma Cozma 3, Iasi-700554, Romania, mobile: +40740528231, e-mail: cornelia.mairean@psih.uaic.ro

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Introduction

We always want to be confident in our memories, but errors in recalls are not uncommon. Early memory research showed that memory can be both reproductive and reconstructive (Bartlett, 1932; cited in Roediger & McDermott, 1995). While reproductive memory refers to accurately reproducing information from memory, reconstructive memory involves a more active process when people assume, infer, or imagine what happened in order to fill in missing elements. During this process of reconstruction the past, errors are likely to occur. In some situations, these errors go beyond filling in minor gaps, leading to memories for events that we never experienced, but we only imagined or they were suggested to us (e.g. Bransford & Johnson, 1973). These memories are called false memories. Although they can be harmless in many daily life situation, false memories can have detrimental effects when they appear in legal or clinical proceedings. In the legal settings, the reliability of memory recollections is very important because these recollections are often the determining evidence factor in deciding whether a suspect should be convicted (Otgaar, Howe, Peters, Sauerland, & Raymaekers, 2013; Zhu et al., 2010). In clinical settings, many therapists use imagery techniques that can increase the risk of creating false memories (Lindsay & Read, 1994). Therefore, many researchers and professionals are interested in studying the factors that affect the reliability of memories (Brainerd, Reyna, & Ceci, 2008).

Previous studies showed that our memory is influenced by emotional valence of the to-be remembered events (Toffalini, Mirandola, Coli, & Cornoldi, 2015), but there is still considerable debate in the literature regarding whether negative emotional events make false memories more likely than positive events (e.g., Dehon, Bastin, & Larøi, 2008; Gallo, Foster, & Johnson, 2009). Additionally it is apparent that some individual differences, like mental imagery, may increase vulnerability to false memories (Conway & Loveday, 2015). The overall aim of this study is to investigate how the emotional valence of an event and individual differences in terms of mental imagery interact in predicting the susceptibility to false memories.

The role of emotional valence

Several studies have induced different emotions to the participants in order to investigate the occurrence of false memories. Although many studies have shown an enhancing effect of emotional content of the to-be-remembered material on retention accuracy (Nielson & Powless, 2007), evidences for false memories are mixed. Some studies showed that negatively induced moods through materials with a negative valence increase the

propensity toward false memories (e.g., Dehon, Larøi, & Van der Linden, 2011; Howe, Candel, Otgaar, Malone, & Wimmer, 2010). On the contrary, other studies suggest that temporary negative mood reduce the occurrence of memory errors, whereas positive mood have an opposite effect (Monds, Paterson, Kemp, & Bryant, 2013; Otgaar et al., 2013; Storbeck & Clore, 2005). There are also some evidences suggesting that emotional material, both positive and negative, protects against inferential memory errors, compared to a neutral material (Mirandola, Toffalini, Grassano, Cornoldi, & Melinder, 2014).

Some researchers tried to explain the differences between processing consequences of different emotional materials. According to the affect-as-information hypothesis (Toffalini, Mirandola, Drabik, Melinder, & Cornoldi, 2014; for overviews, see Corson & Verrier, 2007; Storbeck & Clore, 2005), negative mood lead to a better encoding, because it is interpreted as a negative feedback on one's own performance (Storbeck & Clore, 2005, 2011). On the contrary, positive mood would promote an increase reliance on stereotypes (Ruder & Bless, 2003). A theoretical framework that explain this hypothesis is socio-emotional selectivity theory (e.g., Carstensen & Mikels, 2005). According to this theory, adults pay a greater attention to the details of negative stimuli because they have higher informational content. Further, studies have shown that a greater attention to the details of experiences reduce false memories (Brainerd & Reyna, 2005; Brainerd et al., 2008). Another explanation for the abovementioned mixed findings is provided by the Paradoxical Negative Emotion (PNE) hypothesis (Porter, Taylor, & ten Brinke, 2008). This paradigm sustain that negative events, compared to neutral or positive events, facilitate accurate recall, but also paradoxically increase the likelihood of false memories. The explanation for this hypothesis is based on the relation between emotions and memory. Negative emotions enhances memory in general but also increases susceptibility to misinformation relative to emotional events. As a consequence, memories for negative emotional events are powerful and fragile. The paradoxical effect consist in the fact that the two memory's characteristics, power and fragility, are presented simultaneously at the same individual, for the same event. The authors also explain this hypothesis by the fact that more processing time to consider whether an event exists in your memory increase the number of both true and false details recalled, particularly for negative events (Porter et al., 2008).

Considering the recent mixed findings concerning wherever different emotional stimuli have different effects on the occurrence of false memories, we consider important to investigate wherever the emotional valence of an event interact with particular individual differences in explaining the tendency to report false memories.

The role of mental imagery

Although not always consistent, previous studies showed that individual differences in terms of personality may have an important role in determining the tendency to report false memories (Zhu et al., 2010). There are some recent evidences suggesting that imagery, for example, is related to the development of false memories (Conway & Loveday, 2015). Mental imagery was defined as the experience of seeing something in the absence of sensory input, with 'the mind's eye' (Kosslyn, Ganis, & Thompson, 2001). The sponta¬neous use of mental imagery in daily life is sometimes described as a trait measure of mental imagery use (e.g., McCarthy-Jones, Knowles, & Rowse, 2012; Nelis, Holmes, Griffith, & Raes, 2014; Pearson, Deeprose, Wallace-Hadrill, Burnett Heyes, & Holmes, 2013).

There is an intrinsic relatedness of memory and imagery, due to the reconstructive nature of our memory. Unlike recording media, memory is not only a reproduction of the past experiences (Conway & Loveday, 2015). Mental imagery often intervenes in order to fill gaps of the to-be remembered event or thing. According to this assumption, previous studies confirmed the fact that participants who reported using more imagery were also more likely to report false memories (Wilkinson & Hyman, 1998; Winograd, Peluso, & Glover, 1998). However, some studies showed that imagery manipulation increased the probability of creating a false memory of an event, but also increased the probability of recovering true events (Roberts, 2002), even the one that were previously unable to be recalled (Hyman & Pentland, 1996). Therefore, a high level of mental imagery has both advantages, because imagery ability makes a person better at encoding information in a visual form, and disadvantages, because this ability can create a vulnerability to develop false memories.

Because the link between imagery and memory was not clarified and previous studies report inconsistent result, further work is needed in order to better understand this relation. It has important implication both in legal and in clinical practice, when the veracity of a person's memory is very important. Despite specific practices that can promote false memory, a professional should be aware of the impact of particular individual differences on false memory creation over which he has little control. Individual differences in terms of mental imagery represent the focus of the present study.

The present study

Most of the studies about false memories showed that they occur when the participants are exposed to misleading post-event information (Loftus, 2005). This procedure is called misinformation technique (Morgan, Southwick, Steffian, Hazlett, & Loftus, 2013). In this study, we want to assess the occurrence of false memory in the absence of a misinformation technique. Because suggestive questions and post-event misinformation can lead to false memories, we can prevent their occurrence by avoiding the use of these techniques. However, it remains the question if false memories can occur without being stimulated. In order to study the occurrence of false memories, a paradigm containing video was used. We preferred this method instead of the Deese–Roediger–McDermott (DRM; Roediger & McDermott, 1995) paradigm, that is the traditional and the most common paradigm used in the studies about false memories. It involves participants memorizing sets of semantically related word-lists. When recalling these lists, participants often report a critical lure – a word not originally presented but strongly related to the studied words. Because laboratory studies have a limited ecological validity, we preferred to use stimuli more closed to the real-life situations in which false memories can occur (film clips with real events instead of words). Recently, researchers have also resorted to false memory paradigms based on visual scenes and the studies revealed their effectiveness (Otgaar et al., 2013; Otgaar, Howe, Peters, Smeets, & Moritz 2014; Peters, Engel, Hauschildt, Moritz, Jelinek, & Otgaar, 2012).

Based on previous mixed empirical findings presented above, regarding the role played by emotional valence in recognition, the first aim of the present study is to assess the influence of emotional valence of an event on false memories. Moreover, because individual differences may interfere in the process of recognition and may explain the mixed findings regarding the memory' accuracy for different emotional events, we want to explore the interaction between emotional valence of an event and individual differences in mental imagery in determining the occurrence of false memories. Due to the mixed findings with respect to the effect of emotion on false memory rates, we cannot anticipate a direction of the effect. However, we consider that people who are more likely to spontaneous use imagery are also more susceptible to report false memory and this effect can interact with an event emotional valence.

Method

Participants

Participants were invited to take part in the study in exchange for course credits. In total, 138 participants completed the study. There are not exclusion criteria for participants. Six participants failed to complete the task required by the study and were excluded from the dataset. The final sample of the 132 participants consisted of 83.3 % women and 16.7 % men, aged between 18 and 27 (mean age of 21.49 years, SD = 3.66). The participants were students from the Faculty of Psychology and Education Sciences, Alexandru Ioan Cuza University, and received credits for their involvement.

Materials and measures

Video False Memory Paradigm

According to previous studies, we used a video false memory paradigm built around the principles of the DRM paradigm. All the participants were presented with three videos which differs in terms of the emotional valence (negative, neutral, positive). Each video lasted for about 2 minutes (the negative event – 2 minute and 19 seconds, the neutral event – 2 minutes and 22 seconds, positive event – 2 minutes and 10 seconds). According to video false memory paradigm constructed by Peters et al. (2012), the videos were chosen according to the following considerations: (1) themes are universally familiar from human daily-life experience or other sources (e.g., books, movies); (2) easy to identify as theme; (3) detailed dynamic setting; and (4) suitable for the emotional content.

The videos' selection was based on a pilot study. After viewing, in a random order, a series of three negative, three neutral and three positive film clips, 33 students (82.7 % females, Mage = 20.15, SD = 1.03) reported their mood using the ten items from the Positive Affect Negative Affect Schedule (Watson, Clark, & Tellegen, 1988) on an 11-point scale ranging from 0 (sad mood) to 10 (happy mood). The middle point (5) represent the neutral position. The participants were instructed to assess the mood created by the video and they completed the scale after each video. We selected the film, about a child anniversary, that best enhanced the participants' positive mood (M = 9.27, SD = 1.50) and another one, about a flood, that had the strongest negative effect on the participants' affective mood (M = 2.70, SD = 1.79). The anniversary video presents a party from a child birthday, with many peoples, both children and adults, having fun. The flood is a reportage about the consequences of a flood that followed an earthquake. We also wanted to select a neutral film, in order to compare the false memories generated ty the emotion eliciting situation to false memories generated by a neutral event. Based on the results from the pilot study, we observed that neither of the events was evaluated as neutral. However, we selected a film that had the nearest mean to the middle point of the response scale. This video present scenes about a firefighter training exercise (M = 7.70, SD = 1.49).

The recognition task was composed of 60 items: 10 presented items for each video (30 in total) with a corresponding contextual cue from the specific video. Furthermore, 10 non-presented items for each video were included (30 in total). Of the latter items, five were unrelated items (e.g., a present from child' grandparents in the anniversary video) and five were critical, related items (e.g., police car in the flood video). These items were presented in a random order.

The Spontaneous Use of Imagery Scale (SUIS; Reisberg, Pearson, & Kosslyn, 2003) was administered to measure to what extent participants spontaneously use imagery in daily life. This questionnaire consists of 12 items (e.g. When I think about visiting a relative, I almost always have a clear mental picture of him/ her. or Before I get dressed to go out, I first visualize what I will look like if I wear different combinations of clothes.), rated on a 5-point scale (1 = never appropriate, 5 = always completely appropriate). The SUIS has high internal consistency and convergent validity (Reisberg et al., 2003; Nelis et al., 2014). A total score was computed because it is recommended given the unidimensional underlying struc¬ture (Nelis et al., 2014). The Cronbach Alpha in our sample is .77.

To test whether the participants experienced the videos as emotionally or not, we asked them to provide valence ratings on a three-point Likert scale (1 = negative, 2 = neutral, 3 = positive) after watching each video.

Design and procedure

In this study, we used a 2x2 mixed factorial design with one within subjects factor (emotional valence of the event presented) and a between factor (mental imagery). The main dependent variable was the number of false memories reported for the two events. We also computed a score for true memories for the two events presented.

The research took place in a university in the city of Iasi, Romania. Before starting the study, participants were informed that they will participate in a memory study that involves completing a brief scale, watching three short videos and completing a recognition task. Therefore, they were instructed to pay close attention to the videos because they will be asked to recall the details later. The true purpose of the study was concealed. The participants were also informed that their participation is voluntary and that they could terminate the experiment at any point. Participants signed an informed consent, filled in the SUIS and then the films were shown. The participants were tested in six groups of about 20-25 participants for each group. The order of the videos' presentation was counterbalanced. During the recognition task, the participants were asked to indicate whether they had seen a particular item (detail) in a video. Specifically, they were asked to respond with True, False or I am not sure/ I don't remember at a set of statements (20 for each video, in a random order). There were three types of statements: true statements that were presented in the film; false statements

about things that were not presented in the film; and false statements about things that were presented in the film.

Each item had a code consisting of a letter (that represent the initial of the video name) and a number (the number of the item). The participants were informed that the letter represents the video they should have in mind 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 don't remember.

Because the false memories are indicated by the number of True answers at items were the correct answer is False, we asked the participants to respond with True or False, only if they were sure about the answer. For this reason, we included a third answer, so the participants to not be forced to choose between True and False, if they are not sure about the answer. Finally, participants were debriefed and the experimenter thanked them for their involvement.

For each participant, four scores were computed: a score for presented items (the total number of True answers for true statements, which represent a good memory for the videos' content) and two scores for new items (a score for unrelated items and a score for critical related items). All the new items were false, and we computed the number of True answer, that represent false memories. Moreover, according to previous studies (Otgaar & Smeets, 2010; Otgaar et al., 2013), we computed a net accuracy score (true recognition/ true + false recognition).

Results

As we expected, all the participants rated the positive event with 3 and the negative event with 1. In agreement with the results from the pilot test, only 30.2% of the participants rated the neutral film as neutral, while 62.5% rated it as positive. Therefore, we decided to not include it in the subsequent analysis.

True Memory

We conducted a 2 (imagination: low, high) × 2 (valence: negative, positive) mixed ANOVA on the proportion of true recognition. No significant interaction emerged [$F(1,70) = 0.24$, $p=.625$]. The main effects of imagery and valence were also nonsignificant [$F(1,70) = 0.92$, $p=.340$, for imagery, respectively $F(1,70) = 0.81$, $p=.371$, for valence].

False Memory

A paired sample t test was used to compare the false recognition for the positive and negative event. For critical items, the level of false memories for positive event is higher than the level of false memories for negative event [$t(1,131) = 10.85$, $p<0.001$, $\eta 2$ partial = .93]. For unrelated items, there are not significant differences between the level of false memories for positive and for negative event [$t(1,131) = 0.33$, $p=0.377$]. The results are shown in Figure 1.

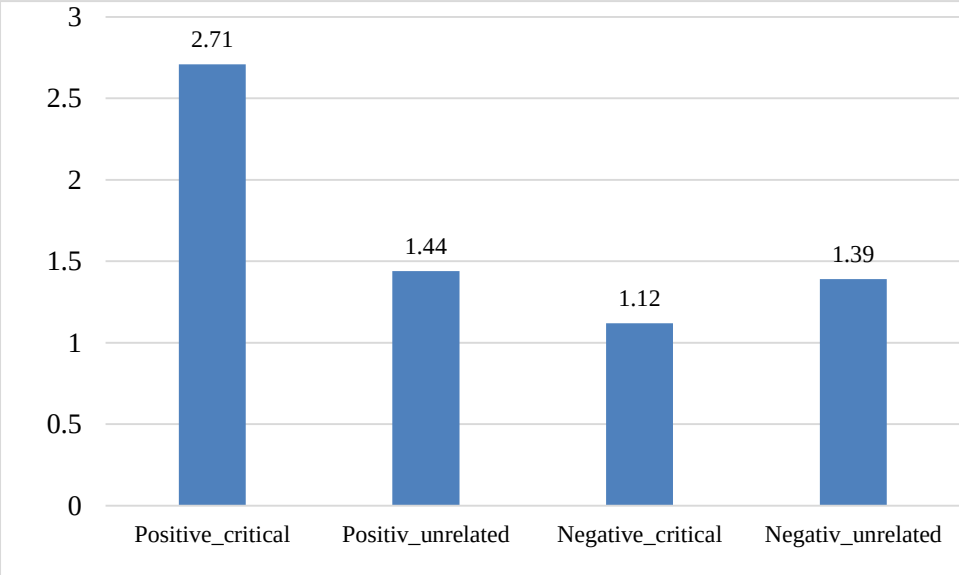

Figure 1: Means for false memories for positive and negative event (N = 132)

A 2 (imagination: low, high) × 2 (valence: negative, positive) mixed ANOVA on the proportion of false recognition for the critical items yielded the following results. Because dividing subjects into two groups based on the median value can distort data (Sava, 2011) and lead to nonsignificant results, in the current study, we used only the lower and upper 25% of participants based on the mental imagery results, in order to assure a more clear distinction between individuals low and high in mental imagery.

No significant interaction emerged [$F(1,70) = 0.96$, $p=0.329$], but we found a significant main effect of the event valence [$F(1,70) = 54.18$, $p<0.001$, $\eta 2$ partial = .44] and imagery [$F(1,70) = 3.56$, $p = 0.051$, $\eta 2$ partial = .04]. Additional contrast tests showed that positive event lead to a higher level of false memory that negative event. Moreover, participants differ in their susceptibility to false memories based on the level of imagery. Specifically, the participants with a high level of mental imagery reported more false memories that the participants with a low level

of mental imagery. For unrelated items, no significant interaction emerged [F(1,70) = 0.03, p=0.863]. The effect of imagery is also nonsignificant [F(1,70) = 0.90, p=0.346]. Positive event lead to a higher level of false memory than negative event [F(1,70) = 23.63, p<.001, ŋ2 partial = .25].

Net Accuracy

We conducted a repeated-measures ANOVA on the accuracy scores. The analyses revealed a nonsignificant imagery × valence interaction [F(1,70) = 0.26, p=0.606]. Simple effects analyses revealed the following findings.

Net accuracy levels did not differ according to the level of imagery [F(1,70) = 2.33, p=0.131], but we found that there was a significant difference between the net accuracy scores for the different emotional events [F(1,70) = 33.54, p < 0.001, ŋ2 partial = 0.32]. That is, for positive events net accuracy scores is lower than the negative accuracy scores.

The means and standard deviation for the groups we compared are presented in table 1.

Table 1. Means for true recognition, false recognition, and net accuracy as a function of imagery and valence

	Low imagery		High imagery	
	Positive	Negative	Positive	Negative
True recognition	14.52 (0.37)	14.02 (0.42)	13.91 (0.39)	13.76 (0.44)
False recognition critical	2.21 (0.32)	0.97 (0.21)	3.05 (0.34)	1.44 (0.22)
False recognition unrelated	0.60 (0.15)	1.23 (0.14)	0.79 (0.16)	1.38 (0.14)
Net accuracy	0.75 (0.02)	0.86 (0.01)	0.70 (0.03)	0.82 (0.02)

Note: SDs in parentheses

Discussion

In the present study, we were interested in the factors influencing different types of spontaneous false memories. Specifically, we investigated if false memories depends on situational (i.e. the emotional valence of an event) and personal factors (i.e. the level of mental imagery). In order to study our aims, we used a video false memory paradigm, because it includes more obvious themes than simple DRM word lists (Otgaar et al., 2013).

The results showed that positive event lead to a higher level of false memory that negative event. Based on this results, the present study sustain the affect-as-information hypothesis (Corson & Verrier, 2007) and contradict the assumption of the paradoxical negative emotion hypothesis (Porter et al., 2008). Previous results also showed that people are not likely to err when they are presented with unpleasant and negative material (Monds et al., 2013; Otgaar et al., 2013; Toffalini et al., 2014). According to the affect-as-information hypothesis and to the previous recent studies, we can explain these findings through the level of attention given to the two films. If the details from negative event drew a greater attention, they were better encoded. As a consequence, the propensity toward false memories was reduces. In our study, there are not significant differences between true memories for positive event and true memories for negative event, therefore these results did not fully sustain that negative stimuli evoke better encoding. However, although our results did not reach the significance level, the tendency of our participants is to report higher true recognition levels for the negative video than for the positive video. Therefore, the negative event is better remembered than the positive event, and it reduce the false memories creation.

The second important result of this study highlight the fact that participants differ in their susceptibility to critical false memories based on their level of mental imagery. This result is partially consistent with our hypothesis. For unrelated false memories, the present result did not reveal individual differences in terms of mental imagery. Moreover, for critical false memories, the effect size is very low. Mental imagery did not interact with the event's emotional valence in influencing false memories. A previous study showed that the difference in false memory rate between high and low imagery participants appear only in combination with a high level of state anxiety and stress (Roberts, 2002). This suggest that the impact of imagery may be more pronounced when people try to remember intense negative events that elicits intense negative emotions (e.g. state anxiety), not only a transient negative mood. Another explanation for these results may involve the temporal distance between watching the film and the completing of recognition task. The participants completed this task soon after watching the videos. It is possible that mental imagery to intervene in order to fill gaps when the temporal distance between stimuli exposure and their recognition is longer. Further studies should assesses this hypothesis. Despite these explanations for the inconsistent role of mental imagery, our study provide some evidence for the implication of mental imagery in false memory creation. Subjects who reported using more imagery were more likely to falsely recognize a critical item. Therefore, when a person's memory is important, in clinical or legal field, different techniques based on mental imagery should be used with caution.

This study is not without limitation. First, the sample size may be too small, therefore the analyses might have missed significance due to the limited statistical power. Second, the videos were not similar in terms of perceptual complexity. The positive video (anniversary) contained more colours that the negative video (flood). This is an important video' characteristic that should be taken under consideration in further studies. Using of black and white scenes could be a way of controlling this confounding variable. Third, the generalizability of our results should be limited particularly to young females, because they represent the majority of our sample.

In summary, the present study offer support for the affect-as-information hypothesis, showing that the positive event increase the probability of false memories creation, compared with the negative event. Further studies, addressed to both males and females, should bring new evidences about the role of emotional valence of an event and individual differences in susceptibility to false memories, given their importance in legal and clinical setting. People with a known propensity towards false memories may be less credible eyewitnesses (Zhu et al., 2010). In clinical practice, a therapist should be aware of

particular individual differences that lead to false memories when he try to reconstruct a past event.

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