

Running head: BELIEF IN OCCURRENCE AND AUTOBIOGRAPHICAL MEMORY

The role of belief in occurrence within autobiographical memory

Alan Scoboria<sup>1</sup>

Dennis L. Jackson<sup>1</sup>

Jennifer Talarico<sup>2</sup>

Maciej Hanczakowski<sup>3</sup>

Lauren Wysman<sup>1</sup>

Giuliana Mazzoni<sup>3</sup>

1 – Department of Psychology, University of Windsor, 401 Sunset, Windsor, ON, N9B3P4  
Canada

2 – Lafayette College, Oechsle Hall, 350 Hamilton Street, Easton, PA 18042

3 – Department of Psychology, University of Hull, Cottingham Road, Hull HU6 7RX, United  
Kingdom

Word count:

Corresponding author:

Alan Scoboria

Department of Psychology

401 Sunset

Windsor, ON, Canada, N9B 3P4

1-519-253-3000 x4090; fax 519-973-7021

scoboria@uwindsor.ca

### Abstract

This article examines the idea that believing that events occurred in the past is a non-memorial decision that reflects underlying processes that are distinct from recollecting events. Research on autobiographical memory has often focused on events that are both believed to have occurred and remembered, thus tending to overlook the distinction between autobiographical belief and recollection. Studying event representations such as *false memories*, *believed-not-remembered events*, and *non-believed memories* shows the influence of non-memorial processes on evaluations of occurrence. Believing that an event occurred and recollecting an event may be more strongly dissociated than previously stated. The relative independence of these constructs was examined in 2 studies. In Study 1, multiple events were cued, and then each was rated on autobiographical belief, recollection, and other memory characteristics. In Study 2, participants described a nonbelieved memory, a believed memory, and a believed-not-remembered event, and they made similar ratings. In both studies, structural equation modeling techniques revealed distinct belief and recollection latent variables. Modeling the predictors of these factors revealed a double dissociation: Perceptual, re-experiencing, and emotional features predicted recollection and not belief, whereas event plausibility strongly predicted belief and weakly predicted recollection. The results show that judgments of autobiographical belief and recollection are distinct, that each is influenced by different sources of information and processes, and that the strength of their relationship varies depending on the type of event under study. The concept of autobiographical belief is elaborated, and implications of the findings are discussed in relation to decision making about events, social influence on memory, metacognition, and recognition processes.

*Keywords:* memory, recollection, autobiographical belief, dissonance, decision making

*Memory believes before knowing remembers. (William Faulkner, Light in August)*

*Memory is a complicated thing, a relative to truth, but not its twin. (Barbara Kingsolver, Animal Dreams)*

Are you able to remember having breakfast today? When you think about the meal, do you re-evolve some of the perceptual aspects of the experience? Do you “see” the surroundings?

Do some vivid tastes come to mind that are reminiscent of the meal? Was there coffee?

This example of remembering a past episode is taken from one of the earliest studies of memory, in which Galton (1880) asked individuals to recall the appearance of the table from that morning’s breakfast. An extensive body of research has since examined memory for events.

Many theorists have observed that when events are remembered, they are frequently accompanied by perceptual and emotional characteristics that are perceived as reminiscent of the original experience (Brewer, 1996; James, 1890/1950; Rubin, 2006; Tulving, 1983).

This re-perception, or *recollection*, of an event is not the only mental experience that occurs when this breakfast is remembered; the event is also believed to have truly occurred in the past.

Furthermore, the presence of recollection is not a necessary condition for such belief in the occurrence of the event. For example, a person may believe they had breakfast because they know that they eat breakfast daily, while lacking a vivid mental representation of that specific breakfast. Or a person may believe they had breakfast based on another person telling them that they ate breakfast that day. In these examples, belief in the event exists absent recollection.

The current research examines the degree to which judgments of *autobiographical belief* are distinct from judgments of *recollection*. Such an investigation is timely, in light of a growing body of evidence that suggest a theoretical dissociation between these components of remembering. Furthermore, evidence is mounting that autobiographical belief is a non-memorial judgment that is strongly influenced by environmental input, particularly through the acquisition

of socially transmitted information and via social influence (Clark, Nash, Fincham, & Mazzoni, 2012; Mazzoni, Scoboria, & Harvey, 2010; Otgaar, Scoboria, & Smeets, 2013). Thus, reports that events occurred in the autobiographical past are only partly based in recollection.

As Brewer (1996) argued, lack of precision in the language used in research on memory contributes to conceptual confusion, therefore a number of terms are defined first. Throughout, the terms *remembering* and *autobiographical memory* (ABM) refer to the entirety of the experience of recalling events occurring to the self in the past. The term *recollection* refers to the mental reexperiencing or re-perceiving of an event, similar to the way it is used by Rubin (2006). The terms *autobiographical belief* and *belief in occurrence* refer to the truth value attributed to the occurrence of an event, whether or not the event is recollected (Mazzoni et al., 2010; Scoboria, Mazzoni, Kirsch, & Relyea, 2004).

### **Belief in Occurrence and Recollection Are Typically Confounded**

Much of the time, recollecting an event and believing that an event occurred happen simultaneously. According to Tulving (1983), “The feeling that the present recollective experience refers to a past event, and the feeling that the experience is veridical, that is it represents the past faithfully, are given as an integral part of the subjective experience of remembering” (p. 187). Per Brewer (1996), memories are “accompanied by a belief that the remembered episode was personally experienced by the individual in that individual’s past” (p. 61), thus stressing that both components are often combined in the act of remembering. Others note that memories are believed to have occurred (Brown & Kulik, 1977; Lampinen & Odegard, 2006) or are believed to be truthful representations of the past (Pillemer, 1998).

In other words, memories are typically believed, and the study of everyday memory is typically the study of *believed memories*. Because autobiographical belief and recollection are both strong

in this case, it is not surprising that the concepts are often confounded. For example, studies of ABM are typically limited to believed memories. A prominent method is the Galton/Crovitz technique (Crovitz & Schiffman, 1974) in which participants are instructed to recall memories in response to cue words, leading to a focus on reporting believed episodes (see Robinson, 1976; Talarico & Mace, 2010). Similarly, flashbulb memories are characterized by strong belief that the event occurred (Neisser & Harsch, 1992; Talarico & Rubin, 2003). More generally, when experimenters ask for memories, the bias is toward reporting events which are strong in both recollection and autobiographical belief (Scoboria & Talarico, 2013).

Some studies have contrasted *believed memories* with intentional fabrications (e.g., imaginings; Arbuthnott, Geelan, & Kealy, 2002; Johnson, Foley, Suengas, & Raye, 1988; Kealy, Kuiper, & Klein, 2006) or non-autobiographical events (e.g., experiences of other people; Crawley & Eacott, 2006). Such mental representations are neither recollected nor believed to have occurred, hence it is not surprising that people are good at discriminating between believed memories and *not-believed-not-remembered events*. If only these two classes of events are considered, it might be concluded that autobiographical belief and recollection co-vary completely, and there is little value in their distinction. Other research, however, shows that the concepts can be partly dissociated.

### **Autobiographical Belief Without Recollection**

There is ample evidence for the existence of autobiographical belief in the absence of recollection. Most people endorse believing that they were born, but do not indicate having a memory (Brewer, 1996), showing that autobiographical beliefs are sometimes inferred from necessary truths (Shtulman, 2009). Autobiographical belief is sometimes based in externally acquired information. For example, autobiographical belief is acquired through social

transmission as in the case of a parent telling a child a story, or by the acquisition of evidence such as seeing oneself in a photograph (Mazzoni & Kirsch, 2002; McGinnis & Roberts, 1996).

Theories of false memory formation propose that when events are suggested, belief in occurrence typically develops prior to memories (Mazzoni, Loftus, & Kirsch, 2001; Pezdek, Finger, & Hodge, 1997; Scoboria et al., 2004). Studies show that false beliefs can be induced without associated increases in recollection (Bernstein, Pernat, & Loftus, 2011; Hart & Schooler, 2006; Mazzoni, Loftus, Seitz, & Lynn, 1999; Pezdek, Blandon-Gitlin, & Gabbay, 2006; Scoboria, Lynn, Hessen, & Fisico, 2007). The literature also shows that correlations between autobiographical belief and recollection tend to be moderate and that belief ratings frequently exceed recollection ratings (Scoboria et al., 2007, 2004; Sharman & Scoboria, 2009).

The literature also demonstrates that social influences have a more rapid and substantial impact on the formation of novel autobiographical beliefs than on recollections (see Clark et al., 2012; Otgaar et al., 2013). False belief ratings can increase quickly when people are told that a family member said that an event occurred, when a credible expert provides evidence that an event happened, or when individuals are told that an event occurred frequently in a self-relevant reference group (Mazzoni et al., 2001, 1999; Scoboria, Mazzoni, Kirsch, & Jimenez, 2006; van Golde, Sharman, & Candel, 2010). The credibility of the social source of suggestions influences the acceptance of suggested information (Echterhoff, Hirst, & Hussy, 2005; Meade & Roediger, 2002) and the formation of false autobiographical beliefs (Scoboria, Wysman, & Otgaar, 2012). Conversely, recollection ratings remain largely unchanged following such social manipulations. Creating false recollections requires procedures such as repeated retrieval efforts and visualization to foster mental simulations that are later misattributed as recollections (Desjardins & Scoboria, 2007; Hessen-Kayfitz & Scoboria, 2012; Hyman & Pentland, 1996; Mazzoni &

Memon, 2003). Likewise, research on socially induced false confessions shows that coerced internalized false confessions are more likely to manifest as internalized beliefs than as memory like confabulations (Kassin & Kiechel, 1996; Nash & Wade, 2009). In sum, the content of socially transmitted messages about the past, the credibility of said messages, the credibility of the messenger, and social factors present at the time of remembering contribute to the development of false autobiographical beliefs, but to a much less extent (if any) to false memories.

### **Recollection Without Autobiographical Belief**

Whereas research on the acceptance of suggested false events has illuminated the development of autobiographical belief in the absence of memory, work on *nonbelieved memories* shows that this dissociation may also operate in the other direction (Mazzoni et al., 2010). Nonbelieved memories are events that people once believed to have occurred but which they stopped believing. Despite the subjective withdrawal of belief, the event continues to be experienced as memory-like (conveying a vivid recollective experience). Mazzoni et al. found that believed and non-believed memories were rated as similar, and as higher than believed-not remembered events, on key indicators of recollection such as vividness of perceptual details and sense of re-experiencing the past. Despite lacking autobiographical belief, mental representations for such events were otherwise similar in characteristic to believed memories. The participants in their study did not make autobiographical belief or recollection ratings about the events, so the levels of each associated with naturally occurring nonbelieved memories are yet to be examined. Social influence also plays a key role in the development of many nonbelieved memories. A majority of respondents in Mazzoni et al. (2010) endorsed social feedback as the reason that they stopped believing in their memory. Studies on the experimental inducement of nonbelieved

memories support this conclusion.

Clark et al. (2012) found that when laboratory created memories are challenged by the experimenter telling participants that events did not occur, belief ratings decreased to a greater extent than recollection ratings. Otgaar et al. (2013, Study 1) found that nonbelieved memories occurred following the social suggestion of false childhood events. In both studies, memory characteristic ratings for experimentally induced nonbelieved memories resembled the naturally occurring nonbelieved memories reported by Mazzoni et al. (2010). The fact that social feedback results in the withdrawal of belief but with a sustained sense of recollection provides further evidence that autobiographical belief is more strongly influenced by social factors than is recollection.

Of further relevance, social input that events occurred differently than they are recalled does not always lead to a loss of autobiographical belief. In the face of disconfirming social evidence, people sometimes choose to defend the belief in their memory, as in the example of the contested memories described by Sheen, Kemp, and Rubin (2001; see also Ikier, Tekcan, Gülgöz, & Küntay, 2003). Other research has reported that social input is a key source of information used for evaluating the occurrence of events. When unclear about or unable to recall events, people are most likely to turn to social sources for assistance (Wade & Garry, 2005), even when the only social source available is not notably credible (Nash & Takarangi, 2011). Finally, autobiographical belief without recollection is sufficient to motivate behavior. This has been demonstrated experimentally via the suggestion of false childhood events (Geraerts et al., 2008) and the induction of internalized false confessions (Kassin & Kiechel, 1996; Russano, Meissner, Narchet, & Kassin, 2005) and has been observed naturalistically in the examples of adults who choose to confront alleged abusers based on the belief that they had been abused as children



without any memory of the abuse (Ost & Nunkoosing, 2010).

### **Potential Independence of Autobiographical Belief and Recollection**

The narrative to this point has presented autobiographical belief and recollection in terms of categories (believed memories, nonbelieved memories, etc.). The discussion of these discrete “types” of events, which have been studied in different parts of the literature, shows that the distinction matters. However, we do not imply that these categories appear in this form in nature. As illustrated in Figure 1, these four types of events (believed memories, not-believed-not-remembered, believed-not-remembered, and non-believed memories) can be placed onto two continuous dimensions, raising the possibility that autobiographical belief and recollection represent distinct continuous variables that can manifest in different combinations across events. If they are continuous, it should be possible to empirically demonstrate the dissociation between these dimensions, in particular if autobiographical events are sampled in a manner that permits variation in each construct relative to the other. This is the goal of the current research.

The idea of belief in occurrence as distinct from recollection is not completely new. James (1890/1950) described a memory as a mental representation to which the “emotion of belief” (p. 650) is attached. The Basic Systems Model (Rubin, 2006) makes the related proposal that memory reports reflect two distinct metacognitive judgments, termed *recollection* and *belief*. Recollection is conceptualized as perceptual re-experiencing of events, and belief as the degree to which an event is perceived as happening in the manner recalled. We emphasize that this type of “belief” is conceptually distinct from the concept of autobiographical belief. For purposes of clarity, in this article we term the “belief” proposed in Rubin’s (2006) model as “belief in recollection.” The Basic Systems Model is important for its emphasis on the phenomenological qualities associated with remembering events. Related research has shown recollection is

predicted by perceptual, re-experiencing, and emotional characteristics, while items thought to measure belief in recollection are predicted by contextual and narrative coherence features (Rubin, Schrauf, & Greenberg, 2003; Rubin & Siegler, 2004). Hence the Basic Systems Model proposes that multiple metamemory judgments contribute to event appraisals, and that different features are reliably associated with each judgment.

Where our approach differs is in the emphasis that Rubin's approach puts on the appraisal of the veridicality of event representations (i.e., "Am I remembering the details of the event accurately?"), whereas our approach emphasizes the appraisal that the event truly occurred (i.e., "Did that event happen?"). These are theoretically distinct aspects of memory monitoring. For example, people can believe that an event occurred while experiencing doubt as to the accuracy of the memory, or they can believe that events occurred while possessing minimal recollection. We return to this issue in the general discussion.

The Nested Model (Scoboria et al., 2004) makes an explicit distinction between autobiographical belief and recollection and proposes a partial dissociation between the concepts. This model arose out of efforts to understand false memory formation, and proposes that while recollected events are typically believed, it is not necessarily the case that believed events are recollected. From this is derived the argument that when recollection is high, autobiographical belief is inferred; and when belief is low, recollection is constrained to be low. Furthermore, the model integrates the concept of event plausibility (the *possibility* of occurrence), which is thought to be more strongly related to belief in occurrence than recollection. For this reason plausibility is also measured in the present work. Also important for the current work, the authors developed items to operationalize belief in occurrence, recollection, and plausibility and showed that these three concepts can be measured reliably and independently.

### **The Current Studies**

The study of false autobiographical beliefs, in which belief exceeds recollection, and of nonbelieved memories, for which recollection theoretically exceeds belief, points to the possibility of a stronger distinction between these constructs than previously stated. Yet, no research has so far measured both with the goal of estimating their dissociation. We propose that belief in occurrence and recollection will dissociate when measured in a manner that permits assessment of underlying latent constructs, and each should be predicted by distinct variables. The conditions needed to accomplish this include measuring each construct using multiple items, and obtaining sufficient variability in the measurement of each. These studies used two distinct methods to elicit autobiographical events. In Study 1, participants were cued to recall events, after which they rated the events using variables taken from prior research on autobiographical remembering. In Study 2, participants provided and made similar ratings for naturally occurring non-believed memories, believed memories, and believed not remembered events. In both studies, structural equation modeling techniques were used to explore the latent structure of autobiographical belief and recollection judgments, and to explore their predictors. We also included items from Rubin, Schrauf, and Greenberg (2003) to assess the relationship of our approach to theirs.

We anticipated finding a reliable distinction between autobiographical belief and recollection. Because the cueing method used in Study 1 is likely to lead to people providing mostly believed memories, their separation would be revealed in a good fit for a two factor model and a moderate inter-factor correlation indicating overlap but not redundancy. We also expected characteristics previously associated with recollection (e.g., perceptual, reexperiencing) would predict more variance in recollection than in autobiographical belief. Based on the Nested Model, we expected

plausibility to predict more variance in belief than in recollection.

In Study 2, we expected to find a similar factor model across and within different types of events, and that the correlation would be similar to that found in Study 1 for believed memories, but would be smaller for the other event types.

## Study 1

### Method

**Participants.** A total of 293 students (82% female; average age 20.2 years,  $SD$  2.02, range 18–25) from two North American institutions participated.

**Measures of belief in occurrence, recollection, and plausibility.** The four items from the Autobiographical Beliefs and Memory Questionnaire (ABMQ; Scoboria et al., 2004) were included to assess four constructs relevant to remembering autobiographical events—general plausibility<sup>1</sup> (event could have happened to others), personal plausibility (event could have happened to self), autobiographical belief (event did happen to self), and memory (for the event)—on 8-point Likert style scales (anchored as *not at all plausible/extremely plausible*; *definitely did not happen/definitely happened*; *no memory at all/clear and complete memory*). Because multiple items per construct are needed to facilitate analyses assessing whether autobiographical belief and recollection are distinct constructs, two new items were added to query strength of recollection and autobiographical belief on 7-point scales. These four items and the remember/know item from Rubin, Schrauf, and Greenberg (2003) were administered to a pilot sample of 164 students (74% women; mean age 20.88 years,  $SD$  3.80). Reliabilities were high for the two item belief in occurrence (Alpha = .89) and three item recollection (Alpha = .91) scales, indicating adequate scale reliability for the main study. These items are provided in the Appendix.

Participants also rated the events on 12 characteristics that are frequently assessed in work on ABM on 7-point scales. Characteristics previously associated with recollection (Johnson et al., 1988; Rubin, Schrauf, & Greenberg, 2003) included reexperiencing (reliving, mental time travel; averaged), perceptual detail, spatial setting, persuasion, current emotion (positive, negative, intensity), event specificity, importance, and prior rehearsal (thought, talked; averaged). Personal plausibility was included as a predictor of autobiographical belief (Scoboria et al., 2004). The belief in memory item from Rubin, Schrauf, and Greenberg (2003) was also included to assess its connection with the other items administered. These items are provided in the online supplemental materials.

**Procedure.** The study was administered via computer using Direct RT software (Version 2007; Jarvis, 2007). Participants were cued to recall five childhood events (from before 6 years of age), one at a time, and to provide a brief 2–3 word description sufficient to remind them of the event. After cueing, the descriptions were presented one at a time in random order and participants rated each using the two autobiographical belief, three recollection, and 12 other items in a fixed order. Events from early life were selected to encourage retrieval of events that might be less accessible, and therefore more variable in recollection and belief in occurrence. Multiple events were cued because generating only one event would likely lead to recall of highly rehearsed memories which would be near ceiling for both constructs. Cueing for all events before soliciting ratings ensured that exposure to items could not bias the selection of events. This method allowed sampling of events without revealing the interest of the study in belief and recollection.

## **Results**

Confirmatory factor analysis (CFA) was used to test the latent structure of belief and recollection judgments. CFA is a structural equation modeling technique that requires that one or more

theoretical models be specified in advance of testing the fit of data to the model. The researcher defines in advance what factors will be present and onto which specific factor(s) items will load. The data are then used to evaluate the extent to which the model explains covariance amongst the measured variables, resulting in an estimate of the degree to which the proposed theoretical model represents a good fit to the data. Further details are provided in the online supplemental materials. Confidence intervals for path coefficients and correlations were estimated based on bootstrapping of 1,000 samples.

Ratings for each item were averaged across the five events. Six multivariate outliers were removed based on Mahalanobis's  $D^2$ , using a cutoff corresponding to  $p < .001$ , resulting in a final total of 287 cases. Two models were then tested in EQS Version 6.1, using robust estimation (to account for some skewness in some variables) for chi-square, fit indices, and standard errors. Model fit was assessed per the recommendations of Jackson, Gillaspay, and Purc-Stephenson (2009). A model with the five belief and recollection items loading on the same latent factor did not fit the data well, Satorra–Bentler (S-B; Satorra & Bentler, 1994) Scaled  $\chi^2(5) = 76.42, p < .001$ ; comparative fit index (CFI)  $.729$ ; root-mean-square error of approximation (RMSEA)  $.227$  (90% CI  $[.183, .271]$ ). The proposed two factor model was a good fit to the data, S-B  $\chi^2(4) = 7.61, p > .05$ ; CFI  $.986$ ; RMSEA  $.073$  (90% CI  $[.000, .140]$ ). The item loadings and the factor correlation are presented in Figure 2. We used 1,000 bootstrap samples for the two factor model, and found agreement between significance tests related to loadings of measured variables on latent variables. This shows that the best fitting model was robust to violation of the normality assumption. The moderate factor correlation ( $r = .516, 95\% \text{ CI } [.38, .63]$ ) was likely due to the fact that the cueing approach primarily elicited believed memories, and few instances in which recollection exceeded belief (see Table 1). Given the preponderance of believed memories

elicited by the cueing method, these results indicate two distinct latent factors that are moderately correlated when believed memories are cued.

The next analyses included the plausibility and memory characteristic indices in the two factor model to predict these factors. We first added all of the predictors (perceptual, setting, reexperiencing [average of “reliving” and “mental time travel”]), specificity, persuasion, significance, rehearsal [average of “thought” and “talked”], positive emotion, negative emotion, emotion intensity, and personal plausibility). In the first model, all predictor variables were allowed to predict both latent variables, and all predictors were allowed to correlate. The disturbance terms for the two latent variables were allowed to correlate in order to determine whether the residual relationship between belief in occurrence and recollection would be attenuated after adding the predictors. It was expected that the model fit would deteriorate through the addition of new variables, because our goal was only to predict the latent variables, and not to model the relationships amongst the predictors. We anticipated that perception and reexperiencing would predict recollection, and more substantially than belief in occurrence, while plausibility would predict belief in occurrence more substantially than recollection.

The initial model indicated that negative emotion, positive emotion, and rehearsal did not predict either factor, and these were dropped. The final predictor model including the remaining predictors yielded a  $\chi^2(27) = 100.92, p = .001$ , with a CFI of .935 and a RMSEA of .098 (90% CI [.078, .118]). The standardized coefficients are presented in Table 2, which shows that perception, re-experiencing, emotion intensity, and specificity uniquely predicted recollection. Plausibility predicted recollection weakly but was a strong predictor of belief in occurrence. Only spatial setting predicted both belief in occurrence and recollection at similar levels. Substantial variance of both latent belief in occurrence ( $R^2 = .508$ ) and recollection ( $R^2 = .859$ ) was

accounted for by these specific predictors (perception, reexperiencing, emotion, specificity, plausibility, spatial for recollection; plausibility and spatial for belief in occurrence). Finally, the correlation between the latent variables (disturbance terms) when the plausibility and memory characteristic items were added was reduced to  $r = .304$  (95% CI [.11, .49]; from  $r = .516$ , 95% CI [.38, .63]), suggesting that as contextual variables are taken into account, autobiographical belief and recollection become more independent.

We fit a final model in which we trimmed all non-significant pathways (see the bottom of Table 1). This model included plausibility and spatial setting to predict belief in occurrence, and included perception, spatial setting, re-experiencing, plausibility, feeling intensity, persuade, and specificity to predict recollection. The model fit was similar to the previous one, S-B 2(29) 98.41,  $p = .001$ ; CFI .934; RMSEA .091 (90% CI [.072, .111]). The predictors accounted for substantial variance in belief in occurrence ( $R^2 = .478$ ) and recollection ( $R^2 = .856$ ), and the correlation between the latent variables (disturbance terms) remained unchanged at  $r = .304$ .

We then included the “belief in memory” item (taken from Rubin, Schrauf, & Greenberg, 2003) in the initial structural model to assess how it overlapped with the constructs examined here.

When this item was specified to cross load on both factors the fit was acceptable: S-B 2(7) 15.65,  $p = .029$ ; CFI .976; RMSEA .067 (90% CI [.020, .111]). Only the loading (.621) on recollection was significant, indicating that this item does not assess belief in occurrence.

## **Discussion**

The results support the view that belief in occurrence and recollection reflect distinct latent constructs. The structural models provided support for two constructs rather than one dimension underlying decisions about remembering. These factors correlated only at a moderate level.

While this moderate correlation might be interpreted as indicating that the two factors are



overlapping, we need to notice first that with the method used in Study 1 the moderate level of correlation can be attributed to the preponderance of *believed memories*. This correlation might simply indicate that we tend to trust our recollections, as we believe they correspond to events that really happened in the past. Indeed, recollection represents a basis for belief (“If I remember, then it must have happened”). While it is tempting to conclude from this correlation that recollections necessarily correspond to real events, the large literature on believed false memories suggests some caution. Hence, our stress on the possibility that the correlation should more accurately be interpreted as reflecting the general *perceived* reliability and utility of memory, rather than the objective reality of the recollected events.

The second result that indicates that belief and recollection are distinct is the double dissociation observed between the predictors of the constructs. Items that predicted recollection well (perceptual, reexperiencing, emotion intensity, event specificity) did not predict belief.

Conversely, plausibility predicted belief strongly and recollection only weakly (only spatial setting predicted both at similar levels). Thus, even when most reported items are believed memories, variables that predict recollection do not predict belief.

While these findings are consistent with work that shows that mental simulation and reexperiencing are associated with recollection, spatial/contextual features are more broadly associated with event attributions, and plausibility primarily predicts belief in occurrence (Addis, Pan, Vu, Laiser, & Schacter, 2009; Johnson et al., 1988; Rubin, Schrauf, & Greenberg, 2003; Scoboria et al., 2004), it is worth noticing that the pattern of results obtained with predictors is also in line also with the Nested Model (Scoboria et al., 2004). The Nested Model describes the relationship between plausibility, belief in occurrence, and recollection obtained when people are asked to report past events. Here, people reported only plausible events, the great majority of

which are believed events, including believed memories. Hence, plausibility is expected to correlate weakly with recollection.

In line with the interpretation that belief and recollection are distinct constructs, it is also important to notice that the correlation between the latent constructs decreased when the predictors were added to the regression model. This reflects the fact that the predictors loaded more clearly and distinctly on only one factor and not the other. In other words, they represent elements (or processes) that are much more involved in one latent construct than the other.

Taking all these results together, the moderate correlation between the two constructs should be interpreted as indicating that belief in occurrence and recollection are distinct factors that under some circumstances co-vary.

One additional point that these results reveal is that the concept of “belief” proposed by Rubin, Schrauf, and Greenberg (2003) does not overlap with belief in occurrence. In fact, it loads on the recollection factor, rather than on the belief in occurrence factor.

Finally, it should be noted that the correlation between the constructs remains misestimated in Study 1, because the events elicited using the cueing method rarely resulted in cases in which belief was rated lower than recollection. Hence, the full implication of the dissociation as implied by nonbelieved memories in Mazzoni et al. (2010) was not revealed in this study. A complete analysis of the relationship implied in Figure 1 requires including events for which recollection exceeds belief. Including nonbelieved memories along with believed memories and believed not remembered events achieves this goal. The inclusion of distinct event types has the potential to replicate the findings of Study 1 while more clearly revealing the degree of the distinction under study. For example, the finding that belief in occurrence and recollection are distinct implies that the correlation between the two should be different for different types of events (e.g., higher for

believed memories than for other event types).

As there is no established method for cuing non-believed memories without asking participants directly, in Study 2 we adopted the method from Mazzoni et al. (2010). Participants identified non-believed memories, believed memories, and believed-notremembered events, and rated each on autobiographical belief, recollection, and related characteristics. Structural equation modeling (SEM) was used to model these events simultaneously. This permitted the evaluation of several hypotheses: (1) that belief in occurrence and recollection are distinct latent constructs within and across event types, (2) that indicators load reliably onto each construct within each event, (3) that correlations between the constructs differ by event type, (4) whether method variance due to repeating items across events impacts the findings, (5) whether the rating of events is driven by individual differences, and (6) whether the pattern of predictors from Study 1 replicates.

Replicating Study 1 under these distinct conditions would provide compelling support for the hypothesis that belief in occurrence and recollection are distinct components of remembering.

## **Study 2**

### **Method**

**Participants.** All students who enrolled in a participant pool at one North American university over 8 months answered a screening question that defined nonbelieved memories and queried whether they had a nonbelieved memory. Those who responded affirmatively were eligible for the study. The final sample included 187 students (71% women; age 18–41 years,  $M = 21.23$ ,  $SD = 4.25$ ) who provided a valid non-believed memory (the event description provided by the participant met the definition of a nonbelieved memory; e.g., some cases represented wishes that past events had not happened).

**Materials and procedure.** The same autobiographical belief and recollection items from Study

1 were used, and one new autobiographical belief item was added (*truly occurred*; see the Appendix). The list of memory characteristics drawn from the literature was more exhaustive and included 21 items: perceptual (visual, auditory, touch, smell/taste), spatial (setting; location of objects, people), temporal (time, duration), re-experiencing (reliving, mental time travel; averaged), rehearsal, complexity, narrative coherence, emotion (past content; current and past intensity; positive, negative valence), significance, and connectedness to other memories. The new items introduced in Study 2 (specific perceptual items, temporal, significance, complexity, coherence, connectedness) are theoretically interesting as shown by prior work (Rubin, Schrauf, & Greenberg, 2003), which makes their relationships to the constructs of interest worth examining. In addition to the item used in Study 1, the “willingness to testify” item from Rubin, Schrauf, and Greenberg (2003) was included as another potential indicator of belief in recollection.

Participants completed an online inventory about four events in a fixed order: (1) a *non-believed memory*, (2) a *believed memory*, and (3) a *believed-but-not-remembered* event, and (4) as a control, a *not-believed-not-remembered* event (an event that happened to another person; see Crawley & Eacott, 2006). For each event, participants described what happened, dated the event, and rated plausibility, belief, recollection and associated characteristics. For the nonbelieved memory, participants also described why they stopped believing their memory and dated when this happened. For the believed memory and believed-not-remembered event, participants were asked to report an event that dated to the age of their non-believed memory. All event descriptions were read, and 10 were dropped (3 believed memories; 7 believed-not-remembered) because the response clearly did not fit the definition of the event type. All events were episodic in nature, defined as taking place at a specific time and location. The timing and reasons for with

drawal of belief are beyond the scope of this article and are not reported here.

## Results

CFA procedures were again used to test a series of two factor models. In this study the fit of the models were tested simultaneously across three event types (believed memory, nonbelieved memory, believed not remembered event). EQS (Version 6.1) was used for all analyses, and the same approach to estimating fit was used as in Study 1. Five multivariate outliers were removed from the analyses. A description of the final model is provided below; complete information on the modeling approach and all models tested is provided in the online supplemental materials. Figure 3 contains a drawing of the final model with the standardized factor loadings for each item on the latent variables (LVs) and the LV correlations. This model provided a good fit with the data,  $S-B 2(108) 143.10, p .013$ ; CFI .966; RMSEA .042 (90% CI [.020, .060]); standardized root-mean-square residual (SRMR) .080. As in Study 1, to assess the accuracy of significance levels in the presence of non-normality, we used 1,000 bootstrap samples and found agreement between significance tests related to latent variable correlations and loadings of measured variables on latent variables.

Figure 3 is described to assist readers who may be less familiar with CFA models. Latent (unobserved) variables are indicated by ovals. There are three LVs each for belief and recollection, one for each type of event. The measured items (observed variables) are indicated by rectangles. Three items define each LV. Arrows point from the latent to the observed variables, indicating the assumption that underlying processes give rise to item responses. The variables on the left side of the figure depict belief in occurrence, and those on the right side depict recollection. The circles to the extreme right and left represent the residual variance associated with each item. Double-arrowed curved lines indicate correlations. The

correlations are estimated correlations between latent variables.

All of the item loadings onto latent variables were statistically significant and large. The correlations between the LVs within each event were statistically significant. This correlation was largest for believed memories ( $r = .45$ , 95% CI [.34, .56]), was numerically smaller for non-believed memories ( $r = .30$ , 95% CI [.12, .48]), and was negative for believed-not-remembered events ( $r = -.17$ , 95% CI [-.36, .09]), confirming the hypothesis that the relationship between belief in occurrence and recollection differs depending on the type of event under study. The correlations for belief and recollection between believed memories and believed-not-remembered events were significant but weak, and the correlations for belief and recollection between non-believed memories and the other events were not significant (these are the “vertical” correlations at the center of the figure). This indicates that there was no systematic bias in the ratings with some individuals rating all events higher and others rating all events lower. Hence, individual differences were distributed mostly independently across the events, further supporting the key theoretical distinction.

To examine the issue of repeating of measures across the events, whether the repetition of items across events affected parameter estimates in the model, we created an additional model using a Multi-Trait Multi-Method approach (Marsh & Grayson, 1995; see the online supplemental materials for further detail). This involved correlating the error terms for repeated items across events. Of these correlations, just two were significant, which indicates that method variance did not notably influence estimates for the other model parameters. In other words, the sampling method worked well—people made distinct ratings about the different events, and ratings on preceding events did not influence ratings on subsequent events.

We next turned to predicting the autobiographical belief and recollection factors. The first model

replicated the final prediction model from Study 1. Items were loaded on the LVs for the event type, and predictors were allowed to correlate and disturbance terms for LVs within event type were also allowed to correlate.

The “perception” item was replaced in this study by the “visual detail” item, and the “significance” item was not available. This model was a good fit (RMSEA .059, 90% CI [.052, .065]), and the pathways of the predictors for believed memories reasonably matched those in Study 1. We next examined whether any additional items might be included in model. After eliminating items that did not load reliably or that resulted in problems with model convergence, one new item was included (connectedness). Also, the “persuade” item showed an affinity for autobiographical belief (particularly for nonbelieved memories); hence, this item was allowed to predict the autobiographical belief LVs. Path coefficients for the final predictor model (RMSEA .053, 90% CI [.047, .060]) are presented in Table 3. Across the event types, visual, reexperiencing, and emotion intensity uniquely predicted recollection; connectedness predicted only belief in occurrence; plausibility predicted autobiographical belief strongly and recollection weakly; and persuasion and spatial details predicted both factors. The pattern varied slightly across the events types. As in Study 1, the correlations between the LVs changed after including the predictors: for believed memories, from .45 to .24 (95% CI [.12, .50]); for nonbelieved memories, from .30 to .19 (95% CI [.12, .50]); and for believed not remembered, from .17 to .04 (95% CI [.19, .28]).

To this point, the estimates for the relationship between autobiographical belief and recollection have been estimated separately for each type of event. In order to estimate the relationship between the constructs across events, we averaged items across the three events and conducted the same type of SEM modeling. The model was an excellent fit to the data: CFI .995; RMSEA

.037 (90% CI [.000, .072]); SRMR .032. The correlation between the LVs was estimated as .12 (95% CI [.07, .29]). Adding the same predictors as in the preceding paragraph to this model resulted in an estimated relationship of .04 (95% CI [.17, .29]).

**Additional analyses.** The analyses to this point focus on item covariance. The distinction between the event types also assumes differences in average autobiographical belief and recollection ratings. Average scores on the factors (see Figure 4) showed the expected pattern. For believed memories, both factors were rated equal and high. For nonbelieved memories, recollection was rated higher than belief, and the converse was the case for believed not remembered events. It is interesting that the difference between autobiographical belief and recollection for nonbelieved memories was just 1.28 (*SD* 1.74) on average, indicating that the direction of the difference is more important than the magnitude. The non-believed non-remembered (control) event showed that, as expected, both factors were rated low when remembering events that happened to other people.

We also examined how the “belief in recollection” items drawn from Rubin, Schrauf, and Greenberg (2003; testify, belief in memory, witness), related to the factors. The “testify” item was strongly bi-modal and hence was not suitable for further analysis. Similar to Study 1, the “belief in memory” item loaded primarily on the recollection factor for believed memories (.53, respectively, on recollection, vs. .16 on belief), and loaded inconsistently for the other events. This further suggests that this item taps something other than autobiographical belief.

### **General Discussion**

The results of the two studies show that belief in occurrence and recollection represent distinct components that are typically both present when people remember autobiographical events. Whereas prior research has shown a partial dissociation (Scoboria et al., 2004), this is the first



research to demonstrate their strong independence. In conventional psychometric terms, in both studies belief in occurrence and recollection were each found to be reliable and valid constructs that underlay reports about autobiographical events. They were found to be distinct even in conditions in which they would be expected to be the most overlapping (i.e., believed memories). The highest estimate of their correspondence indicated no more than 25% shared variance, and 10% shared variance appears to represent the best estimate of the overlap of the constructs for believed memories (Study 1). The amount of nonoverlapping variance is clearly substantial. The correlation between the constructs varied depending on the type of event under examination (Study 2), being the highest for believed memories, lower for events that are remembered but not believed, and reversing for believed-not-remembered events. The higher correlation for believed memories suggests that people typically trust that their recollections reflect events that genuinely occurred. Predicting the constructs provided good evidence for convergent and divergent validity, and revealed a double dissociation in their predictors. Some variables that predicted recollection did not predict autobiographical belief, and conversely, factors that predicted autobiographical beliefs did not predict recollection (or predicted it only weakly). Furthermore, the models tested in Study 2 provided evidence that repeated measures and individual differences in responding did not threaten the validity of these conclusions.

### **Centrality of Autobiographical Belief in Remembering**

Recollection in our approach is largely consistent with current conceptualizations in the literature. Recollection involves the experience of reinstatement of perceptual/temporal/spatial aspects of past perceptual states and is comprised of mental simulation accompanied by a sense of re-experiencing (Addis et al., 2009; Brewer, 1996; Rubin, 2006). Differently from prior conceptualizations, belief in occurrence is defined as the subjective evaluation of the proposition

that an event genuinely occurred in the autobiographical past (Mazzoni et al., 2010). Similar to arguments made about memory attributions in the Reality Monitoring (RM) framework (Lindsay, 2008; Johnson, Raye, Mitchell, & Ankudowich, 2011) and in the Basic Systems Model (Rubin, 2006), recollection and autobiographical belief are each attributions that are based in phenomenal experience, available information, and features of the retrieval context at the time of remembering. Our approach differs from preceding views in emphasizing the key role of belief in occurrence as the summative evaluation of the truth status of events. The inputs to autobiographical belief are not based only on recollection but also on a plethora of diverse information that are available at the time of remembering.

Inspired in part by James's (1890/1950) discussion of remembering, we propose that autobiographical belief is comprised of three distinct attributions: (1) to actual experience, (2) to the self, and (3) to the past. Removal of any of these components renders the mental representation something other than a believed past occurrence. To provide one example for each, without actual experience the representation may be labeled a fantasy; without self, the representation may be labeled as the experience of another; without the past, the representation may be labeled a plan for a future event. The labeling of events as past occurrences is supported by these components. We note that the attribution of events as having occurred does not require recollection at all, as they can be based on social information, factual knowledge, inferential processes, and so forth (see also Mazzoni & Kirsch, 2002).

We assume that once autobiographical beliefs, and by extension believed recollections, are formed, beliefs tends to remain stable unless challenged by salient discrepant information, in a way similar to factual beliefs. In reasoning, for example, it is known that revision of factual beliefs is typically difficult (Elio & Pelletier, 1997), as people not only are motivated to

maintain a consistent set of beliefs, but also consistent beliefs are a hallmark of rationality. In these cases belief change occurs only as a function of the presentation of information inconsistent with prior beliefs (e.g., Elio & Pelletier, 1997; Johnson-Laird, Girotto, & Legrenzi, 2004) or changes in attitude (Festinger, 1957). There are a variety of reasons that autobiographical beliefs are resistant to change, of which we note three. One is that the human cognitive system is prone to believing propositions unless they are explicitly evaluated and rejected (Conway, 1997; Gilbert, 1991). This implies that believing in something is the default mode when processing information. Another is that confirmation bias results in the avoidance or discounting of contradictory evidence (Nickerson, 1998).

The consequence is that contradictory information is not always processed. A third reason is that any cognitive experience which is consistent with expectations as to what one expects to be a “good memory” leads to believing the event that is in the mental representation (see Michael, Garry, & Kirsch, 2012). This means that when people experience the psychological or physiological markers that they have learned to associate with remembering, they assume that the contents of awareness reflect true past experiences. The misattribution of familiarity or processing fluency as reflecting past experience is a common example of this third reason (Bernstein, Whittlesea, & Loftus, 2002). The evidence from false memories and nonbelieved memories shows that autobiographical belief revision can occur when subjectively experienced sources of information about an event disagree. This can take the form of a discrepancy between the content of the belief and the content of recollection. When uncertain about a memory, people are motivated to resolve the discrepancy (Kemp & Burt, 2006). In the case of false memory formation, people initially do not believe that an event occurred but receive a suggestion that it did occur; hence there is a discrepancy between current (lack of) autobiographical belief and

another presumably credible source of information about the event. Some accept the suggestion and come to believe that the event did occur (i.e., they change the belief), some reject the event and maintain the original belief (“that did not happen”), while others seek additional information before making a decision (e.g., asking a parent). Conversely, in the case of nonbelieved memories, individuals have a strongly believed memory that is discrepant with newly acquired information. Here, people may decide to relinquish their belief in the event, producing a nonbelieved memory (see Sacks, 2005, for an illustrative example). Alternatively, they may reject the new information and defend their belief in the event; disputed memories are one example of this outcome (Sheen et al., 2001).

What all of these cases have in common is that two or more sources of information are, at least temporarily, in disagreement regarding the status of autobiographical belief. The disagreement between salient sources of information produces cognitive dissonance, which people are motivated to resolve (Festinger, 1957).

Adapting the dissonance theory to the case of discrepancy between autobiographical belief and recollection as exemplified by nonbelieved memories, a person who obtains information that contradicts a current memory has at least three options to reduce the dissonance: They can devalue their memory (leading to a nonbelieved memory), they can devalue the new information and maintain the original autobiographical belief (leading to a “defended memory”), or they can diminish the importance of the event (it does not matter whether or not the event in fact happened). The dissonance can originate from discrepancies between internal cognitive processes, socially transmitted information, and other features of the social environment. To provide one example, motivations to maintain close and meaningful social relationships may override motivations to be accurate or to maintain the sense that the event belongs to the self

(Cialdini & Goldstein, 2004), thus motivating changes in autobiographical belief. The converse implication is that when belief in occurrence and recollection are in agreement, they will be mutually reinforcing.

In any case, social influence is central to the formation and revision of autobiographical beliefs. This is likely because ABM has developed in, occurs in, and serves social functions (Alea & Bluck, 2003; Pillemer, 1998; see also Blank, 2009). Shared remembering increases knowledge about group members, promotes identity within groups, and leads to development of shared narratives (Hyman, 1994). Having multiple perceivers who communicate about common experiences conveys the advantage that perspectives can be integrated, extending knowledge beyond direct experience. Sharing memories enriches knowledge about the environment, promoting survival. The group can facilitate learning about events that are inaccessible, for which the individual was not present, or which the individual is incapable of remembering (e.g., early life events). In light of this, it seems likely that a notable proportion of autobiographical memory must be comprised of believed events that are based partly on editing due to social feedback, or that are entirely based in the social and cultural transmission of information. Of course, once two people see an event from different vantage points, the information available to each differs and discrepancies must somehow be reconciled when shared. When people discuss shared events and provide different reports, socially produced cognitive dissonance presumably results within each individual.

The impact of such dissonance is illustrated in the case of a woman who kept a detailed diary of events for decades because she was distressed by arguments in her family about what had occurred in the past (Catal & Fitzgerald, 2004). One might speculate that such social dissonance is ideally resolved to arrive at the most accurate account of events that simultaneously achieves

social goals. However, accuracy motivations, personal motivations regarding ownership of events, and social motives may not coincide. People are sometimes motivated to maintain beliefs in events that are central to their sense of self (Sheen et al., 2001). At other times people may alter their memory beliefs in order to escape social confrontation (Kassin, 1997). What does seem apparent is that as soon as organisms develop the capacity to communicate about experiences that they have perceived even somewhat differently, disparities will result which must be resolved in order to promote social cohesion. Agreeing with versions of events proposed by others is sometimes done to avoid conflict and/or to enhance the quality of the relationship. Social influences on remembering are currently a topic of growing interest in the field. It is beyond the scope of this article to provide a survey. We instead note several related domains of interest within this area, to demonstrate the potential reach of the distinction emphasized in this work. Research on topics such as collaborative remembering, memory conformity, and conversational remembering speak to the transactional nature of remembering within the social context (see Hirst & Echterhoff, 2012, for a review). Some propose that memory is inherently social, in that how people learn to remember and communicate about remembering is learned in the context of early relationships (Fivush, Haden, & Reese, 2006). Social influence is important for understanding individuals who come to recall past abuse in therapy and later retract said memories. Such cases reveal social and cognitive factors which contribute to the development and withdrawal of memories, some of which appear to be based in false recollection, and others in false belief absent recollection (Ost & Nunkoosing, 2010; Sarbin, 1998).

Although our data provide a strong argument on the distinction between recollection and belief in occurrence, this distinction has tended to be overlooked in the literature. This is not surprising, because both constructs are robustly present in the reports that people provide when asked for

memories. Their empirical disambiguation requires that each is assessed under conditions where each shows sufficient variability independent of the other. Hence, while they can be distinguished if directly assessed with reliable items (Study 1), the need to do so only becomes apparent when the existence of counterintuitive event representations such as nonbelieved memories and believed-not-remembered events is known.

One interpretation as to why recollections tend to be believed is that memory is typically sufficiently reliable to be useful. Recollective experience is a valid predictor of the occurrence of events enough of the time. It is interesting to notice, however, that even in these cases the degree of correspondence between recollection and belief in occurrence is at the greatest moderate, which suggests that recollection alone cannot explain why a remembered event is deemed to have occurred. Much more is needed to understand why people decide that a certain event had happened, or why they are certain that they had a particular experience in their life.

Our research highlights the importance of autobiographical belief as a key component of remembering, and brings into question the degree to which prior memory findings are influenced by recollection, autobiographical belief, or their combination. Most research in autobiographical memory has used either diary methods, in which participants are asked to report memories of personal events that are remembered during their daily life, or the GaltonCrovitz method, in which cues are presented and participants are requested to report memories about their past elicited by the cues.

In many instances, strong claims have been made from data so collected about how autobiographical memory is structured and organized (e.g., Conway & Pleydell-Pearce, 2000). However it is not clear the extent to which such organization reflects the influence of recollection, of autobiographical belief, or a combination of the two. We also need to underline

that autobiographical semantic knowledge does not correspond to the belief in occurrence.

While the first reflects factual knowledge about oneself, the latter represents the final results of the decision about whether an event happened in reality. Even the important attempts of examining the recollective and accuracy appraisal components of autobiographical reports done in previous work do not draw a real distinction between the two elements. We have shown that the “belief” variables measured in these studies (e.g., Rubin, 2006) do not measure the occurrence of the reported event, but the belief in the accuracy of the memory.

Another good example of the importance of distinguishing between belief in occurrence and recollection is represented by the “crashing memory” effect, as it shows that what is superficially reported as a memory can be in effect a belief. In crashing memory studies, participants are asked whether they remember seeing non-existent media footage for aspects of prominent public events (e.g., video footage of the moment of the car crash that ended the life of Diana, Princess of Wales). Typically a large number of participants endorse remembering seeing the non-existent footage, an effect that was initially described as a false memory phenomenon (Crombag, Wagenaar, & Van Koppen, 1996). More recently, however, Smeets, Telgen, Ost, Jelicic, and Merckelbach (2009) examined the degree to which this effect was rooted in recollection as opposed to being due to communicative factors related to how the question about the event was asked. They found that while the standard question did initially elicit endorsements of memory, follow up questioning revealed that a majority of the reports in fact reflected autobiographical beliefs (“I believe I saw the video, but do not recollect the video itself”) or plausibility statements (“I must have seen the video”) and not recollection. They noted that a very interesting 10% of individuals did continue to insist they recalled seeing the video even after being informed that it did not exist. While these people clearly do appear to have false memories, the “false



memories” elicited with the crashing memory procedure are then mostly the result of belief judgments, at times of plausibility judgments, and only rarely reflect recollection. Similarly, in studies of memory contagion it is critical to distinguish between reports that are based in recollection and those that are due to other factors (Roediger, Meade, & Bergman, 2001). Such studies document that individuals incorporate erroneous information recalled by others into their own memory reports. However, it is important to distinguish whether changes in individuals’ memory reports in response to social input are due to compliance with the experimental situation or are due to internal changes in beliefs about studied material (Meade & Roediger, 2002). False confessions might be thought of as an extreme example of memory contagion, and work on the issue has shown that it is important to distinguish between compliant false confessions, which are simply due to acquiescence, internalized false confessions (which are a type of autobiographical belief), and confabulated false confessions (in which recollection is at play; Kassin & Kiechel, 1996).

Distinguishing between internalized and confabulated false confessions reflects the distinction between autobiographical belief and recollection, and is key to understanding the different routes by which confessions come about. The distinction is also crucial for evaluating the consequences that false confessions can have in real life (e.g., when false confessions can be retracted). Hence, it is important to assess with care the bases for memory reports. What appear to be believed memories may be instead autobiographical beliefs that are based in non-recollective information, such as learning from another person that an event occurred, or inferring that an event must have happened from other factual data.

Our results also highlight the importance of assessing the meaning assigned to common terms when talking about memory reports. This has been shown for example by Otgaar et al. (2013),

who reported, in the context of false memory implantation studies, cases in which subjective reports of events as believed versus remembered disagreed with objective judgments that events were or were not remembered (e.g., judged as a memory, reported as believed but not remembered by the participant, and vice versa).

They argued that people often use language associated with remembering quite loosely to describe events that have varying levels of associated autobiographical belief and recollection. Use of words such as “remember” and “memory” do not necessarily indicate recollection, while the failure to use such words does not preclude the presence of recollection. Speaking with conviction about past events may be driven by strength of belief, and does not necessarily indicate recollection. Recollection is also not necessary for people to decide how to act, as shown by forensic cases in which people have decided to sue family members for a sexual abuse that they did not recollect, but instead strongly believed had happened. The critical point we wish to make here is that in order to understand memory reports it is essential to assess the degree to which they are supported by belief or recollection or both, without relying on the terminology used by the participants. The methodology used in the current studies represents one way to accomplish this task.

### **Belief in Occurrence, Recollection, and Confidence**

To return to the topic of metacognition as related to remembering, this work brings into question what is being measured when confidence ratings are taken during memory tasks. It seems worth considering whether autobiographical belief judgments for events and confidence judgments for event details reflect distinct processes. Brewer (1996) raises a similar point when defining ABM as comprised of three components: belief that the event happened, a recollected image, and confidence in the contents of the image.

Our approach emphasizes the former (judgments of occurrence), whereas Rubin (2006) emphasizes the latter (assessment of accuracy). To illustrate this distinction, consider Lerner and Lowe's (1958) song "I remember it well," which (when read literally) involves the character Honoré recalling to Marnita a time when they met in the past, to which she responds with corrections to the details that he provides. The opening lines are, "We met at nine. *We met at eight. I was on time. No, you were late. Ah yes, I remember it well. We dined with friends. We dined alone. A tenor sang. A baritone. . . .*" If he agrees with the revisions, his confidence in the details "nine" and "tenor" presumably decrease, confidence in "eight" and "baritone" increase, and his recollection is reconstructed, but without any effect at any point on the strength of the belief that the event occurred.

This raises a number of implications. First, confidence ratings when taken for entire events may be confounded with autobiographical belief. Second, autobiographical belief and confidence in the details within recollections might, but also might not, reflect similar processes directed at different levels of knowledge specificity. The current data provide only preliminary evidence on the issue. Our data show that belief in recollection items load on the recollection factor and not on the autobiographical belief factor for believed memories, which is consistent with the idea of a distinction between recollection and "belief in recollection" (Fitzgerald & Broadbridge, 2013; Rubin, Burt, & Fifield, 2003; Rubin, Schrauf, & Greenberg, 2003; Rubin & Siegler, 2004). The degree of separation between belief in occurrence and recollection also suggests that different monitoring processes might contribute to each. Thus, our approach and Rubin's are complementary, in that they describe distinct types of beliefs about events—whether they are believed to have occurred, and whether the representation is viewed to be accurate.

### **Belief in Occurrence and Recognition Memory**

Our discussion has focused on autobiographical memory. In the context of situating the current work generally within the field, it is also pertinent to consider the utility of theorizing about belief in occurrence in relation to more basic cognitive models of recognition. Current theorizing on recognition memory tends to overlook how non-memorial information can influence judgments of past occurrence. This is not to say that there are no studies on the effects of context information. Indeed, many studies have looked at situations in which context information is given to participants when judging past occurrence. For example, a body of research investigates how memory reports of an event provided by one person affect another person's memory report for the same event (e.g., Gabbert, Memon, & Wright, 2006; Roediger et al., 2001). In this case the other person's memory report constitutes context information for one's own memory for the event. However, these studies seem to look at this phenomenon from a perspective in which context information serves to mislead a person (but see Rajaram & Pereira-Pasarin, 2007), either by contradicting a true memory for an event (McCloskey & Zaragoza, 1985; Wright, Gabbert, Memon, & London, 2008) or by implanting a false belief when no memory exists (Lindsay & Johnson, 1989; Meade & Roediger, 2002). This line of enquiry was first proposed in research on the misinformation effect (Loftus, Miller, & Burns, 1978) and has recently been developed in the studies looking at the so called social conformity effects (Gabbert, Memon, & Allen, 2003). In this view, context information that contradicts memory is simply wrong and thus strategies of discounting such context information are necessary to protect the accuracy of memory reports. The perspective we propose differs substantially from this tradition. We wish to argue that non-memorial, belief-like information is often used for the better to inform recognition judgments, particularly in situations in which memory is absent or fails. A similar argument is made by Jaeger, Cox, and Dobbins (2012), who stress the importance of what they term *context*

*information* for old/new item recognition judgments. They note that people should normally be able to enhance the accuracy of reports by using information provided by external sources and maintain that under normal circumstances there should be no reason to expect that other people's memory reports are systematically wrong.

Hence, it often makes sense to incorporate information provided by others into one's own reports. The benefit of this approach is that it describes the final decision (old-new) in a recognition task as a function of both memory *and* context information. Typically recognition judgments are investigated using a procedure in which participants are asked to judge whether a test probe was presented earlier. Such old-new judgments are thought to derive from positioning the probe along a continuum representing the strength of the signal. The so called dual-process models (Yonelinas, 1994, 2001) postulate two processes, familiarity and recollection (note: this is a distinct use of the term recollection than in the current article), that affect the strength of the signal. The strength of the recollection signal serves to unequivocally indicate that the probe is "old," without the need to consult the familiarity strength of the probe. Jaeger et al. (2012) found that context information affected the placement of the familiarity criterion while having no effect on decisions based on recollection.

Consistent with this approach, we suggest that current recognition models concentrate on memorial aspects and do not consider the act of remembering in its whole complexity, which includes non-memorial information as an integral component.

We think that integrating models of recognition with our results within the framework of autobiographical remembering may prove fruitful for the development of models in which memory is analyzed in its real complexity, and for our understanding of the processes involved in real-life remembering. We claim, along with Wixted (2007), that judgments of occurrence are

based on *strength of evidence*, which can be conceived as a single dimension created by integrating information provided not only by familiarity and recollection, but also by all other available non-memorial information. In other words, the notion of *evidence* in a memory task should be extended to incorporate non-memorial information sources. Within this framework, the sources are jointly used to arrive at the conclusion about what happened in the past. Belief in occurrence in this context might be understood as a person's interpretation of the event's placement on this strength of evidence dimension. One potential outcome is disagreement between memorial and non-memorial signals, a situation we already discussed, in which additional processes (e.g., weighing information) will be activated to inform the decision. This results in a flexible memory system which is capable of editing and reinterpreting both recollection and familiarity-based output and also other evidence.

What this approach accomplishes is to recognize that the decision whether an event occurred can be reached in the absence of familiarity or recollection, and also that nonmemorial information can discount recollection. For the present, this approach is mute on how evidence from different sources is merged or weighted to create the strength of evidence dimension. It seems intuitively obvious that recollection carries substantial weight when present, and that recollected events are commonly placed high on the evidence dimension. We suggest that the views proposed here can facilitate understanding the relation between recognition memory and phenomena examined outside the laboratory. This approach may also prove useful for understanding effects obtained in the laboratory that are not easily captured by existing frameworks, as they stress memory processes while largely ignoring external information (e.g., diagnostic monitoring; Gallo, 2004).

### **Conclusion**

The take home message is that recollective memory is not the sole basis for judging the

occurrence of events. Most, if not all, would agree that there are autobiographical events that are believed to have occurred, even though no memory is retrieved. For example, we are told what happened when we were young and we tend to believe such stories. More surprisingly, research shows that there are also vivid recollections that are not believed to have occurred (e.g., Mazzoni et al., 2010). The research presented in this article demonstrates a strong distinction between belief in occurrence and recollection. The processes that impact recollection tend to be internal and cognitive/memorial in nature. The processes that impact autobiographical belief originate in both internal and external experience and are strongly socially mediated. In order to fully understand judgments about occurrence, which represent the final step in any memory task, it is important to consider the variety of sources and influences, both memorial and social, from which beliefs about the past are derived.

This leads us to consider what advantages there might be to the existence of these two relatively distinct systems both relating to remembering the past. One possibility is that recollection and autobiographical belief each serve as checks on the other. The origins of each can be quite distinct. Recollection tends to be rooted in direct experience, whereas autobiographical belief can be derived from a variety of internal signals or environmental sources. A believed memory is the recollection of an event that is believed to derive from direct experience. When the belief is challenged by discrepant information, it is clearly not adaptive to immediately and always agree with the new information and discard the memory as definitively erroneous. It is possible that the new information is itself in error, in which case a hasty change in belief would have been unwarranted. The presence of recollection and its strength might serve as a check for the reliability of the discordant information.

Recollection thus could modulate the belief. The same could occur with the belief. A strong

belief might modulate the content of the memory, as is implied in some models on the creation of false memories (e.g., Hyman & Kleinknecht, 1999; Mazzoni & Kirsch, 2002; Scoboria et al., 2004). What the current data suggest is that this reciprocal modulation of the two systems is not limited to the creation of false memories but might be a characteristic of human memory in general.

### References

- Addis, D. R., Pan, L., Vu, M. A., Laiser, N., & Schacter, D. L. (2009). Constructive episodic simulation of the future and the past: Distinct subsystems of a core brain network mediate imagining and remembering. *Neuropsychologia, 47*, 2222–2238. doi:10.1016/j.neuropsychologia.2008.10.026
- Alea, N., & Bluck, S. (2003). Why are you telling me that? A conceptual model of the social function of autobiographical memory. *Memory, 11*, 165–178. doi:10.1080/741938207
- Arbuthnott, K. D., Geelen, C. B., & Kealy, K. L. K. (2002). Phenomenal characteristics of guided imagery, natural imagery and autobiographical memories. *Memory & Cognition, 30*, 519–528. doi:10.3758/BF03194953
- Bernstein, D. M., Pernat, N., & Loftus, E. F. (2011). The false memory diet: False memories alter food preference. In V. R. Preedy, R. R. Watson, & C. R. Martin (Eds.), *Handbook of behavior, food, and nutrition* (pp. 1645–1663). New York, NY: Springer. doi:10.1007/978-0-387-92271-3\_107
- Bernstein, D. M., Whittlesea, B. W. A., & Loftus, E. F. (2002). Increasing confidence in remote autobiographical memory and general knowledge: Extensions of the revelation effect. *Memory & Cognition, 30*, 432–438. doi:10.3758/BF03194943



- Blank, H. (2009). Remembering: A theoretical interface between memory and social psychology. *Social Psychology, 40*, 164–175. doi:10.1027/1864-9335.40.3.164
- Brewer, W. F. (1996). What is recollective memory? In D. C. Rubin (Ed.), *Remembering our past: Studies in autobiographical memory* (pp. 19–66). doi:10.1017/CBO9780511527913.002
- Brown, R., & Kulik, J. (1977). Flashbulb memories. *Cognition, 5*, 73–99. doi:10.1016/0010-0277(77)90018-X
- Catal, L. L., & Fitzgerald, J. M. (2004). Autobiographical memory in two older adults over a twenty-year retention interval. *Memory & Cognition, 32*, 311–323. doi:10.3758/BF03196861
- Cialdini, R. B., & Goldstein, N. J. (2004). Social influence: Compliance and conformity. *Annual Review of Psychology, 55*, 591–621. doi:10.1146/annurev.psych.55.090902.142015
- Clark, A., Nash, R. A., Fincham, G., & Mazzoni, G. (2012). Creating non-believed memories for recent autobiographical events. *PLoS ONE, 7*(3), e32998. doi:10.1371/journal.pone.0032998
- Conway, M. (1997). Past and present: Recovered memories and false memories. In M. Conway (Ed.), *Recovered memories and false memories* (pp. 150–191). New York, NY: Oxford University Press.
- Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self-memory system. *Psychological Review, 107*, 261–288.
- Crawley, R. A., & Eacott, M. J. (2006). Memories of early childhood: Qualities of the experience of recollection. *Memory & Cognition, 34*, 287–294. doi:10.3758/BF03193407
- Crombag, H. F. M., Wagenaar, W. A., & Van Koppen, P. J. (1996). Crashing memories and the problem of “source monitoring”. *Applied Cognitive Psychology, 10*, 95–104. doi:10.1002/(SICI)1099-0720(199604)10:295::AID-ACP3663.0.CO;2-#
- Crovitz, H. F., & Schiffman, H. (1974). Frequency of episodic memories as a function of their

age. *Bulletin of the Psychonomic Society*, 4, 517–518.

Desjardins, T., & Scoboria, A. (2007). “You and your best friend Suzy put slime in Ms.

Smollett’s desk”: Producing false memories with selfrelevant details. *Psychonomic Bulletin & Review*, 14, 1090–1095. doi:10.3758/BF03193096

Echterhoff, G., Hirst, W., & Hussy, W. (2005). How eyewitnesses resist misinformation: Social postwarnings and the monitoring of memory characteristics. *Memory & Cognition*, 33, 770–782. doi:10.3758/BF03193073

Elio, R., & Pelletier, F. J. (1997). Belief change as propositional update. *Cognitive Science*, 21, 419–460. doi:10.1207/s15516709cog2104\_2

Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford, CA: Stanford University Press.

Fitzgerald, J. M., & Broadbridge, C. L. (2013). Latent constructs of the Autobiographical Memory Questionnaire: A recollection-belief model of autobiographical experience. *Memory*, 21, 230–248. doi:10.1080/09658211.2012.725736

Fivush, R., Haden, C. A., & Reese, E. (2006). Elaborating on elaborations: Role of maternal reminiscing style in cognitive and socioemotional development. *Child Development*, 77, 1568–1588. doi:10.1111/j.1467-8624.2006.00960.x

Gabbert, F., Memon, A., & Allan, K. (2003). Memory conformity: Can eyewitnesses influence each other’s memories for an event? *Applied Cognitive Psychology*, 17, 533–543. doi:10.1002/acp.885

Gabbert, F., Memon, A., & Wright, D. B. (2006). Memory conformity: Disentangling the steps toward influence during a discussion. *Psychonomic Bulletin & Review*, 13, 480–485. doi:10.3758/BF03193873

Gallo, D. A. (2004). Using recall to reduce false recognition: Diagnostic and disqualifying

monitoring. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *30*, 120–128. doi:10.1037/0278-7393.30.1.120

Galton, F. (1880). Statistics of mental imagery. *Mind*, *5*, 301–318. doi:10.1093/mind/os-V.19.301

Geraerts, E., Bernstein, D. M., Merckelbach, H., Linders, C., Raymaekers, L., & Loftus, E. F. (2008). Lasting false beliefs and their behavioral consequences. *Psychological Science*, *19*, 749–753. doi:10.1111/j.1467-9280.2008.02151.x

Gilbert. (1991). How mental systems believe. *American Psychologist*, *46*, 107–119. doi:10.1037/0003-066X.46.2.107

Hart, R. E., & Schooler, J. W. (2006). Increasing belief in the experience of an invasive procedure that never happened: The role of plausibility and schematicity. *Applied Cognitive Psychology*, *20*, 661–669. doi:10.1002/acp.1218

Hessen-Kayfitz, J., & Scoboria, A. (2012). False memory is in the details: Photographic details differentially predict memory formation. *Applied Cognitive Psychology*, *26*, 333–341. doi:10.1002/acp.1839

Hirst, W., & Echterhoff, G. (2012). Remembering in conversations: The social sharing and reshaping of memories. *Annual Review of Psychology*, *63*, 55–79. doi:10.1146/annurev-psych-120710-100340

Hyman, I. E. (1994). Conversational remembering: Story recall with a peer versus for an experimenter. *Applied Cognitive Psychology*, *8*, 49–66. doi:10.1002/acp.2350080106

Hyman, I. E., & Kleinknecht, E. E. (1999). False childhood memories: Research, theory, and applications. In L. M. Williams & V. L. Banyard (Eds.), *Trauma and memory* (pp. 175–188). Thousand Oaks, CA: Sage.

Hyman, I. E., & Pentland, J. (1996). The role of mental imagery in the creation of false childhood memories. *Journal of Memory and Language, 35*, 101–117.

doi:10.1006/jmla.1996.0006

Ikier, S., Tekcan, A., Gülgöz, S., & Küntay, A. (2003). Whose life is it anyway? Adoption of each other's autobiographical memories by twins. *Applied Cognitive Psychology, 17*, 237–247.

doi:10.1002/acp.869

Jackson, D. L., Gillaspay, J. A., Jr., & Purc-Stephenson, R. (2009). Reporting practices in confirmatory factor analysis: An overview and some recommendations. *Psychological Methods, 14*, 6–23. doi:10.1037/a0014694

Jaeger, A., Cox, J. C., & Dobbins, I. G. (2012). Recognition confidence under violated and confirmed memory expectations. *Journal of Experimental Psychology: General, 141*, 282–301.

doi:10.1037/a0025687

James, W. (1950). *The principles of psychology*. Oxford, England: Dover Publications. (Original work published 1890)

Jarvis, B. G. (2007). DirectRT (Version 2007) [Computer software]. New York, NY: Empirisoft.

Johnson, M. K., Foley, M. A., Suengas, A. G., & Raye, C. L. (1988). Phenomenal characteristics of memories for perceived and imagined autobiographical events. *Journal of Experimental Psychology: General, 117*, 371–376. doi:10.1037/0096-3445.117.4.371

doi:10.1037/0096-3445.117.4.371

Johnson, M. K., Raye, C. L., Mitchell, K. J., & Ankudowich, E. (2011). The cognitive neuroscience of true and false memories. In R. F. Belli (Ed.), *True and false recovered memories: Toward a reconciliation of the debate. Vol. 58: Nebraska Symposium on Motivation* (pp. 15–52). New York, NY: Springer.

Johnson-Laird, P. N., Girotto, V., & Legrenzi, P. (2004). Reasoning from inconsistency to

consistency. *Psychological Review*, *111*, 640–661. doi:10.1037/0033-295X.111.3.640

Kassin, S. M. (1997). The psychology of confession evidence. *American Psychologist*, *52*, 221–233. doi:10.1037/0003-066X.52.3.221

Kassin, S. M., & Kiechel, K. L. (1996). The social psychology of false confessions: Compliance, internalization, and confabulation. *Psychological Science*, *7*, 125–128. doi:10.1111/j.1467-9280.1996.tb00344.x

Kealy, K. L. K., Kuiper, N. A., & Klein, D. N. (2006). Characteristics associated with real and made-up events: The effects of event valence, event elaboration, and individual differences. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement*, *38*, 158–175. doi:10.1037/cjbs2006005

Kemp, S., & Burt, C. D. B. (2006). Memories of uncertain origin: Dreamt or real? *Memory*, *14*, 87–93. doi:10.1080/09658210444000548

Lampinen, J. M., & Odegard, T. N. (2006). Memory editing mechanisms. *Memory*, *14*, 649–654. doi:10.1080/09658210600648407

Lerner, A. J., & Lowe, F. (1958). I remember it well. On *Gigi*, original cast sound track album [LP]. New York, NY: Metro-Goldwyn-Mayer.

Lindsay, D. S. (2008). Source monitoring. In H. L. Roediger, III (Ed.), *Cognitive psychology of memory: Vol. 2 of Learning and memory: A comprehensive reference* (pp. 325–348). Oxford, England: Elsevier.

Lindsay, D. S., & Johnson, M. K. (1989). The eyewitness suggestibility effect and memory for source. *Memory & Cognition*, *17*, 349–358. doi:10.3758/BF03198473

Loftus, E. F., Miller, D. G., & Burns, H. J. (1978). Semantic integration of verbal information into a visual memory. *Journal of Experimental Psychology: Human Learning and Memory*, *4*,

19–31. doi:10.1037/0278-7393.4.1.19

Marsh, H. W., & Grayson, D. (1995). Latent variable models of multitrait- multimethod data. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 177–198). Thousand Oaks, CA: Sage.

Mazzoni, G., & Kirsch, I. (2002). Autobiographical memories and beliefs: A preliminary metacognitive model. In T. J. Perfect & B. L. Schwartz (Eds.), *Applied metacognition* (pp. 121–145). Cambridge, England: Cambridge University Press. doi:10.1017/CBO9780511489976.007

Mazzoni, G. A. L., Loftus, E. F., & Kirsch, I. (2001). Changing beliefs about implausible autobiographical events: A little plausibility goes a long way. *Journal of Experimental Psychology: Applied*, 7, 51–59. doi:10.1037/1076-898X.7.1.51

Mazzoni, G. A. L., Loftus, E. F., Seitz, A., & Lynn, S. J. (1999). Changing beliefs and memories through dream interpretation. *Applied Cognitive Psychology*, 13, 125–144. doi:10.1002/(SICI)1099-0720(199904)13:2125::AID-ACP5603.0.CO;2-5

Mazzoni, G., & Memon, A. (2003). Imagination can create false autobiographical memories. *Psychological Science*, 14, 186–188.

Mazzoni, G., & Scoboria, A., & Harvey, L. (2010). Non-believed memories. *Psychological Science*, 21, 1334–1340. doi:10.1177/0956797610379865

McCloskey, M., & Zaragoza, M. (1985). Misleading postevent information and memory for events: Arguments and evidence against memory impairment hypotheses. *Journal of Experimental Psychology: General*, 114, 1–16. doi:10.1037/0096-3445.114.1.1

McGinnis, D., & Roberts, P. (1996). Qualitative characteristics of vivid memories attributed to real and imagined experiences. *American Journal of Psychology*, 109, 59–77. doi:10.2307/1422927

Meade, M. L., & Roediger, H. L. (2002). Explorations in the social contagion of memory.

*Memory & Cognition*, *30*, 995–1009. doi:10.3758/BF03194318

Michael, R. B., Garry, M., & Kirsch, I. (2012). Suggestion, cognition, and behavior. *Current*

*Directions in Psychological Science*, *21*, 151–156. doi:10.1177/0963721412446369

Nash, R. A., & Takarangi, M. K. T. (2011). Reconstructing alcohol-induced memory blackouts.

*Memory*, *19*, 566–573. doi:10.1080/09658211.2011.590508

Nash, R. A., & Wade, K. A. (2009). Innocent but proven guilty: Eliciting internalized false confessions using doctored-video evidence. *Applied Cognitive Psychology*, *23*, 624–637.

doi:10.1002/acp.1500

Neisser, U., & Harsch, N. (1992). Phantom flashbulbs: False recollections of hearing the news about challenger. In E. Winograd & U. Neisser (Eds.), *Affect and accuracy in recall: Studies of “flashbulb” memories* (pp. 9–31). doi:10.1017/CBO9780511664069.003

Nickerson, R. S. (1998). Confirmation bias: A ubiquitous phenomenon in many guises. *Review of General Psychology*, *2*, 175–220. doi:10.1037/1089-2680.2.2.175

Ost, J., & Nunkoosing, K. (2010). Reconstructing Bartlett and revisiting retractions of contested claims of abuse. In J. Haaken & P. Reavey (Eds.), *Memory matters: Contexts for understanding sexual abuse recollections* (pp. 41–62). New York, NY: Routledge/Taylor & Francis Group.

Otgaar, H., Scoboria, A., & Smeets, T. (2013). Experimentally evoking nonbelieved memories for childhood events. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *39*, 717–730. doi:10.1037/a0029668

Pezdek, K., Blandon-Gitlin, I., & Gabbay, P. (2006). Imagination and memory: Does imagining implausible events lead to false autobiographical memories? *Psychonomic Bulletin & Review*, *13*, 764–769. doi:10.3758/BF03193994

Pezdek, K., Finger, K., & Hodge, D. (1997). Planting false childhood memories: The role of event plausibility. *Psychological Science, 8*, 437–441. doi:10.1111/j.1467-9280.1997.tb00457.x

Pillemer, D. B. (1998). *Momentous events, vivid memories*. Cambridge, MA: Harvard University Press.

Rajaram, S., & Pereira-Pasarin, L. P. (2007). Collaboration can improve individual recognition memory: Evidence from immediate and delayed tests. *Psychonomic Bulletin & Review, 14*, 95–100. doi:10.3758/BF03194034

Robinson, J. A. (1976). Sampling autobiographical memory. *Cognitive Psychology, 8*, 578–595. doi:10.1016/0010-0285(76)90020-7

Roediger, H. L., Meade, M. L., & Bergman, E. T. (2001). Social contagion of memory. *Psychonomic Bulletin & Review, 8*, 365–371. doi:10.3758/BF03196174

Rubin, D. C. (2006). The basic-systems model of episodic memory. *Perspectives on Psychological Science, 1*, 277–311. doi:10.1111/j.1745-6916.2006.00017.x

Rubin, D. C., Burt, C. D. B., & Fifield, S. J. (2003). Experimental manipulations of the phenomenology of memory. *Memory & Cognition, 31*, 877–886. doi:10.3758/BF03196442

Rubin, D. C., Schrauf, R. W., & Greenberg, D. L. (2003). Belief and recollection of autobiographical memories. *Memory & Cognition, 31*, 887–901. doi:10.3758/BF03196443

Rubin, D. C., & Siegler, I. C. (2004). Facets of personality and the phenomenology of autobiographical memory. *Applied Cognitive Psychology, 18*, 913–930. doi:10.1002/acp.1038

Russano, M. B., Meissner, C. A., Narchet, F. M., & Kassin, S. M. (2005). Investigating true and false confessions within a novel experimental paradigm. *Psychological Science, 16*, 481–486.

Sacks, O. (2005). On memory. *The Threepenny Review*. Retrieved from [http://www.threepennyreview.com/samples/sacks\\_w05.html](http://www.threepennyreview.com/samples/sacks_w05.html)



- Sarbin, T. R. (1998). Believed-in imaginings: A narrative approach. In J. de Rivera & T. R. Sarbin (Eds.), *Believed-in imaginings: The narrative construction of reality* (pp. 15–30). Washington, DC: American Psychological Association. doi:10.1037/10303-001
- Satorra, A., & Bentler, P. M. (1994). Corrections to test statistics and standard errors in covariance structure analysis. In A. von Eye & C. C. Clogg (Eds.), *Latent variables analysis: Applications to developmental research* (pp. 399–419). Thousand Oaks, CA: Sage.
- Scoboria, A., Lynn, S. J., Hessen, J., & Fisico, S. (2007). So that's why I don't remember: Normalising forgetting of childhood events influences false autobiographical beliefs but not memories. *Memory, 15*, 801–813. doi:10.1080/09658210701685266
- Scoboria, A., Mazzoni, G. A. L., Kirsch, I., & Jimenez, S. (2006). The effects of prevalence and script information on plausibility, belief, and memory of autobiographical events. *Applied Cognitive Psychology, 20*, 1049–1064. doi:10.1002/acp.1240
- Scoboria, A., Mazzoni, G. A. L., Kirsch, I., & Relya, M. (2004). Plausibility and belief in autobiographical memory. *Applied Cognitive Psychology, 18*, 791–807. doi:10.1002/acp.1062
- Scoboria, A., & Talarico, J. (2013). *Characteristics of nonbelieved memories in spontaneously-generated autobiographical events*. Manuscript submitted for publication.
- Scoboria, A., Wysman, L., & Otgaar, H. (2012). Credible suggestions affect false autobiographical beliefs. *Memory, 20*, 429–442. doi: 10.1080/09658211.2012.677449
- Sharman, S. J., & Scoboria, A. (2009). Imagination equally influences false memories of high and low plausibility events. *Applied Cognitive Psychology, 23*, 813–827. doi:10.1002/acp.1515
- Sheen, M., Kemp, S., & Rubin, D. (2001). Twins dispute memory ownership: A new false memory phenomenon. *Memory & Cognition, 29*, 779–788. doi:10.3758/BF03196407
- Shtulman, A. (2009). The development of possibility judgment within and across domains.

*Cognitive Development*, 24, 293–309. doi:10.1016/j.cogdev.2008.12.006

Smeets, T., Telgen, S., Ost, J., Jelicic, M., & Merckelbach, H. (2009). What's behind crashing memories? Plausibility, belief, and memory in reports of having seen non-existent images.

*Applied Cognitive Psychology*, 23, 1333–1341. doi:10.1002/acp.1544

Talarico, J. M., & Mace, J. H. (2010). Involuntary and voluntary memory sequencing phenomena: An interesting puzzle for the study of autobiographical memory organization and retrieval. In J. H. Mace (Ed.), *The act of remembering: Toward an understanding of how we recall the past* (pp. 71–82). doi:10.1002/9781444328202.ch5

Talarico, J. M., & Rubin, D. C. (2003). Confidence, not consistency, characterizes flashbulb memories. *Psychological Science*, 14, 455–461. doi:10.1111/1467-9280.02453

Tulving, E. (1983). *Elements of episodic memory*. Oxford, England: Clarendon Press.

van Golde, C., Sharman, S. J., & Candel, I. (2010). High prevalence information from different sources affects the development of false beliefs. *Applied Cognitive Psychology*, 24, 152–163. doi:10.1002/acp.1558

Wade, K. A., & Garry, M. (2005). Strategies for verifying false autobiographical memories. *American Journal of Psychology*, 118, 587–602.

Wixted, J. T. (2007). Dual-process theory and signal-detection theory of recognition memory. *Psychological Review*, 114, 152–176. doi:10.1037/0033-295X.114.1.152

Wright, D. B., Gabbert, F., Memon, A., & London, K. (2008). Changing the criterion for memory conformity in free recall and recognition. *Memory*, 16, 137–148. doi:10.1080/09658210701836174

Yonelinas, A. P. (1994). Receiver-operating characteristics in recognition memory: Evidence for

a dual-process model. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 20, 1341–1354. doi:10.1037/0278-7393.20.6.1341

Yonelinas, A. P. (2001). Components of episodic memory: The contribution of recollection and familiarity. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 356, 1363–1374. doi:10.1098/rstb.2001.0939

Notes:

1 General plausibility was redundant with personal plausibility for the purposes of predicting autobiographical belief and recollection in both studies and, hence, was dropped from all analyses.

Table 1

Distribution of difference scores between the belief in occurrence and recollection factors

Belief less recollection score	% age
Below zero	2.6%
Zero to .99	34.9%
1 to 1.99	24.2%
2 to 2.99	19.0%
3 to 3.99	10.5%
4 to 4.99	5.9%
5 to 5.99	2.0%
6 to 7	0.9%

Table 2

Study 1, Coefficients when predicting belief in occurrence and recollection from memory characteristic items.

	Item	Autobiographical belief		Recollection	
		Coefficient	Sig.	Coefficient	Sig.
Initial prediction model	Perceptual	0.01		0.38	<.001
	Setting	0.18	0.006	0.23	<.001
	Reexperience <sup>1</sup>	0.00		0.28	<.001
	Plausibility	0.61	< .001	0.10	0.003
	Feeling intensity	0.06		0.09	0.008
	Persuade	-0.07		-0.14	<.001
	Specific	0.08		0.09	0.024
Trimmed prediction model	Perceptual			0.38	<.001
	Setting	0.21	0.002	0.24	<.001
	Reexperience <sup>1</sup>			0.28	<.001
	Plausibility	0.63	< .001	0.09	0.003
	Feeling intensity			0.08	0.006
	Persuade			-0.14	<.001
	Specific			0.08	0.024

Note: The coefficients were derived using Structural Equation modeling. In the initial model, all seven items were used to predict both the autobiographical belief and recollection factors. The trimmed model included only pathways that were statistically significant in the initial model. 1 – Average of 'reliving' and 'mental time travel' items.

Table 3

Study 2, Coefficients when predicting belief in occurrence and recollection from memory characteristic items for event types simultaneously.

		Autobiographical belief		Recollection	
		Coefficient	p-value	Coefficient	p-value
Believed memory	Personal plausibility	0.64	< 0.001	0.23	< 0.001
	Setting	0.19	< 0.001	0.32	< 0.001
	Feeling intensity			0.20	0.004
	Persuade	-0.11	0.061	-0.16	0.018
	Reexperience			0.15	0.069
	Visual detail			0.24	0.013
	Connected	-0.04	0.439		
Nonbelieved memory	Personal plausibility	0.62	< 0.001	0.15	0.047
	Setting	-0.01	0.553	0.26	0.003
	Feeling intensity			0.11	0.130
	Persuade	-0.38	< 0.001	-0.18	0.011
	Reexperience			0.17	0.046
	Visual detail			0.33	< 0.001
	Connected	0.10	0.002		
Believed not-remembered event	Personal plausibility	0.82	< 0.001	-0.20	< 0.001
	Setting	-0.03	0.896	0.28	< 0.001
	Feeling intensity			-0.07	0.306
	Persuade	-0.10	0.040	-0.15	0.012
	Reexperience			0.48	< 0.001
	Visual detail			0.08	0.303
	Connected	0.10	0.024		

Note: This model replicates the trimmed model identified in Study 1, with the addition of the ‘connectedness to other events in memory’ item as loading onto the autobiographical belief factor, and adding a pathway for the ‘persuade’ item to autobiographical belief.

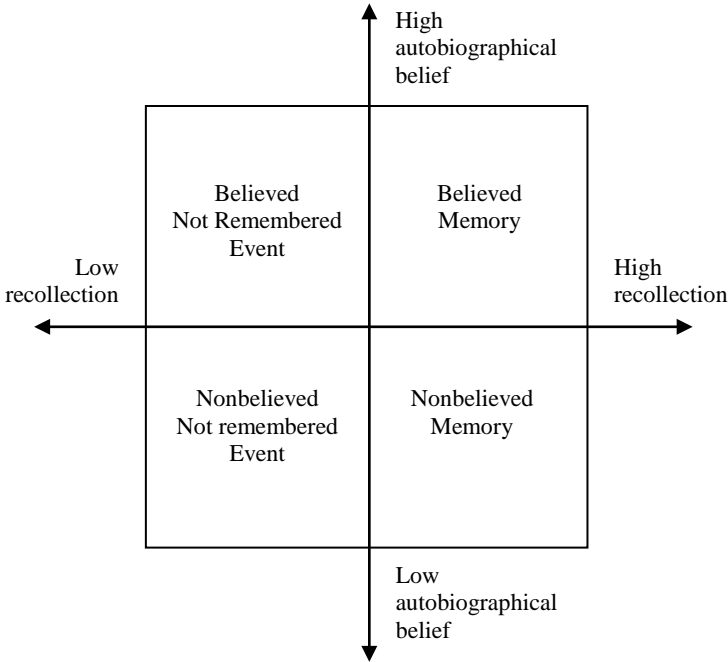


Figure 1.

Event categories resulting from crossing of autobiographical belief and recollection, and autobiographical belief and recollection as continuous dimensions.

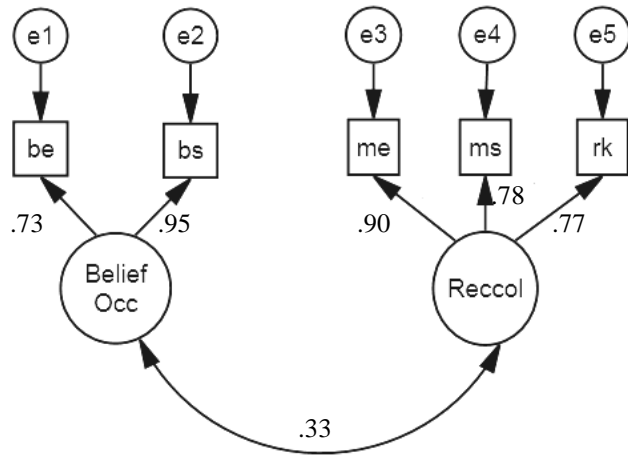


Figure 2. Study 1, Item loadings for two factor confirmatory model. Belief Occ – Belief in occurrence latent factor. Reccol – Recollection latent factor. BE: ABMQ belief item; BS: Belief strength item; ME: ABMQ memory item; MS: Memory strength item; RK: Remember/know item.



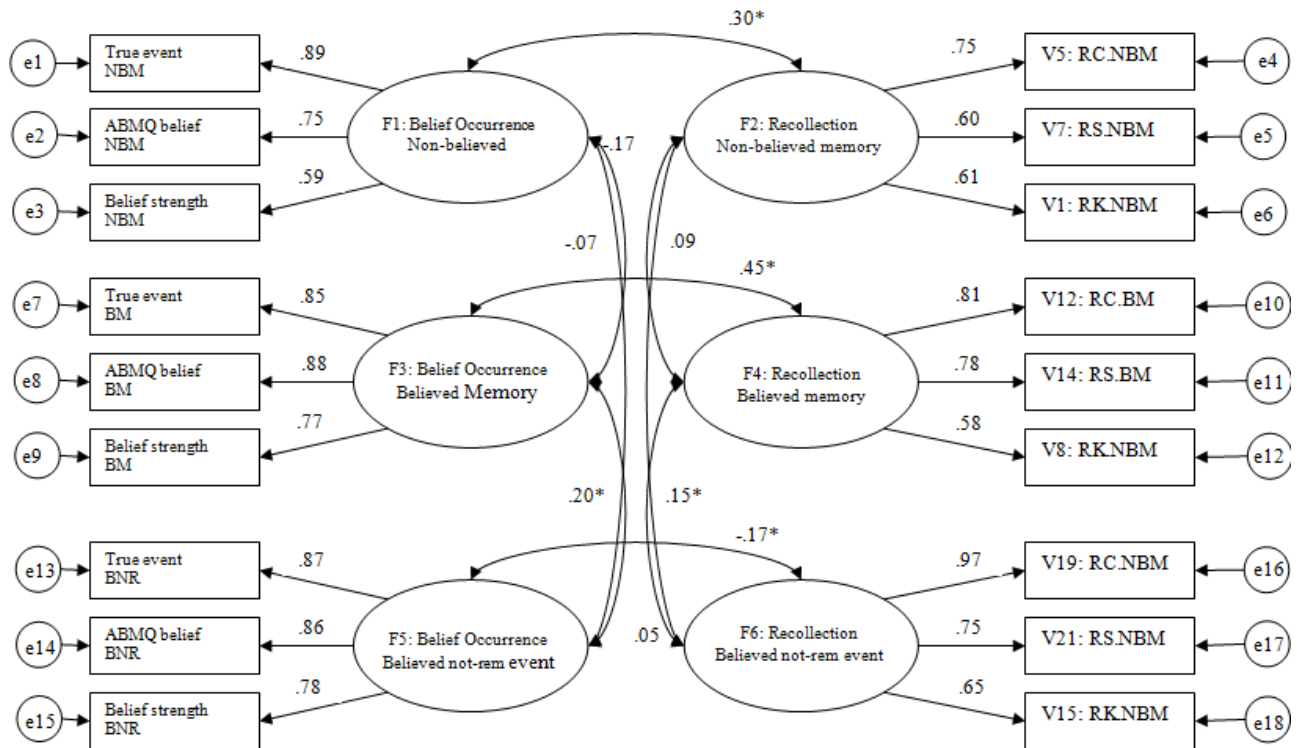


Figure 3. Study 2, Final structural model. Each event (nonbelieved memory, believed memory, believed not-remembered event) is modeled simultaneously. Statistically significant latent variable correlations are indicated by \*. All factor loadings are statistically significant.

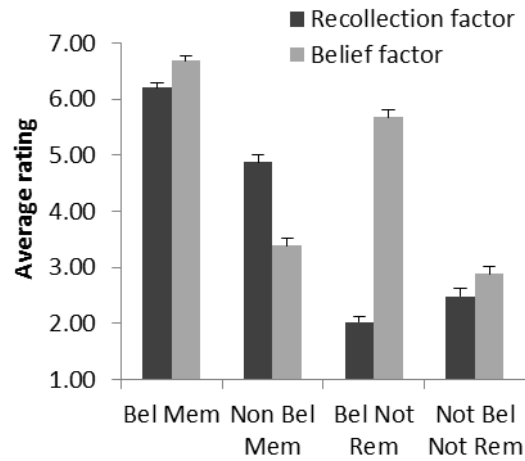


Figure 4. Study 2, Mean belief in occurrence and recollection ratings for believed memories, nonbelieved memories, believed not remembered events, and not believed not remembered events. Bars show standard errors.

## Appendix A –Belief in Occurrence and Recollection Items

## Belief in occurrence

1. How likely is it that you personally did in fact experience this event? <sup>1</sup>  
1 Definitely did not happen; 8 Definitely happened
2. How strong is your belief that this event actually occurred (whether or not you remember the event)? <sup>3</sup>  
1 No belief, 3 Weak belief, 5 Moderate belief, 7 Strong belief
3. It is true that this event occurred to me. \* <sup>3</sup>  
1 Not at all true; 7 Extremely true

## Recollection

1. Do you actually remember experiencing this event? <sup>1</sup>  
1 No memory of event at all, 8 Clear and complete memory of event
2. How strong is your memory for this event (whether or not you believe the event occurred)? <sup>3</sup>  
1 No memory, 3 Weak memory, 5 Moderate memory, 7 Strong memory
3. Sometimes people know something happened to them without being able to actually remember it. As I think about the event, I can actually *remember* it rather than just knowing that it happened. <sup>2</sup>  
1 Not at all, 3 Vaguely, 5 Distinctly, 7 As much as any memory

1 – From Scoboria et al. (2004). 2 - From Rubin, Schrauf & Greenberg (2003). 3 – New item. \* Study 2 only.

## **Supplemental Materials**

### **Contents**

1. Description of the structural modeling approach
2. Items used in Study 1
3. Items used in Study 2

### **Description of structural modeling approach**

One approach to construct validation is via confirmatory factor analysis (CFA), which is a member of a family of statistical techniques termed structural equation modeling. All structural equation modeling techniques require that one or more theoretical models be specified in advance of testing the fit of data to the model. In confirmatory analysis the specification of the theoretical model precedes the data; it is a restrictive, hypothesis testing approach. In CFA, the researcher states what factors will be present, and onto which specific factor(s) items will load. Data are then used to evaluate the extent to which the model explains covariance amongst the measured variables.

### **CFA models**

We used CFA to examine the validity of items used to assess recollection and belief in the occurrence of events, and to test various hypotheses about how recollection and belief relate to each other within each type of event and across events as is appropriate according to Brown (2006). A strength of CFA is that various hypotheses can be modeled simultaneously. Hence CFA allowed us to test whether recollection is independent of belief in occurrence, validate the measures used to assess belief and recollection, estimate their intercorrelations, and to test for the influence of potential methodological confounds. Below we provide the technical details of this

analysis, followed by a discussion of the findings.

**Data Analysis.** For fitting the various CFA models, we used Robust Maximum Likelihood estimation method with the Satorra and Bentler (1994)  $\chi^2$  correction as well as the robust fit measures, as the assumptions of multivariate normality were not met due to some variables having excessive kurtosis.

To assess model fit, we followed the recommendations of Jackson, Gillaspay, and Purc-Stephenson (2009) and report the Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA) and the Standardized Root Mean Residual (SRMR). We did not set *a priori* cutoff values for model fit, as these should be based on the research domain (Marsh, Hau, & Wen, 2004). Since there is little work in this area, it is premature to adopt specific cutoffs. We based our choices on model comparison, theoretical appropriateness and empirical fit. Typically, good fit is indicated by high CFI (about .95 and above), low RMSEA (about .06 and below), and low SRMR (about .08 and below). We also examined the Akaike Information Criterion (AIC, Akaike, 1987) which is recommended when comparing non-hierarchically ordered models.

### Study 1

In Study 1, we tested two relatively straightforward structural models. In the first model we examined whether the five items loaded on a single latent variable. In the second model we examined whet the items loaded onto distinct autobiographical belief and recollection factors. Via CFA we examined the assumptions: 1) that belief in occurrence and recollection are independent latent constructs, 2) that indicators of each construct load reliably onto each latent construct. Full details of these models are provided in the paper.

Six multivariate outliers were removed based on Mahalanobis'  $D^2$ , using a cut-off corresponding to  $p < .001$ , resulting in a final total of 287 cases. Two models were then tested in

EQS VERSION 6.1, using robust estimation for Chi-square, fit indices, and standard errors. Model fit was assessed per the recommendations of Jackson, Gillaspay, and Purc-Stephenson (2009). A model with the five belief and recollection items loading on the same latent factor did not fit the data well, Satorra-Bentler (S-B; Satorra & Bentler, 1994) Scaled  $\chi^2 (5) = 76.42, p < .001$ ; CFI = .729; RMSEA = .227 (90% CI .183 to .271). The proposed two factor model was a good fit to the data, *S-B*  $\chi^2 (4) = 7.61, p = .055$ ; CFI = .986; RMSEA = .073 (90% CI 0.000 to 0.140). The item loadings and the factor correlation are presented in Figure 2. We used 1000 bootstrap samples for the two factor model, and found agreement between significance tests related to loadings of measured variables on latent variables.

## Study 2

In Study 2 we tested a basic model in which we theorized that belief and recollection would manifest as distinct latent variables across the different types of events elicited (nonbelieved memories, believed memories, believed not remembered events), followed by a series of refined models in order to account for alternative explanations to this main hypothesis. The specifics of the various models and details of the statistical approach are provided below. Via CFA we examined the assumptions: 1) that belief in occurrence and recollection are independent latent constructs, 2) that indicators of each construct load reliably onto each latent construct, and 3) that correlations between the factors are higher for believed memories, and lower within the other events and when aggregated across events.

### Models Tested.

Models were tested with and without five extreme multivariate outliers (on Mahalanobis' Distance using  $p < .001$ ). The results suggested that the outliers attenuated most factor loadings and one factor correlation. Thus, we report the findings without these outliers. We used EQS

(6.1) for all analyses.

We used six items to assess the characteristics of each event, three to assess belief in occurrence (ABMQ belief, belief strength, true occurrence), and three to assess recollection (ABMQ memory, memory strength, remember/know). We used these items to form two latent variables, belief and recollection, for each event.

All models were identified according to the counting rule (see e.g., Kline, 2010). The scale of each latent variable was set by fixing one of the indicator paths to 1.0 – so called unit loading identification. The models are described in Table S1. All of the models shared the feature that each event was best represented by two latent variables, belief in occurrence and recollection. Each model tested a different hypothesis about the structure of ratings for the three events. To summarize, Model 1 specified the basic proposed latent variable loadings and correlations between separate belief in occurrence and recollection latent variables within events. The subsequent models added latent variable correlations between events (Model 2), correlated error terms for repetitions of the same item across the three events to account for repeated measures (Model 3), and the combination of both (Model 4).

Based on the theoretical rationale and the results of Study 1, we anticipated that Model 1 would fit the data reasonably well. The subsequent models examine whether accounting for method variance and/or individual differences in responding influence the parameter estimates. Model 2 seems plausible as it allows for the two processes of belief and recognition to correlate within events and for common processes to correlate across events, and should provide good fit because of the relaxation of the assumption of independence of common processes across events. Model 3 should provide a greater fit if some of the covariance across is due to similar item wording, rather than just the processes the items measure. Model 4 is a combination of Models 2

and 3. We anticipated that Model 4 would show very good fit to the data because, relative to the other models, it includes a large number of parameters to account for observed covariances.

Model 3 provides for a test of method variance. The same prompts were used for each event to gather ratings on each event. Each item was used as an indicator of autobiographical or recollection across all three event types: believed memories, believed not-recalled memories, and non-believed memories. This introduces a potential confound into the study design and raises the possibility that method variance could be biasing the parameter estimates in our model. Model 3 addresses this question through a form of multi-trait multi-method analysis known by using the correlated trait correlated uniqueness approach (e.g., Marsh & Grayson, 1995). By allowing the error variances of like prompts to covary across events, we are testing the hypothesis that events are correlated, at least in part, by the use of these common methods. The extent of the improvement in fit indicates whether method variance represents a substantial confound to our conclusions. We note that Models 3 and 4 were conducted to assess the impact of the repetition of measurements across the events. Because the main finding of Models 3 and 4 was that repetition of measurements had no meaningful influence on the parameters in Model 2 (see below), Model 2 is the final model presented in the main paper.

We note that there are other approaches to conducting multi-trait multi-method analyses in the SEM framework and one that corresponds more closely to Campbell and Fiske's (1959) approach. This approach involves specifying methods as latent variables. Unfortunately, this method can very frequently result in failures to converge on an appropriate solution, including out of range parameter estimates (see e.g., Brown, 2006). It is for this reason that we chose to use the correlated-trait correlated-method approach to investigating the question of whether our inferences were confounded by method variance.



**Table S1. Summary of models tested (Study 2)**

Model	Specification	To test
1	Belief in occurrence and recollection latent variables for each event are allowed to correlate within events (e.g., within believed memories).	Reflects independent processes for belief in occurrence and recollection. Reflects an association between belief in occurrence and recall that is context dependent – i.e., these latent variables can correlate and correlations can vary from one event type to another.
2	Same as Model 1, but includes correlations among common latent variables across events e.g., recollection for believed memory is allowed to correlate with recollection for non-believed, etc.	In addition to Model 1, reflects the hypothesis that the processes of belief in occurrence and recollection potentially covary due to individual differences. Positive correlations would be indicative of an overarching influence of individual difference(s) for recall and belief in recognition.
3	Same as model 1 with the addition of allowing covariances for item error terms across events for each latent variable.	This model reflects the hypothesis that some portion of the relationship among belief in occurrence and recollect latent variables across events is due to similarities in item wording. Thus like items are allowed to be associated via covariances among error terms. This is consistent with modeling method variance.
4	Model 2 and Model 3 combined	Test impact of intercorrelated latent variables and controlling method variance simultaneously. Indicates whether the combination of both exceeds the contribution of either model alone. Better fit of this model indicates that accounting for both method variance and latent variable correlations best explains the relationships amongst the latent variables.

### CFA modeling results

Table S2 contains fit information for each model described above. Many of the indices indicated reasonable fit relative to the data in most areas of research in psychology (see e.g., Jackson et al., 2009). Models 4 and 2 had the lowest AIC values, indicating the best fit taking into account parsimony. According to the RMSEA, Models 2, 3 and 4 had similar fit.

**Table S2. Fit Information for All Tested Models (Study 2)**

Model	S-B $\chi^2$	Df	CFI	RMSEA	RMSEA LO	RMSEA HI	SRMR
1	195.70	131	0.961	0.047	0.030	0.062	0.093
2	178.15	125	0.970	0.042	0.023	0.058	0.082
3	158.25	112	0.967	0.046	0.027	0.063	0.089
4	143.10	106	0.972	0.044	0.023	0.061	0.080

Note: S-B  $\chi^2$  = Satorra-Bentler  $\chi^2$ ; df = degrees of freedom; AIC = Aikaike's Information Criterion; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; RMSEA LO = 5<sup>th</sup> percentile confidence interval for RMSEA; RMSEA HI = 95<sup>th</sup> percentile confidence interval for RMSEA; SRMR = Standardized Root Mean Residual. All values except SRMR are based on the S-B robust  $\chi^2$  estimate.

**Best fitting CFA model**

We now review the findings for the final model (Model 2). Figure S1 contains a drawing of this model with the standardized factor loadings for each item on the latent variables and the latent variable correlations. We briefly describe this figure, to assist readers who may be less familiar with CFA modeling techniques. Latent (unobserved) variables are indicated by ovals. There are three latent variables each for belief and recollection, one for each type of event. The measured items (observed variables) are indicated by rectangles. Three items define each latent variable. Arrows point from the latent variables to the observed variables, indicating the assumption that an underlying process gives rise to item responses. The latent variables on the left side of the figure depict belief in occurrence, and those on the right side depict recollection. The circles to the extreme right and left of the figure represent the residual variance associated with each measured item. Double-arrowed curved lines indicate correlations. The correlations toward the interior are estimated correlations between the latent variables. All of the item loadings onto latent variables were statistically significant. The correlations between the latent variables within event were all statistically significant. This correlation was substantial for believed memories (.45), lower for non-believed memories (.30), and negative for believed-not-remembered events (-.17).

The correlations for belief and recollection between believed memories and believed-not-remembered events were significant but weak. The correlations for belief and recollection between non-believed memories and the other events were not significant. This indicates that individuals did not respond to the events systematically, with some rating all events higher and others rating all events lower. Hence individual differences were distributed mostly independently across the events, further supporting the theoretical distinction between belief in

occurrence and recollection. The implications of this best fitting model are discussed below.

Turning to Models 3 and 4, of the 18 error correlations, just two were significant. This suggests that method variance (using the same items to rate multiple events) did not notably influence estimates for the other model parameters. In other words, the sampling method worked well – people made distinct ratings about the different events.

### **Bootstrap Results**

To assure of the accuracy of significance levels in the presence of non-normality, we also utilized a bootstrapping approach (e.g., Efron, 1979). Bootstrapping has the advantage of relaxing the statistical assumption of multivariate normality (Yung & Bentler, 1996). In bootstrapping, observations from the data set are sampled with replacement repeatedly, which allows for the construction of empirically based confidence intervals. We used 1000 bootstrap samples for Model 4-r, and found agreement between significance tests related to latent variable correlations, loadings of measured variables on latent variables, and the correlated error terms. This shows that the best fitting model was robust to violation of the normality assumption.

In summary, our theoretical modeling converged on a best fitting model with excellent fit to the data. This model was robust to concerns regarding item distribution, method variance due to repeated sampling of items, and responding due to individual differences. This model provides compelling evidence for the dissociation between belief in occurrence and recollection.

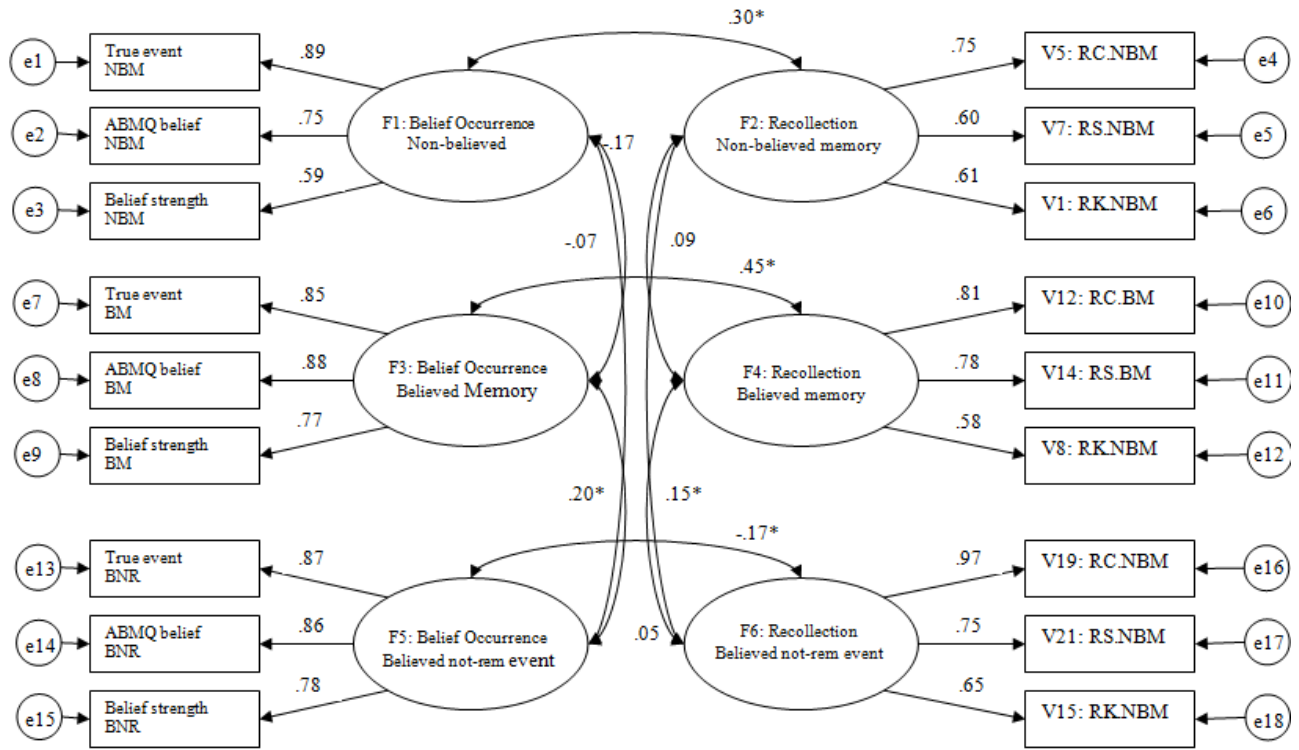


Figure S1. Final structural model (Model 2). Each event (nonbelieved memory, believed memory, believed not-remembered event) is modeled simultaneously. Statistically significant latent variable correlations are indicated by \*. All factor loadings are statistically significant.

**Items used in Study 1**

**Items used in Study 2**

## Supplement References

- Akaike, H. (1987). Factor analysis and AIC. *Psychometrika*, *52*, 317–332.  
doi:10.1007/BF02294359
- Bentler, P.M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*, 238-246.
- Brown, T.A. (2006). *Confirmatory factor analysis for applied research*. New York: Guilford.
- Browne, M.W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K.A. Bollen & J.S. Long (Eds.). *Testing structural equation models*. Sage: Newbury Park, CA.
- Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by multitrait-multimethod matrix. *Psychological Bulletin*, *56*, 81-105.
- Efron, B. (1979). Bootstrap methods: Another look at the jackknife. *The annals of statistics*, *7*, 1-26.
- Gagné, P. E. Hancock , G. R. (2006). Measurement model quality, sample size, and solution propriety in confirmatory factor models. *Multivariate Behavioral Research*, *41*, 65-83.  
doi:10.1207/s15327906mbr4101\_5.
- Hancock, G.R., & Mueller, R.O. (2001). Rethinking construct reliability within latent variable systems. In R. Cudeck, S. du Toit, & D. Sörbom (Eds.), *Structural Equation Modeling: Present and Future — A Festschrift in honor of Karl Jöreskog*. Lincolnwood, IL: Scientific Software International, Inc.
- Jackson, D.L., Gillaspay, J.A., Jr., & Purc-Stephenson, R. (2009). Reporting practices in confirmatory factor analysis: An overview and some recommendations. *Psychological Methods*, *14*, 6–23. doi:10.1037/a0014694
- Kline, R.B. (2010). *Principles and practice of structural equation modeling* (3rd ed.). Guilford Press: New York.



- Marsh, H. W., & Grayson, D. (1995). Latent variable models of multitrait-multimethod data. In R. H. Hoyle (Ed.) *Structural equation modeling: Concepts, issues, and applications* (pp. 177-198). Thousand Oaks, CA: Sage.
- Marsh, H.W., Hau, K-T., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers of overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling, 11*, 320-341.  
doi:10.1207/s15328007sem1103\_2
- Raykov, T. (1997). Estimation of composite reliability for congeneric measures. *Applied Psychological Measurement, 21*, 173-184. doi:10.1177/01466216970212006
- Satorra, A., & Bentler, P.M. (1994). Corrections to test statistics and standard errors in covariance structure analysis. *Proceedings of the Business and Economic Statistics Section of the American Statistical Association*, 308-313.
- Yung, Y-F, & Bentler, P.M. (1996). Bootstrapping techniques in analysis of mean and covariance structures. In G. A. Marcoulides & R. E. Schumacker (Eds.) *Advanced structural equation modeling*. Mahwah, NJ: Lawrence Erlbaum.

