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Source misattributions may increase the accuracy of source judgments

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Misattribution of remembered information from one source to another is commonly associated with false memories, but we demonstrate that it also may underlie memories that accord with past events. Participants imagined drawings of objects in four different locations. For each, a drawing of a similarly shaped object was seen in the same location, a different location, or not seen. When tested on memory for objects' origin (seen/imagined) and location, more false "seen" responses, but also more correct location responses, were given to imagined objects if a similar object had been seen, versus not seen, in the same location. We argue that misattribution of feature information (e.g., shape, location) from seen objects to similar imagined ones increased false memories of seeing objects but also increased correct location memories, provided the misattributed location matched the imagined objects' location. Thus, consistent with the source-monitoring framework, imperfect source-attribution processes underlie false *and* true memories.

The idea that remembered information from one source may be mistakenly attributed to a different source (i.e., source misattribution) has proven useful in explaining a variety of false memory phenomena (Johnson, Hashtroudi, & Lindsay, 1993; Mitchell & Johnson, 2000). For example, after studying a list of words, all of which are related to a single nonpresented word, people often falsely remember the nonpresented word (Deese, 1959; Roediger & McDermott, 1995). Roediger, Watson, McDermott, and Gallo (2001) have argued that this occurs because the study list activates semantic information about the nonpresented word and, at test, the activated information is attributed, not to internal activation processes, but to presentation of the word in the study list. Also, source misattribution has been implicated in eyewitness suggestibility effects in which participants falsely remember seeing items in a witnessed scene that were only suggested to them verbally after the fact (e.g., Keogh & Markham, 1998; Schooler, Gerhard, & Loftus, 1986; Zaragoza & Lane, 1994). By this explanation (Zaragoza & Mitchell, 1996), participants encode semantic information about nonpresented items when they encounter the suggestion, and they furthermore spontaneously imagine visual information about the items, and this information may be misattributed to the witnessed scene. As a final example, imagined line drawings of objects are more often falsely remembered as seen when participants have, versus have not, seen real drawings of visually or conceptually similar objects (e.g., Geraci & Franklin, 2004; Henkel & Franklin, 1998). This increase in false memory for having seen the drawings is thought to be due to the misattribution of perceived feature information from seen objects to similar imagined objects, with which the information is also consistent.[1] These examples demonstrate that memory researchers appreciate the significance of attribution processes in the formation of false memories.

The role of source attributions in memory has been described in the source-monitoring framework (SMF; e.g., Johnson et al., 1993; Johnson & Raye, 1981). According to the SMF, mental activity typically is not propositionally labeled as to its source. Therefore, the source of activated information cannot be directly recovered but rather must be inferred. Inferences are influenced by the degree of match between the quality and quantity of activated information and the expected characteristics of information from different sources. All other things being equal, when information is consistent with our expectations for a memory from a particular source, we infer that the information was derived from that source and attribute it accordingly. When activated information from one source is sufficiently characteristic of expected information from another source, source misattributions may occur.

The SMF's ideas about source attribution are so often invoked in relation to false memories (e.g., Goff & Roediger, 1998; Gordon, Franklin, & Beck, 2005; Henkel & Franklin, 1998; Hyman & Pentland, 1996; Lindsay, Allen, Chan,

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& Dahl, 2004; Niedzwienska, 2003; Roediger et al., 2001; Zaragoza & Mitchell, 1996) it risks obscuring the larger point of the framework, which is that all memories, whether they accurately reflect past events or not, are the product of basically the same revival, evaluation, and attribution processes. In other words, source attribution is as much a part of true memories as false ones. This can be contrasted with theories suggesting differences in the type of information on which false and true memories are based (gist vs. verbatim traces; Brainerd & Reyna, 2002) or processes by which they are recovered (familiarity versus recollection; Jacoby & Whitehouse, 1989). In this paper, we seek to highlight commonalities in the information and processes underlying both false and true memories by demonstrating that source misattribution may lead to accurate memories, as well as inaccurate ones.

To explore source misattribution as a basis for accurate memory, we required an experimental setting in which feature information from one source could support a correct response to a memory probe, even if misattributed. To this end, we adapted a procedure in which the misattribution of specific features (e.g., shape, location) from seen items (e.g., *magnifying glass*) to visually similar imagined items (e.g., *lollipop*) has previously been shown to induce false memories for having seen imagined items (Henkel & Franklin, 1998; Lyle & Johnson, 2006). In the current procedure, similar seen and imagined items sometimes shared an identical perceptual feature (location on the screen). Systematic misattribution of this shared feature should lead to increased accurate memory for the location of imagined items.

In this procedure, participants saw and imagined objects in the corners of a computer screen. Half of the imagined objects were similar in shape to a single seen object. For each imagined object, a similar object was seen in the same location, a different location, or not seen at all. On a later source memory test, participants saw the names of objects and indicated whether the objects had been seen, imagined, or were new. For objects judged seen, participants also reported in which corner the drawings had appeared. We know from previous studies that seeing a visually similar object should increase false "seen" responses to imagined objects (Henkel & Franklin, 1998; Lyle & Johnson, 2006). More to the point of the current investigation, we also know that, when falsely remembered as seen, imagined objects are attributed to the location in which a visually similar object had been seen (Lyle & Johnson, 2006, Experiment 1). That is, in an earlier experiment, when objects were imagined in the center of a computer screen and objects were seen in the four corners of the screen, falsely remembered drawings of imagined objects were more likely than chance predicts to be attributed to the corner in which a similarly shaped object had appeared. We proposed that this was due to the inadvertent reactivation and misattribution of specific features of seen objects upon test of similar imagined objects—a process dubbed *feature importation*. In the current study, feature importation should increase correctly reporting details of a target event *if the imported feature matches one that was actually part of the target event*. In other words, if location information from similar seen objects is imported into memories of imagined objects in the same-location condition, then location accuracy should be highest in that condition, but we would assume that some of those accurate memories are the product of source misattribution.

By predicting that the misattribution of feature information may lead to accurate feature memory, we are suggesting that source misattribution may mimic the effect of successful feature binding. Correct recall of a detail like location often is assumed to reflect the successful operation of processes by which the multiple features of complex events are bound together in memory (Chalfonte & Johnson, 1996). While this is surely one route to memory accuracy, it is not the only one. For example, schemas (e.g., Brewer & Treyens, 1981), stereotypes (Mather, Johnson, & De Leonardis, 1999), or, generally speaking, response biases (see Batchelder & Riefer, 1990) all may lead, in some circumstances, to memories that accord with past events, even if details of those events were not tightly bound at encoding. Here, we suggest that the misattribution of specific feature information from discrete similar events may be yet another route to memory accuracy.

Although the importation of location information from seen objects may increase location accuracy for imagined objects in the same-location condition, the importation of actually perceived features, in general, should reduce the accuracy of perceived-or-imagined judgments for imagined objects in both the same- and different-location conditions. That is because, as described above, when features of seen objects are misattributed to similar imagined objects, false "seen" responses increase, and this has been shown whether objects are seen and imagined in the same location (Henkel & Franklin, 1998) or different ones (Lyle & Johnson, 2006). Hence, ironically, seeing a similar object in the same location may increase accurate report of *where* an object was imagined to occur, but decrease accurate report of *how* it occurred (i.e., as an imagination or a perception).

If feature importation may occur whether similar objects are perceived and imagined in the same location or different ones, then how might seeing a similar object in a different location affect location accuracy for imagined objects? One prediction is that location accuracy will be lower when a similar object is seen in a different location versus not seen at all, because the imagined object would be systematically misattributed to the location of the seen object. The current procedure allows us to examine this question.

Finally, in addition to perceived-or-imagined and location judgments, participants rated how vividly they remembered the shape, and how confidently they remembered the location, of objects judged to have been seen or imagined. As described above, we expected memories of imagined objects to import features from similar seen objects, thereby increasing the misattribution of those memories to prior perception (even as, in some cases, it supported accurate location memories). Therefore, this experiment provided an opportunity to replicate and extend our finding that the importation of perceived feature information increases the subjective vividness of, and confidence in, false memories (Lyle & Johnson, 2006). This is an important issue for exploration, given practical concerns about the subjective experience of false memories.

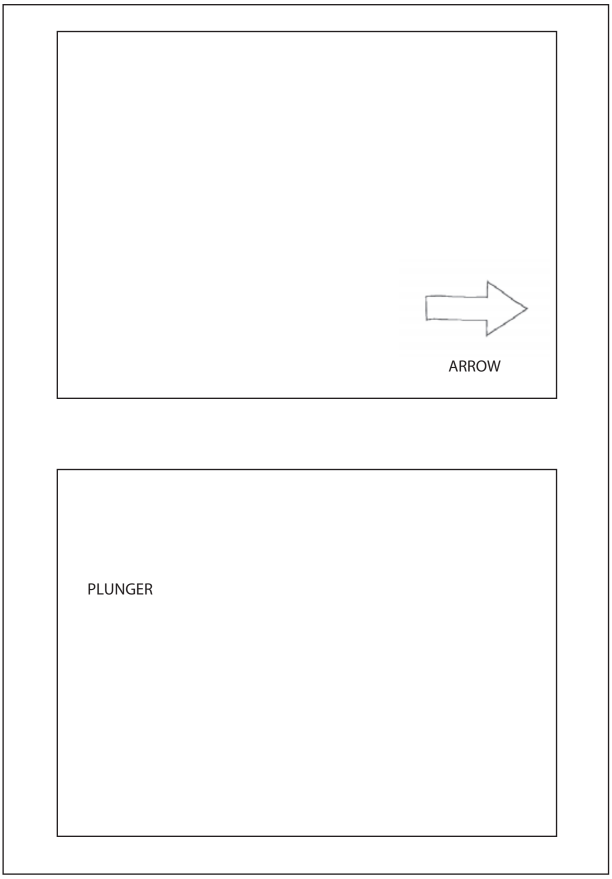

Figure 1. Examples of slides used for perception (top) and imagination (bottom) trials.

METHOD

Design

The experiment had a 2 (origin: perceived or imagined) × 3 (pair type: control, visual, or conceptual) × 2 (location of pair member: same or different) within-participants design.

Participants

Participants were 32 Yale University students (25 females, 7 males), who received either money or credit in an Introductory Psychology course for participating.

Materials

A total of 64 slides were presented using Microsoft PowerPoint. Half showed the name of an object with a black-and-white line drawing of that object directly above the name (for perception trials) and half showed only the name of an object (for imagination trials). Object names (together with drawings of the objects, if applicable) appeared near the four corners of the computer screen (see Figure 1). Drawings of objects were taken from a pool developed by Henkel and colleagues (Henkel & Franklin, 1998; Henkel, Johnson, & De Leonardis, 1998).

Although objects were presented individually, each object was "paired" with a single other object that appeared in the sequence (see Henkel & Franklin, 1998; Henkel et al., 1998, for details on pair norming). There were three pair types: visually similar ($n = 8$), conceptually similar ($n = 8$), and control ($n = 16$). Pairs consisted of one seen object and one to-be-imagined object (hereafter *imagined objects*). In visual pairs, the objects had similar typical shapes, but were otherwise unrelated (e.g., *cane* and *crowbar*). In conceptual pairs, objects were conceptually related, but were not similar in shape (e.g., *mailbox* and *envelope*). In control pairs, objects had no obvious similarity of any sort (e.g., *plunger* and *arrow*).

Imagined objects were pseudorandomly assigned to corners of the computer screen with the restriction that an equal number of objects from each pair type were assigned to each corner. The location of imagined objects was invariant across participants. For half of the imagined objects from each pair type in each corner, the object's seen pair member appeared in the same location and, for the other half, the seen pair member appeared in a different location. When a seen pair member appeared in a different location, the location to which it was assigned was pseudorandomly determined with the restrictions that 1) an object never appeared diagonally across the screen from its pair member and 2) one quarter of the seen objects from each pair type appeared in each corner. Two sets of perception trials were created and used such that each seen object appeared in the same location as its imagined pair member for half the participants and in a different location for the other participants.

Slides were pseudorandomly ordered with the following restrictions: no more than 4 perception or imagination trials occurred in a row; pair members were presented at least 26 trials apart; and the imagined object was presented before the seen object for half the pairs of each type and after the seen object for the other half. Presentation order was counterbalanced for visual and conceptual pairs such that each object was presented before and after its pair member for an equal number of participants.

The source memory test consisted of the names of the 64 seen and imagined objects plus the names of 32 new objects presented in a pseudorandom, intermixed order. New objects were chosen to have no obvious similarities to any of the seen or imagined objects. Pair members from visual and conceptual pairs were tested at least 21 trials apart. Test order was counterbalanced for objects from visual and conceptual pairs such that each object was tested before and after its pair member for an equal number of participants. Each object name was followed by the response options Perceived, Imagined, and New. Underneath the Perceived and Imagined options were the response options Upper Left, Lower Left, Upper Right, and Lower Right.

The memory characteristics questionnaire (MCQ) was adapted from Johnson, Foley, Suengas, and Raye (1988) and consisted of the same object names as the source memory test. Shape vividness ratings were made on a six-point scale that ranged from 0 = *no memory* to 5 = *extremely clear or vivid memory*. Location confidence ratings were made on a four-point scale with 0 = *Not at all confident/Guessing*, 1 = *More than a guess but more unsure than sure*, 2 = *More confident than not*, and 3 = *Extremely confident/As sure as I can be*.

Procedure

Slides for perception and imagination trials were presented for 7 seconds each. On perception trials, participants stated out loud the location of the object and how long they estimated it would take them to reproduce by hand the drawing they were seeing. On imagination trials, participants were instructed to imagine a simple black-and-white line drawing of an object above the object name, just as actual drawings appeared above object names on perception trials. Participants stated in which corner they were imagining the object and how long they estimated it would take them to reproduce by hand the drawing they were imagining. Responses on perception and imagination trials were recorded by the experimenter.

Forty-eight hours later participants were given a surprise source memory test (the retention interval was based on previous studies indicating that this interval produces a reasonable number of source misattributions, e.g., Lyle & Johnson, 2006; cf. Lyle, Bloise, & Johnson, 2006). Participants indicated whether each object had been perceived, imagined, or was new. For objects participants remembered seeing or imagining, participants also indicated the corner in which the object had been seen or imagined. After the source memory test, participants were given an MCQ on which to rate how clearly or vividly they remembered the shape, and how confidently

Table 1
Mean Proportion Corrected Recognition (With Standard Errors) As a Function of Origin, Pair Type, and Pair Member Location

		Origin				
		Imagined		Perceived		
Pair Type	Pair Member Location	*M*	*SE*	*M*	*SE*	Means
Control	Same	.75	.03	.56	.04	.66
	Different	.75	.03	.52	.04	.64
Visual	Same	.78	.04	.46	.06	.62
	Different	.77	.02	.57	.04	.67
Conceptual	Same	.73	.04	.54	.05	.64
	Different	.67	.04	.55	.05	.61
Mean	Same	.75		.52		
	Different	.73		.55		

they remembered the location, of drawings they remembered seeing and mental images they remembered generating.

RESULTS

Unless otherwise stated, all reported differences were significant at the $p < .05$ level.

The order in which pair members were presented in the slide sequence (i.e., whether items were imagined before their pair member was seen or vice versa) and tested on the source memory test did not reliably influence the effects of interest. Therefore, those two variables are not discussed further.

Recognition Memory

Although our primary research questions concerned location and perceived-imagined source judgments, we first report old-new recognition memory. Table 1 shows corrected recognition scores (hits [proportion of seen and imagined objects correctly recognized as old, regardless of actual source] minus false alarms [proportion of new objects judged old]). These scores were submitted to a 2 (origin: perceived or imagined) × 3 (pair type: control, visual, or conceptual) × 2 (location of pair member: same or different) within-participants ANOVA. The only significant effect was a main effect of origin [$F(1,31) = 62.41$, $MS_{\text{e}} = .07$]. Similar to other experiments comparing perception and imagination (e.g., Durso & Johnson, 1980), the proportion of imagined objects recognized as old ($M = .74$) was greater than the proportion of seen objects ($M = .53$).

Because we were chiefly concerned with memories for imagined events, subsequent analyses were conducted separately for imagined and seen objects. Results are presented first for imagined objects.

Location Judgments for Imagined Objects

Of the imagined objects correctly recognized as old, what proportion were attributed to the location in which they had been imagined? To answer that question, we initially ignored whether the objects were correctly judged to have been imagined or falsely judged to have been seen, and focused on the location reported for the objects. The proportion of objects attributed to their actual location (see Table 2) was submitted to a 3 (pair type: control, visual, or conceptual) × 2 (pair member location: same or different) ANOVA. The only significant effect was the interaction between pair type and pair member location [$F(2,60) = 3.32$, $MS_{\text{e}} = .04$].[2] For imagined objects from conceptual and control pairs, location accuracy was not affected by pair member location [largest $t(30) = .14$]. However, for visual-imagined objects, location accuracy was significantly greater when a similarly shaped object had been seen in the same location versus a different one [$t(30) = 2.80$]. Furthermore, planned comparisons indicated that accuracy for visual-imagined objects was significantly greater than for control-imagined objects in the same-location condition [$t(30) = 2.50$] but not reliably lower in the different-location condition [$t(30) = .86$]. Thus, as predicted, more correct location responses were obtained in the condition in which a similar object was seen in the same location, versus not seen at all, although this held only for visual similarity, not conceptual. When a visually similar object was seen in a different location, location accuracy did not differ significantly from the control level.

Perceived-Imagined Judgments for Imagined Objects

What effect did seeing a similar object have on the perceived-imagined judgment that preceded each location attribution? Of the imagined objects identified as old, we calculated the proportion erroneously judged seen, instead of correctly judged imagined (see Table 3). The proportions were submitted to an ANOVA with the same design as the one used above for location accuracy. There was a marginally significant main effect of pair type [$F(2,60) = 2.55$, $MS_{\text{e}} = .06$, $p < .09$] such that false "seen" responses to imagined objects were more likely when a visually similar object had been seen ($M = .31$, collapsed across pair member location) than in the control condition, in which no visually or conceptually similar object had been seen ($M = .21$, collapsed across pair member location); this difference was significant according to a planned comparison [$t(30) = 2.47$].

There was also a marginally significant interaction between pair type and pair member location [$F(2,60) = 2.65$, $MS_{\text{e}} = .03$, $p < .08$] driven by the fact that false "seen" responses to conceptual-imagined objects were marginally more likely when a conceptually similar object was seen in the same location versus a different location [$t(30) = 1.92$, $p = .06$], but, for objects from visual and

Table 2
Mean Proportion Correct Location Attributions for Imagined Objects (With Standard Errors) As a Function of Pair Type and Pair Member Location

	Pair Member Location				
	Same		Different		
Pair Type	*M*	*SE*	*M*	*SE*	Mean
Control	.52	.04	.51	.04	.52
Visual	.64	.04	.47	.04	.56
Conceptual	.57	.05	.57	.06	.57
Mean	.58		.52		

Table 3
Mean Proportion Imagined Objects Judged Perceived (With Standard Errors) As a Function of Pair Type and Pair Member Location

	Pair Member Location				
	Same		Different		
Pair Type	*M*	*SE*	*M*	*SE*	Mean
Control	.20	.04	.22	.03	.21
Visual	.31	.05	.30	.05	.31
Conceptual	.34	.06	.22	.04	.28
Mean	.28		.25		

control pairs, pair member location had no effect on the proportion of false "seen" responses [largest [$t(30) = .68$]. Seeing a conceptually similar object in the same location increased false "seen" responses over the level for control objects [$t(30) = 2.29$]. In contrast, in the different location condition, the proportion of false "seen" responses was equivalent for conceptual and control objects. In sum, conceptual similarity to a seen object increased false "seen" responses to imagined objects in this experiment, but only when the similar objects occurred in the same location. It is interesting that past experiments that have shown that conceptual similarity increases false memories (Henkel, 2004; Henkel & Franklin, 1998, Experiment 2) only included a same-location condition.

A key result from the analyses of location and perceived-imagined source judgments is that, when a pair member was seen in the same location, location accuracy was greater for visual than control objects, but so was the rate of false "seen" responses. Was location accuracy for visual-imagined objects greater than for control-imagined objects regardless of whether the objects were correctly judged imagined or falsely judged seen? To address that question, which concerns location accuracy conditional on perceived-imagined judgment, we calculated location accuracy for visual- and control-imagined objects in the same-location condition as a function of whether they were judged seen or judged imagined (see Figure 2). The proportion of correct location responses was submitted to a 2 (pair type: control or visual) × 2 (perceived-imagined response: seen or imagined) within-participants ANOVA. Only 16 participants could be included in the analysis, because only those participants gave both "seen" and "imagined" responses to both visual and control objects in the same-location condition. There was a significant effect of pair type [$F(1,15) = 7.23$, $MS_{\mathrm{e}} = .10$]. As reported above, location accuracy was greater for visual than control objects and the current analysis furthermore revealed that this difference held whether the visual and control objects were judged imagined (*M*s = .73 and .57, respectively) or judged seen (*M*s = .59 and .34, respectively). Less important for present purposes, there was also a marginally significant effect of perceived-imagined response [$F(1,15) = 3.52$, $MS_{\mathrm{e}} = .15$, $p = .08$], with location accuracy tending to be higher for objects rightly judged imagined ($M = .65$) versus wrongly judged perceived ($M = .47$). Although the reduced sample size precludes drawing any firm conclusions, this analysis at least suggests that seeing a visually similar object in the same location boosts location accuracy for imagined objects over a control level, regardless of whether the objects are correctly remembered as imagined or falsely remembered as seen.

MCQ Ratings of Feature Information in False Memories

When imagined objects were falsely remembered as seen, did the subjective quality of feature information in the memories differ as a function of the type of pair member that was seen (i.e., visually similar, conceptually similar, or control)? We calculated mean shape vividness and location confidence ratings for imagined objects from each of the three pair types, given that the objects were judged seen (see Table 4). For comparison, we also calculated mean shape and location ratings for seen objects, given that they were judged seen.[3] In other words, we compared false memories for three types of imagined object with true memories for seen objects. Only the 18 participants who gave "seen" responses to visual-imagined, conceptual-imagined, control-imagined, and seen objects were included. Mean shape and location ratings were submitted to separate one-way ANOVAs with object type as a within-participants variable with four levels. Both shape and location ratings differed significantly by object type [shape, $F(3,51) = 3.22$, $MS_{\mathrm{e}} = .58$; location, $F(3,51) = 4.31$, $MS_{\mathrm{e}} = .26$]. Replicating our previous findings (Lyle & Johnson, 2006), shape vividness ratings for visual-imagined objects were significantly higher than for control-imagined objects [$t(17) = 2.73$] and not different than those for seen objects. In contrast, shape vividness ratings for conceptual-imagined objects were not significantly higher than for control-imagined objects and were significantly lower than for seen objects [$t(17) = 2.98$].

Mirroring the pattern of shape vividness ratings, location confidence ratings were significantly higher for vi-

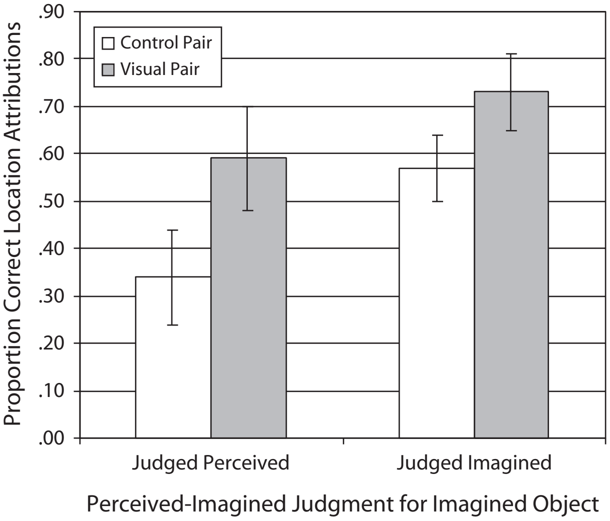

Figure 2. Mean proportion correct location attributions for imagined objects in the same-location condition as a function of pair type and perceived-imagined judgment.

Table 4
Mean Shape Vividness and Location Confidence Ratings for Objects of Various Types, Given Perceived Response (With Standard Errors)

	Shape Vividness		Location Confidence	
Object Type	*M*	*SE*	*M*	*SE*
Control-imagined	3.1	.24	1.1	.16
Conceptual-imagined	3.3	.24	1.4	.24
Visual-imagined	3.7	.21	1.5	.21
Seen	3.8	.15	1.7	.14

sual-imagined objects than for control-imagined objects [$t(17) = 2.88$] and not reliably different than for seen objects [$t(17) = .93$]. Ratings for conceptual-imagined objects were not significantly higher than for control-imagined objects [$t(17) = 1.81$], although neither were they significantly lower than for seen objects [$t(17) = 1.39$].

Importation of Erroneous Location Information

This experiment also allowed us to examine whether memories of imagined objects import erroneous (nonmatching) location information from seen objects. In our earlier experiments (Lyle & Johnson, 2006), we tested for the importation of erroneous location by looking at the proportion of imagined objects (which were always imagined in the center of the screen) that, upon being falsely judged seen, were attributed to the location of a seen pair member (i.e., congruent attributions). In those experiments, objects were always seen in the four corners of a computer screen so, by chance alone, 25% of the location attributions for falsely remembered imagined objects would be congruent. We found that the incidence of congruent attributions was significantly greater than chance for visual- and conceptual-imagined objects, demonstrating the importation of erroneous location information into false memories of imagined objects. For comparison with our earlier findings, we analyzed our current data in an analogous fashion. To conduct the analysis, we isolated cases in which the following conditions were met: (1) an imagined object's seen pair member was in a different location (thereby providing a potential source of erroneous location information), (2) the imagined object was falsely remembered as seen, and (3) the imagined object was not attributed to its actual location. Of those objects incorrectly located, what proportion were attributed to the particular erroneous location previously occupied by a seen pair member? Chance predicts that the proportion would be .33 (one out of three), because there were three wrong locations to which the object could be attributed. Indeed, the number of control-imagined objects that met the above criteria, across all participants, was 26 and the proportion attributed to the location of an arbitrarily chosen seen object was .27, which does not differ reliably from chance [$\chi^2(1) = .43$]. In contrast, of the visual-imagined objects that met the same criteria ($n = 22$), the proportion attributed to the location of a similar seen object was .55, which is significantly greater than chance predicts [$\chi^2(1) = 4.62$]. That proportion was calculated by combining data from all objects that met criteria for analysis, without regard for the contribution of individual participants. This leaves open the possibility that the effect was due to the responses of a subset of participants. However, for the 16 participants who gave responses to visual-imagined objects that met the specified criteria, the mean proportion of congruent attributions per participant was .53, which is comparable to the proportion calculated across objects. The number of conceptual-imagined objects that met the criteria ($n = 12$) was too small to permit statistical analysis. In sum, for visual-imagined objects, the result is analogous to the one we obtained previously in that false memories of imagined objects imported erroneous location information from similar seen objects.

The design of the present experiment also allowed us to test whether the importation of erroneous location information extended to imagined objects that were correctly remembered as imagined, versus falsely remembered as seen. We conducted an analysis identical to the one described above, except that it included objects judged imagined, rather than seen. Of the control-imagined objects meeting criteria for analysis ($n = 78$), the proportion of congruent attributions was only .29, which is, as expected, no different than chance [$\chi^2(1) = .44$]. A different pattern emerged for the visual-imagined objects ($n = 36$). The proportion of congruent attributions for those objects was .50, which is significantly greater than predicted by chance [$\chi^2(1) = 4.71$]. For the 25 participants who contributed data to the analysis, the mean proportion of congruent attributions per participant was .48. Repeating this analysis on conceptual-imagined objects ($n = 29$), the proportion attributed congruently was .24, which does not differ reliably from chance [$\chi^2(1) = 1.03$]; for the 19 participants whose data were included in this analysis, the mean proportion of congruent attributions per participant was .26. Thus, memories of imagined objects that were true in that they identified the objects as imagined, nevertheless imported erroneous location from visually similar (but not conceptually similar) objects.

In sum, the preceding two analyses show that, in the different-location condition, memories for imagined objects, if they did not contain veridical location information, tended to contain location information corresponding to that of a visually similar object. Thus, as predicted, seeing a similar object in a different location systematically influenced location attributions for imagined objects, although, as described above, it did not reduce overall location accuracy for those objects compared to a control level.

Location and Perceived-Imagined Judgments for Seen Objects

For seen objects, location and perceived-imagined source accuracy was analyzed in the same manner as for imagined objects above.[4] Neither pair type nor pair member location (or their interaction) reliably affected location or perceived-imagined judgments. For completeness, data analogous to those presented in Tables 1 and 2 for imagined objects are presented for seen objects in Tables 5 and 6, respectively.

Conceptual similarity to seen objects has been found to produce location importing by imagined objects (Lyle &

Table 5
Mean Proportion Correct Location Attributions for Seen Objects (With Standard Errors) As a Function of Pair Type and Pair Member Location

	Pair Member Location				
	Same		Different		
Pair Type	*M*	*SE*	*M*	*SE*	Mean
Control	.49	.05	.55	.05	.52
Visual	.63	.07	.61	.07	.62
Conceptual	.57	.07	.48	.06	.53
Mean	.56		.55		

Johnson, 2006) and to increase false "seen" responses to those objects (Henkel, 2004; Henkel & Franklin, 1998), but the effects of interest in this experiment were stronger for visual-imagined than conceptual-imagined objects. Visual and conceptual similarity may have somewhat different effects depending on various factors, including the orienting task performed during the slide sequence, the location of seen and imagined objects, and the nature of the source discrimination (e.g., perceived-imagined-new versus simply perceived-new). As we do not yet understand which factors were important in producing the differences between conceptual- and visual-imagined objects in this experiment, we limit the following discussion to the latter.

DISCUSSION

The central finding from this experiment was that there were more accurate memories for the location of imagined objects when participants had seen a visually similar object in the same location versus in a different location or versus when no similar object had been seen at all. We argue that there were more accurate memories in the similar/same-location condition because, in that condition only, accurate memories could result from either successfully binding the imagined object's location *or* misattributing matching location information from a similar seen object.

We next provide a fuller account of how location information consistent with a correct location response could have been misattributed from a seen object to an imagined one. We propose, based on basic principles of cuing in memory retrieval, that, upon test of visual-imagined objects in the same-location condition, there was some probability that shape features of a similar seen object, due to their similarity to the shape features of the imagined object, would be reactivated. We furthermore suggest that other features of the similar seen object, besides shape, might also be reactivated, provided they were bound to shape during perception of the object. This suggestion is inspired by the finding that features that are bound together tend to reactivate together (Nyberg, Habib, McIntosh, & Tulving, 2000). The "other" feature information that is reactivated along with shape could include location, to the extent that location and shape were bound together. Hence, specific location and shape information encoded during perception of a seen object might be reactivated upon test of a similar imagined object (just as it might be reactivated upon test of the seen object itself). This information then might be misattributed to the imagined object. We assume that misattribution of these perceptual features is more likely if they were not tightly bound to the object's conceptual features. The conceptual features of seen objects are inconsistent with similarly shaped, but conceptually distinct, imagined objects and, if reactivated upon test of similar-imagined objects, they might create doubt about whether the reactivated perceptual features actually "belong" to the imagined object.

The misattribution of perceived shape and location information to imagined objects in the same-location condition would have two primary consequences for memory judgments about those objects compared to control-imagined objects. One, it would increase judgments that visual-imagined objects were seen because the perceived information would contribute (along with imagined information actually generated during the imagination trials) to a pool of reactivated perceptual information that, insofar as it included more or more specific details, was more like what would be expected of memories for seen objects (Conway, Pleydell-Pearce, Whitecross, & Sharpe, 2003; Johnson et al., 1988; McGinnis & Roberts, 1996; Suengas & Johnson; 1988). Indeed, we found that perceived-imagined errors were greater for visual- than control-imagined objects in the same-location condition.

Two, the misattribution of perceived location information would increase correct location responses for visual-imagined objects over the control level. Assuming that the likelihood of binding location information to visual- and control-imagined objects was the same during the initial imagination trials, there nonetheless would be more correct location responses for visual-imagined objects because, for those objects, there was some chance that, even if location were not strongly bound to the objects themselves, location information consistent with their true location (i.e., that of a similar seen object) would be reactivated when they were tested. The idea that similar seen objects were a potential source of location information in cases of location-binding failure for imagined objects is in line with our finding that, in the different-location condition, when objects were not attributed to their actual location (indicating location-binding failure), they tended to be attributed to the location of a similar seen object.

The importation of location apparently occurred relatively nonconsciously and unintentionally (see also Lyle

Table 6
Mean Proportion Seen Objects Judged Imagined (With Standard Errors) As a Function of Pair Type and Pair Member Location

	Pair Member Location				
	Same		Different		
Pair Type	*M*	*SE*	*M*	*SE*	Mean
Control	.17	.04	.11	.03	.14
Visual	.22	.06	.19	.06	.21
Conceptual	.14	.05	.12	.05	.13
Mean	.18		.14		

& Johnson, 2006). According to posttest screening, only 10 of 32 participants (31.3%) reported noticing any of the similar pairs of objects (*M* = 2.1 out of 8 pairs) and, of those, only three reported noticing that similar objects sometimes appeared in the same location. No participant reported basing location responses on explicit memory for the location of other objects. This is not to say that people never intentionally access memory for similar events when making feature attributions, only that it is unlikely to account for the present results.

It is interesting that, by our explanation, greater location accuracy for visual-imagined objects in the same-location condition is, in part, a consequence of binding failure – namely, the failure to bind perceptual features of seen objects to conceptual ones. This failure potentiates the importation of location information (along with shape information) from memories of seen objects into memories of visually similar, but conceptually distinct, imagined objects. This highlights the intriguing idea that, in some cases, our ability to accurately report the details of an event is not simply due to the operation of successful feature-binding processes during encoding of the event, but rather to a more complex interaction of encoding processes occurring across multiple similar events and attribution processes occurring for the particular event at retrieval.

As described above, seeing a similar object in the same location, versus not seeing one at all, decreased accuracy on one source memory measure (perceived-imagined judgments) but increased accuracy on another (location judgments). This bears noting because, to our knowledge, it is the first reported finding that the same factor may benefit one type of source memory for a particular event while simultaneously harming another. This is consistent with the idea that source memory is not a unitary construct and it suggests that there may be value in collecting multiple source judgments about events, as opposed to only one, as is usually done. Furthermore, this generalizes findings that some manipulations have opposite effects on source and item memory (e.g., Lindsay & Johnson, 1991; Johnson, Nolde, & De Leonardis, 1996; Jurica & Shimamura, 1999; Mulligan, 2004).

Two of our findings indicate that, even when imagined objects were correctly remembered as imagined, memories for those objects sometimes included location information imported from similar seen objects. One, when not attributed to the correct location, imagined objects in the different-location condition tended to be attributed to the location of a similar seen object, even when the objects were correctly judged imagined. Two, the greater location accuracy for visual-imagined objects in the same-location condition extended to those objects that were correctly judged imagined. If perceived location information (presumably along with perceived shape features) were misattributed to imagined objects in those cases, why were the objects not erroneously judged seen? There are several possible reasons. For example, according to the SMF, perceived-imagined judgments are based on more than simply the quality and quantity of perceptual detail remembered about an event. They are also influenced by memory for cognitive operations performed during the event. Memories of imagined objects that imported perceived features without being attributed to perception may have been those that included a clear record of the cognitive operations involved in imagining the objects (e.g., Finke, Johnson, & Shyi, 1988; Johnson, Raye, Foley, & Foley, 1981); the cognitive operations may have led participants to give an imagined response despite the activation of numerous and/or specific shape features. That is consistent with the SMF's claim that different features may be weighted differently in source judgments. Another (not mutually exclusive possibility) is that imagined objects that imported perceived features, but nonetheless were judged imagined, may have been those whose seen pair members were relatively poorly encoded such that the reactivated perceived information, although having a perceptual origin and specifying a particular location, did not seem particularly characteristic of perception. This explanation is consistent with the SMF's claim that memories of imagined and perceived events differ only on average in terms of their perceptual detail; some memories of perceived events include as little or less perceptual detail than memories of imagined events. In general, cases in which memories of imagined objects import features of seen objects without being misattributed to perception warrant further investigation because they reveal that the importation of perceived information does not invariably lead to the undesirable outcome of falsely remembering things that were never seen.

The current findings have implications for theories of illusory episodic content. Why do false memories sometimes contain specific details (or episodic content) about events that never happened (e.g., Gallo, McDermott, Percer, & Roediger, 2001; Keogh & Markham, 1998; Lampinen, Neuschatz, & Payne, 1999; Loftus, 1979; Schooler et al., 1986)? The present research suggests that it is not necessary, in all cases, to posit two entirely distinct sets of processes that give rise to accurate and illusory episodic content. Rather, for example, we may falsely remember seeing a nonexistent object in a particular location (e.g., Lyle & Johnson, 2006) for the same reason (i.e., misattribution of information from similar events) we accurately remember imagining an object in the location where we actually imagined it.

One other finding of interest came from our comparison of the subjective quality of false memories of nonexistent drawings to that of memories for actual drawings. The quality of shape and location information in false memories of visual-imagined objects (as indexed by shape vividness and location confidence ratings) was significantly more vivid and compelling than in false memories of control-imagined objects and, critically, not significantly different than in memories of seen objects, given that the objects of each type were judged seen. The equivalence of ratings for false memories of visual-imagined objects and true memories of seen objects is striking because many prior studies have found, using rating scales similar to the ones we used, that the perceptual information in memories of nonperceived events is reliably less vivid and compelling than that in memories of actually-perceived events (e.g., Hyman & Pentland, 1996; Lampinen, Odegard, &

Bullington, 2003; Mather, Henkel, & Johnson, 1997), although the difference is sometimes small. Indeed, in the present experiment, we did obtain a reliable difference between false memories of control-imagined objects and true memories of seen objects. False memories of visual-imagined objects receive higher ratings than those of control-imagined objects because, while both presumably contain imagined feature information, a subset of the former also contains perceived feature information imported from similar seen objects. Therefore, the lack of a significant difference between visual-imagined and seen objects on our measures of subjective experience suggests that memories based on a combination of imagined and perceived information may be as vivid and compelling as memories based primarily on perceived information (as memory for seen objects presumably were). In other words, different combinations of feature information may be associated with very similar subjective experiences.

In conclusion, source misattribution, which is widely associated with false memories, may sometimes underlie memories that accurately reflect past events. Memories can be right for the same reasons they can be wrong.

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NOTES

1. In effect, false memories in this case arise from two separable source misattributions. Feature information from one source (i.e., a seen object) may be misattributed to another source (i.e., an imagined object) and this may cause the object from an imagined source to be misattributed to a perceptual source.

2. One participant did not give any old responses to visual-imagined objects in the same-location condition and thus was not included in this analysis or the analysis of perceived-imagined judgments.

3. Preliminary analyses indicated that mean shape and location ratings did not differ for seen objects from the three pair types, hence mean ratings for seen objects are collapsed across pair type.

4. Six participants did not give any old responses to objects in one or more of the six cells and thus could not be included in either of these analyses.

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