Psychological Science

Point-and-Shoot Memories: The Influence of Taking Photos on Memory for a Museum Tour

Linda A. Henkel

Research Article

Point-and-Shoot Memories: The Influence of Taking Photos on Memory for a Museum Tour

Linda A. Henkel
Fairfield University

Abstract

Two studies examined whether photographing objects impacts what is remembered about them. Participants were led on a guided tour of an art museum and were directed to observe some objects and to photograph others. Results showed a photo-taking-impairment effect: If participants took a photo of each object as a whole, they remembered fewer objects and remembered fewer details about the objects and the objects' locations in the museum than if they instead only observed the objects and did not photograph them. However, when participants zoomed in to photograph a specific part of the object, their subsequent recognition and detail memory was not impaired, and, in fact, memory for features that were not zoomed in on was just as strong as memory for features that were zoomed in on. This finding highlights key differences between people's memory and the camera's "memory" and suggests that the additional attentional and cognitive processes engaged by this focused activity can eliminate the photo-taking-impairment effect.

Taking a photograph is as easy as pointing and shooting, providing an external memory of one's experiences. It is estimated that people took more than 3 billion photos in 2012 and that 300 million photos are uploaded to Facebook each day (Schwartz, 2013). To what extent does capturing one's life events with a camera shape what one subsequently remembers? Surprisingly little is known about this. Several studies have examined the extent to which looking at and reviewing photos influences memory and have found that photos act as valuable retrieval cues that help people reactivate and remember their experiences (Deocampo & Hudson, 2003; Hudson & Fivush, 1991; Koutstaal, Schacter, Johnson, Angell, & Gross, 1998; Koutstaal, Schacter, Johnson, & Galluccio, 1999; Schacter, Koutstaal, Johnson, Gross, & Angell, 1997; St. Jacques & Schacter, 2013). Some researchers have employed passive camera systems that people wear and that take photos during the course of the day, and have found that many months later, people are quite good at discriminating photos of their own experiences from photos of unrelated events that other people experienced (Milton et al., 2011).

Studies using these passive camera "life-logging" systems have focused on the effects of reviewing the day's photos on people's memory retention, and it has been found that such photo review benefits memory and cognitive performance in patients with amnesia and other severe memory impairments (Berry et al., 2007; Loveday & Conway, 2011) as well as people without any neurological difficulties (Hodges, Berry, & Wood, 2011).

In studies in which people actively and deliberately took photographs of themselves and their life experiences (e.g., activities during their summer vacation; places they visited), the focus has primarily been on understanding the organization and structure of events and time periods in autobiographical memories (Burt, Kemp, & Conway, 2003, 2008; Kemp, Burt, & Malinen, 2009; St. Jacques, Rubin, LaBar, & Cabeza, 2008). Thus, research to date has not yet addressed the impact of the

Corresponding Author:
Linda A. Henkel, Department of Psychology, Fairfield University, N. Benson Rd., Fairfield, CT 06824
E-mail: lhenkel@fairfield.edu

act of taking a photo on one's subsequent memory. In the present study, participants were led on a guided tour of an art museum, the Bellarmine Museum of Art, during which they were asked to view particular objects of art and were directed to photograph some of the objects. In Experiment 1, participants' memory for objects they photographed was compared with their memory for objects they viewed but did not photograph, and in Experiment 2, participants' memory for objects they photographed as a whole, photographed by zooming in on one part of the object, or viewed but did not photograph was compared.

People report that they take photographs and record videos as a way to remember events in their lives (Chalfen, 1998; Harrison, 2002). On the one hand, photographing objects could have positive effects on memory because it may focus one's attention and, hence, increase the memorability of the scene. In addition, photographing an object is a more active process than observing it, and research on the enactment effect has shown that people better remember actions they have performed than actions they have only thought about or observed (Roediger & Zaromb, 2010). On the other hand, taking photos may have a detrimental impact on memory. Photographing a scene may divide one's attention, similar to when people multitask by using cell phones while driving or walking (Hyman, Boss, Wise, McKenzie, & Caggiano, 2010) or laptop computers while learning material (Fried, 2008; Hembrooke & Gay, 2003; Smith, Isaak, Senette, & Abadie, 2011). People may also pay less attention to a scene if they take photos, counting on the external device of the camera to "remember" for them, as suggested by research showing that people were less likely to remember information if they expected to have future access to it (e.g., on an external storage device, such as a computer, or via the Internet; Sparrow, Liu, & Wegner, 2011). In this regard, taking a photo could serve as a cue to "dismiss and forget," as in directed-forgetting studies in which people's memory for items they were told to forget was typically worse than for items they were told to remember (Golding & MacLeod, 1998).

Experiment 1

Method

Participants were 28 undergraduates, 1 of whom failed to return for the second session. Of the remaining 27 participants (6 men, 21 women; mean age = 19.41 years, *SD* = 1.34, range = 18–23), 33% had never been to the museum before, and the remainder reported not having been there in the past month or longer. Individuals participated in return for course credit or extra credit. Participants were told that they would be led on a tour of

a museum and that during the tour they would be asked to photograph some objects and to observe other objects without taking a photo; they were asked to pay attention to the objects and told that they would later be asked about what the works of art looked like. They were given time to practice using the digital camera, which had a screen viewer that allowed them to see the object the camera was aimed at and the photo that was taken. They were told to be sure to line up the shot carefully by angling the camera horizontally or vertically and zooming in as needed to get the best shot of the whole object.

On the tour, participants visited 30 objects, including paintings, sculptures, pottery, tools, jewels, and mosaics; of these 30 objects, 15 were photographed and 15 were observed. Two sets were used to counterbalance the objects across the photographed and observed conditions, and participants were randomly assigned to one of the two sets. Each participant was tested individually and was given a list of the names of the 30 works of art. The participant read the name of the first object out loud to the experimenter, who then took him or her to that object. The participant was directed to look at the object for 20 s and then was instructed either to take a photo or to continue looking at the object for another 10 s. After the 30 s, the participant read the name of the next object on the list, and the same procedure was repeated, for all 30 objects. The objects were located in four different rooms of the museum, and the tour was ordered such that participants viewed each object once without passing by it later.

The next day, participants' memory was assessed by first asking them to write down the names of all of the objects they remembered and to indicate which of the objects they had photographed and which they had observed. If they could not remember the name of an object, they were told to write a brief description of it. After completing the free-recall test, participants were given a name-recognition test that consisted of the names of the 30 objects of art from the museum tour randomly intermixed with 10 names of other objects of art that were not part of the museum tour but that were objects participants could plausibly have seen in the museum setting. In the name-recognition test, the names of the objects appeared one at a time on a computer screen, and individuals were instructed to indicate for each object whether they had taken a photo of it on the tour, had observed it on the tour, or believed that it was a new object that was not part of the museum tour.

For objects identified as photographed or observed, participants were asked about a visual detail of that object and given four multiple-choice response options. For instance, for the Tang Dynasty warrior figure— an object on the tour—the visual-detail question was, "What did the warrior have in his hands?" and the

corresponding response options were "a shield," "a spear," "his helmet," and "nothing." Participants then were asked to rate how confident they were that they had remembered the detail correctly, using a 4-point scale (1 = *guessing/no confidence*; 2 = *a little confident*; 3 = *confident*; 4 = *very confident*).

Last, participants were given a photo-recognition test in which the same 40 objects were used but were presented in a different, random order and a photo of each object appeared along with its name. Participants' task was to indicate whether the object had been photographed earlier, had been observed earlier, or was new and, thus, not part of the museum tour.

Results and discussion

An alpha level of .05 was used. Participants' accuracy in remembering visual details about the objects they visited on the museum tour was negatively affected by photographing the objects. As shown in Table 1, the proportion of questions answered correctly about the objects' visual details was significantly lower for objects participants photographed than for objects they observed but did not photograph, $F(1, 26) = 10.95$, $p = .003$, $\eta^2 = .42$.

Taking a photograph of an object impaired participants' accuracy in remembering that the object had been encountered as well, as shown by the results of a 2 × 2 analysis of variance (ANOVA) that examined the impact of source (photographed, observed) and specificity of retrieval cue (name recognition, photo recognition) on the proportion of objects on the museum tour that were correctly recognized as having been encountered. As shown in Figure 1, the main effect for source was significant, $F(1, 26) = 4.06$, $p = .05$, $\eta^2 = .16$, as was the main effect for retrieval cue, $F(1, 26) = 17.27$, $p < .001$, $\eta^2 = .68$, with no significant interaction, $F(1, 26) = 0.33$, $p = .57$. Recognition accuracy was lower for photographed objects (.88) than for observed objects (.91) and was higher when participants saw photos of the objects in the
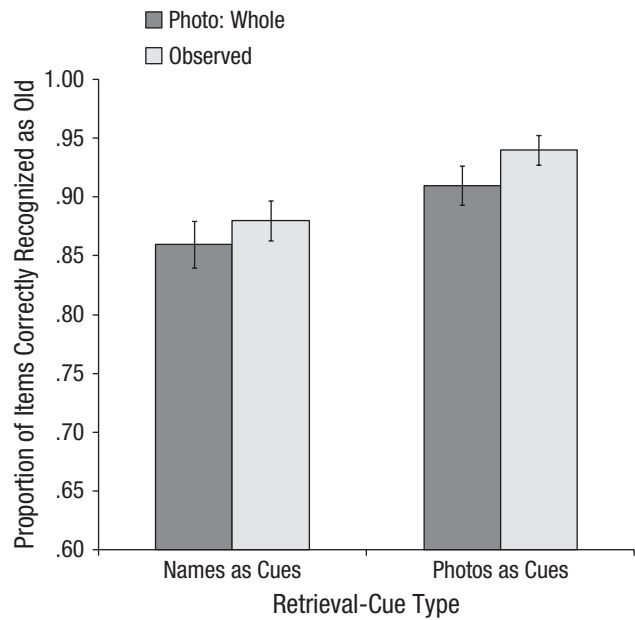
Table 1. Proportion of Questions Answered Correctly About Objects' Visual Details and Locations as a Function of Photographing or Observing the Objects

| Experiment and measure | Photographed | | Observed |
	Whole	Part	
Experiment 1			
Visual detail	.55 (.03)	—	.64 (.03)
Experiment 2			
Visual detail	.38 (.02)	.46 (.02)	.44 (.03)
Location	.67 (.03)	.45 (.04)	.74 (.03)

Note: The table presents proportions for each measure. Standard errors are shown in parentheses.

Fig. 1. Results from Experiment 1: proportion of works of art encountered on the museum tour that were correctly recognized as old as a function of source and retrieval-cue type. Error bars represent standard errors.

photo-recognition test (.92) than when they read their names in the name-recognition test (.87). The order of the two tests was necessarily fixed because the photo-recognition test would provide answers to questions about the objects' details. The photos presumably provided additional, more detailed, concrete cues about the specific objects, and these cues likely contributed to the memory advantage in the photo-recognition test. However, although participants did see and read aloud the names of the objects, because the primary experience of the object was based on observing it, the photo advantage may also reflect some degree of encoding specificity.

As noted earlier, research has shown that people better remember actions they have performed than actions they have just thought about or observed (Roediger & Zaromb, 2010) and, hence, people might be more likely to remember that they had photographed an object than to remember that they had observed it, even in the face of lower detail memory and recognition accuracy for photographed objects. Results, however, did not show a source-memory advantage for photographed objects. The proportion of objects correctly attributed to their source was examined in a Source (photographed, observed) × Retrieval Cue (name recognition, photo recognition) ANOVA. Source accuracy for photographed objects was in fact lower than for observed objects, although this difference was driven by a significant interaction that qualified the main effects, $F(1, 26) = 4.57$, $p = .04$, $\eta^2 = .30$. When the names of objects were given as

retrieval cues, source accuracy for photographed objects (.61) and observed objects (.62) did not differ, but when photos were provided as retrieval cues, source accuracy was higher for observed objects (.71) than for photographed objects (.61).

Participants recalled fewer than half of the objects that they had photographed (M = .47, SE = .04) or observed (M = .48, SE = .03), with no significant difference between the two sources, $F(1, 26)$ = 0.09, p = .77; hence, recall data are not discussed further.

Experiment 2

The findings from Experiment 1 showed no memory advantage for photographed objects and, in fact, showed a photo-taking-impairment effect: People remembered fewer objects overall and remembered fewer details about the objects they had photographed compared with objects they had observed. One key difference between the two conditions in Experiment 1 was that participants had 30 uninterrupted seconds to view the object in the observed condition, whereas they had only 20 s to view the object and then 10 s to line up a shot and take a photo of it in the photographed condition. Taking a photo of the object may have diverted participants' attention from the object to the camera, thereby reducing memory for the object, even though the visual focus of the camera and the resulting photo obviously were about the object.

In Experiment 2, participants were given 25 uninterrupted seconds to view each object, and for objects they were asked to photograph, they were then given additional time to do so. In this way, they spent extra time with the photographed objects; thus, if a photo-taking-impairment effect were found, it could not be due to participants' having less time to view the object. In addition, a third condition was added in which participants were asked to take a photo of the object by zooming in on one specified part of it (e.g., the Tang Dynasty warrior's hands). Pilot testing established that individuals required an average of 5 to 6 s to angle the camera, zoom in to take a photo of either the whole object or a specified part of the object, and glance at the photo in the camera's display screen, with no reliable difference in the amount of time required to take a photo of the whole object or of a part of the object. This manipulation was added to address the question of whether focusing on one specified part draws attention to the object in a way that photographing the object as a whole does not. It is possible that the divided attention created by taking a photo of the whole object is similar to that induced by multitasking with technology (Smith et al., 2011) and, therefore, impairs subsequent memory, whereas the focused attention required to actively and physically

zoom in on a specified feature does not impair subsequent memory.

The impact of attentional focus can be further examined by contrasting people's memory for the part of the object on which they did or did not focus. Research on *boundary extension* has shown that people's memory for a scene often contains nonpresented details that lay just beyond the actual boundaries of the scene and that this phenomenon is especially likely to occur when viewing a close-up scene compared with a wider-angle scene (Hubbard, Hutchison, & Courtney, 2010; Intraub, Bender, & Mangels, 1992). Studies on boundary extension have involved people looking at scenes or photos but not taking the photos themselves. It remains to be seen whether the act of zooming in on a part of an object while photographing it will impair or enhance memory. Along similar lines, Experiment 2 examined whether individuals' memory for a contextual detail unrelated to the object's appearance—what room the object had been in—would be helped or harmed by their focusing attention on photographing the object.

Method

Participants were 46 undergraduates (10 men, 36 women; mean age = 19.78 years, SD = 1.28, range = 18–23). The materials and procedure were similar to those used in Experiment 1 with the following exceptions. The works of art on the museum tour consisted of 27 objects, of which 9 were photographed as a whole, 9 were photographed by zooming in on a specified part, and 9 were observed but not photographed. Objects in these three conditions were counterbalanced. For objects photographed by zooming in on a specific part, the particular feature that was zoomed in on was also counterbalanced (e.g., the head vs. the feet of a statue; the ground vs. the sky in a painting), which resulted in six sets. Participants were tested individually and were randomly assigned to one of the six sets. After reading the name of the first object on the list out loud to the experimenter, the participant was taken to the object and given 25 s to view the object. For some of the objects, after the 25 s of viewing, the participant was instructed to photograph either the whole object or a specified part of the object. After doing so, the participant read the name of the next object on the list, was brought to the object, and the same procedure was repeated, for all 27 objects.

The next day, participants were asked to remember the objects visited on the museum tour. They were first given the names of various objects of art (the 27 old objects randomly intermixed with 10 new objects) and asked to indicate which of the objects were part of the museum tour and which were new. For those objects identified as part of the museum tour, participants were

asked (a) to indicate whether they had taken a photo of the object or had observed the object and (b) to answer two questions about different visual details of the object, each of which had four response options. For objects photographed by zooming in on one part of the object, one question pertained to a feature zoomed in on and one question pertained to a feature not zoomed in on. Participants were asked to rate their confidence in the remembered details and then were given a photo-recognition test. After indicating whether the depicted object had been photographed, had been observed, or was new, participants were shown a map of the museum with four numbered rooms and asked to indicate which room the object had been located in.

Results and discussion

An alpha level of .05 was used, and all follow-up comparisons for significant effects were post hoc Scheffé tests. As Table 1 shows, the proportion of correctly answered questions about visual details of objects was affected by what participants did when they viewed the object, $F(2, 90) = 5.15$, $p = .008$, $\eta^2 = .11$. Replicating the photo-taking-impairment effect seen in Experiment 1, results showed that participants' memory accuracy for visual details about the objects was significantly lower for objects photographed as a whole than for objects that were only observed. However, the manner in which objects were photographed mediated this effect: When objects were photographed by zooming in on one part, memory for details was not harmed and was, in fact, comparable to memory for details when objects were observed.

Furthermore, although photographing the objects as a whole led to a decline in participants' memory for visual details about the objects, zooming in on one aspect of an object served to protect memory not only for the part that was zoomed in on but also for the part that was not zoomed in on. For objects that were photographed by zooming in on one feature, no significant difference in the proportion of details remembered correctly was found between the details that were zoomed in on ($M = .48$, $SE = .03$) and the details that were not zoomed in on ($M = .45$, $SE = .02$), $F(1, 45) = 0.97$, $p = .33$. Thus, what the person remembered was not necessarily what the camera shot captured—the camera's "eye" is not the "mind's eye." This suggests that the effect is not a perceptual process whereby additional visual attention is paid to the feature being zoomed in on but, rather, is based on paying attention to the object in its entirety as one focuses the camera on one feature of it, and is consistent with the perceptual-schema account of boundary extension, which states that observers activate the larger context of a scene while viewing it (Hubbard et al., 2010).

Interestingly, the "boundaries" in the perceptual schema appear to have been centered around the object and did not extend to the broader context of the room the object was located in. The inclusion of questions about memory for the location of objects allowed for another glimpse into how photographing objects can impair memory, and results showed that participants' memory for contextual details about objects was also impaired by photographing them. There was a significant main effect of source on memory accuracy for the location of the object in the museum, $F(2, 90) = 32.68$, $p < .001$, $\eta^2 = .73$ (see Table 1). Participants were less accurate at remembering the location of objects they had photographed—either in whole or in part—than the location of objects they had merely observed. Participants' location memory was less accurate, in fact, when they had taken a photo of part of the object than when they had photographed the object as a whole, which suggests that the added attention that preserved memory for details when photographing part of an object came at the expense of attention to surrounding contextual features, such as the object's location.

As in Experiment 1, photographing objects also had a detrimental effect on individuals' ability to recognize which objects had been part of the museum tour. As shown in Figure 2, an ANOVA examining the impact of source (photographed whole object, photographed part of object, observed) and retrieval cue (name recognition,
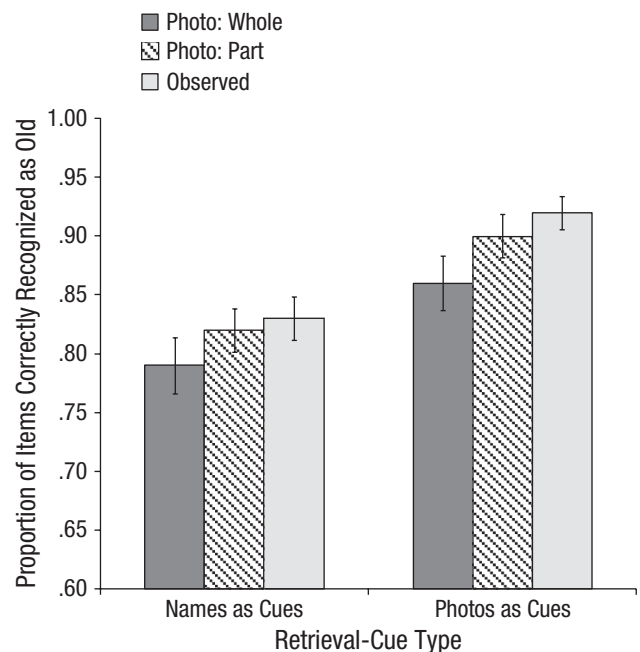

Fig. 2. Results from Experiment 2: proportion of works of art encountered on the museum tour that were correctly recognized as old as a function of source and retrieval-cue type. Error bars represent standard errors.

photo recognition) on recognition accuracy yielded a significant main effect for source, $F(2, 90) = 4.03$, $p = .02$, $\eta^2 = .09$. Post hoc Scheffé tests showed that participants recognized fewer objects that they had photographed as a whole (.83) than objects that they had observed but not photographed (.87) or objects that they had photographed a part of (.86). Participants' recognition accuracy did not differ for objects that were observed or photographed by zooming in on one part. A significant main effect for retrieval cue was also found, $F(1, 45) = 32.06$, $p < .001$, $\eta^2 = .71$, with significantly higher recognition accuracy when photos were provided as cues (.89) than when only the names were provided as cues (.81), with no significant interaction, $F(2, 90) = 0.45$, $p = .64$.

Source accuracy in remembering whether the objects had been photographed or only observed was far from perfect but was above chance level, and as in Experiment 1, there was a significant Source × Retrieval Cue interaction, $F(2, 90) = 3.01$, $p = .05$, $\eta^2 = .07$. For objects that were observed, source accuracy was higher when photos were provided as cues (.69) than when only the names were given as cues (.60). However, for objects that were photographed (either in whole or in part), source accuracy did not reliably differ when photos rather than names were provided as retrieval cues—whole photos: photo retrieval cue = .64, name retrieval cue = .67; partial photos: photo retrieval cue = .71, name retrieval cue = .68.

General Discussion

The findings from these two experiments show that photographing objects on a museum tour had a detrimental effect on memory of the objects. When participants took photos of whole objects after viewing them, they remembered fewer objects and remembered fewer details about the objects and the objects' locations than when they only observed the objects without photographing them. Despite the added time or attention required to angle the camera and adjust the lens so as to capture the best shot of the object in its entirety, the act of photographing the object appears to enable people to dismiss the object from memory, thereby relying on the external devise of the camera to "remember" for them (see Sparrow et al., 2011). However, when participants were asked to take a photo of a specific part of the object, which required them to zoom in on that part, their subsequent recognition and detail memory accuracy was not impaired, and, in fact, their memory for features that were not zoomed in on was just as high as their memory for features that were zoomed in on. This finding highlights key differences between people's memory and the camera's "memory" and suggests that the additional attentional and cognitive processes engaged by this focused activity can eliminate the photo-taking-impairment effect.

Given the ubiquity of digital photography in people's lives, understanding how memory is affected by the act of taking photographs is a meaningful avenue of research. Future research should examine whether similar effects are seen when people are free to choose what objects to photograph. After all, people are likely to take photos of objects that they value, find important, or want to remember. Their metacognitive beliefs about whether they would be likely to forget an object without an external record and their preference for external versus internal storage should also be examined (see Stöber & Esser, 2001).

In addition, the present study examined only the role of photographing objects, not what happens when people review those photos after taking them. Past work has shown that reviewing photos can provide valuable retrieval cues that reactivate and retain memories for the photographed experiences (e.g., Koutstaal et al., 1998; Koutstaal et al., 1999), although research has suggested that the sheer volume and lack of organization of digital photos for personal memories discourages many people from accessing and reminiscing about them (Bowen & Petrelli, 2011). In addition, despite the ease of social sharing of photos today, families spend less time together in person sharing and reviewing their digital photos than they did with physical prints and photo albums in the past (Nunes, Greenberg, & Neustaedter, 2009). Similar to the finding that reviewing notes taken during class boosts retention better than merely taking notes (Bui, Myerson, & Hale, 2013; Knight & McKelvie, 1986), it may be that our photos can help us remember only if we actually access and interact with them, rather than just amass them.

References

Berry, M., Kapur, N., Williams, L., Hodges, S., Watson, P., Smyth, G., . . . Wood, K. (2007). The use of a wearable camera, SenseCam, as a pictorial diary to improve autobiographical memory in a patient with limbic encephalitis: A preliminary report. *Neuropsychological Rehabilitation*, *17*, 582–601.

Bowen, S., & Petrelli, D. (2011). Remembering today tomorrow: Exploring the human-centered design of digital mementos. *International Journal of Human-Computer Studies*, *69*, 324–337.

Bui, D. C., Myerson, J., & Hale, S. (2013). Note-taking with computers: Exploring alternative strategies for improved recall. *Journal of Educational Psychology*, *105*, 299–309.

Burt, C. D. B., Kemp, S., & Conway, M. (2003). Themes, events, and episodes in autobiographical memory. *Memory & Cognition*, *31*, 317–325.

Burt, C. D. B., Kemp, S., & Conway, M. (2008). Ordering the components of autobiographical events. *Acta Psychologica*, *127*, 36–45.

Chalfen, R. (1998). Family photograph appreciation: Dynamics of medium, interpretation and memory. *Communication & Cognition*, *31*, 161–178.

Deocampo, J., & Hudson, J. (2003). Reinstatement of 2-year-olds' event memory using photographs. *Memory*, *11*, 13–25.

Fried, C. B. (2008). In-class laptop use and its effects on student learning. *Computers & Education*, *50*, 906–914.

Golding, J. M., & MacLeod, C. M. (1998). *Intentional forgetting: Interdisciplinary approaches*. Mahwah, NJ: Erlbaum.

Harrison, B. (2002). Photographic visions and narrative inquiry. *Narrative Inquiry*, *12*, 87–111.

Hembrooke, H., & Gay, G. (2003). The laptop and the lecture: The effects of multitasking in learning environments. *Journal of Computing in Higher Education*, *15*, 46–64.

Hodges, S., Berry, E., & Wood, K. (2011). SenseCam: A wearable camera that stimulates and rehabilitates autobiographical memory. *Memory*, *19*, 685–696.

Hubbard, T. L., Hutchison, J. L., & Courtney, J. R. (2010). Boundary extension: Findings and theories. *Quarterly Journal of Experimental Psychology*, *63*, 1467–1494.

Hudson, J. A., & Fivush, R. (1991). As time goes by: Sixth graders remember a kindergarten experience. *Applied Cognitive Psychology*, *5*, 347–360.

Hyman, I. E., Jr., Boss, S., Wise, B. M., McKenzie, K. E., & Caggiano, J. M. (2010). Did you see the unicycling clown? Inattentional blindness while walking and talking on a cell phone. *Applied Cognitive Psychology*, *24*, 597–607.

Intraub, H., Bender, R. S., & Mangels, J. A. (1992). Looking at pictures but remembering scenes. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18*, 180–191.

Kemp, S., Burt, C. D. B., & Malinen, S. (2009). Investigating the structure of autobiographical memory using reaction times. *Memory*, *17*, 511–517.

Knight, L. J., & McKelvie, S. J. (1986). Effects of attendance, note-taking, and review on memory for a lecture: Encoding vs. external storage functions of notes. *Canadian Journal of Behavioural Science*, *18*, 52–61.

Koutstaal, W., Schacter, D., Johnson, M., Angell, K., & Gross, M. (1998). Post-event review in older and younger adults: Improving memory accessibility of complex everyday events. *Psychology and Aging*, *13*, 277–296.

Koutstaal, W., Schacter, D., Johnson, M., & Galluccio, L. (1999). Facilitation and impairment of event memory produced by photograph review. *Memory & Cognition*, *27*, 478–493.

Loveday, C., & Conway, M. A. (2011). Using SenseCam with an amnesic patient: Accessing inaccessible everyday memories. *Memory*, *19*, 697–704.

Milton, F., Muhlert, N., Butler, C. R., Smith, A., Benattayallah, A., & Zeman, A. Z. (2011). An fMRI study of long-term everyday memory using SenseCam. *Memory*, *19*, 733–744.

Nunes, M., Greenberg, S., & Neustaedter, C. (2009). Using physical memorabilia as opportunities to move into collocated digital photo-sharing. *International Journal of Human-Computer Studies*, *67*, 1087–1111.

Roediger, H. L., III, & Zaromb, F. M. (2010). Memory for action. In L. Backman & L. Nyberg (Eds.), *Memory, aging and the brain* (pp. 24–52). New York, NY: Psychology Press.

Schacter, D., Koutstaal, W., Johnson, M., Gross, M., & Angell, K. (1997). False recollection induced by photographs: A comparison of older and younger adults. *Psychology and Aging*, *12*, 203–215.

Schwartz, H. (2013). *How many photos have been taken ever?* Retrieved from http://www.buzzfeed.com/hunterschwarz/how-many-photos-have-been-taken-ever-6zgv

Smith, T. S., Isaak, M. I., Senette, C. G., & Abadie, B. G. (2011). Effects of cell-phone and text-message distractions on true and false recognition. *Cyberpsychology, Behavior, and Social Networking*, *14*, 351–358.

Sparrow, B., Liu, J., & Wegner, D. M. (2011). Google effects on memory: Cognitive consequences of having information at our fingertips. *Science*, *333*, 476–478.

St. Jacques, P., Rubin, D. C., LaBar, K. S., & Cabeza, R. (2008). The short and long of it: Neural correlates of temporal-order memory for autobiographical events. *Journal of Cognitive Neuroscience*, *20*, 1327–1341.

St. Jacques, P., & Schacter, D. L. (2013). Modifying memory: Selectively enhancing and updating personal memories for a museum tour by reactivating them. *Psychological Science*, *24*, 537–543.

Stöber, J., & Esser, K. B. (2001). Text anxiety and metamemory: General preference for external over internal information storage. *Personality and Individual Differences*, *30*, 775–781.