Learning Through Virtual Product Experience:

The Role of Imagery on True Versus False Memories

ANN E. SCHLOSSER*

To appear in the December 2006 of the *Journal of Consumer Research*

*Ann E. Schlosser is Assistant Professor of marketing at the University of Washington Business School, Box 353200, Seattle, WA 98195-3200 (aschloss@u.washington.edu). The author thanks the editor, associate editor, three anonymous reviewers, the participants of the 2004 University of Washington Marketing Camp, Tiffany Barnett White, Robert Wyer and Richard Yalch for their insightful comments and suggestions.

Two experiments examined the effect of interacting with a virtual object (i.e., *object-interactivity*) on true and false memories. Although object-interactivity will likely improve memory of associations compared to static pictures and text, it may lead to the creation of vivid internally-generated recollections that pose as real memories. Consequently, compared to information conveyed via static pictures and text, object-interactivity may cause people to falsely recognize more non-presented features. The results support these hypotheses and provide converging evidence that this false recognition effect is due to using imagery during retrieval and is robust, emerging regardless of individuals' goals (to search or browse) or learning intent.

"The difference between false memories and true ones is the same as for jewels: it is always the false ones that look the most real, the most brilliant." Salvador Dali

As reflected in the above quote, separating true from false memories is often difficult. Though important, understanding how marketing communication affects both true and false memories is a largely understudied consumer behavior topic. For instance, when evaluating an advertisement designed to educate consumers about a new product, marketers often assess whether consumers remember information presented in the advertisement (i.e., true memories), but neglect to assess whether they incorrectly remember information that was *not* presented (i.e., false memories). The goal of this article is to investigate whether communication tools that elicit vivid mental images might improve certain true memories while increasing false memories.

Understanding the role that imagery plays in consumer learning is an important consumer behavior topic. There has been a call "to explore the factors under [marketers'] control that can influence imagery vividness and concreteness and that thus affect consumers' abilities to remember product-related information" (MacInnis and Price, 1987, p. 477). This article focuses upon one tool available to marketers in interactive media environments: *object-interactivity*. Object-interactivity involves having a virtual experience with the product and elicits more vivid mental images than do static pictures and text (Schlosser 2003). Because imagery-evoking stimuli can improve memory (e.g., Childers and Houston 1984; Lutz and Lutz 1977; Paivio 1971), object-interactivity will likely improve certain true memories compared to static pictures and text (a picture site). Yet, it may also lead to more false memories. Indeed, scholars argue that although learning via physical experience with a product is vivid, it can create an illusory sense of competence (Hoch and Deighton 1989). Likewise, the benefits of learning via virtual experience may come with costs: the ease of generating vivid mental images may create later confusion regarding whether a retrieved mental image was perceived or imagined, thereby leading to more false memories. This article begins with a discussion of how object-interactivity might improve true memories, followed by how it may lead to more false memories.

OBJECT-INTERACTIVITY AND TRUE MEMORIES

With object-interactivity, the user directly manipulates virtual objects (Schlosser 2003). Direct manipulation of virtual objects occurs when there is a continuous change in images as a result of user behaviors that resemble the corresponding physical behaviors (Shneiderman 1987). An example would be using the mouse to click on the shutter button of a virtual camera and then seeing the picture appear in its preview window. Reading instructions on how to take a picture would not be object-interactivity because it does not involve interaction with the virtual object.

Object-interactivity produces vivid mental images (Schlosser 2003), or mental images that are rich in sensory (e.g., visual) and contextual (e.g., temporal, spatial) detail. For instance, individuals with a vivid mental image of a camera are likely able to remember that they should press a button located on the right side of the camera to turn it on before taking a picture. In contrast, text and static pictures likely elicit nonvivid mental images, or mental images that are faint and cannot be easily expanded into an associated context (Bower 1972).

If object-interactivity produces more vivid—or perceptually detailed and associated—mental images than a picture site does, then it should lead to better performance on tasks that require remembering associations. Indeed, storing information as related rather than separate items improves memory for associations (e.g., Hunt and Einstein 1980; Meyers-Levy 1991; McGee 1980). For instance, memory for pairs (e.g., dog-car) is better when these pairs are visualized as interacting with each other (e.g., a dog driving a car) than as separate (a dog and a car; Bower 1972; McGee 1980). When learning how to operate products, one important goal is to remember which feature (e.g., the button on the top right side of the camera) performs a function (e.g., to take a picture). Object-interactivity should improve performance on such tasks.

H1: Those who visit an object-interactive site will correctly match more features with their functions than will those who visit a picture site.

Although object-interactivity should improve memory for associations, it may not improve all types of memory. Encoding information as associated images improves memory for associations but not for individual items. As a result, encoding information as associations often has little performance advantage on tests that require remembering individual items, such as recognition tests (e.g., McGee 1980) and can lead to even more false memories (e.g., Roediger and McDermott 1995). Thus, object-interactivity will likely improve true memory on a matching task but not on a recognition task. In fact, it may lead to more false memories than a picture site.

OBJECT-INTERACTIVITY AND FALSE MEMORIES

Although research has examined the effect of marketing communications on true memories, its effect on false memories is a relatively unexplored area, with a few notable exceptions (Braun 1999; Braun, Ellis, and Loftus 2002). Prior research has focused on how advertising affects consumers’ recollections of their past experiences (e.g., their childhood experiences at a Disney resort). In contrast, the focus of this article is on how marketing communication that is designed to educate can simultaneously increase true and false memories.

False memories have received more attention in psychology (see for a review Loftus

2003). False memories are a source-monitoring problem (Mitchell and Johnson 2000): the individual misattributes the origin of an imagined memory to an external rather than internal source (i.e., it was perceived rather than imagined). To determine the source of a memory, individuals check its qualitative characteristics such as its sensory, spatial and temporal details (Johnson et al. 1993). Because memories for perceived events tend to have more sensory and contextual detail than memories for imagined events, false memories occur when imagined events have these characteristics (Johnson et al. 1993)—that is, when they are vivid.

Recognition judgments typically require source monitoring (Johnson et al. 1993; Roediger and Mcdermott 1995). Many studies of false memory ask participants whether they recognize a critical lure from a study list. A critical lure is a "new" item that is plausible and highly related to the studied items (Roediger and Mcdermott 1995). False memories occur with a false positive response, or when individuals incorrectly identify a "new" (or imagined) item as "old" (or previously perceived). Unlike tasks that require remembering associations (such as the matching task), correctly identifying a critical lure as "new" requires making fine discriminations (Hunt and Einstein 1981; Meyers-Levy 1991). In fact, the lure itself may interfere with the retrieval process, especially among those who encoded information as associated items (Arndt and Reder 2003; Hege and Dodson 2004)—or when mental images are vivid. Indeed, vivid memories often contain imagined details (Bower 1972). Likewise, Bartlett (1932) argued that reconstructive memory is more likely to occur with rich than simplified materials because in the former case, individuals are more likely to "fill in" the missing pieces of their memories.

It may be easiest for individuals to vividly imagine a critical lure when their mental images of the original event are vivid, such as those generated at an object-interactive site. When answering questions, individuals refresh the original event by mentally picturing it and then scan this image for the answer (Pham and Johar 1997). However, the act of scanning a mental image for the answer might interfere with individuals' ability to accurately reproduce the event. Indeed, post-event information can alter individuals' memories of the original event (Loftus 2003). For instance, asking individuals whether a critical lure appeared in the original event might alter their memories of the original event. In fact, reflecting upon a critical lure may cause it to acquire the same level of detail as the original event (Mitchell and Johnson 2000). Because object-interactivity produces more vivid mental images than static pictures and text (Schlosser 2003), thinking about the critical lure may cause it to become more vivid for those who visited an object-interactive than picture site. As a result, they may experience greater confusion between whether a mental image was imagined or perceived compared to those who visited a picture site.

Object-interactivity is unlikely to increase all recognition errors, however, such as forgetting previously presented items. Regardless of whether items are organized in memory as associated images, the items themselves should be encoded into memory (Arndt and Reder 2003; McGee 1980). That is, visitors to both sites should encode the presented items. As a result, there should be a strong memory trace for the presented items regardless of the type of site visited. If this is the case, then there should be little difference between the object-interactive and picture sites for false negatives, or incorrectly identifying a presented ("old") item as "new." Hence, object-interactivity should only affect errors related to false memories: false positives.

H2: More false positives (but not false negatives) will be observed among those who visited an object-interactive than picture site.

Experiment 1 tests these hypotheses while accounting for individuals' goals for visiting a site: for entertainment (*browsers*) versus to find specific information (*searchers*). Although an object-interactive (picture) site is more congruent with browsers' (searchers') than searchers' (browsers') goals, both experience more vivid mental imagery at an object-interactive than picture site (Schlosser 2003). Because individuals engage in greater cognitive elaboration when the site supports their goals (Schlosser 2003), the effect of object-interactivity on true and false memories (hypotheses 1-2) may be qualified by goal if cognitive elaboration improves true memories while also increasing false memories by making it more difficult for individuals to distinguish between what they thought and what they perceived. However, if vivid mental imagery accounts for the effects of object-interactivity on memory, then hypotheses 1 and 2 should be supported regardless of individuals' goals. Experiment 2 tests whether mental imagery during retrieval can explain the effect of object-interactivity on false memories (see figure 1).

Insert figure 1 about here

EXPERIMENT 1

Method

One-hundred and seventy-three undergraduates participated in partial fulfillment of a course requirement. The experimental design was a 2 (site: object-interactive vs. picture) x 2 (goal: to search vs. browse) factorial. Site was manipulated through the use of Macromedia's Shockwave® technology (the object-interactive site) or through text and static pictures (the picture site). At the object-interactive site, participants could interact with the product by rolling over and clicking on its image to produce changes and gather additional information about it.

The picture site contained the same information but in a storyboard format. Thus, virtual product interaction was not possible. Goal was manipulated by telling participants that during their visit to part of a site featuring a specific digital camera, they should "have fun, looking at whatever you consider interesting and/or entertaining" (browsers) or "efficiently find something specific at the site" (searchers). Those assigned to search then identified two questions they had about the product that they would look for the answers to while at the site. In order for browsers and searchers to have similarly heterogeneous information needs, what to look for was not specified.

Each participant sat at a computer, which displayed the instructions, the website and the survey. Participants received the goal instructions before visiting either site. To control for the time participants spent at the site and any impact this might have upon the dependent variables, all participants viewed the site for five minutes, which is consistent with the time imposed in prior research (Schlosser 2003). After this time elapsed, participants completed an online survey. For the recognition task, participants were given 10 digital camera attributes and asked to indicate whether each was present or absent on the camera they just viewed at the website. Seven were present and three were absent. False positives occur when participants identify an absent attribute as present, whereas false negatives occur when participants identify a present attribute as absent. Consistent with prior research on false recognition (e.g., Arndt and Reder 2003), the absent items were critical lures, or those that are plausible and related to digital cameras. The matching test followed. For this test, there was an image of the camera with each button and dial (i.e., feature) represented by a letter. Below the image, participants matched each of these 10 features to their corresponding function such as to turn on the camera, zoom in, or set the timer.

At the end of the survey were the goal and site manipulation checks. For goal, participants reported how much time they spent "looking for specific information" (i.e., searching) and “looking to be entertained” (i.e., browsing). For site, they were asked, “How passive did you find this Web site (i.e. how much did you feel like a passive observer when viewing this page)?” and “How interactive did you find this Web site (i.e., how much did you feel like you were invited to participate in determining what you saw and experienced)?” To assess whether object-interactivity elicits more vivid mental images than the picture site, participants were asked, “How much did the Web site bring to mind concrete images or mental pictures?” Although both sites contained the same information, participants were also asked, “How informative did you find this Web site?” The scale for these goal and site questions ranged from 0 (not at all) to 4 (a lot). To control for any effect that language proficiency and prior knowledge of digital cameras might have on task performance, both were measured and used as covariates in the following analyses. For language, participants reported whether they are native English speakers. Prior knowledge of digital cameras was measured on three semantic differential scales ranging from –3 to +3 and anchored with unfamiliar/familiar, inexperienced/ experienced and not knowledgeable/knowledgable. Their responses were averaged ($\alpha = .97$).

Results

The data were analyzed with 2 (site) x 2 (goal) ANCOVAs, controlling for language and prior knowledge. Supporting the goal manipulation, browsers spent more time browsing than searchers did (*M*’s = 2.04 vs. 1.32, $F(1, 167) = 16.49$, $p < .01$), whereas searchers spent more time searching than browsers did (*M*’s = 2.57 vs. 1.96, $F(1, 167) = 13.60$, $p < .01$). Supporting the site manipulation, the object-interactive site was deemed to be less passive than the picture site (*M*’s = 1.69 vs. 2.76, $F(1, 167) = 35.45$, $p < .01$), but more interactive (*M*’s = 3.07 vs. 1.24, *F*(1, 125) = 115.28, *p* < .01), and producing more vivid mental images (*M*'s = 2.65 vs. 1.81, *F*(1, 167) = 22.59, *p* < .01). The sites did not differ in perceived informativeness (*F*(1, 167) < 1).

Supporting hypothesis 1, more correct matches were made by those who visited the object-interactive than picture site (*M*'s = 5.28 vs. 3.02, *F*(1, 167) = 43.66, *p* < .01). No other effects were significant (*F*(1, 167)'s < 1.95, *ns*, see table 1). For the total number of correct recognitions, no effects were significant (*F*(1, 167)'s < 2.11, *ns*). Unlike the matching task, object-interactivity was no better than the picture site (*M*'s = 7.69 vs. 7.94, *F*(1, 167) = 1.72, *ns*). Thus, object-interactivity appears to improve memory of associations but not of individual items.

Insert table 1 about here

Hypothesis 2 predicts that object-interactivity should lead to more false positives but not false negatives than the picture site. Because the total number of absent and present attributes differed, proportions were calculated. In addition, to stabilize the variance of proportions (e.g., Hogg and Craig 1995), arcsine transformations were calculated before analyzing the data. For ease of interpretation, however, the untransformed means are reported in the text and table. A 2 (site) x 2 (goal) x 2 (error, a within-subject variable: false positive vs. negative) ANCOVA yielded a significant site x error interaction (*F*(1, 167) = 4.88, *p* < .05). Contrasts support hypothesis 2: A higher proportion of false positives were made by those who visited the object-interactive than picture site (*M*'s = .53 vs. .43, *F*(1, 167) = 5.09, *p* < .05), whereas the proportion of false negatives did not differ between sites (*M*'s = .10 vs. .11, *F*(1, 167) < 1). Goal did not moderate this effect: the goal x site x error interaction was not significant (*F*(1, 167) = 1.98, *ns*, see table 1). Thus, object-interactivity influenced false positives for both browsers and searchers.

Conclusions

The results support hypotheses 1 and 2: object-interactivity improved memory of associations but also led to more false memories than the picture site did despite whether the site supported individuals' goals. Experiment 2 examined the role that imagery plays during retrieval in the occurrence of false memories. False positives likely occur because people determine whether an attribute is present by retrieving and searching a mental image for this attribute. Because the retrieved image is more vivid for those who visited the object-interactive than picture site, they should experience greater confusion regarding which (if any) elements of this image are imagined versus perceived, thereby leading to more false positives. If this is the case, then discouraging the use of imagery during retrieval should reduce the amount of false positives made by those visiting the object-interactive site. In contrast, if there is a strong memory trace for attributes that were presented at the site, then individuals should recognize these attributes (thereby avoiding false negatives) despite the type of site visited or retrieval instructions.

H3: Encouraging the use of imagery during retrieval will lead to more false positives (but not false negatives) among those who visited the object-interactive than picture site, whereas discouraging the use of imagery during retrieval should eliminate this site effect on false positives.

In experiment 1, participants were unaware of the upcoming test. Though such incidental learning conditions reflect most consumer learning environments (Batra and Ray 1983), people may more carefully learn, store and monitor the source of the acquired information when they expect a test. As a result, under such intentional learning conditions, the difference between sites in the number of false positives made may be reduced. On the other hand, imagery tactics can enhance incidental learning, thereby reducing the gap between incidental and intentional learning (cf., MacInnis and Price 1987). Thus, there may be little effect of learning intent on memory.

EXPERIMENT 2

Method

Two-hundred and sixty-two undergraduates participated in partial fulfillment of a course requirement. The experimental design was a 2 (site) x 2 (learning: incidental vs. intentional) x 2 (retrieval: imagery encouraged vs. discouraged) factorial design. The materials and procedure were the same as experiment 1 with the following exceptions. Before visiting the site, those in the incidental learning condition were told to “read about and experience the camera. You will later be asked for your opinion of it,” while those in the intentional learning condition were told to “learn as much as you can about the camera. You will later be tested on this material.”

The retrieval manipulation appeared after participants visited the site but before they took the tests. Those encouraged to use imagery were told that when answering the test questions, they should “visualize the camera and use this visual image to find the correct solution. Don’t feel that you need to be coldly analytical in making your decision. Utilize the power of your imagination to envision a clear picture of the camera.” In contrast, those discouraged from using imagery were told to “be careful and well reasoned in your answers. Don’t let your imagination get the better of you. Utilize the power of your analytical mind and choose the answer that seems the most logical.” These instructions were modifications of those used in prior research (McGill and Anand 1989). After reading these instructions, participants completed the recognition and matching tests. Afterwards, to assess the effectiveness of the learning manipulation, participants indicated on a scale ranging from 0 (strongly disagree) to 4 (strongly agree) the degree to which they read the product information at the site to study the product and to form an opinion of it.

Results

The data were analyzed with 2 (site) x 2 (learning) x 2 (retrieval) ANCOVAs, controlling for language and prior knowledge. Supporting the learning manipulation, compared to those in the incidental learning condition, those in the intentional learning condition agreed more that they read the information to study the product (M's = 2.40 vs. 2.00, $F(1, 252) = 9.86$, $p < .01$) and less to form an opinion of it (M's = 2.35 vs. 2.70. $F(1, 252) = 6.89$, $p < .01$).

For the number of correct matches, consistent with hypothesis 1, more correct matches were made by those who visited the object-interactive than picture site (M's = 5.80 vs. 4.19, $F(1, 252) = 44.87$, $p < .01$). All other effects were nonsignificant ($F(1, 252)$'s < 1.20, *ns*, see table 1). Furthermore, consistent with the idea that object-interactivity improves memory of associations but not of individual items, object-interactivity did not improve recognition performance (M's = 7.97 vs. 7.89, $F(1, 252) < 1$). The only significant finding was that recognition was higher when imagery was discouraged than encouraged (M's = 8.06 vs. 7.79, $F(1, 252) = 3.87$, $p = .05$; all other $F(1, 252)$'s < 3.65, $p > .05$). This appears to be due to fewer false positives being made in the object-interactive condition when imagery was discouraged than encouraged (see table 1).

An arsine transformation of the proportions of false positives and negatives were analyzed with a 2 (site) x 2 (learning) x 2 (retrieval) x 2 (error: false positive vs. negative)

ANCOVA, which yielded a significant site x retrieval x error interaction ($F(1, 252) = 5.10$, $p < .05$). Contrasts support hypothesis 3: Encouraging the use of imagery led to proportionally more false positives made by those who visited the object-interactive than picture site (.49 vs. .41, $F(1, 136) = 7.13$, $p < .01$), whereas discouraging the use of imagery eliminated this effect (.36 vs. .39 respectively, $F(1, 114) < 2.90$, *ns*). Furthermore, there were no significant site effects for false negatives, regardless of whether imagery was encouraged ($F(1, 136) < 1$) or discouraged ($F(1, 114) < 1$, see table 1). It appears that object-interactivity leads to more false positives than a picture site does because individuals use imagery to retrieve information from memory, which can cause them to vividly “see” the absent items. Furthermore, learning instructions had no significant influence on the proportion of errors made after visiting the object-interactive versus picture site ($F(1, 252) < 1$). Thus, the effect of object-interactivity on false positives is quite strong, emerging even when participants were intentionally learning the product information.

DISCUSSION

Prior research has shown that imagery-evoking tools can enhance learning. This article contributes to this by demonstrating that although imagery-evoking tools can enhance learning, they can also increase false memories. Specifically, although object-interactivity improved memory of associations compared to a picture site, it led to proportionally more false positives. In fact, these effects were robust, emerging in spite of individuals’ goals and learning intent.

Experiment 2 demonstrated that imagery plays an important role in the occurrence of false positives. Hypothesis 2 is based on the assumption that when determining whether an attribute was presented at the site, individuals retrieve and search their stored image for this attribute. During this process, however, they may reconstruct this image, thereby believing that their visualization of the absent attribute means that it was actually presented. This is especially likely to occur when the image is vivid (i.e., for those who visited the object-interactive site). Supporting this prediction, the results demonstrate that encouraging the use of imagery during retrieval led to more false positives being made by those who visited the object-interactive than picture site, whereas discouraging the use of imagery during retrieval eliminated this effect.

These findings have important theoretical and managerial implications. For example, others have argued that direct experience can create an illusory sense of competence (Hoch and Deighton 1989). The present research suggests that although a sense of competence may be warranted when learning associations, it is not warranted when recognizing specific items. That is, although virtual experience was better than a picture site for learning associations, it was no better for recognizing presented items, and was worse for rejecting absent items. These findings suggest that marketing managers should test their campaigns for both true and false memories. Although it may seem advantageous for consumers to believe that a product has features that it actually does not have (e.g., by increasing store visits and purchases), it may ultimately lead to customer dissatisfaction. Because false memories reflect source-monitoring errors—or believing that absent attributes were actually presented in the marketing campaign—consumers who discover that the product does not have these attributes will likely feel misled by the company.

One concern regarding research on false memories is that it may reflect a shift in response criteria (Roediger and McDermott 1999). According to signal detection theory (SDT), individuals' responses depend upon both the strength of the signal (the presented item) and their response criteria, or their decision to err on the side of risking or avoiding false alarms (Green and Swets 1966). Yet, response biases are unlikely to account for the present findings because according to SDT, these biases occur when individuals know (1) the conditional probabilities of the signal and noise distributions and (2) the payoff matrix (e.g., the penalty for making a false alarm). Neither of these conditions was present in the current experiments. Moreover, efforts to reduce guessing biases have not eliminated the occurrence of false memories (Roediger and McDermott 1999). Likewise, in experiment 2, learning intent—which should reduce the likelihood of guessing and thus risking false alarms—did not influence the proportion of false positives. Furthermore, the findings were localized in false positives and not false negatives. For example, discouraging imagery during retrieval reduced the effect of object-interactivity on false positives but had no significant effect on false negatives. Such findings are difficult to explain in terms of simple shifts in response criteria (Roediger and McDermott 1999).

One limitation is that the experiments focused upon recognition and not recall. Unlike recognition, recall involves sampling items from memory before deciding whether the sampled item was presented (Gillund and Shiffrin 1984). An interesting future research direction is to examine how object-interactivity might influence the strategies used to sample items from memory and the implications that this has for the occurrence of false memories. For instance, those who visited the object-interactive site may be more likely to sample items from memory by scanning (reconstructed) mental images. In fact, because object-interactivity produces more vivid mental images, people may recall items more readily and be more certain of these recollections. It would also be worthwhile to examine how product knowledge might moderate these findings. Participants were likely knowledgeable about cameras in general and were fairly knowledgeable about digital cameras (*M*'s = .91 and .71 on a scale ranging from –3 to +3 in experiments 1 and 2). Yet, with a more radical innovation, object-interactivity may increase false memories only among experts, or those with enough product knowledge to vividly imagine absent attributes.

REFERENCES

Arndt, Jason and Lynne M. Reder (2003), “The Effect of Distinctive Visual Information on False Recognition,” *Journal of Memory and Language*, 48(January), 1-15.

Bartlett, Frederic C. (1932), *Remembering*, London: Cambridge University Press.

Batra, Rajeev and Michael L. Ray (1983), "Advertising Situations: The Implications of Differential Involvement and Accompanying Affect Responses," in *Information Processing Research in Advertising*, ed. Richard J. Harris, Hillsdale, NJ: Lawrence Erlbaum Associates, 127-52.

Bower, Gordon (1972), “Mental Imagery and Associative Learning,” in *Cognition in Learning and Memory*, ed. Lee Gregg, New York: John Wiley.

Braun, Kathryn A. (1999), “Postexperience Advertising Effects on Consumer Memory,” *Journal of Consumer Research*, 25 (March), 319-34.

Braun, Kathryn A., Rhiannon Ellis and Elizabeth F. Loftus (2002), “Make my memory: How advertising can change our memories of the past,” *Psychology & Marketing*, 19(1), 1-24.

Childers, Terry L. and Michael J. Houston (1984), “Conditions for a Picture-Superiority Effect on Consumer Memory,” *The Journal of Consumer Research*, 11 (September), 643-54.

Gillund, Gary and Richard M. Shiffrin (1984), "A Retrieval Model for Both Recognition and Recall," *Psychological Review*, 91 (1), 1-67.

Green, David M. and John A. Swets (1966), *Signal Detection Theory and Psychophysics*, New York: John Wiley.

Gregory, Larry W., Robert B. Cialdini and Kathleen M. Carpenter (1982), "Self-relevant Scenarios as Mediators of Likelihood Estimates and Compliance: Does Imagining Make it So?" *Journal of Personality and Social Psychology*, 43 (July), 89-99.

Hege, Amanda C G and Chad S Dodson (2004), “Why Distinctive Information Reduces False Memories: Evidence for Both Impoverished Relational-Encoding and Distinctiveness Heuristic Accounts,” *Journal of Experimental Psychology: Learning, memory, and cognition,* 30(July), 787-95.

Hoch, Stephen J. and John Deighton (1989), "Managing What Consumers Learn From Experience," *Journal of Marketing*, 53 (April), 1-20.

Hogg, Robert and Allen T. Craig (1995), *Introduction to Mathematical Statistics*, Prentice Hall.

Hunt, R. Reed and Einstein, Gilles O. (1981), “Relational and Item-specific Information in Memory,” *Journal of Verbal Learning & Verbal Behavior.* 20(October), 497-514.

Johnson, Marcia K., Shahin Hashtroudi and D. Stephen Lindsay (1993), “Source Monitoring,” *Psychological Bulletin*, *114*(July), 3-28.

Loftus, Elizabeth F. (2003), “Make-Believe Memories,” *American Psychologist*, 58 (November), 867-73.

Lutz, Kathryn A. and Richard J. Lutz (1977), “Effects of Interactive Imagery on Learning: Application to Advertising,” *Journal of Applied Psychology, 62*, 493-98.

MacInnis, Deborah J. and Linda L. Price (1987), “The Role of Imagery in Information Processing: Review and Extensions,” *Journal of Consumer Research*, 13 (March), 473-91.

McGee, Rob (1980), “Imagery and Recognition Memory,” *Memory and Cognition,* 8 (5), 394-9.

McGill, Ann L. and Punam Anand (1989), "The Effect of Vivid Attributes on the Evaluation of Alternatives: The Role of Differential Attention and Cognitive Elaboration," *Journal of Consumer Research*, 16 (September), 188-96.

Meyers-Levy, Joan (1991), “Elaborating on Elaboration: The Distinction Between Relational and Item-Specific Elaboration,” *Journal of Consumer Research*, 18 (December), 358-67.

Mitchell, Karen J. and Marcia K Johnson (2000), “Source Monitoring: Attributing Mental Experiences,” in *The Oxford Handbook of Memory*, ed. Endel Tulving and Fergus Craik, London: Oxford University Press, 179-95.

Paivio, Allan (1971), *Imagery and Verbal Processes*, New York: Holt, Rinehart & Winston.

Pham, Michel Tuan and Gita Venkataramani Johar (1997), “Contingent Processes of Source Identification,” *The Journal of Consumer Research*, 24 (December), 249-65.

Roediger, Henry L III and Kathleen B.Mcdermott (1995), “Creating False Memories: Remembering Words not Presented in Lists,” *Journal of Experimental Psychology: Learning, memory, and cognition.* 21 (July), 803-14.

--------- (1999), “False Alarms and False Memories,” *Psychological Review*, 106(April), 406-10.

Schlosser, Ann E. (2003), “Experiencing Products in a Virtual World: The Role of Goals and Imagery in Influencing Attitudes versus Intentions,” *Journal of Consumer Research, 30* (September), 184-98.

Shneiderman, Ben (1987), *Designing the User Interface: Strategies for Effective Human-Computer Interaction*, Reading, MA: Addison-Wesley.

TABLE 1

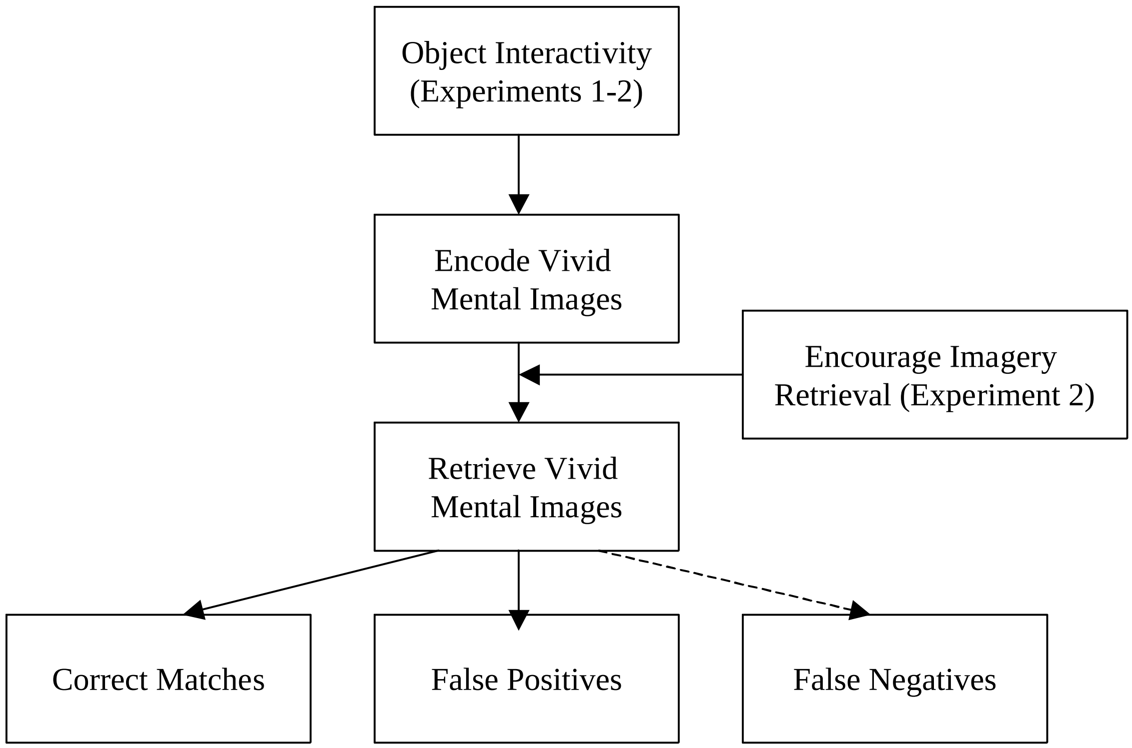
THE EFFECT OF SITE AND GOAL OR IMAGERY RETRIEVAL ON MATCHES AND RECOGNTION

			Number of Correct Responses		Proportion of Recognition Errors	
Experiment	Moderator	Site	Correct Matches	Correct Recognition	False Positives	False Negatives
1	Browsers	Object-Interactive	5.50_{a}	7.52_{a}	$.50_{a}$	$.14_{a}$
		Picture	3.29_{b}	7.80_{a}	$.43_{b}$	$.13_{a}$
	Searchers	Object-Interactive	5.07_{a}	7.83_{a}	$.56_{a}$	$.07_{a}$
		Picture	2.76_{b}	8.05_{a}	$.44_{b}$	$.09_{a}$
2	Imagery Encouraged	Object-Interactive	5.89_{a}	7.69_{a}	$.49_{a}$	$.12_{a}$
		Picture	4.41_{b}	7.90_{ab}	$.41_{b}$	$.12_{a}$
	Imagery Discouraged	Object-Interactive	5.79_{a}	8.22_{b}	$.36_{b}$	$.10_{a}$
		Picture	3.97_{b}	7.92_{ab}	$.39_{b}$	$.13_{a}$

NOTE.--Different subscripts represent pairwise comparisons within experiment and column that are significantly different at $p < .05$.

FIGURE 1

THE EFFECT OF OBJECT INTERACTIVITY ON VIVID MENTAL IMAGERY, CORRECT MATCHES AND RECOGNITION ERRORS



NOTE.— A dashed line reflects a null effect.