

## False Memory Is in the Details: Photographic Details Differentially Predict Memory Formation

JOANNA K. HESSEN-KAYFITZ and ALAN SCOBORIA\*

*University of Windsor, Windsor, ON, Canada*

*Summary: Although false memory formation is a well-documented phenomenon, the strength and rates of false memory formation vary across studies. Research indicates that the types of details provided in suggestions differentially influence memory formation, with some details enhancing and others impeding memories. This study explored the facilitation of false memories using doctored photographs, by manipulating the presence of salient familiar and unfamiliar details within photographs. Over three interviews, 82 participants viewed four photographs allegedly provided by parents. One was a doctored photograph depicting a hot-air balloon ride, in which the presence of salient self-relevant and unfamiliar details was varied. Participants rated the strength of their memory and associated memory characteristics for the events. Including self-relevant details without unfamiliar details resulted in the highest memory ratings and greater increases in memory characteristic ratings. Memories were weakest when both details were provided. The theoretical implications of the findings are discussed. Copyright © 2011 John Wiley & Sons, Ltd.*

Imagine that you are shown two unfamiliar childhood photographs. Both depict you with a close friend. In the first, you stand before the Pyramids of Giza. In the second, you walk along a lakeshore near an unfamiliar lighthouse. Knowing you have never been to Egypt, you suspect that something sneaky may be going on with the first photo. But what about the second photo? You do not remember this lighthouse. That is clearly your best childhood friend. . . you remember that goofy haircut well. . . but when and where would you have been with your friend and near a lighthouse? This is the topic of the present paper: How do the details in unfamiliar photographs influence how people attempt to remember an unremembered event, particularly when they are unaware that the photograph was doctored and that the event did not occur?

The malleability of memory is well documented. A large body of research shows that memories are reconstructions of the past rather than literal renderings thereof, and as such are susceptible to change and fabrication (Neisser, 1996; Wright & Loftus, 1998). Studies of false memory show that a substantial minority of individuals come to develop memories following the suggestion of nonoccurring childhood events. In such studies, participants typically receive narratives supplied by their parents among which a false event is introduced. This approach has been used in numerous studies to suggest written or verbally presented narratives (e.g. Heaps & Nash, 2001, Hyman & Pentland, 1996; Loftus & Pickrell, 1995). After engaging in procedures purported to aid recall over multiple recall attempts, an average of 33% of participants come to remember events across studies (Strange, Gerrie & Garry, 2005). Furthermore, subjective memory ratings and associated memory characteristics are rated higher on average following such suggestive procedures (Desjardins & Scoboria, 2007; Hyman & Pentland, 1996).

Extending this research to the provision of false photographs, Wade, Garry, Read, and Lindsay (2002) examined

whether using a doctored photograph would lead to acceptance of a false event. They posited that if photographs provide incontrovertible evidence of events, then they should be even more likely to lead to memory formation than false narratives. They showed participants three true photographs and a fourth doctored photograph to depict a fictitious hot-air balloon ride. Following three interviews, 50% of participants were judged as having remembered the false event. In another study, Lindsay, Hagen, Read, Wade, and Garry (2004) found that the inclusion of an event-relevant true photograph along with a verbally presented narrative resulted in a substantially higher false memory rate than if the narrative was presented alone. Recent research by Strange, Hayne, and Garry (2008) examined the effect of presenting two different types of doctored photographs to children. The authors presented 10-year-old participants with a photograph depicting a hot-air balloon, for half of whom the photo was doctored to include them and their family members posing in the balloon. Children who viewed the picture that included their family were more likely to be judged as having developed a memory.

These studies suggest that photographs can lead to a substantial number of false memories, and may be a more powerful suggestive medium than verbal narrative. To compare the false memory yields of false narratives and false photographs, Garry and Wade (2005) provided one group of participants with a false narrative and another group with a doctored photograph for the same false event. Whereas 50% in the photo condition once again developed a memory, 82% in the narrative condition were judged as having memories. To explain this advantage for narratives, Garry and Wade (2005) proposed that photographs impose constraints on the development of the type of fluent processing associated with remembering relative to narratives. Whereas the ambiguity of narratives allows individuals to generate their own details to flesh out their mental image for an event, photographs limit the flexibility to freely imagine idiosyncratic details. Certain details depicted in the photograph may limit which details can be recalled, as

\*Correspondence to: Alan Scoboria, Department of Psychology, 401 Sunset, Windsor, ON, Canada N9B 3P4.  
E-mail: scoboria@uwindsor.ca

well as the way in which the details depicted can be visualized. Thus, photos impose stronger limitations on finding matching information in memory, thereby increasing the likelihood that a false event will be rejected.

To further illustrate how a visually presented image might be inherently constraining, consider a request to recall an event that happened in one's elementary school. If told about an event in a narrative format, one can visually imagine the school from any perspective they wish (from any angle, from the interior, the exterior, a specific room, etc.). If told about an event and also shown a photograph of the event, one is provided with just one of many possible perspectives from which the school might be represented. This may not be the perspective from which the individual might have, without the aid of the photograph, chosen to imagine the school. Therefore, while on the one hand a photograph provides salient and relevant retrieval cues, it also places limits on the idiosyncratic internal cues that individuals might generate when trying to recall the event. For narratives, the lack of specificity and visual detail allows for the retrieval of images from memory and the generation of a greater number of images, both of which can also serve to cue additional retrieval and imagery (e.g. related memory fragments and details associated with the event context). The apparent ease with which these familiar cues are generated may be misattributed as evidence that the event itself is familiar (i.e. fluency attribution hypothesis; Whittlesea, 1993), which increases the likelihood that the false event will be endorsed as being true. Furthermore, as the images associated with the event become more memory-like, the likelihood of source monitoring errors increases wherein the resulting mental representation is misattributed as a true memory for a past event (Johnson, Hashtroudi & Lindsay, 1993).

While Garry and Wade's (2005) work sheds light on differences between suggestive media, the question of variability within a medium remains. The memory formation rates in false memory studies using narratives vary widely, ranging from 0% (Pezdek, Finger, & Hodge, 1997) to 82% (Garry & Wade, 2005); see Wade, Garry, Nash and Harper (2010) for further discussion of false memory rates. The strength of memories based on subjective report also varies (Desjardins & Scoboria, 2007; Hyman & Pentland, 1996; Mazzoni & Memon, 2003). A variety of factors are known to influence this variability, such as the use of imagination (Hyman & Pentland, 1996), the plausibility of events (Pezdek et al., 1997), and the presence of self-relevant information in suggestions (Desjardins & Scoboria, 2007). One explanation for the influence of self-relevant details is that they serve to promote fluency of processing, a process proposed by Whittlesea's (1993) fluency attribution hypothesis and subsequent discrepancy attribution hypothesis (Whittlesea & Williams, 1998). As will be elaborated upon in the following discussion, self-relevant details may facilitate the endorsement of the false event by promoting feelings of familiarity that become misattributed to the false event.

The present work examines how the familiarity of details in photos may make the photo as a whole more or less fluency promoting. We examined the influence of fluency-promoting details, which we defined as elements in the photograph that were familiar and obviously part of one's

autobiographical history (i.e. autobiographically consistent). Such details are highly familiar to the individual, and thus they stand out and are noticed. We also examined the influence of details that are less autobiographically consistent than self-relevant details, which we termed "unfamiliar" details and which are thus more likely to impede fluency. Unfamiliar details introduce a measure of constraint on processing. However, when familiar and unfamiliar details are presented together, they must be reconciled within any subsequent search of memory that influences the decision about whether or not the event is remembered. By familiar, we refer to details that the individual recognizes as a part of her or his autobiographical history. By unfamiliar, we refer to details that the individual does not recognize and that he or she must reconcile in order to remember the event.

We created doctored photographs similar to those provided in previous studies, and included in them a familiar self-relevant detail to promote fluency (self with a parent on a hot-air balloon ride) or an unfamiliar detail to impede fluency (a lighthouse in the background), both or neither. This allowed us to examine how each type of detail influenced the development of false memories. Hence, one set of details did not place constraints on processing, whereas the other did constrain processing. We note that while we could not be certain that our participants did not view a lighthouse during their childhood, the specific lighthouse depicted was unfamiliar to most, if not all, of the participants. Because of this, the lighthouse detail places constraints on processing in particular when presented alongside other details ("when could I have ridden in a balloon near a lighthouse?"). We opted to call the two details "familiar" and "unfamiliar" because constraint is not a property of the detail in the photograph. Whether or not a detail is constraining is determined by how the detail is perceived by the individual (i.e. how it coincides with autobiographical knowledge).

The metric we were most interested in exploring was that of individuals' own reports of remembering because this indexes participants' own experience of recollection. One study that asked participants to rate their degree of memory for a target false event found that subjective memory ratings mirrored objective judgments of false memory formation (Desjardins & Scoboria, 2007).

At least two prominent theoretical models elucidate the ways in which the presentation of various details within the photographic medium might influence memory formation. According to Whittlesea's (1993) fluency attribution model as referenced above, feelings of familiarity do not necessarily result from the retrieval of information from memory, but rather from the unconscious attribution of fluent processing to prior exposure to a stimulus. Specifically, processing a stimulus with ease may lead to the erroneous conclusion that a feeling of familiarity is due to having encountered the stimulus previously (i.e. as part of a memory). Several false memory studies show a relationship between self-relevant information and the likelihood of false memory formation. Hyman, Husband, and Billings (1995) reported that individuals who incorporated self-knowledge into their imagery were more likely to endorse false memories than those who did not (see also Oakes & Hyman, 2001, for further discussion of the role of the self in false memory

formation). Desjardins & Scoboria (2007) proposed that self-relevant details presented in false narratives promote memory formation in part by inducing feelings of familiarity that result in belief that the event must have occurred, which supports a more sustained search for a memory. Autobiographically consistent (self-relevant) details are processed with greater ease because they have been previously encountered in one's autobiographical history and thought about many times in the past, and because the self is a highly organized and efficient knowledge structure (Symons & Johnson, 1997). When these types of details produce fluent processing in the context of attempting to recall an unremembered event, the resulting sense of familiarity may be erroneously attributed to the occurrence of the event, leading to the event being endorsed as true (Jacoby, Kelly & Dywan, 1989). Conversely, autobiographically inconsistent details presumably do not promote processing fluency because they are not part of one's autobiographical history. Accordingly, they may impede fluency associated with other more familiar, autobiographically consistent details, and therefore should not contribute to remembering.

A second relevant theoretical view is the Self Memory System model (Conway & Pleydell-Pearce, 2000; Conway, Singer & Tagini, 2004). This model is particularly relevant because it articulates a relationship between autobiographical memory and the self. This theory proposes that people hold sets of self-schemas in memory, which are long-term memory representations of different versions of the self. Currently active versions of the self form the working self-concept, the goal of which is to maintain cognitive consonance. The working self-concept accomplishes this by acting as a gatekeeper that controls access to autobiographical material by directing the generation of memory retrieval models with parameters that either facilitate or inhibit memory searches. Specific autobiographically consistent self-relevant details are consonant with the working self-concept, and thus contribute to the generation of broad, yet focused, retrieval models that facilitate the search for associated material, thereby increasing the likelihood that an unremembered event will be accepted as true. Conversely, autobiographically inconsistent details do not fit with the working self, resulting in narrower and more restrictive search models, thereby increasing the likelihood of rejecting an unremembered event. Furthermore, this model suggests that the combination of specific autobiographically consistent and autobiographically inconsistent details may result in the narrowest search model of all because the correspondence of the two items of information must be reconciled. The memory search model must reconcile seeing a highly familiar self-relevant piece of information in conjunction with a prominent unfamiliar piece of information.

Thus, the presence of autobiographically consistent (fluency-promoting) information should lead to attributing a false event to childhood, and unfamiliar (fluency-impeding) information may inhibit the likelihood of such attribution errors. These predictions are also consistent with source monitoring theory (Johnson et al., 1993) because autobiographically consistent information is expected to produce an experience that resembles that associated with recalling a true past event, which serves as evidence by which occurrence of the event to oneself in the past can be inferred. Autobiographically

inconsistent details, by interrupting or inhibiting both fluency as well as other automatic attributional processes, should reduce the likelihood of the event being attributed to memory.

On the basis of the literature and these theoretical views, we anticipated that the relative mixture of the different types of details in doctored photographs should influence the subjective strength of false memories. Presumably, the greatest degree of memory formation will occur when search models are both broad and fluent, which should occur when a photograph depicts familiar, autobiographically consistent details without any salient unfamiliar, autobiographically inconsistent details. In general, the presence of salient, self-relevant, familiar details should promote memory formation, and the presence of salient, unfamiliar details should impede memory formation. If fluency of processing is most important, photographs low in fluency-promoting details should have the least influence on memory formation. Furthermore, if self-relevant information produces a powerful experience of fluency, then unfamiliar details may have little or no influence on false memories (providing they are not bizarre; see Thomas & Loftus, 2002). However, if the breadth of memory search is also important, then presenting these details in combination may impede memory formation. Here, the lack of familiarity for one detail may interfere with the familiarity of the other, leading to a narrow memory search that attempts to reconcile, 'When was I with my parent and also near a lighthouse?'

To test these predictions, we adopted the procedures used by Garry and Wade (2005). We used the same hot-air balloon ride event, and varied the presence of autobiographically consistent fluency-promoting and unfamiliar fluency-impeding details in the doctored photograph. Participants took part in three interviews, in which they were asked to recall four childhood events depicted in photographs. Participants provided memory characteristic ratings following the first and third interviews, and plausibility, belief, and memory ratings after the third interview. Our main prediction was that the group that viewed the photo with self-relevant details without the unfamiliar detail would report the strongest false memories, and those who viewed the photo with both the self-relevant and the unfamiliar detail would report the weakest false memories.

## METHOD

### Participants

Eighty-two undergraduates (77% female; ages 17–28;  $M = 19.89$ ,  $SD = 2.08$ ) completed all sessions and were included in the final data set. Of those initially eligible, 180 provided parent contact information, and 88 responses were received from parents. Six were excluded, two for previously experiencing a balloon ride and four for not completing all interviews. Participants received course credit and were entered into a raffle.

### Design

The study was a  $2 \times 2$  between subjects design whereby four conditions were created according to the two levels of each independent variable. These were presence or absence of a fluency-promoting detail (self and a parent), and presence

or absence of an unfamiliar fluency-impeding detail (a prominent lighthouse in the background).

## Materials

*Obtaining photographs from parents.* Participants' parents were given a list of themes to assist in selecting photographs (e.g. parties, vacations) of the participant before age 6 and, to the degree possible, photographs that the participant had not seen before. No lower age limit was imposed upon the parents, although no photograph depicting the participant below the age of 3 years was included so that the events depicted were after the period of infantile amnesia. Parents provided a brief narrative about each picture, and indicated if their child had ever taken a hot-air balloon ride. Parents were asked not to discuss the materials until the study was completed.

*Booklets.* The photographs were scanned at high resolution. Four photographs were selected, one of which was a doctored photo. A booklet was created for each participant, which contained four 4 × 6-inch black and white photographs on separate pages printed at high resolution (1200 dpi). These consisted of three true and one false (doctored) photographs. Each photograph was accompanied by a brief one-line description of the event (e.g. 'Hot-air balloon ride; you and your dad posing for the ride's cameraman').

*Treatment of photographs.* After being scanned, the true photographs were not altered in any way aside from being printed in black and white to be included in the booklet. Each true photograph contained the participant, who was visible to varying degrees (i.e. sometimes the participant was depicted close-up and other times the participant was distant). No digital manipulation was applied to the true photographs. Creation of the critical doctored photograph involved digitally inserting the participant and a parent into the photograph depicting them in the hot-air balloon using Adobe Photoshop®. In self-relevant conditions, the parent and child were clearly visible. To conceal the individuals in the non-fluency-promoting conditions, a digital lens flare filter was used to realistically obscure the subject and their parent. The background in the nonconstrained conditions consisted of nondescript clouds. In fluency-impeding conditions, a lighthouse surrounded by trees was placed in the background. This detail was selected because it was judged by the authors to be distinctive and plausible, but not bizarre. See Appendix A for sample photographs.

## Measures

*Autobiographical Belief and Memory Questionnaire.* The Autobiographical Belief and Memory Questionnaire (ABMQ; Scoboria, Mazzoni, Kirsch, & Relyea, 2004) served as the measure of subjective judgments about past events, including memory. The questionnaire assesses general and personal plausibility (where 1 = not at all plausible and 8 = extremely plausible), autobiographical belief (where 1 = definitely did not happen and 8 = definitely did happen), and autobiographical memory (where 1 = no memory and 8 = clear and complete memory). Participants rated five events. The first, fourth, and fifth events were the same

for all participants (choking on an object, bone density screening, seeing a UFO). One of the participants' true events was placed second, and the false event was placed third.

*Memory characteristics questionnaire.* Participants rated the characteristics of their memories with the same eight questions used by Garry and Wade (2005). The purpose was to examine characteristics associated with efforts to recall the false event. Participants rated whether they could (where 1 = low, 7 = high): relive the event in their mind; see the event in their mind; hear the event in their mind; feel emotions associated with the event; remember the event rather than just know that it happened; remember the event as a coherent story; believe the event occurred as remembered; and whether they had talked/thought about the event before.

*Judges' ratings.* The first and third interviews were audiotaped and transcribed. Based on these transcripts, participants were classified by two independent judges (a procedure consistent with Lindsay et al. 2004), who are blind to the experimental conditions, as having either (i) no images; (ii) images only; or (iii) memories for each of the four events, according to Lindsay et al.'s (2004) criteria. For both the first and last interviews, the content that was judged was that which was obtained at the very end of the session (i.e. at the end of the guided imagery and context reinstatement, as further discussed in the next section). The judges were two research assistants employed in the laboratory. They were trained for coding using sample event transcripts until an inter-rater agreement of 90% was obtained. The judges attained an inter-rater agreement of 88% on the actual transcripts; disagreements were resolved through discussion.

## Procedure

All procedures were reviewed by the University of Windsor Research Ethics Board. Participants were told that their parents would be asked to share nonsensitive childhood photographs. Once a parent responded, the participant was randomized to a condition, and a personalized booklet was created.

Participants were interviewed three times over 1 week, following Garry & Wade's (2005) procedure. Four research assistants who were blind to the hypotheses administered the procedures, and each participant met with the same assistant for all three interviews. In Interview 1, participants were told that the purpose of the study was to evaluate memory recovery techniques for childhood events. Each photograph was presented in turn; the false photograph was always presented third. Participants were asked to describe everything they could recall about each event. If unable to recall, participants were told that many people have difficulty remembering events that happened a long time ago because they have not thought about them. With the photograph present in front of the participant at all times, context reinstatement and guided imagery were then used to aid recall. Specifically, participants were asked to concentrate and to try bringing the event into focus. They were told to close their eyes and to imagine that they were back in the situation. They were encouraged to focus for 1 min on details of the event, such as what they may have been feeling at the time,

what they may have been thinking, what it may have been like to experience the event, what season it was, and who was with them, etc. They were then asked if they could remember anything further, after which the next photograph was introduced, and this procedure was repeated. After reviewing the four photos, participants rated the memory characteristics questionnaire. They were given their booklet to take home, were asked to review it daily, and were asked not to discuss the events with anyone during the study.

The subsequent interviews followed the same format. Interview 2 differed in that the memory characteristics questionnaire was not administered. At the conclusion of the third interview, participants also completed the ABMQ. Also following Interview 3, participants were asked how frequently they thought about the events during the study, and if they discussed any event with others. Participants were then told that one event was false and were asked to identify which they thought it was. Finally, the false event was disclosed and participants were debriefed.

## RESULTS AND DISCUSSION

Our primary question was whether subjective memory ratings in the condition containing self-relevant details without unfamiliar details would be greater than in the other groups. Furthermore, we were interested in whether self-relevant details would generally be associated with stronger memory ratings and unfamiliar details with lower memory ratings. The average ABMQ ratings are presented in Table 1.

The results revealed that the highest subjective memory ratings for the false event were associated with self-relevant details without unfamiliar details. In statistical terms, analysis of ABMQ memory ratings for the target false event using a factorial between-subjects ANOVA (self-relevant by unfamiliar) revealed a significant interaction [ $F(1, 78) = 7.88, p < .01$ ]. Post-hoc  $t$ -tests adjusting for group differences in variance showed that the self-relevant/no-unfamiliar-detail group made higher memory ratings than the other groups [ $t(19.86) = 2.33, p = .030, d = .72$ ]. Because variability was high between groups, we also conducted nonparametric Mann-Whitney  $U$ -tests, which also showed that the self-relevant/no-unfamiliar-detail group provided higher memory ratings than the other groups [ $U = 406.00, p = .011$ ]. We did not find any significant main effects. Hence, the specific combination of the types of details is what proved important. This finding differs from that found by Desjardins and Scoboria (2007) in that they found that those exposed to self-relevant details gave significantly higher memory ratings

than did those not exposed to self-relevant details. Desjardins and Scoboria (2007) did not find a significant effect for salient non-self-relevant details or an interaction between the two types of details. A plausible explanation for this discrepancy is that the relative power of fluency-promoting and fluency-impeding details differs when presented in the narrative medium compared with the photographic medium in that they become more and less influential, respectively, as will be further discussed in the following text.

The false photograph received strong ratings on the ABMQ belief item across conditions, with the average rating above the scale midpoint ( $M = 4.57, SD = 2.7$ ). No group differences were found for personal plausibility and belief (all  $p > .10$ ), indicating that the types of information in the photos facilitated variability in the development of memories and not plausibility or belief judgments about the false event. High belief ratings indicate that the suggestion was generally credible to all participants. We also found that those who received self-relevant details made higher general plausibility ratings than did those who received non-self-relevant photos [ $F(1, 78) = 5.04, p = .028, d = .50$ ]. This indicates that the presence of self-relevant details affected thinking about the possibility of the event occurring to at least some people in general.

A metric frequently used in the false memory literature is judges' ratings of events. We examined whether judges thought that event narratives reflected memories, images but not memories, or no images or memory. Judges' ratings by condition, event (true or false), and interview are presented in Table 2. There were no statistically significant differences among the groups for the false event; logistic regression analyses failed to find any main effects or interaction (all  $p > .10$ ). Hence, while the pattern of judgments mirrored that for the ABMQ memory ratings (e.g. the self-relevant/no-unfamiliar-detail group showed the highest number of memories and images, and the self-relevant/unfamiliar-detail group showed the lowest number), statistically the groups were not differentiated. The ABMQ memory item did correlate significantly with judge's ratings for the third interview [Spearman's  $\rho = .59, p < .001$ ], indicating a moderate correspondence between the subjective ratings and objective judgments. This suggests that the failure to find significant differences in judges' ratings is related to lack of statistical power for nonparametric tests. Additionally, we note that the false memory rate is consistently about 50% in the studies that employ this doctored photograph procedure (Garry & Wade, 2005; Wade et al., 2002), and that the minimum false memory under plausible conditions is about 15% to 20% (see Ost, Foster, Costall & Bull, 2005). This leaves a relatively narrow window to produce group

Table 1. Average Autobiographical Belief and Memory Questionnaire ratings by group at Interview 3

	General plausibility		Personal plausibility		Autobiographical belief		Memory	
	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>
No self-relevant, no unfamiliar	4.43	2.27	4.52	2.21	4.33	2.60	1.43	0.93
Self-relevant, no unfamiliar	5.53	1.98	5.26	2.40	4.58	2.76	2.68	2.26
No self-relevant, unfamiliar	4.29	1.59	4.71	2.10	4.71	2.59	1.67	1.20
Self-relevant, unfamiliar	5.14	1.98	4.90	2.17	4.67	2.85	1.24	0.54

Note: Items were rated using an 8-point Likert-style scale.

Table 2. Judges' image and memory ratings by experimental condition and time

	Interview 1			Interview 3		
	None (%)	Images (%)	Memories (%)	None (%)	Images (%)	Memories (%)
True events <sup>a</sup>						
No self-relevant, no unfamiliar	11.11	46.03	42.86	11.11	44.44	44.44
Self-relevant, no unfamiliar	21.05	45.61	33.33	8.77	40.35	50.88
No self-relevant, unfamiliar	17.46	26.98	55.56	12.70	25.81	60.49
Self-relevant, unfamiliar	20.63	47.62	31.75	15.46	34.92	49.62
False events						
No self-relevant, no unfamiliar	76.47	23.53	0.00	76.47	11.76	11.76
Self-relevant, no unfamiliar	61.11	33.33	5.56	52.94	28.41	18.65
No self-relevant, unfamiliar	80.00	15.00	5.00	63.16	21.05	15.79
Self-relevant, unfamiliar	83.33	16.67	0.00	73.68	21.05	5.27

<sup>a</sup>For true events, the proportions are reported across all true events (three per participant).

differences via experimental methods. The only solution to this issue is increased sample size, which is challenging in this type of study. Analysis of continuous variables, such as the subjective memory reports emphasized here, remains more feasible.

An additional factor that bears underscoring is that the research studies to date that have employed doctored photographs depicting hot-air balloon rides (e.g. Garry & Wade, 2005; Wade et al., 2002) have been conducted in New Zealand, where such rides are reportedly more common than in Canada. Hence, the general plausibility of the target event may have been lower for the present population than for that in previous research, which may partly explain the somewhat lower false memory rates in this study. However, the general plausibility ratings suggest that the current participants viewed the event to be moderately plausible. We did not find any differences among the groups in the rates of true memories recalled across the procedures. However, we noticed one difference in our results from that of prior published studies. Most studies reported a high level of memory for the true events (e.g. 97% in the study of Garry & Wade, 2005). In this study, just a quarter (25.6%) recalled all three of the true events by the end of the procedures; 30.8% recalled two of the true events, 14.1% recalled one true event, and 29.5% did not recall any of the true events. Because of lack of recognition of true photographs, the suggestive procedure may not have been as persuasive as in prior studies. Analyses removing those with zero true memories did not change the overall pattern of results.

We were also interested in the development of robust false memories, which we defined as memory ratings above the midpoint of the scale. We selected this value because 75% of the true events rated using the subjective memory question received this rating or higher on the memory scale. At this cutoff, 21% of participants in the self-relevant/no-unfamiliar-detail condition formed a memory, compared with 3% in the other conditions [ $\chi^2(1) = 6.88, p = .027$ ]. This indicates that familiarity coupled with relatively low impedance contributes to false memory formation. We emphasize that we do not state that familiarity was entirely unimpeded in the self-relevant/no-unfamiliar-detail condition, because other aspects of the false photograph that were held constant across the conditions were likely unfamiliar and therefore may have impeded fluency of processing to some degree (i.e. the appearance of the balloon).

We next examined memory characteristics ratings for the false event following the first and third interviews (see

Tables 3 and 4). For the true events, ratings were similar across the four groups. It was not surprising that true events received higher ratings on average than the false memories. Turning to false memories, on examination of the item distributions, we found that three items (coherence, remember/know, and rehearsal) showed low variance and clustered at the scale floor across all groups at both time points; these were not further analyzed. The remaining items for the false event (visual and auditory details, emotion, reliving, belief in memory) correlated at high levels ( $r > .70$ ) and were averaged to create a composite memory characteristic rating. We did this to simplify reporting; analysis of each item individually produced the same pattern of results as in the analysis described in the following text. We were interested to see whether the groups differed in their average ratings at both time points, and whether ratings increased over time due to retrieval efforts. In light of the ABMQ memory findings, we also anticipated that the self-relevant/no-unfamiliar-detail group would provide higher ratings than the other conditions.

We conducted a  $2 \times 2 \times 2$  mixed ANOVA on the composite memory characteristics score, with self-relevant and unfamiliar details between subjects, and time (Interview 1 versus Interview 3) within subjects. This produced a significant three-way interaction [ $F(1,78) = 5.99, p = .017$ ], which is plotted in Figure 1. Post-hoc *t*-tests revealed that the groups did not differ significantly at Interview 1 (all  $p > .10$ ). Scores increased significantly between interviews in the self-relevant, no-unfamiliar-detail group [ $t(18) = 3.31, p = .004, d = .46$ ], whereas they did not increase significantly in the remaining three groups; non-self-relevant, no-unfamiliar [ $t(20) = 1.20, p = .24, d = .23$ ]; non-self-relevant, unfamiliar [ $t(20) = 1.24, p = .23, d = .27$ ]; and self-relevant, unfamiliar [ $t(20) = .34, p = .74, d = -.06$ ]. Change for the self-relevant, unfamiliar group was particularly flat, which indicates that presenting these details in combination restricted the development of the perceptual, emotional, and experiential aspects of remembering.

It seems that when self-relevant and unfamiliar details are presented together in photographs, any feelings of familiarity that may be activated by the former are likely inhibited or negated by the latter. As proposed by Whittlesea (1993), the individual experiences a disproportionately smaller than expected processing speed (given the presence of the autobiographically consistent self-relevant detail), and such 'disfluency' may be interpreted to mean that the event has not been

Table 3. Average memory characteristic ratings for the false event by group and time

		Interview 1				Interview 3			
		No SR, No UF	No SR, UF	SR, No UF	SR, UF	No SR, No UF	No SR, UF	SR, No UF	SR, UF
Reliving	Mean	1.19	1.50	1.56	1.20	1.78	1.85	2.22	1.30
	SD	0.39	1.00	1.15	0.70	1.22	1.39	1.70	0.73
Visual	Mean	1.69	1.40	1.78	1.30	1.89	1.85	2.56	1.35
	SD	1.07	0.99	1.35	0.57	1.45	1.46	1.82	0.59
Auditory	Mean	1.25	1.40	1.44	1.25	1.39	1.70	2.22	1.10
	SD	0.55	0.99	0.78	0.44	0.78	1.08	1.52	0.45
Emotion	Mean	1.75	1.35	2.06	1.60	1.94	1.75	2.61	1.60
	SD	1.22	0.88	1.63	0.99	1.39	1.16	1.65	0.94
Remember/know	Mean	1.08	1.30	1.42	1.20	1.22	1.55	1.74	1.15
	SD	0.26	0.73	0.71	0.52	0.73	1.23	1.83	0.37
Coherence	Mean	1.31	1.10	1.44	1.15	1.44	1.55	1.72	1.05
	SD	0.57	0.31	1.10	0.49	0.98	0.94	1.13	0.22
Belief in memory	Mean	1.36	1.25	1.56	1.25	1.61	1.75	2.17	1.10
	SD	0.76	0.79	1.34	0.64	1.33	1.33	1.79	0.45
Rehearsal	Mean	1.08	1.10	1.28	1.00	1.33	1.20	1.44	1.00
	SD	0.26	0.31	1.18	0.00	1.41	0.41	1.42	0.00

Note: Items were rated using a 7-point Likert-style scale.

successfully remembered. Using Conway and Pleydell-Pearce's (2000) working self-concept model, cognitive dissonance is aroused when both types of detail are encountered together, leading to a narrow memory search model thereby reducing the likelihood that a memory will be endorsed.

The current findings differ from those reported by Strange et al. (2008), which showed that participants' subjective memory ratings did not differ as a factor of the type of photograph presented, whereas the objective ratings did. The most likely explanation for this difference from the current findings is the age of the participants: theirs were children, ours were young adults. The meta-memory skills required to reflect on the qualities of internally generated memories may not yet be sufficiently developed for subjective ratings to coincide with objective ratings. Thus, the metacognitive skills that are thought to be at play within adults (i.e. responding to surprising fluency or disfluency of processing) are likely yet to be acquired by the children in Strange et al.'s (2008) study. In support of this view, evidence suggests that although some

aspects of declarative metamemory develop steadily over the elementary school years, these skills are not completely developed until adolescence or even later (Schneider, 2008).

We note that the lens flare modification to the non-self-relevant photographs does represent one systematic difference between the self-relevant and non-self-relevant conditions. It is possible that individuals who saw these photos weighed the credibility of the photo differently than people who did not see the lens flare. While we cannot rule out this possibility, we note that (i) the figures in the balloon, although obscured, were able to be perceived by individuals and were likely to be inferred as the people described in the picture caption; (ii) belief ratings were equivalent between the self-relevant and non-self-relevant groups, and thus attributions of the event to occurrence in the past were not influenced by this difference between the photos, although it remains possible that memory search strategies were affected. Another confound that bears acknowledgment is the treatment of the true photographs versus the doctored photographs.

Table 4. Average memory characteristic ratings for the true events by group and time

		Interview 1				Interview 3			
		No SR, No UF	No SR, UF	SR, No UF	SR, UF	No SR, No UF	No SR, UF	SR, No UF	SR, UF
Reliving	Mean	4.11	3.87	3.81	3.65	4.11	4.48	4.53	4.03
	SD	1.26	1.39	1.15	1.09	1.54	1.22	1.10	1.53
Visual	Mean	4.43	4.33	4.14	3.87	4.16	4.71	4.74	4.06
	SD	1.25	1.49	1.18	1.14	1.51	1.31	0.93	1.52
Auditory	Mean	3.14	3.17	3.02	2.62	3.22	3.70	3.63	3.11
	SD	1.38	1.46	1.03	1.05	1.42	1.39	1.28	1.36
Emotion	Mean	3.90	3.87	4.25	3.67	3.98	4.22	4.26	3.94
	SD	1.44	1.32	1.33	1.11	1.56	1.19	1.37	1.50
Remember/ know	Mean	4.27	3.94	3.95	3.14	4.10	4.38	4.35	3.76
	SD	1.25	1.43	1.35	1.16	1.64	1.42	1.36	1.63
Coherence	Mean	3.73	3.22	3.23	2.51	3.71	3.76	3.49	3.16
	SD	1.34	1.50	1.22	1.07	1.65	1.27	1.16	1.46
Belief in memory	Mean	4.10	3.86	3.86	3.29	4.11	4.49	4.07	3.71
	SD	1.33	1.48	1.25	1.38	1.54	1.47	1.29	1.86
Rehearsal	Mean	3.94	3.48	3.42	3.59	4.02	4.00	3.58	3.32
	SD	1.38	1.66	1.39	1.31	1.83	1.72	1.54	1.45

Note: Items were rated using a 7-point Likert-style scale. Statistics are averages across three true events.

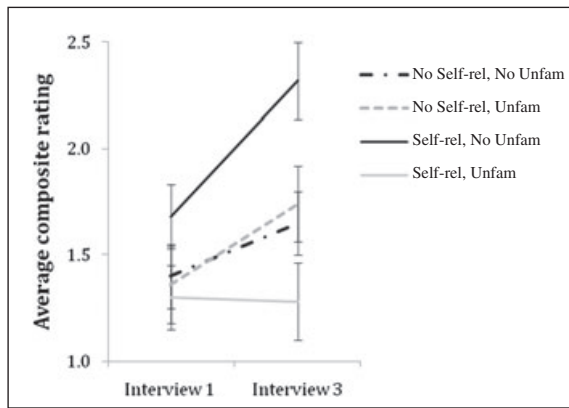


Figure 1. Memory characteristics ratings composite score by experimental condition and time. The composite score plotted is the average of the following memory characteristic items: visual details, auditory details, emotion, reliving, and belief in memory. Bars depict standard errors of measurement. Self-rel: Self relevant details. Unfam: Unfamiliar details

In the true photos, the subject was always present (although not always prominently), whereas in the latter, the subject was only present half of the time (i.e. in the self-relevant conditions). This may have resulted in the event depicted in the doctored photograph to stand out. As already noted, we do think it is likely that individuals in the non-self-relevant conditions inferred that the photograph depicted them in the balloon. This point also holds no bearing regarding the most pertinent contrast between the self-relevant photos that were and were not inclusive of the unfamiliar detail. In light of these potential issues, future work that varies details in photographs (or other suggestive media) should hold constant as many aspects of the presentation that are not key to the manipulation, and should vary aspects of the true photos that are also varied in the manipulated photograph in order to control perceptions of the quality of photos in general.

It bears mentioning that the concepts of fluency promotion and fluency impediment are more complex than simply the relationship between certain types of familiar and unfamiliar details. For example, fluency of processing can be impeded in more than one manner. One way is to simply increase the number of salient, autobiographically inconsistent (and thus unfamiliar) details in a photograph or narrative. Another way is to couple self-relevant (i.e. autobiographically consistent) details with other autobiographically consistent but contextually inconsistent details. Finally, one could increase the amount of fluency-promoting details with the assumption that there will come a point where such details will impede the formation false memories because of the relative implausibility of so many autobiographically consistent, familiar objects being grouped together. This could be thought of as *fluency saturation*: the point at which autobiographically consistent, familiar details cease to enhance fluency of processing and subsequent memory formation, but rather impede it. In each of the above-mentioned examples, the memory search model that is generated will likely vary in breadth. Nevertheless, the purpose of the present study was an initial exploration of the hypothesized manner in which fluency-promoting and fluency-impeding details operate; subsequent research can take a closer look at the intricate relationships between them.

To return to the broad concept of media of presentation and false memory formation, we wonder if photographically presented self-relevant details may be less influential, and salient unfamiliar details more influential, relative to when these types of details are presented in a narrative format. Photographically presented details are highly salient and cannot be easily dismissed or ignored. Conversely, if someone is told that they went on a balloon ride with their parent and it was near a lighthouse, he or she is free to view the event in their own unique manner. In this study, participants who were shown a picture with an unfamiliar detail, but not a depiction of those involved, are similarly free to imagine which parent they were with and what they and their parent may have looked like.

When presented in photographic form, the fluency-promoting power of autobiographically consistent, familiar details overall may be reduced, whereas the fluency-impeding power of less autobiographically inconsistent, unfamiliar details may be increased. Additionally, autobiographically consistent details may be weakened in the presence of unfamiliar details, because the latter draws the viewer to the contrast between the details, resulting in lowered processing fluency and/or increasing dissonance, such that the individual may come to reject the event. Without this fluency-impeding unfamiliar detail, the fluency-promoting autobiographically consistent detail is able to exert its full suggestive power. It is here that the individual is apt to become deceived; experience fluency, which is attributed to the unremembered event; and infer that the event must have occurred based upon familiarity and resulting inference that the event must have happened. Future work on the influence of the types of details within and between different suggestive media is likely to shed additional light on the processes that underlie false memory formation.

Applied implications emerging from this study are that false memory formation may be enhanced through the incorporation of fluency-promoting details (while simultaneously minimizing fluency-impeding details) into the therapeutic or legal process. These findings suggest that the strength of false memories is enhanced to the degree to which suggestions emphasize self-relevant or other familiar information and de-emphasize unfamiliar and contradictory information. The literature to date suggests that false memories can be created in the laboratory. What is less clear are the specific mechanisms through which this creation is fostered. On the basis of the findings from this study, details that promote fluency of processing in the absence of details that impede such fluency seem to represent a key factor that merits further examination, in both the photographic and the narrative medium.

## ACKNOWLEDGEMENTS

Our thanks to Dr. Ira Hyman and an anonymous reviewer for their comments to help improve the manuscript. We thank Lisa Dadd, Michelle Krieger, Claire Lowrey, Norm Lundale, Vanessa McColl, Mike Rigido, and Lauren Wysman for assistance with data collection and coding. This research was done in partial fulfillment of the requirements for the first author's MA degree at the University of Windsor. This work was supported by a Natural Science and Engineering Research Council of Canada Discovery Grant to the second author.



REFERENCES

Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self-memory system. *Psychological Review*, 107, 261–288. DOI: 10.1037//0033-295X.107.2.261

Conway, M. A., Singer, J. A., & Tagini, A. (2004). The self and autobiographical memory: Correspondence and coherence. *Social Cognition*, 22, 491–529. DOI: 10.1521/soco.22.5.491.50768

Desjardins, T., & Scoboria, A. (2007). You and your best friend Suzy put Slime in Ms. Smollett's desk: Producing false memories with self-relevant details. *Psychonomic Bulletin & Review*, 14, 1090–1095. DOI: 10.3758/BF03193096

Garry, M., & Wade, K. (2005). Actually, a picture is worth less than 45 words: Narratives produce more false memories than photographs do. *Psychonomic Bulletin & Review*, 12, 359–366. DOI: 10.3758/BF03196385

Heaps, C. M., & Nash, M. (2001). Comparing recollective experience in true and false autobiographical memories. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 27, 920–930. DOI: 10.1037/0278-7393.27.4.920

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

Hyman, I. E., Husband, T. H., & Billings, F. J. (1995). False memories of childhood experiences. *Applied Cognitive Psychology*, 9, 181–197. DOI: 10.1002/acp.2350090302

Jacoby, L. L., Kelly, C. M., & Dywan, J. (1989). Memory attributions. In H. Roediger, & F. Craik (Eds.), *Varieties of memory and consciousness: Essays in honour of Endel Tulving* (pp. 391–422). Hillsdale, NJ: Lawrence Earlbaum Associates.

Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin*, 114, 3–28. DOI: 10.1037/0033-2909.114.1.3

Lindsay, D. S., Hagen, L., Read, J. D., Wade, K. A., & Garry, M. (2004). True photographs and false memories. *Psychological Science*, 15, 149–154. DOI: 10.1111/j.0956-7976.2004.01503002.x

Loftus, E. F., & Pickrell, J. E. (1995). The formation of false memories. *Psychiatric Annals*, 25(12), 720–725.

Mazzoni, G., & Memon, A. (2003). Imagination can create false autobiographical memories. *Psychological Science*, 14, 186–188. DOI: 10.1046/j.1432-1327.2000.01821.x

Neisser, U. (1996). Remembering as doing. *Brain and Behaviour Sciences*, 19, 203–204. DOI: 10.1017/S0140525X00042308

Oakes, M. A., & Hyman, I. E., Jr. (2001). The role of the self in false memory creation. *Journal of Aggression, Maltreatment, and Trauma*, 4, 87–103. DOI: 10.1300/J146v04n02\_05

Ost, J., Foster, S., Costall, A., & Bull, R. (2005). False reports of childhood events in appropriate interviews. *Memory*, 13, 700–710. DOI: 10.1080/09658210444000340

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

Schneider, W. (2008). The development of metacognitive knowledge in children and adolescents: Major trends and implications for education. *Mind, Brain, and Education*, 2(3), 114–121. DOI: 10.1111/j.1751-228X.2008.00041.x

Scoboria, A., Mazzoni, G., Kirsch, I. & Relyea, M. (2004). Plausibility and belief in autobiographical memory. *Applied Cognitive Psychology*, 18(7), 791–807. DOI: 10.1002/acp.1062

Strange, D., Gerrie, M. P., & Garry, M. (2005). A few seemingly harmless routes to a false memory. *Cognitive Processes*, 6, 237–242. DOI: 10.1007/s10339-005-0009-7

Strange, D., Hayne, H., & Garry, M. (2008). A photo, a suggestion, a false memory. *Applied Cognitive Psychology*, 22, 587–603. DOI: 10.1002/acp.1390

Symons, C. S., & Johnson, B. T. (1997). The self-reference effect in memory: A meta-analysis. *Psychological Bulletin*, 121, 371–394. DOI: 10.1037/0033-2909.121.3.371

Thomas, A. K., & Loftus, E. L. (2002). Creating bizarre false memories through imagination. *Memory and Cognition*, 3, 423–431. DOI: 10.3758/BF03194942

Wade, K. A., Garry, M., Nash, R. A., & Harper, D. (2010). Anchoring effects in the development of false childhood memories. *Psychonomic Bulletin & Review*, 17, 66–72. DOI: 10.3758/PBR.17.1.66

Wade, K. A., Garry, M., Read, J. D., & Lindsay, D. S. (2002). A picture is worth a thousand lies: Using false photographs to create false childhood memories. *Psychonomic Bulletin & Review*, 9, 597–603.

Whittlesea, B. W. A. (1993). Illusions of familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 19, 1235–1253. DOI: 10.1037/0278-7393.19.6.1235

Whittlesea, B. W. A., & Williams, L. D. (1998). Why do strangers feel familiar, but friends don't? A discrepancy attribution account of feelings of familiarity. *Acta Psychologica*, 98, 141–165. DOI: 10.1016/S0001-6918(97)00040-1

Wright, D. B., & Loftus, E. F. (1998). How misinformation alters memories. *Journal of Experimental Child Psychology*, 71, 155–164. DOI: 10.1006/jecp.1998.2467

APPENDIX  
SAMPLE DOCTORED PHOTOGRAPHS BY EXPERIMENTAL CONDITION

	No Self-relevant Detail	Self-relevant Detail
No Unfamiliar Detail		
Unfamiliar Detail		