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ARTICLE IN PRESS

Journal of Applied Research in Memory and Cognition xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Journal of Applied Research in Memory and Cognition

journal homepage: www.elsevier.com/locate/jarmac

Forget in a Flash: A Further Investigation of the Photo-Taking-Impairment Effect

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A photo-taking-impairment effect has been observed such that participants are less likely to remember objects they photograph than objects they only observe. According to the offloading hypothesis, taking photos allows people to offload organic memory onto the camera's prosthetic memory, which they can rely upon to "remember" for them. We tested this hypothesis by manipulating whether participants perceived photo-taking as capable of serving as a form of offloading. In Experiment 1, participants used the ephemeral photo application Snapchat. In Experiment 2, participants manually deleted photos after taking them. In both experiments, participants exhibited a significant photo-taking-impairment effect even though they did not expect to have access to the photos. In fact, the effect was just as large as when participants believed they would have access to the photos. These results suggest that offloading may not be the sole, or even primary, mechanism for the photo-taking-impairment effect.

General Audience Summary

Taking a photo can cause something to be less well remembered than if it is simply observed. This photo-taking-impairment effect has been explained by a cognitive offloading account such that when people take photos they come to rely on the camera to "remember" what was photographed for them, not bothering to remember it for themselves. Experiment 1 tested this hypothesis by using the ephemeral photo-messaging application Snapchat. Photos taken with Snapchat are not saved for future access, and thus an offloading account would seem to predict less impairment as a result of taking photos using Snapchat than as a result of using a traditional camera application because participants should not expect the camera to remember on their behalf. Contrary to this prediction, participants showed just as much impairment after taking photos using Snapchat as they did using a typical camera application. In Experiment 2 participants manually deleted photos after taking them. Again, a significant photo-taking-impairment effect was observed even though participants did not expect to have access to the photos. These results suggest that explicit offloading cannot fully account for the photo-taking-impairment effect. Instead, they are more consistent with the idea that photo-taking disrupts how people engage or encode the objects they are viewing, an effect that may have little to do with how photo-taking also has the potential to serve as a form of offloading.

Keywords: Photo-taking impairment, Offloading, Transactive memory, Snapchat

Author Note

The authors thank Talia Bernstein, Jack (Yanchen) Liu, and Nicolas Santer for their help collecting preliminary data that made this work possible, Kamaria Potier and Madison Holdredge for help with data collection, and Patrawat Samermit for lending equipment needed for data collection.

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Please cite this article in press as: Soares, J. S., & Storm, B.C. Forget in a Flash: A Further Investigation of the Photo-Taking-Impairment Effect. *Journal of Applied Research in Memory and Cognition* (2017), https://doi.org/10.1016/j.jarmac.2017.10.004

"I used to carry a camera when I traveled, but almost never took pictures with it, and apologized when I returned home, until I realized that my reluctance to point and click was really a reluctance to line up and edit and frame whatever I was seeing or hearing or smelling. The fall of the morning sunlight against the glittering sea. The crinkled face of an old woman selling spices in the market. It was, I believe, an instinctive reluctance to remove myself from my experience, an experience that could only occur far from home and habit, where the rules as much as the landscape were unfamiliar. To photograph it was somehow to reduce and domesticate my experience and ultimately to kill it."

Russel Banks, 2015

The widespread use of camera phones has made it easier than ever to capture, store, and share photographs, yet little is known about how photographing an experience influences memory of that experience. Photographs can serve as powerful cues for facilitating retrieval (Berry et al., 2007; Deocampo & Hudson, 2003; Hodges, Berry, & Wood, 2011; Loveday & Conway, 2011; St Jacques & Schacter, 2013), but what about the act of taking a photo itself? Does taking a photo make someone more or less likely to remember the experience being photographed?

People often report taking photos as a strategy for remembering information and life events (Chalfen, 1998; Harrison, 2002), and indeed there are many reasons to expect taking a photo to improve memory for the objects and experiences being photographed. Photo-taking can isolate an item from other items (Von Restorff, 1933; Wallace, 1965), for example, or lead to a deeper, more elaborate, or more variable encoding opportunity (Craik & Lockhart, 1972; Estes, 1950; Glenberg, 1979; Nist & Hogrebe, 1987). As demonstrated by Henkel (2014), however, taking a photo can have the opposite effect, rendering photographed objects less well-remembered than observed objects.

Henkel's (2014) study involved participants going on a guided museum tour while they took photos of certain objects (art pieces) and observed others. Participants were later tested, without access to the camera, on what they saw. Henkel found that photographed objects were less well-remembered than observed objects, a phenomenon referred to as the photo-taking-impairment effect. Henkel speculated that the effect could be the result of offloading, with participants not needing to remember the photographed objects because they could safely assume that the camera was doing the remembering for them (Risko & Gilbert, 2016).

The offloading hypothesis of the photo-taking-impairment effect draws heavily from transactive memory theory (Wegner, 1987; Wegner, Guiliano, & Hertel, 1985). Couples tend to split the labor of remembering based on their relative ease of recall, for example, with each person strategically relying on the other to remember certain information (Wegner, Erber, & Raymond, 1991). Their shared memory system is called transactive memory. Transactive memories are not just shared among groups of people, but also between people and objects that can "remember" (Ward, 2013). Taking notes (Eskritt & Ma, 2014), saving on a computer (Sparrow, Liu, & Wegner, 2011), or accessing the Internet (Ferguson, McLean, & Risko, 2015), for example, can create a transactive memory system reliant on the prosthetic memory of a notepad, computer, or Internet. This form of offloading is likely to have many benefits in that it allows individuals to focus on other tasks (Storm & Stone, 2015), but it can also make offloaded information less recallable in the future than it would have been otherwise when the transactive memory partner is not available (Sparrow et al., 2011). Henkel's (2014) photo-taking-impairment effect could be explained by participants offloading their memory onto the camera. Specifically, participants may have failed to remember the photographed objects because they relied on the camera's prosthetic memory instead of their own organic memories.

An alternative possibility is what we refer to as the attentional-disengagement hypothesis—the idea that when people take photos they disengage from the moment to handle the task of capturing the object or experience, thus leading them to encode it less deeply or elaborately than they would have otherwise. Recent work by Niforatos, Cinel, Mack, Langheinrich, and Ward (2017), for example, replicated the photo-taking-impairment effect, but only when participants manually took photos. Specifically, the effect was not observed when photos were taken automatically by a wearable camera. In other work, participants have also reported being somewhat aware of the experience that taking photos can cause them to become disengaged. Mols, Broekhuijsen, van den Hoven, Markopoulos, and Eggen (2015), for example, found that when asked to use various methods to document a trip, participants reported feeling more disengaged from the experience when taking photos relative to other recording strategies. Such disengagement could prompt participants to perform shallower encoding processes and make them more likely to miss or fail to encode visual details into memory—not only during the photo-taking experience itself, but also, perhaps, when participants continue to process and consolidate the experience into memory after photo-taking is complete. A critical assumption of the attentional-disengagement hypothesis is that encoding suffers automatically as a consequence of taking photos, and therefore that the photo-taking-impairment effect should not depend on whether the photographer considers the camera a reliable transactive memory partner.

The current study sought to extend the work of Henkel (2014) while more directly testing the offloading hypothesis. To do this, we employed a laboratory version of Henkel's paradigm (taking pictures of paintings on a computer screen) that included the two conditions employed by Henkel (camera vs. observe) as well as a third condition in which participants took photos but could not rely on the camera to "remember" for them. In this new condition, the camera did not function as an effective transactive memory partner and participants should therefore not have considered taking photos to serve as a form of offloading. According to the offloading hypothesis, if participants do not expect the camera to save the photos, then the photo-taking-impairment effect should be eliminated or greatly reduced. According to the attentional-disengagement hypothesis, however, taking photos should impair memory regardless of whether participants expect the photos to be saved.

Experiment 1

To construct a condition in which participants would be able to take photos but not consider it a form of offloading, we took advantage of the smartphone application Snapchat. Snapchat is a photo-messenger application that takes photos and sends them to contacts without saving the photos. Once the sender has shared a photo, it is no longer available on their phone. Likewise, once viewed on the recipient's phone, the photo disappears. We used a camera phone rather than a standalone camera because Snapchat is only available on smartphones, and for purposes of ecological validity (far more photos are taken today with smartphones than with standalone cameras; Heyman, 2015).

Because Snapchat takes photos without saving them, it allows participants to capture photos without expecting the camera to save the information being photographed. According to the offloading hypothesis, the photo-taking-impairment effect should be reduced in this condition. That is, Snapchatted information should be remembered like observed information because participants cannot rely on the phone to remember for them. At the very least, the offloading hypothesis would seem to predict that participants should remember the photographed objects better in the Snapchat condition than in the camera condition, whereas the disengagement hypothesis predicts impairment automatically regardless of whether photos are saved.

Method

Participants. Forty-two undergraduates from the University of California, Santa Cruz (UCSC) participated for partial course credit.

Design. The experiment was run within-subjects and included three levels of a single independent variable (condition): Observe, Camera, and Snapchat. In the Observe condition, participants simply observed the images presented on a computer screen. In the Camera and Snapchat conditions, participants used the Camera or Snapchat application to photograph images presented on a computer screen. The dependent variable was performance on a multiple-choice visual detail test that tested memory for the objects in a way similar to the visual detail test used by Henkel (2014).

Materials. Participants were equipped with an Apple iPhone 5. The iPhone had three applications available for participants to use: Snapchat, Camera, and Photo Album. Fifteen images of paintings were selected. The paintings were available for non-commercial use online and could be resized without degrading image quality. The paintings were chosen because they provided enough visual detail to ask participants multiple questions at test. Abstract paintings were avoided.

A slide was created for each painting to be shown during the experiment, with the image sized to a height of 4.95″ and a width of 9.00″. The title and artist for each painting appeared above the image in black 44-point text. The 15 paintings were organized into three blocks of five, separated by instructions that determined the condition assignment of each block. Paintings always appeared in the same order, but instructions were counterbalanced using a Latin Square across the three blocks of paintings, simultaneously counterbalancing both painting assignment to condition and condition order across participants.

The test consisted of 30 multiple-choice questions, two for each of the 15 paintings that were presented during the study phase. Pairs of questions about the same painting appeared in succession. The questions asked about various visual details in the paintings and referenced the paintings by title and artist; for example, "What was the instructor cutting with scissors in *The Anatomy Lesson* by Rembrandt?" The correct answer (in this case, *the cadaver's arm*), along with three lures were presented below each question. Participants were required to provide a response on every test question.

Procedure. Participants were run individually in a laboratory. The experiment consisted of three main phases: Demonstration, Study, and Test.

Demonstration. Participants were seated at a desk with a desktop computer and an iPhone 5. They were informed that they would be loaned the phone for the duration of the study and that they would be able to use the phone to access the photos they took when completing a later test. Participants were shown how to use the basic iPhone camera application and how to access the phone's photo album to review the images they captured. They were also shown how to use Snapchat to take and send photos to an account set up by the experimenter. It was stressed in the instructions that unlike photos taken with the camera, photos taken with Snapchat would not be saved on the phone (or anywhere else) for participants to access later. An experimenter then demonstrated how to take photos with each application and access photos taken with Camera on a sample painting. Finally, before proceeding to the study phase, participants were shown a sample multiple-choice question to ensure they knew they would be tested and the type of test they would be given (i.e., visual detail).

Study. Participants were given instructions about what to do when paintings were displayed in each of the three blocks. Each painting was displayed on screen for 15 s with each slide advancing automatically. During the block of Observe trials, participants were instructed to "look at the painting and title for the entire time" and to "place the experiment phone face down on the desk" while viewing the paintings. During the block of Camera trials, participants were instructed to "take a photo of [the painting and title] with the application Camera, which will save it to the Photo Album" and to continue to look at the painting for what remained of the 15 s. During the block of Snapchat trials, participants were instructed, once a painting appeared, to "Snapchat and send it to the contact 'Snap Here"' within the application. They were also told to continue to look at the painting for what remained of the 15 s. For both the Camera and Snapchat conditions, participants were told to "make sure to include the entire painting in the frame, including the name." An experimenter remained close to the participant to verify that they complied with the instructions, which they reliably did.

Test. After the Study phase was complete, the experimenter took the phone back from the participant. After a 10-min delay, during which participants played Tetris on the same computer,

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participants were given a maximum of 10 min to complete the multiple-choice test. They were informed that they would not have access to the camera right before beginning the test. Following the test, participants were given a survey that asked demographic questions as well as about their use of Snapchat. After completing the survey, participants were debriefed and thanked for their participation.

Results

Responses from the visual detail test were scored by an experimenter blind to condition using a coding scheme determined prior to data collection. A repeated-measures ANOVA was run to investigate differences in test performance between the three conditions (Observe vs. Camera vs. Snapchat). The ANOVA revealed a significant main effect, $F(2, 82) = 15.35$, $p < .001$, $\eta_p^2 = .27$. We then investigated differences between the conditions using planned comparisons. Importantly, as can be observed in the left panel of Figure 1, Henkel's (2014) photo-taking-impairment effect replicated. Specifically, participants correctly answered fewer questions about the details of the paintings in the Camera condition than in the Observe condition, $t(41) = 3.12$, $p = .003$, $d = 0.70$, 95% CI [0.24, 1.16]. In contrast to the predictions of the offloading hypothesis, however, a photo-taking-impairment effect was also observed in the Snapchat condition, $t(41) = 5.78$, $p < .001$, $d = 1.21$, 95% CI [0.74, 1.68]. In fact, participants performed less well in the Snapchat condition than in the Camera condition $t(41) = 2.23$, $p = .031$, $d = .48$, 95% CI [0.03, 0.92], a finding that would seem difficult to explain from the perspective of the offloading hypothesis.

Several results deserve emphasis. First, the photo-taking-impairment effect replicated using a somewhat artificial laboratory task (relative to that used by Henkel, 2014) in which participants observed and took pictures of paintings as they appeared on a computer screen, a task which would seem to be much easier for researchers to adapt in the future. Second, the use of Snapchat failed to reduce the photo-taking-impairment effect. In fact, the impairment effect was larger in the Snapchat condition than in the Camera condition. Although intriguing, this difference should be interpreted with caution. Most notably, time was controlled in such a way that participants had 15 s to view the paintings in all three conditions, including the conditions in which participants had to use part of their time to take photos. There are advantages to this sort of control as in natural settings the use of cameras can impede the amount of exposure one has to an object, but there are also disadvantages when it comes to interpreting the theoretical mechanisms involved in causing the photo-taking-impairment effect. Namely, participants may not have been able to spend as much time encoding the objects in the Snapchat condition as in the Camera condition. Henkel (2014) controlled for this difference and still showed a photo-taking-impairment effect, but relative to the Camera condition, taking pictures via Snapchat may have been even more time-consuming. Indeed, based on our subjective/anecdotal observations, participants did take longer interacting with the phone in the Snapchat condition than in the Camera condition. Another potential issue is that despite our instructions, participants may not have been fully convinced that the photos taken with Snapchat would be unavailable to them. If participants did not believe the Snapchat manipulation, then the condition would not have provided a fair test of the offloading hypothesis.

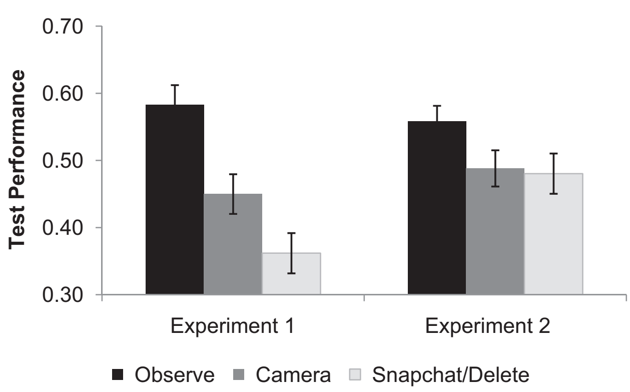

Figure 1. Mean proportion of visual detail multiple-choice questions answered correctly as a function of condition in Experiments 1 and 2. The Observe condition consisted of questions about paintings participants only observed. The Camera condition consisted of questions about paintings participants took pictures of with the Camera application. The Snapchat condition was used only in Experiment 1 and consisted of questions about paintings participants photographed using the Snapchat application. The Delete condition appeared only in Experiment 2 and consisted of questions about paintings participants photographed using the Camera application and immediately deleted. Note that because each multiple-choice question included four options, chance performance was 0.25. Error bars indicate standard error of the mean.

Experiment 2

In Experiment 2 we aimed to replicate the photo-taking-impairment effect while controlling for potential differences in time available to visually encode the paintings and ensuring that participants fully understood that the photos would be saved in one condition and not in the other. First, we replaced the Snapchat condition with a Delete condition in which participants were instructed to delete each photo immediately after taking it. The Delete condition has the benefit of allowing us to be confident participants fully understood that the photos would be unavailable for subsequent review. Second, steps were taken to ensure that observation time was equal or even greater in the Camera conditions than in the Observe condition. Specifically, the timer for participants to view paintings started only after they finished taking a photo. Thus, participants had 15 s of unimpeded view time regardless of whether they took a photo of the object prior to that viewing. It is important to note that this methodological decision differed from that of Henkel (2014). Specifically, in the experiment used to control for exposure duration, Henkel had participants view the museum objects for a specified amount of time before taking a photo. Reversing the order allowed us to test the hypothesis that photo-taking disrupts encoding not only during the act of taking a photo, but in the seconds following as well—that participants would still have impaired memory for a photographed painting even when given the same amount of time to view the painting after deleting the photo (and therefore knowing that they would not have access to it).

Method

Participants. Fifty-one UCSC undergraduates participated for partial course credit. Sample size was determined based on the results of a power analysis using data from Experiment 1. Specifically, the analysis suggested that a sample size of at least 49 would be necessary to give us 90% power to observe a significant photo-taking-impairment effect (assuming an alpha of .05), which we rounded up to 51 to have equal numbers of participants randomly assigned to each of the counterbalancing conditions.

Design. The experiment was within-subjects and included three levels of the independent variable (condition): Observe, Camera, and Delete. The Observe and Camera conditions were the same as those employed in Experiment 1. In the Delete condition, participants took photos of the paintings and then immediately deleted them.

Materials. The Snapchat application was removed from the main screen of the iPhone. Thus, participants only had the Camera and Photo Album applications available on the main screen. Other than that, the materials were the same as those used in Experiment 1.

Procedure. Participants were run individually in a laboratory. The same protocol was used as in Experiment 1 except as noted below.

Demonstration. Participants were not shown how to use Snapchat. Instead, participants were shown how to delete photos after taking them using the Camera application.

Study. Participants were given a set of instructions before each block of five trials. The instructions for the Observe trials were identical to those of Experiment 1. Specifically, participants were given 15 s to view each of the paintings. For the Camera trials, participants were told to photograph each painting before pressing the spacebar to view the painting for an additional 15 s. For the Delete trials, participants were told to photograph and immediately delete the photo of the painting before pressing the spacebar to view the painting for an additional 15 s. As in Experiment 1, participants were told that they would be given a test on the visual details of the paintings and led to believe that they would have access to the photos they took when taking that test (or more specifically the photos they took but did not delete).

Test. The filled delay, final test, and post-experiment survey were the same as in Experiment 1. Unfortunately, due to experimenter error, only 31 of the 51 participants were administered the demographic and survey questions at the conclusion of the study. In addition to the demographic questions asked in Experiment 1, participants were also asked the open-ended question: "What effect do you think taking a photo of an event has on your memory for it?"

Results

A repeated-measures ANOVA was run on the visual-detail multiple-choice test data (Observe vs. Camera vs. Delete), revealing a significant main effect of condition, $F(2, 100) = 4.26$, $p = .017$, $\eta_p^2 = .08$. As shown in the right panel of Figure 1, participants correctly answered fewer questions about the details of the paintings in the Camera condition than in the Observe condition, $t(50) = 2.30$, $p = .026$, $d = 0.58$, 95% CI [0.23, 0.93], once again replicating the photo-taking-impairment effect. Similar to Experiment 1, however, and contrary to the offloading hypothesis, the photo-taking-impairment effect remained significant even when participants deleted photos immediately after taking them, $t(50) = 2.92$, $p = .005$, $d = 0.61$, 95% CI [0.30, 0.92]. Performance in the Camera and Delete conditions did not significantly differ, $t(50) = .25$, $p = .80$.

Responses to the debriefing question about the effects of photo-taking on photographed material were marked by an experimenter blind to participant performance as belonging to one of four categories: benefit, no effect, not sure, and impairment. All responses aligned with one of these categories. Surprisingly, despite just experiencing a photo-taking-impairment effect (at least when combined across participants), most participants (52%) reported that taking photos helps them remember. Of the remaining participants, 3% had no guess, 26% predicted no effect, and only 19% of participants correctly responded that taking photos impairs memory. Interestingly, the majority (62.5%) of the participants who reported believing that photo-taking improves memory nevertheless remembered less about the paintings they photographed than those they simply observed.

General Discussion

A photo-taking-impairment effect was observed in every condition in which photos were taken, even in the Snapchat and Delete conditions in which participants did not save the photos they took. These results are inconsistent with the offloading hypothesis. If taking photos causes people to forget because they think of the camera as a prosthetic memory device onto which they can offload memory, then making the camera less reliable (or entirely unreliable in the case of the Snapchat and Delete conditions) should have eliminated or significantly reduced the extent to which memory was impaired. Instead, memory was impaired by photo-taking regardless of whether participants thought the photos would be saved, a finding that suggests that some other mechanism might be at play. Indeed, the results are more consistent with the idea that taking photos causes participants to limit or disengage their attention when encoding an experience, an effect that is assumed to take place regardless of whether participants believe the photos are being saved.

Importantly, the photo-taking-impairment effect was observed in Experiment 2 even though total viewing time was controlled. Participants were given 15 additional seconds to view the paintings after taking the picture, giving them effectively more time to look at the paintings in the Camera and Delete conditions than in the Observe condition. This finding suggests that the photo-taking-impairment effect cannot be explained by participants simply being distracted or disengaged while using the camera, but that photo-taking prospectively impairs how an experience is encoded even after the camera is put down. Reasonably, participants could have re-engaged with the paintings during the time after taking a photo, especially when they knew the photo was deleted or rendered inaccessible,

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leading to a level of encoding at least as good (if not better) in the camera conditions than in the observe condition. Our results instead suggest that after taking a photo, participants continued to encode the paintings less effectively than they would have otherwise.

Although speculative, one possible interpretation of this finding is that participants suffered from a sort of metacognitive illusion. Specifically, photo-taking may have given participants a subjective sense of encoding fluency, leading them to think they had already encoded the objects—not only via the camera, but via their own organic memory—thus rendering them less likely to put additional effort toward encoding the objects in the time that followed. Said differently, photo-taking may have led participants to think that they had already encoded the paintings, making them less likely to employ the type of encoding strategies that would have been useful for improving memory (Bjork, Dunlosky, & Kornell, 2013; Hertzog, Dunlosky, Robinson, & Kidder, 2003; Koriat, 1993). A related possibility is that encoding was disrupted by a sort of automatic offloading. Although the present results are inconsistent with an "explicit" form of offloading, they cannot rule out the possibility that through learned experience, people develop a sort of implicit transactive memory system with cameras such that they automatically process information in a way that assumes photographed information is going to be offloaded and available later (even if they consciously know this to be untrue). Indeed, if this sort of automatic offloading does occur then it could be a mechanism by which photo-taking causes attentional disengagement.

Clearly, the mechanisms and boundary conditions of the photo-taking impairment-effect remain to be elucidated. It is possible, for example, that any secondary task can cause attentional disengagement. Future research should explore whether there is something unique about taking photos that causes people to become less likely to encode an experience. Furthermore, it is unclear whether the effect is limited to the type of photo-taking situation used here and by Henkel (2014) in which individuals are instructed to take pictures of some objects but not of others (a control feature which is necessary for current purposes but which may not reflect situations outside of the laboratory where participants decide on their own whether to take a photo). Recent work has shown that when participants can decide for themselves what items to photograph (i.e., "volitional photography") photo-taking can enhance both engagement in an experience (Diehl, Zauberman, & Barasch, 2016) and memory for that experience (Barasch, Diehl, Silberman, & Zauberman, 2017). Thus, it is possible that taking pictures impairs memory by disrupting attentional engagement, but only when participants are not actively in control of deciding what to photograph. At this point we still know very little about exactly when and why photo-taking impairs memory.

So where do our findings leave snap-happy photographers and social media addicts documenting their daily lives? Although it remains to be seen whether the present results generalize to other types of conditions, they do suggest that taking photos can impair a person's ability to remember the details of the experiences being photographed, an effect that appears to linger even after the camera has been put down. Of course, one of the benefits of taking photos is that the photo-taker can look back at the photos later, thus arguably providing a much more powerful opportunity to transactively remember the details of an experience than would be possible through observation alone. This benefit requires that participants actually take the time to successfully locate and view their photos, however; something which may be done far less frequently than one would imagine (Whittaker, Bergman, & Clough, 2010). It is also worth noting that photos can only capture a portion of an experience and that photographic review may therefore not always help participants recover the uncaptured portions of an experience. In this way Russell Banks (2015) may not have been exaggerating when he wrote that to photograph an experience was "somehow to reduce and domesticate (it) and ultimately to kill it." To the extent that taking a photo does affect memory for an experience, whatever aspect of that experience that is impaired could remain impaired. For a truly memorable experience, therefore, it might sometimes be best to put the camera away.

Conflicts of Interest Statement

The authors declare no conflicts of interest.

Author Contributions

JS designed the experiments and analyzed the data under the supervision of BS. Both authors contributed to the writing of the manuscript.

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Received 14 August 2017;
received in revised form 19 September 2017;
accepted 16 October 2017
Available online xxx