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Emotion and false memory: How goal-irrelevance can be relevant for what people remember

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ABSTRACT

Elaborating on misleading information concerning emotional events can lead people to form false memories. The present experiment compared participants' susceptibility to false memories when they elaborated on information associated with positive versus negative emotion and pregoal versus postgoal emotion. Pregoal emotion reflects appraisals that goal attainment or failure is anticipated but has not yet occurred (e.g., hope and fear). Postgoal emotion reflects appraisals that goal attainment or failure has already occurred (e.g., happiness and devastation). Participants watched a slideshow depicting an interaction between a couple and were asked to empathise with the protagonist's feelings of hope (positive pregoal), happiness (positive postgoal), fear (negative pregoal), or devastation (negative postgoal); in control conditions, no emotion was mentioned. Participants were then asked to reflect on details of the interaction that had occurred (true) or had not occurred (false), and that were relevant or irrelevant to the protagonist's goal. Irrespective of emotional valence, participants in the pregoal conditions were more susceptible to false memories concerning goal-irrelevant details than were participants in the other conditions. These findings support the view that pregoal emotions narrow attention to information relevant to goal pursuit, increasing susceptibility to false memories for irrelevant information.

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False memory; emotion; misinformation; motivation; valence; goal-relevance

Memory can be surprisingly inaccurate. People forget, are vulnerable to memory distortion, and can even be led to recall events that never happened (e.g., Schacter, 2001). A well-known method for examining the malleability of memory is the misinformation paradigm (e.g., Loftus, 2005). After an event occurs, people who are exposed to misleading suggestions about what occurred often incorporate these suggestions into their accounts of the original event (e.g., Frenda, Nichols, & Loftus, 2011; Loftus, 1979; Okado & Stark, 2005). The resulting "false" memories have been explained by source misattribution (e.g., Ayers & Reder, 1998; Johnson, Hashtroudi, & Lindsay, 1993): over time, people forget the source of the misinformation and mistakenly attribute it to the event. Studies concerning false memories have great scope and significance. They not only provide basic insights into the process of remembering, but also have major implications for both forensic and clinical practice (e.g., Kaplan, Van Damme, Levine, & Loftus, 2016; McNally, 2003; Schacter & Loftus, 2013).

False memories elicited by the misinformation paradigm illustrate the power of suggestion and people's tendency to integrate bits of information encountered at various times into a cohesive memory. Other research has demonstrated the power of imagination to alter memory (see Loftus & Bernstein, 2005, for a review). Rich

false memories of having been lost in a shopping mall (Loftus & Pickrell, 1995), having been hospitalised (Hyman, Husband, & Billings, 1995), having been the victim of an animal attack (Porter, Yuille, & Lehman, 1999), or nearly having been drowned (Heaps & Nash, 2001) have all been elicited by suggesting that relatives reported that the events occurred and then asking people repeatedly to imagine or try to recall the event. Researchers have also combined these approaches, by instructing participants in the misinformation paradigm to imagine and elaborate on the suggested false details (e.g., Drivdahl & Zaragoza, 2001). This combination of imagination and suggestion is an ecologically valid way to study false memory. In real life, people frequently contemplate experiences after they occur, and often in emotional terms. Depending on the information that they have been exposed to in the meantime, they might unwittingly elaborate on false details. This can have far-reaching consequences, especially in legal contexts. Eye-witnesses are typically asked to be as specific as possible in their recollection of the witnessed event, urging them to elaborate on suggested details of what was generally a highly emotional experience. Building on work by Drivdahl and Zaragoza (2001) and Drivdahl, Zaragoza, and Learned (2009), the present study aimed to clarify the

mechanisms by which emotional elaboration influences the quality of people's memories.

When participants in the misinformation paradigm elaborate on suggested details, the process of elaboration increases their susceptibility to false memories (e.g., Drivdahl & Zaragoza, 2001). Aspects contributing to this effect may be visual imagery strengthening the memory representation, and/or the act of generation eliciting a certain mental model (see Lane & Zaragoza, 2007, for a discussion). Importantly, however, elaborating on *emotional* aspects of suggested events increases the likelihood of false memories to an even greater extent than elaborating on perceptual details. In a study by Drivdahl et al. (2009), participants watched an excerpt from an adventure movie. They then read a narrative that provided a largely accurate account of the events shown in the video but also contained some misleading suggestions. Next, they engaged in either emotional or perceptual elaboration on both suggested and true events. Emotional elaboration involved imagining, and then rating, how strongly a character in the video felt a particular emotion as a consequence of the event (e.g., "Imagine how embarrassed he felt at having injured himself in front of the other campers"). Perceptual elaboration involved imagining and rating perceptual features of the event (e.g., "Imagine how hard he fell on the floor when he injured himself"). A control group simply rated the grammatical correctness of true and false sentences from the narrative. One week later, participants' memory for the true and false details was assessed.

Drivdahl et al. (2009) found that, compared to the control group, elaboration increased the likelihood of remembering false details, with emotional elaboration leading to higher false memory than perceptual elaboration. These findings show that emotional elaboration can be an additional catalyst for false memory creation but also raise questions about the precise mechanism underlying the effect. Participants in the emotional elaboration condition were asked to elaborate on a variety of negative emotions (embarrassed, upset, disgusted, irate, and resentful) and were not asked to elaborate on positive emotions. As a result, it is not possible to disentangle the contributions to false memory creation of emotional arousal, emotional valence, and other dimensions such as the relevance of the false details to the individual's goals.

Past research suggests a number of ways that elaborating on emotional characteristics of events could increase susceptibility to false memories. The traditional view on emotion and memory holds that emotional arousal narrows attention, leading to enhanced memory for central information at the expense of memory for peripheral details (e.g., Christianson, 1992; Easterbrook, 1959). However, the negative or positive valence of emotion may also affect people's memories. Some investigators have argued that it is negative emotion (rather than arousal generally or positive emotion) that narrows the scope of attention and impairs memory for peripheral details (e.g.,

Berntsen, 2002; van Steenbergen, Band, & Hommel, 2011; Yeghyan & Yonelinas, 2011). A related view, the Paradoxical Negative Emotion hypothesis (Porter, Taylor, & ten Brinke, 2008), holds that events eliciting negative emotion often signal future danger, making it adaptive to retain information about them from a wide range of sources. As a result, negative emotion may facilitate detailed memory but also increase vulnerability to false memories.

Consistent with these views, misinformation studies have shown increased false memories for peripheral details of negative scenes compared to positive and neutral scenes (e.g., Porter, Spencer, & Birt, 2003). For instance, people remembering negative photographs had fewer correct and more false memories about peripheral details of the images than people remembering positive or neutral photographs (Van Damme & Smets, 2014). Similarly, false memory studies using other paradigms have shown an increased likelihood of false memories for negative materials, both in children and in adults (e.g., Brainerd, Holliday, Reyna, Yang, & Toglia, 2010; Dehon, Laroi, & Van der Linden, 2010; Otgaar, Candel, & Merckelbach, 2008). These findings raise concerns about the accuracy of people's memory for negative, arousing information in legal settings. For instance, when witnesses recall a crime scene or jurors recall upsetting testimony during the course of a trial, they are likely to remember central, threatening information. However, they may be susceptible to misinformation concerning peripheral details, such as the setting in which the crime occurred, that are important for establishing a defendant's innocence or guilt.

To date, most research has overlooked how the motivations associated with specific emotions may affect memory. According to a motivational perspective on emotion and cognition (e.g., Gable & Harmon-Jones, 2008, 2010a, 2010b, 2010c; Kaplan, Van Damme, & Levine, 2012; see also Levine & Edelman, 2009), the goals or motivations associated with people's emotions determine the breadth of cognitive processing. Pregoal emotions (e.g., hope and fear) reflect appraisals that goal attainment or failure is anticipated but has not yet occurred. These emotions are associated with the motivation to approach or avoid a stimulus and are therefore high in "motivational intensity" (Gable & Harmon-Jones, 2010b). In such states, it is functional to attend to and remember information that is relevant to the active goal, which might come at the expense of attention to and memory for irrelevant information. In contrast, postgoal emotions (e.g., happiness and sadness) reflect appraisals that goal attainment or failure has already occurred. In such states, it is functional to attend to and remember a broad range of information, as one should take into account consequences of success or failure and orient towards new goals.

A growing body of research suggests that, to understand the relation between emotion and memory, researchers need to go beyond the dimensions of arousal and valence, and consider the differing motivations

associated with discrete emotions (for a review, see Kaplan et al., 2016). Contrasting pregoal and postgoal emotions may help to clarify when and why emotion increases susceptibility to false memories. Pregoal emotions such as fear, which are high in motivational intensity, powerfully direct attention to features of events that are of central importance for avoiding threats and for removing obstacles to the individual's goals. When people's attentional resources are limited, susceptibility to misinformation increases (Loftus, 2005). A narrow attentional focus leaves people susceptible to false memories concerning details that are peripheral to their goals (e.g., Wessel & Merckelbach, 1997). The aims of the present study were to examine whether elaborating on false information in the context of emotions increases susceptibility to false memories,¹ and to assess the contributions of emotional valence and motivational intensity to susceptibility to false memories concerning goal-relevant versus irrelevant information.

The present study

The present study assessed the effects of positive and negative emotions, which were high in motivational intensity (pregoal) or low in motivational intensity (postgoal), on participants' susceptibility to false memories for information that was goal-relevant versus irrelevant. Because it is difficult to control for stimulus complexity when eliciting discrete emotions using different stimuli, the study made use of a single ambiguous interaction that could be framed in different ways (cf. Cahill & McGaugh, 1995). Participants were told that they would be watching a slideshow depicting an interaction between a couple. They were asked to empathise with the woman protagonist's feelings of hope (positive pregoal), happiness (positive postgoal), fear (negative pregoal), or devastation (negative postgoal) concerning her goal of being in a stable long-term relationship. To control for effects of arousal, all of the emotions were relatively high arousal emotions. Thus, condition-specific instructions were administered before participants viewed the slides and framed the emotional tone of the events depicted in the slideshow. In the control and perceptual conditions, no emotion was mentioned (see Appendix 1 for condition-specific instructions). Explicit statement of the main character's goal made it possible to distinguish between central (goal-relevant) and peripheral (goal-irrelevant) details.

After watching the slideshow, participants were asked to reflect on details of the interaction that had occurred (true) or had not occurred (false), and that were relevant or irrelevant to the protagonist's goal. Participants in a perceptual elaboration condition reflected on true and false details of the interaction but no reference was made to the woman's feelings. Participants in the control condition reflected on certain moments of the interaction but no mention was made to true or false details. Later, all participants underwent

a memory test for true and false details that were relevant and irrelevant to the protagonist's goal.

We hypothesised that participants who were exposed to misinformation would report more false details than participants in the control condition who were not exposed to misinformation. Based on Drivdahl et al.'s (2009) findings, we further hypothesised that participants in the emotional elaboration conditions would report more false details than participants in the non-emotional perceptual elaboration condition. However, we expected this effect to be moderated by emotion type and by the relevance of the details to the protagonist's goals. Pregoal emotions promote narrowing of attention to goal-relevant information (Kaplan et al., 2016) and people are more susceptible to misinformation when their attention is limited (Loftus, 2005). Hence, participants in the pregoal conditions (hope and fear) were expected to be more susceptible to false memories for goal-irrelevant details than other participants. These participants might also show enhanced memory, and reduced false memory, for goal-relevant details.² In contrast, because postgoal emotions broaden attention, elaborating on postgoal emotions was expected to reduce false memories about goal-irrelevant details.

Method

Participants

Undergraduate students from the University of California, Irvine, participated in the study for course credit ($N = 321$). Data from 48 additional participants were omitted because these participants failed an attention check. The remaining group consisted of 242 female students (75%) and 79 male students (25%), with an average age of 20.07 years ($SD = 2.69$; range 18–42). All participants had normal or corrected-to-normal vision.

Design and materials

The study used a 6 (condition) \times 2 (true vs. false details) \times 2 (goal-relevant vs. goal-irrelevant details) design. Condition was a between-subjects variable. True/false detail and goal-relevant/irrelevant detail were within-subjects variables. Participants were randomly assigned to one of six conditions. They were instructed to empathise with feelings of hope (positive pregoal emotion; $n = 56$), happiness (positive postgoal emotion; $n = 57$), fear (negative pregoal emotion; $n = 60$), or devastation (negative postgoal emotion; $n = 47$), or in a perceptual elaboration condition, no emotion was mentioned ($n = 48$). In each of these five conditions, participants were asked to reflect on true and false details that were goal-relevant and goal-irrelevant. For participants in a sixth control condition, no emotion was mentioned and participants were exposed to neither true nor false details ($n = 53$).

The experiment was carried out online and the stimuli consisted of a slideshow, eight elaboration items, 16 memory test items, and a set of filler questionnaires.

The slideshow depicted the interaction between a young couple (Christina and Seth) and was taken from Okado (2008). It was selected because it could be used within the context of various emotions and because the event sequence matched the complexity of a real-world scenario. Of the original 50 slides, three were left out (numbers 36, 46, 47) in order to increase the ambiguity of the story.

Two versions of the slideshow were created, which were identical except for eight slides about which eight elaboration items were formulated. Using two versions of these slides allowed for counterbalancing of four true and four false suggestions. As shown in Table 1, half of the true and false suggestions were relevant to Christina's goal of maintaining a stable long-term relationship and half were irrelevant. For example, a goal-relevant detail was that Seth kissed Christina, which was true in one version of the slideshow and false in the other (where Seth simply hugged Christina). This was translated into an elaboration item as follows: "Imagine how hopeful Christina felt as Seth kissed her when she arrived at his apartment, eager for this to mean that he really loved her." A goal-irrelevant detail was that the closet door was open (versus closed): "Imagine how hopeful Christina felt when she approached the open closet door to get one of Seth's sweaters, hoping he would be glad to see her when she returned." The true and false details were identical across conditions, except for the control condition, in which no details were mentioned (see Appendix 2 for a list of the details).

Thus, all participants witnessed the same set of events and elaborated on the same real and suggested details, but did so in varying emotional contexts. The specific formulation of the details was adapted to fit with the specific emotion involved (hope, happiness, fear, and devastation) or to include a perceptual detail. The wording was matched as closely as possible across conditions. For instance, the suggestion of Seth kissing Christina was adapted as follows in the various other emotional conditions:

Imagine how happy/afraid/devastated Christina felt as Seth kissed her when she arrived at his apartment, knowing that it showed he really loved her/scared that this did not necessarily mean that he really loved her/knowing that it didn't mean he really loved her.

In the perceptual and control conditions, this became: "Imagine how straight Christina was standing as Seth

kissed her when she arrived at his apartment" and "Imagine when Christina arrived at Seth's apartment." Thus, items in the control condition referred to the events in the slides in a general way, without mentioning either true or false details.

The memory test consisted of 16 statements. Half referred to true details and half referred to false details. Half of each type of item had been suggested earlier. Thus, memory was assessed for four types of details: true suggested details, false suggested details, true non-suggested details, and false non-suggested details. Due to the use of two versions of the slide sequence, there were also two versions of the memory test, counterbalancing true and false suggested details. An overview of all test items is given in Appendix 3.

Procedure

The session was introduced as comprising several tasks. Participants were told that they would view a slideshow depicting real-world events, after which they would be asked to make judgments regarding their perceptions of these events as well as to complete a number of questionnaires. They were tested in groups of 2–16 people and provided written consent. An overview of the procedure is provided in Figure 1.

In the first phase of the experiment, participants viewed one of the two slideshow versions. Each of the 47 slides was shown for 2 s, resulting in a total duration of about 1.5 min. Participants were asked to watch the slide sequence attentively, but no mention of a subsequent memory test was made (i.e., incidental encoding). Before viewing, participants read a brief introduction to the characters involved. They were told that they would see a couple, Christina and Seth, who had been together for two years. Additional explanation depended on the condition. Participants in the emotional conditions were told that—throughout everything that happened—Christina felt hopeful, happy, afraid, or devastated (see Appendix 1 for specific instructions). In the perceptual and control conditions, no reference to Christina's feelings was made. Next, participants completed filler tasks for 10 minutes, which consisted of a mood check and a series of emotion and personality questionnaires.

In the second phase of the experiment, participants were asked to elaborate on true and false suggested details in the context of either Christina's feelings or a certain perceptual characteristic. Participants in all conditions (except the control condition) elaborated on identical details, which were all formulated from the viewpoint of Christina. Participants were asked to imagine eight specific situations that were supposedly part of the slides, and were told that the aim of this phase was to assess their ability "to imagine, to form a mental picture, and to empathize with how others feel" (emotional conditions) or "to imagine, to form a mental picture, and to visualize other people's actions" (perceptual and control conditions). In fact, four of the scenarios

Table 1. Counterbalancing of elaboration items.

Slide	Detail	Goal-relevant?	Version 1	Version 2
9	Seth and Christina kiss	Yes	True	False
10	Seth takes Christina's coat	No	False	True
19	Christina puts on lipstick	Yes	False	True
27	Closet door is open	No	True	False
30	Christina looks at computer screen	No	False	True
31	Seth is asleep	Yes	True	False
32	Christina turns off TV with remote control	No	True	False
40	Christina leaves front door open	Yes	False	True

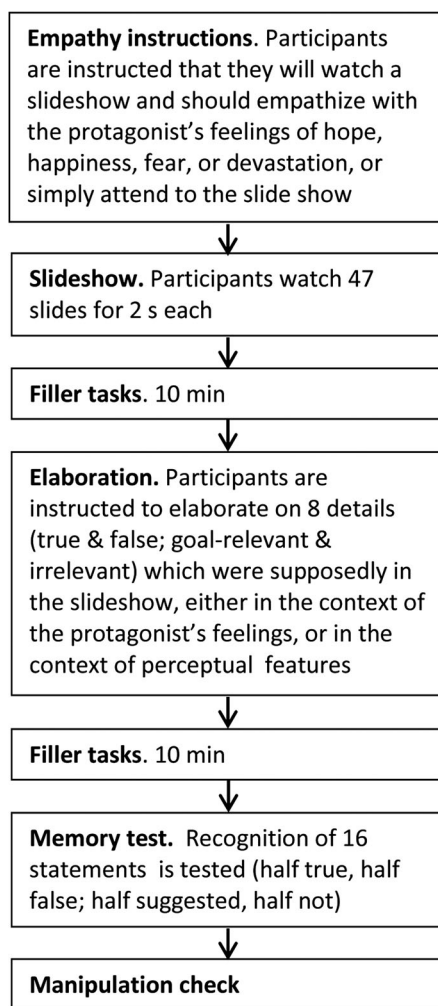


Figure 1. Overview of experimental procedure.

contained true information (presented in the slides), and four contained false information (not presented in the slides). Half were goal-relevant and half were goal-irrelevant (see Table 1). Participants were asked to picture each situation as vividly as possible before responding. In the emotional conditions, they were asked to rate the intensity of the emotion felt by Christina in each situation ("How hopeful/happy/afraid/devastated did she feel?"), as well as how vividly they could picture the situation, both on a seven-point scale. In the perceptual and control conditions, participants were asked to evaluate a perceptual characteristic (e.g., Christina's posture), as well as how vividly they could picture the situation. Items were presented chronologically (i.e., in the order of the story), so participants would know at which time the mentioned events took place (cf. Zaragoza, Mitchell, Payment, & Drivdahl, 2011). There were never more than two true or false details in a row. After the elaboration phase, participants rated their mood and arousal level, and completed filler tasks for approximately 10 min.

In the third phase of the experiment, participants completed an unexpected source memory test consisting of 16

statements (see Appendix 3). Eight contained details that had been suggested during the elaboration phase; the other eight did not. Half of each referred to events that had been shown in the slides, and half to events that had not been shown. Participants were asked to indicate the source of each event: Had it been part of the slideshow, the elaboration questionnaire, neither, or both? They did so by answering the questions "Was the event shown in the slides" and "Was the event mentioned in the questionnaire", with one of the following response options: "no", "yes, I believe so", or "yes, I remember so". The latter two options reflected the remember/know procedure as developed by Tulving (1985), and was explained to participants in terms of whether or not they were able to recollect specific details of the event mentioned. An example was used to clarify the distinction (cf. Drivdahl et al., 2009). Also, it was explained that believing is not the same as low confidence, as someone can be extremely confident that an event happened, even though he cannot recall the specific details. Therefore, participants were also asked to indicate their degree of confidence on a seven-point scale.

Participants' understanding of the distinction between remembering and knowing was tested immediately after explaining it. Due to the simplicity of this test of instruction comprehension, it was used as an attention check. Data from participants who failed the attention check were excluded from the analyses. The experiment concluded with a manipulation check. Participants were given a list of emotions and were asked to indicate the extent to which they believed Christina felt each emotion, taking into account what they knew about the couple from the instructions. In addition, they were asked to rate, on a seven-point scale, how strongly they empathised with Christina and how plausible they believed the imagination scenarios to be.

Results

One-way analyses of variance (ANOVA) on participants' ratings of Christina's emotions were conducted as a manipulation check. A statistically significant effect of condition was found for all emotion words (all $p_s < .0001$, R^2 ranging from .08 to .42). As expected, for each emotion, the highest rating was obtained in the targeted condition (e.g., ratings of Christina feeling hopeful were highest in the positive pregoal condition). In the perceptual and control conditions, no differences were found among ratings for all emotion adjectives, as expected. There were no differences between conditions in ratings of the degree of empathy with Christina, nor in the rated plausibility of the scenarios imagined during the elaboration phase ($F_s \approx 1$). Participants' mood did not differ across conditions ($p_s \geq .20$).

Source memory was assessed by examining whether or not participants attributed suggested and non-suggested true and false details to the slides. Separate analyses were conducted for believing versus remembering each

Table 2. Mean proportions of belief (=“belief” judgments + “remember” judgments) by condition, item type, and goal-relevance.

	Suggested false details		Suggested true details		Non-suggested false details	Non-suggested true details
	Goal-relevant	Goal-irrelevant	Goal-relevant	Goal-irrelevant		
Positive pregoal	.46 (.05)	.58 (.05)	.89 (.03)	.83 (.04)	.29 (.03)	.88 (.02)
Positive postgoal	.39 (.05)	.42 (.04)	.89 (.03)	.74 (.05)	.26 (.03)	.82 (.02)
Negative pregoal	.33 (.04)	.54 (.05)	.91 (.03)	.85 (.03)	.31 (.03)	.87 (.02)
Negative postgoal	.39 (.05)	.43 (.05)	.90 (.03)	.79 (.04)	.21 (.03)	.87 (.03)
Perceptual	.38 (.05)	.44 (.05)	.86 (.03)	.78 (.04)	.32 (.04)	.92 (.02)
Control	.09 (.03)	.31 (.05)	.85 (.03)	.75 (.04)	.33 (.03)	.92 (.02)

Note: Standard errors of the mean are given in parentheses.

type of detail. Participants who indicated that they *remembered* having seen an event in the slides presumably also *believed* that they saw the event. Therefore, both “remember” and “belief” judgments were taken as evidence of belief (cf. Drivdahl et al., 2009). Mean proportions of belief (i.e., belief judgments + remember judgments) for each type of detail are shown in Table 2. Mean proportions of remember-only judgments for each type of detail are shown in Table 3. An alpha level of .05 was used for all statistical tests.

Memory for suggested false details

False belief

A 6 (condition) \times 2 (goal-relevant vs. irrelevant detail) mixed-factors ANOVA was conducted on the proportions of suggested false details that participants believed to have appeared in the slides (i.e., endorsed). The results showed a main effect of condition, $F(5, 315) = 8.28$, $MSE = 0.14$, $p < .0001$, $\eta_p^2 = .12$. Pairwise Tukey comparisons revealed that participants in all misinformation conditions endorsed more false details than did participants in the control condition (all $p_s < .01$). A main effect of goal-relevance was also found, $F(1, 315) = 18.95$, $MSE = 0.11$, $p < .0001$, $\eta_p^2 = .06$. Goal-irrelevant false details were endorsed more frequently than goal-relevant false details. However, although the interaction was not statistically significant ($p = .12$), simple main effect analyses of endorsement of false details by condition showed a difference between goal-relevant and goal-irrelevant details only in three conditions: positive pregoal, $F(1, 315) = 4.06$, $p = .0449$, negative pregoal, $F(1, 315) = 12.07$, $p = .0006$, and the control condition, $F(1, 315) = 11.56$, $p = .0008$.

In order to test a priori predictions concerning motivational intensity (pre- versus postgoal emotion) and

memory, we proceeded to conduct separate one-way ANOVAs on the proportions of false details endorsed that were goal-relevant versus irrelevant. For goal-relevant details, a significant main effect of condition, $F(5, 315) = 6.84$, $MSE = 0.12$, $p < .0001$, $R^2 = .10$, provided evidence solely for a misinformation effect: participants in the misinformation conditions endorsed more false details than did participants in the control condition, $t(315) = 5.54$, $p < .0001$. All relevant pairwise comparisons were statistically significant (Tukey, all $p_s \leq .005$), and there were no other differences between groups.

For goal-irrelevant details, a significant effect of condition was also found, $F(5, 315) = 4.08$, $MSE = 0.12$, $p = .0013$, $R^2 = .06$, but planned contrasts revealed a different pattern. On average, there was a misinformation effect: a planned contrast comparing the average of all misinformation conditions with the control condition showed significantly more false memories in the misinformation conditions than in the control condition, $t(315) = 3.20$, $p = .002$. However, pairwise Tukey comparisons only revealed a significant difference with the control condition for the pregoal conditions (hope: $p = .001$; fear: $p = .008$), but not for postgoal and perceptual conditions. Moreover, as shown in Table 2, participants in the pregoal conditions endorsed significantly more false details than did participants in the postgoal and perceptual conditions, $t(315) = 3.05$, $p = .003$. Comparing the emotional conditions, a 2 (valence: positive vs. negative emotion) \times 2 (motivational intensity: pregoal vs. postgoal emotion) ANOVA revealed a significant main effect of motivational intensity, $F(1, 216) = 8.15$, $MSE = 0.13$, $p = .005$, $\eta_p^2 = .04$, but no effect of valence nor an interaction ($F_s < 1$). Thus, as shown in Figure 2, participants in the pregoal conditions endorsed more goal-irrelevant false details than did participants in the postgoal conditions, regardless of valence.

Table 3. Mean proportions of “remember” judgments by condition, item type, and goal-relevance.

	Suggested false details		Suggested true details		Non-suggested false details	Non-suggested true details
	Goal-relevant	Goal-irrelevant	Goal-relevant	Goal-irrelevant		
Positive pregoal	.26 (.04)	.29 (.04)	.76 (.04)	.59 (.05)	.05 (.01)	.71 (.03)
Positive postgoal	.21 (.05)	.19 (.03)	.84 (.03)	.53 (.05)	.06 (.02)	.64 (.04)
Negative pregoal	.20 (.04)	.25 (.04)	.78 (.04)	.68 (.04)	.08 (.02)	.69 (.03)
Negative postgoal	.23 (.05)	.14 (.04)	.79 (.04)	.56 (.05)	.06 (.02)	.73 (.04)
Perceptual	.21 (.04)	.20 (.04)	.81 (.04)	.50 (.04)	.06 (.02)	.79 (.03)
Control	.02 (.01)	.10 (.03)	.80 (.04)	.56 (.04)	.04 (.01)	.74 (.04)

Note: Standard errors of the mean are given in parentheses.

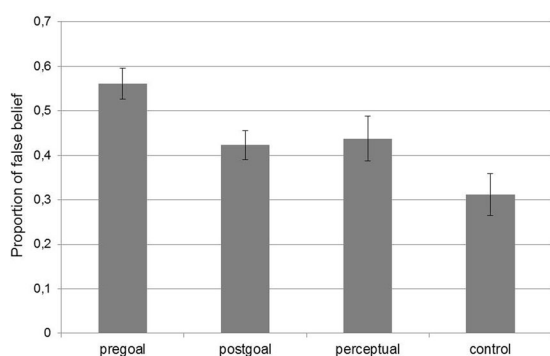


Figure 2. Mean proportions of belief (= “belief” judgments + “remember” judgments) for goal-irrelevant false details by condition. Bars represent standard errors of the mean.

False remembering

The pattern of results obtained for false remember judgments was similar to that for false belief, therefore only the most important comparisons are discussed. For *goal-relevant* details, a significant effect of condition, $F(5, 315) = 4.76$, $MSE = 0.08$, $p = .0004$, $R^2 = .07$, revealed only a misinformation effect: participants in the misinformation conditions remembered more false details as part of the slides than participants in the control condition (Tukey, all $p_s < .02$). As shown in Table 3, for *goal-irrelevant* details, participants in the pregoal conditions remembered more false details than did participants in the postgoal and perceptual conditions, $F(5, 315) = 3.42$, $MSE = 0.08$, $p = .005$, $R^2 = .05$; $t(315) = 2.79$, $p = .006$. Comparing the emotional conditions, a 2 (valence) \times 2 (motivational intensity) ANOVA again revealed a main effect of motivational intensity, $F(1, 216) = 7.11$, $MSE = 0.09$, $p = .008$, $\eta_p^2 = .03$, but no effect of valence nor an interaction ($F_s < 1$). Thus, as shown in Figure 3, participants in the pregoal conditions remembered more goal-irrelevant false details than did participants in the postgoal conditions, regardless of valence.

Memory for suggested true details

A 6 (condition) \times 2 (goal-relevant vs. irrelevant detail) mixed-factors ANOVA on true belief (i.e., belief judgments

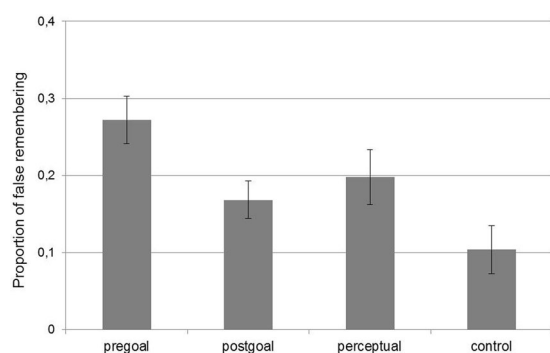


Figure 3. Mean proportions of “remember” judgments for goal-irrelevant false details by condition. Bars represent standard errors of the mean.

+ remember judgments) revealed that participants endorsed more goal-relevant than goal-irrelevant true details, $F(1, 315) = 24.46$, $MSE = 0.06$, $p < .0001$, $\eta_p^2 = .07$. No other statistically significant effects were found. The lack of a main effect of condition ($F \approx 1$) suggests that the task was so easy that it did not matter whether or not the details were mentioned during the elaboration phase. The same analysis on remember judgments similarly showed that participants remembered more goal-relevant than goal-irrelevant true details, $F(1, 315) = 109.83$, $MSE = 0.08$, $p < .0001$, $\eta_p^2 = .26$. In addition, a significant interaction was found between condition and goal-relevance, $F(5, 315) = 2.62$, $MSE = 0.08$, $p = .02$, $\eta_p^2 = .04$. However, analyses of simple main effects showed that the difference between goal-relevant and goal-irrelevant details was statistically significant in each condition (all $p_s < .05$). Also, separate follow-up ANOVAs on remember judgments for goal-relevant and irrelevant information revealed no statistically significant differences across conditions in the number of true details remembered.

Confidence in endorsed suggested details

For both false and true suggested details, a 6 (condition) \times 2 (goal-relevant vs. irrelevant detail) mixed-factors ANOVA was also carried out on the confidence ratings. Participants were more confident about endorsed goal-relevant details than about endorsed goal-irrelevant details, both for true items ($M = 6.38$ vs. 5.70), $F(1, 315) = 101.62$, $MSE = 0.71$, $p < .0001$, $\eta_p^2 = .24$, and for false items ($M = 5.79$ vs. 5.26), $F(1, 315) = 43.71$, $MSE = 1.03$, $p < .0001$, $\eta_p^2 = .12$. No other statistically significant effects were found.

Next, confidence ratings were conditionalised on the accuracy of participants’ responses (cf. Loftus, Donders, Hoffman, & Schooler, 1989; Van Damme & Seynaeve, 2013). Separate one-way ANOVAs by condition were conducted on confidence for correct and incorrect responses to each type of item. Differences in confidence were found only for correct responses to goal-relevant false details (i.e., *not* endorsing them), $F(5, 263) = 2.70$, $MSE = 1.57$, $p = .02$, $R^2 = .05$. *Post hoc* analyses revealed both a misinformation effect (i.e., greater confidence when no misinformation was given), $t(263) = 2.81$, $p = .0053$, and an effect of motivational intensity, $t(263) = 2.34$, $p = .02$, with greater confidence in pregoal than in postgoal conditions ($M = 6.10$ vs. 5.66).

Memory for non-suggested details

False details

No statistically significant effect of condition was found for beliefs concerning non-suggested false details, $F(5, 315) = 1.84$, $MSE = 0.05$, $p = .11$, $R^2 = .03$. However, a valence (2) \times motivational intensity (2) ANOVA on the emotional conditions revealed a significant effect of motivational intensity, $F(1, 216) = 4.75$, $MSE = 0.05$, $p = .03$, $\eta_p^2 = .02$. Participants in postgoal conditions endorsed fewer false

non-suggested details than did participants in pregoal conditions. Remember judgments for this type of detail were rare ($M = 0.06$; see Table 3) and did not differ by condition ($F < 1$). In addition, no differences between conditions were found in memory confidence ($F < 1$).

True details

For beliefs about non-suggested true details, a significant effect of condition was found, $F(5, 315) = 3.19$, $MSE = 0.03$, $p = .008$, $R^2 = .05$. Participants endorsed more non-suggested true details in the non-emotional conditions (perceptual and control) than in the emotional conditions, $t(315) = 3.23$, $p = .001$. Similar results were found for remember judgments for non-suggested true details, although the effect of condition did not reach the .05 level of statistical significance, $F(5, 315) = 2.09$, $MSE = 0.06$, $p = .07$, $R^2 = .03$. The *post hoc* tested difference between participants in the non-emotional versus emotional conditions was statistically significant though, $t(315) = 2.35$, $p = .02$. Confidence ratings also showed the same pattern, with a significant effect of condition, $F(5, 315) = 2.71$, $MSE = 0.94$, $p = .02$, $R^2 = .04$, revealing greater confidence in non-emotional conditions than in emotional conditions ($M = 6.22$ vs. 5.92), $t(315) = 2.60$, $p = .01$.

Vividness of imagination

A one-way ANOVA on vividness of imagination as rated during the elaboration phase (i.e., averaged over the various elaboration items) showed an effect of condition, $F(5, 315) = 18.97$, $MSE = 1.16$, $p < .0001$, $R^2 = .23$, revealing greater vividness in the emotional conditions than in the non-emotional conditions ($M = 5.25$ vs. 4.00), $t(315) = 9.71$, $p < .0001$. The same pattern was obtained for true and false details and for goal-relevant and irrelevant details. As vividness of imagination might affect later memory, correlations between vividness and memory for the various types of suggested details were evaluated. More vivid imagination was indeed shown to be associated with greater likelihood of endorsing both true and false, goal-relevant and irrelevant, suggested details (r ranging from .12 to .26, $p_s < .04$). When vividness was added as a covariate to the analyses on source memory for true and false suggested details as reported above, it consistently showed a statistically significant effect in addition to other effects obtained but never changed the pattern of results.

Discussion

This study examined the effects of emotional elaboration on susceptibility to misinformation. We carefully manipulated emotional context by crossing the effects of valence and motivation while keeping the degree of arousal constant. Participants were encouraged to elaborate on positive pregoal emotion (hope), positive postgoal emotion (happiness), negative pregoal emotion (fear), negative postgoal emotion (devastation), perceptual information, or they

were in a control condition. They watched a slideshow about a couple, elaborated on true and false suggested details, and evaluated the source of those and other details in an unexpected source memory test. Ratings of Christina's emotions revealed that the various emotional contexts were successfully induced. A misinformation effect was evident from an increased tendency to attribute false details to the slides if these details had been suggested during the elaboration phase than if they had not (control condition).

Susceptibility to false memories did not differ in function of mere emotionality or valence, but instead showed motivational influences. Participants who had watched the slideshow and elaborated on true and false details from a pregoal point of view showed an increased likelihood of both believing and remembering falsely suggested goal-irrelevant information, compared to participants in all other conditions. In other words, regardless of the valence of the emotional context, pregoal emotions elicited greater susceptibility to false suggestions about goal-irrelevant details than both postgoal emotions and no emotion. The effect is consistent with a narrowed focus of attention onto information that will facilitate goal attainment or prevent failure, at the expense of irrelevant details. This pattern of results suggests that the attention of participants in the pregoal conditions was led by Christina's hopes or fears, and as a result, they paid less attention to goal-irrelevant details and were forced to rely more strongly on the elaboration questionnaire for information about goal-irrelevant details. Our findings differ from those showing that negative emotion leads to greater susceptibility to false memories than positive emotion (e.g., Berntsen, 2002; Porter et al., 2008). This difference may reflect the fact that research on emotional valence has typically neglected to assess effects of motivational intensity on false memory, and often contrasts pregoal negative emotion (e.g., fear) with postgoal positive emotion (e.g., happiness; for reviews see Harmon-Jones, Price, & Gable, 2012; Kaplan et al., 2016).

We had expected that participants in the pregoal conditions would not only be more susceptible to false memories for goal-irrelevant details but might also show better memory for goal-relevant details. Although there were no statistically significant effects on memory per se, the latter prediction was confirmed by results in terms of confidence: when compared to postgoal emotions, pregoal emotions induced greater confidence in correct rejection of goal-relevant false details. Taken together, results for the pregoal emotional conditions are in line with studies showing motivational effects of emotion on attention and memory (e.g., Gable & Harmon-Jones, 2008, 2010a, 2010b, 2010c) and are best explained in terms of a narrowed focus of attention due to goal pursuit. Results for the postgoal emotional conditions are complementary to this pattern and also in line with the motivational literature: participants in the postgoal conditions showed improved detection of non-suggested incorrect details, implying that a broad range of information was attended to while watching the original event.

Memory for non-suggested true details was slightly impaired in the emotional conditions, compared to the non-emotional conditions. This might be attributed to a different focus while watching the slide sequence. While participants in the emotional conditions were instructed to “try to empathize with Christina as much as possible” in order to maintain focus on Christina’s emotions, participants in the non-emotional conditions were simply asked to watch the slide sequence attentively (see Appendix 1).

Drivdahl et al. (2009) suggested that it might be easier or more natural for participants to engage in emotional elaboration than to engage in other types of elaboration, which could predispose them to greater vulnerability to misattribution of the suggested details’ source in emotional than in non-emotional elaboration conditions (cf. Johnson & Raye, 1981). In the present experiment, vividness of imagination was indeed rated higher in the emotional conditions than in the non-emotional conditions. This might have been due to “easier” elaboration, but also to the fact that the elaboration sentences in the emotional conditions were longer and more specific, in order to make a clear distinction between positive/negative valence and pregoal/postgoal emotions. Additionally, consistent with studies illustrating the power of imagination (e.g., Heaps & Nash, 2001; Hyman et al., 1995; Loftus & Pickrell, 1995; Porter et al., 1999), the vividness with which details were imagined during the elaboration phase was positively associated with later memory. Thus, more vivid elaboration of suggested false details was associated with greater susceptibility to false memories. Importantly, however, adding vividness of imagination as a covariate to the analyses on source memory for true and false suggested details did not change the result pattern, implying that differences in vividness were not responsible for the obtained differences in terms of motivational intensity and goal-relevance.

It should be noted that the experimental manipulation in the present study does not allow us to isolate the effect of emotional elaboration from the effect of participants’ emotional experience while watching the slides (as a result of the emotional context that was sketched beforehand). In daily life, however, when people experience emotional situations, they also think back about them later, going over both emotional and non-emotional details. The present study mirrors this type of behaviour. We all contemplate our experiences and, when exposed to false suggestions, may unknowingly elaborate on false information.

In conclusion, studies investigating false memories provide basic insights into the process of remembering and illustrate people’s vulnerability to source confusion, over-generalisation, and the integration of false information into memory. Clarifying the mechanisms through which emotions affect the quality of our memories additionally has major implications for both forensic and clinical practice. Both witnessed events and events discussed in therapy are typically negative, arousing, and relevant to personal goals. Hence, it is vitally important to

extend the scope of investigation so that not only valence and arousal, but also motivational effects on memory are being considered. For instance, during a trial, jurors may be exposed to testimonies that evoke fear, or they may be exposed to testimonies conveying the devastating impact a crime had on victims, evoking sadness (Bandes & Salerno, 2014). The present study took the essential step of distinguishing between pregoal and postgoal emotions, and demonstrated that pregoal emotions, such as fear and hope, increase susceptibility to false memories for goal-irrelevant details. The pattern of results strongly supports the view that people’s motivational appraisals affect the type of details attended to and remembered. Given that emotions permeate all of our actions, thoughts, and memories, the current findings also attest to the importance of further attention to motivational appraisals in investigations of the effects of emotion on cognition.

Notes

1. The present study was not aimed at investigating the effect of elaboration on (false) memory per se, as this has already repeatedly been demonstrated by Zaragoza and colleagues (Drivdahl & Zaragoza, 2001; Drivdahl et al., 2009; Lane & Zaragoza, 2007; Zaragoza et al., 2011).
2. This hypothesis was tentative. Narrowing attention to particular features of an event implies that the other features will not receive attention, leading to poor memory. However, attention narrowing does not necessarily enhance memory for attended information (Van Damme & Smets, 2014; Wessel & Merckelbach, 1997).

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Appendix 1. Instructions before viewing the slide sequence

All participants:

You will see a slide sequence depicting a couple, Christina and Seth. They have been together for two years and often spend time together.

Positive pregoal (hope):

Throughout everything that happens, Christina feels hopeful. She loves Seth and wants to make this relationship work. Although they sometimes fight, she truly hopes that Seth wants the same things as she does and that everything will turn out fine. She is hopeful that they will soon be moving in together. Watch the slide sequence attentively. Try to empathize with Christina as much as possible, keeping in mind that she feels hopeful.

Positive postgoal (happiness):

Throughout everything that happens, Christina feels happy. She loves Seth and is delighted with how well their relationship works. Although they sometimes fight, she knows that Seth loves her and that they both want the same things. They will be moving in together and she is really happy about that. Watch the slide sequence attentively. Try to empathize with Christina as much as possible, keeping in mind that she feels happy.

Negative pregoal (fear):

Throughout everything that happens, Christina feels afraid. She loves Seth, but is worried that this relationship won't work. Because they sometimes fight, she is afraid that Seth doesn't want the same things as she does. She wants to move in together, but what if he doesn't want the same? Watch the slide sequence attentively. Try to empathize with Christina as much as possible, keeping in mind that she feels afraid.

Negative postgoal (devastation):

Throughout everything that happens, Christina feels devastated. She loves Seth, but knows that their relationship just doesn't work. Because they sometimes fight, she is certain that they both want different things. She is devastated that Seth doesn't want to move in together. Watch the slide sequence attentively. Try to empathize with Christina as much as possible, keeping in mind that she feels devastated.

Perceptual condition & Control condition:

Watch the slide sequence attentively.

Appendix 2. Elaboration items**1) GOAL-RELEVANT (slide 9)***Positive pregoal*

Imagine how HOPEFUL Christina felt as Seth kissed her when she arrived at his apartment, EAGER for this to mean that he really loved her.

Positive postgoal

Imagine how HAPPY Christina felt as Seth kissed her when she arrived at his apartment, KNOWING that it showed he really loved her.

Negative pregoal

Imagine how AFRAID Christina felt as Seth kissed her when she arrived at his apartment, SCARED that this did not necessarily mean that he really loved her.

Negative postgoal

Imagine how DEVASTATED Christina felt as Seth kissed her when she arrived at his apartment, KNOWING that it didn't mean he really loved her.

Perceptual

Imagine how STRAIGHT Christina WAS STANDING as Seth kissed her when she arrived at his apartment.

Control

Imagine when Christina arrived at Seth's apartment.

2) GOAL-IRRELEVANT (slide 10)*Positive pregoal*

Imagine how HOPEFUL Christina felt when she came in and Seth took her coat, HOPING that Seth would want to spend quality time with her.

Positive postgoal

Imagine how HAPPY Christina felt when she came in and Seth took her coat, KNOWING that Seth wanted to spend quality time with her.

Negative pregoal

Imagine how AFRAID Christina felt when she came in and Seth took her coat, FEARING that Seth would not want to spend quality time with her.

Negative postgoal

Imagine how DEVASTATED Christina felt when she came in and Seth took her coat, CERTAIN that Seth would not want to spend quality time with her.

Perceptual

Imagine how CLOSE Christina stood next to Seth, when she came in and he took her coat.

Control

Imagine when Christina came into the apartment.

3) GOAL-RELEVANT (slide 19)*Positive pregoal*

Imagine how HOPEFUL Christina felt when she put on some lipstick in the bathroom, EAGER for Seth to pay attention to her when she returned.

Positive postgoal

Imagine how HAPPY Christina felt when she put on some lipstick in the bathroom, KNOWING that Seth would pay attention to her when she returned.

Negative pregoal

Imagine how AFRAID Christina felt when she put on some lipstick in the bathroom, FEARING that Seth might not pay attention to her when she returned.

Negative postgoal

Imagine how DEVASTATED Christina felt when she put on some lipstick in the bathroom, KNOWING that Seth would not pay attention to her when she returned.

Perceptual

Imagine how FAR Christina LEANED FORWARD to put on some lipstick in the bathroom.

Control

Imagine when Christina went to freshen up in the bathroom.

4) GOAL-IRRELEVANT (slide 27)*Positive pregoal*

Imagine how HOPEFUL Christina felt when she approached the open closet door to get one of Seth's sweaters, HOPING he would be glad to see her when she returned.

Positive postgoal

Imagine how HAPPY Christina felt when she approached the open closet door to get one of Seth's sweaters, KNOWING he would be glad to see her when she returned.

Negative pregoal

Imagine how AFRAID Christina felt when she approached the open closet door to get one of Seth's sweaters, SCARED he would not be glad to see her when she returned.

Negative postgoal

Imagine how DEVASTATED Christina felt when she approached the open closet door to get one of Seth's sweaters, KNOWING he would not be glad to see her when she returned.

Perceptual

Imagine how STRAIGHT Christina was standing in front of the open closet door, when she went to get one of Seth's sweaters.

Control

Imagine when Christina was standing in front of the closet to get one of Seth's sweaters.

5) GOAL-IRRELEVANT (slide 30)*Positive pregoal*

Imagine how HOPEFUL Christina felt when she was in the study room and looked at the computer screen, HOPING she would be able to talk to Seth about anything.

Positive postgoal

Imagine how HAPPY Christina felt when she was in the study room and looked at the computer screen, KNOWING she and Seth could always talk about anything.

Negative pregoal

Imagine how AFRAID Christina felt when she was in the study room and looked at the computer screen, FEARING she and Seth would not know what to say to each other.

Negative postgoal

Imagine how DEVASTATED Christina felt when she was in the study room and looked at the computer screen, KNOWING she and Seth never knew what to say to each other.

Perceptual

Imagine how Christina TURNED HER HEAD when she was in the study room and looked at the computer screen.

Control

Imagine when Christina was in the study room.

6) GOAL-RELEVANT (slide 31)*Positive pregoal*

Imagine how HOPEFUL Christina felt when she came back into the living room in Seth's sweater and saw him sleeping on the couch, EAGER to live together and to wake up next to him every day.

Positive postgoal

Imagine how HAPPY Christina felt when she came back into the living room in Seth's sweater and saw him sleeping on the couch, KNOWING that they would soon live together and she would wake up next to him every day.

Negative pregoal

Imagine how AFRAID Christina felt when she came back into the living room in Seth's sweater and saw him sleeping on the couch, FEARING that he wouldn't want to live together and she would not wake up next to him every day.

Negative postgoal

Imagine how DEVASTATED Christina felt when she came back into the living room in Seth's sweater and saw him sleeping on the couch, KNOWING that he didn't want to live together and she would not wake up next to him every day.

Perceptual

Imagine how Christina stood in the living room in Seth's sweater, LEANING on her left foot, and saw him sleeping on the couch.

Control

Imagine when Christina came back into the living room in Seth's sweater and saw him.

7) GOAL-IRRELEVANT (slide 32)*Positive pregoal*

Imagine how HOPEFUL Christina felt when turning off the television with the remote control, HOPING that she and Seth would spend more quality time in the next couple of days.

Positive postgoal

Imagine how HAPPY Christina felt when turning off the television with the remote control, KNOWING that she and Seth would spend more quality time in the next couple of days.

Negative pregoal

Imagine how AFRAID Christina felt when turning off the television with the remote control, FEARING that she and Seth would not spend any quality time in the next couple of days.

Negative postgoal

Imagine how DEVASTATED Christina felt when turning off the television with the remote control, KNOWING that she and Seth would not spend any quality time in the next couple of days.

Perceptual

Imagine how Christina STRETCHED her arm when turning off the television with the remote control.

Control

Imagine when Christina turned off the television.

8) GOAL-RELEVANT (slide 40)*Positive pregoal*

Imagine how HOPEFUL Christina felt leaving the front door open when walking out of the apartment, WANTING Seth to come after her.

Positive postgoal

Imagine how HAPPY Christina felt leaving the front door open when walking out of the apartment, CERTAIN that Seth would come after her.

Negative pregoal

Imagine how AFRAID Christina felt leaving the front door open when walking out of the apartment, SCARED that Seth would not come after her.

Negative postgoal

Imagine how DEVASTATED Christina felt leaving the front door open when walking out of the apartment, CERTAIN that Seth would not want to come after her.

Perceptual

Imagine how Christina HELD the front door with her hand, leaving it open when walking out of the apartment.

Control

Imagine when Christina walked out of the apartment.

Appendix 3. Source memory test items, in chronological order

	Test item	Item type		Goal-relevant?
		Version 1	Version 2	
1	Seth smiled when he opened the door for Christina	Non-suggested	true	
2	Seth kissed Christina when she arrived	Suggested true	Suggested false	Yes
3	When Christina came in, Seth took her coat	Suggested false	Suggested true	No
4	The curtains were closed when Christina first came into the living room	Non-suggested	false	
5	Christina took her bag with her when she went to the bathroom	Non-suggested	true	
6	When Christina was in the bathroom, she put on some lipstick	Suggested false	Suggested true	Yes
7	When Christina came back from the bathroom, Seth had put his feet on the coffee table	Non-suggested	false	
8	Before she left the room to get a sweater, Christina was lying in Seth's arms	Non-suggested	false	
9	When Christina went to get one of Seth's sweaters, the closet door was already open	Suggested true	Suggested false	No
10	Christina was looking at the computer screen while she was in the study room	Suggested false	Suggested true	No
11	When Christina came back into the living room in Seth's sweater, Seth was sleeping on the couch	Suggested true	Suggested false	Yes
12	Christina used the remote suggested true to turn off the television	Suggested true	Suggested false	No
13	While arguing with Seth, Christina was pointing at him	Non-suggested	false	
14	Christina accidentally left her bag on the couch when she walked out of the apartment	Non-suggested	true	
15	Christina left the front door open when she walked out of the apartment	Suggested false	Suggested true	Yes
16	When Christina and Seth made up in the hallway, they hugged each other	Non-suggested	true	