# Capturing Life: The Effect of Filming on Memory

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**Abstract**

Prior research has unveiled a "photo-taking impairment" effect such that we tend to remember objects less when we take pictures of them compared to only observing them. It is still unclear what causes this effect and whether it also applies to filming. This paper investigates whether filming animations, impairs memory similarly to taking pictures and whether the type of stimulus being filmed has an influence on memory recall. Participants were asked to observe and film 12 stimuli (6 moving paintings and 6 sport fragments) after which they took two memory tests (one after 10 minutes and one after one week). Results showed no memory impairment caused by filming, either after 10 minutes or one week and no significant difference in memory score between the two stimuli. Participants did however score significantly higher on the memory tests for the moving painting stimulus when they looked on the smartphone screen during filming.

Keywords: Photo-taking impairment, Video, Memory, Filming, Camera

## 1. Introduction

Whether it's the nice vacation you took with loved ones or a note with important information, we all take pictures and videos of things we want to remember. The advent of the smartphone and increasing size of memory in our devices means that we don't really have to discriminate anymore between what to save and what to discard (Ibrahim, 2015; Lim, 2019). Consequently, the number of pictures and videos that we take on our phones has skyrocketed (Richter, 2017). Despite (or maybe because of) the amount of media we create, not many people ever revisit this media after creation (Barasch et al., 2017). This might not sound like a big problem; after all, if we have enough memory on our devices to take as many pictures and videos as we want and we enjoy creating all this media, what does it matter whether we review it later or not? Besides societies' shifting values of preferring to 'be there in the moment' over capturing every moment with our digital devices, it turns out it matters quite a lot (Morrison and Gomez, 2014; Weilenmann, 2021).

In an experiment done by Henkel, it was found that taking pictures of objects made people remember said objects worse than if they would only observe the objects, as long as they don't review the pictures (2014). Participants were taken on a tour through a museum and were told to take a picture of certain objects, while merely having to observe others. When just observing, the participants scored reliably higher on a subsequent memory test than when they had also taken a picture of the object (Henkel, 2014). Henkel called this effect the *photo-taking impairment effect* (PTIE) and hypothesised that this effect might be due to people using the photo camera as an extension of their organic memory and therefore not needing to use their own memory to remember the objects as much (2014). Other researchers were able to replicate these results, which further proves that our penchant for taking pictures might actually be working against us (Niforatos et al., 2017; Soares and Storm, 2018; Tamir et al., 2018).

What we however don't know is whether this effect also translates to other types of media capture. The aforementioned studies all have in common that they investigate the connection between taking pictures and memory impairment. This is however not the only way we use our smartphones to save the events we would like to remember. One important type of media that we mentioned before but has barely been researched, is video. It is unclear whether PTIE also applies to filming events as opposed to taking pictures. If we take Henkel's hypothesis for PTIE in account, it would logically follow that filming should similarly impair memory as taking pictures. After all, filming creates a video of an event that will be externally saved and thus doesn't have to be saved (as vividly) by our organic memory. That said, Henkel also found that our memory for objects is **not** impaired when people zoom in during picture taking (2014). The exact reason for why PTIE happens has however remained unclear to this day. We thus can't be sure if this impairment effect, also manifests when shooting videos.

This paper seeks to answer this question by conducting an experiment similar to previous research done on PTIE, but focused on filming. Investigating whether there is a memory impairment effect for filming can help us understand PTIE better. For instance, if no memory impairment effect is found for filming, it's less likely that PTIE happens because of people using media as a digital extension of their memory. Moreover, depending on whether filming does or doesn't impair memory, we might want to change the way we use our smartphones to remember things. If filming does impair our memory, it could be better to leave our digital devices at home the next time we go on vacation and/or find a different way of saving important notes. However, if filming does not impair our memory, videos could be a good substitute for creating digital memories of things we want to remember.

## 2. Theoretical Background

In her paper, Henkel suggested that PTIE might be due to people *offloading* their memory on the camera and as such using it as an extension of their own memory. This is in line with previous research that found a similar effect. That research showed that when people expected information to be (reliably) accessible later on, they remembered the information less and instead remembered the place where the information was stored (Sparrow et al., 2011). The offloading hypothesis is also supported by Van Nimwegen and Bergman, who found that when people looked at pictures and messages they expected to be deleted, they remembered them better than when no such cue was given (2019).

Later results however seem to debunk this hypothesis. Instead, it was suggested that the memory impairment is a result of *attentional disengagement*. For offloading, one would expect no memory impairment to take place when information isn't reliably stored or not stored at all. However, when making people delete the pictures they just took, the memory impairment was found to be just as strong as when people did not delete anything (Soares and Storm, 2018). Because of these findings, it was suggested that it is actually the act of taking pictures that causes the memory impairment. To take a picture people might shift their focus to the camera itself and/or getting the right angle, which distracts from the object in front of them and therefore disrupts the encoding of the image in the brain (Soares and Storm, 2018). Additional support for this hypothesis came from Niforatos et al., as they found that participants taking manual pictures during a tour performed worse on a memory test than people who wore a device that automatically took pictures and people that didn't take any pictures at all (2017). Additionally, participants that took pictures with an app that limited the number of photos they could take, scored significantly worse on a memory test that was taken a week after the tour, than participants that were asked to only observe. This memory impairment effect did not show up in the memory test done directly after the tour.

Another study that supports this theory, wasn't able to reproduce the photo-taking impairment effect at all. In this study people were allowed to freely take pictures of whatever they wanted, which actually improved the participants memory for the visual objects (Barasch et al., 2017). This was explained by the fact that because the participants were allowed to choose what to capture themselves (whereas this was not the case in Henkel's and Soares and Storm's study), they felt more engaged (Henkel, 2014; Soares and Storm, 2018; Barasch et al., 2017). Later studies by Tamir et al. and Niforatos et al., however did also allow their participants to take pictures freely and were able to replicate the photo-taking impairment effect, making this theory less likely (Niforatos et al, 2017; Tamir et al., 2018).

Because of all the conflicting results, Curie and Westerman hypothesized that the impairment effect might only come in play for conceptual memory (meaning), while actually improving perceptual memory (image) (2021). They argued that the memory test in the Barasch et al. study was more focused on the perceptual memory, while the tests done by Henkel and Soares and Storm focused more on conceptual memory. They were however not able to prove this hypothesis and instead found that the impairment effect affects memory more generally.

Moreover, while there is some evidence for attentional disengagement being the cause of the memory impairment effect in Niforatos et al.'s study, Soares and Storm were not able to find any proof for this. On the contrary, their findings showed that there was no difference in memory impairment whether participants took pictures first and then observed or vice versa, which would not be expected if attentional disengagement was the source for the memory impairment. They argued that if people were instructed to take a picture first and then observe the image for an additional amount of time, there should be no difference between people taking a picture first or people only observing the object, as they would have the same amount of (uninterrupted) time to encode the memory of the object in their brain (Soares and Storm, 2018). Instead, Soares and Storm argued that the impairment effect might be due to people *automatically offloading* their memory when using a digital device. We might be so accustomed to these devices saving our memories for us, that use of the device triggers the effect, no matter whether information is later deleted or not (Soares and Storm, 2018).

While more research is needed to find the cause of PTIE, we also don't know whether this effect is applicable to other forms of media capture. There is for instance no research yet (to our knowledge) that looked into whether PTIE also applies to video capturing. If we automatically offload our memory to digital devices, we should expect the same memory impairment effect to happen when filming an object. We would also find this result if we follow the findings from Niforatos et al. (2017). After all, the act of shooting a video, redirects (similarly to taking photos) attention from the captured image to the capturing device and involves distractions such as thinking about what to capture and from what angle (2017).

A different theory would however appear if we look at the paper of Mols et al. and their findings (2015). In this paper it was found that while shooting videos does ask a lot of attention of the user, it also provokes more engagement in the user. The participants in the study didn't feel disconnected when shooting videos, whereas they did feel so when taking pictures. This could mean that because video is more engaging it might not disrupt the encoding process of memories in the same way as picture taking. This finding would also give more support to the theory of Barasch et al. that PTIE happens when people feel disengaged with the media they capture (2017).

## 3. Research Questions

Prior studies have found a memory impairment effect for picture taking, however much remains unclear about how and why this effect takes place. One question we seek to answer is whether this effect only happens for photo-taking or if it could also affect filming. Moreover, in a study done by Niforatos et al., the scores of participants instructed to only observe what they saw during a tour, were significantly higher after a week than the scores of participants that were instructed to take a limited number of photos (2017). This significant difference in score could not be found in the memory test directly after the tour, which led us to the first research question:

*RQ1: Does filming invoke a similar memory impairment effect as PTIE, and if not, could this be due to a belated memory impairment effect?*

Prior work looking into PTIE asked participants to take pictures of (for instance) objects, which are static stimuli (Barasch et al., 2017; Henkel, 2014). Filming by definition lends itself better for capturing events rather than objects. This raised the following research question:

*RQ2: Does filming a static stimulus which is moved across the screen significantly impair memory more than a video stimulus?*

## 4. Methods

To study whether filming can cause memory impairments, we decided to conduct a lab study. Participants were shown a slideshow with 12 pre-selected animations, which consisted of one block of 6 moving paintings (zoomed-in images of paintings that slowly move across the screen) and one block of 6 video fragments of sport competitions (see Appendix for a list of paintings and videos used). Half of the paintings and videos had to be filmed and the other half observed and none of the animations featured any sound. The paintings were copied from a study by Soares and Storm (2018).

Furthermore, ten minutes after completing the slideshow the participants took a memory test about the animations they just saw, which was followed up by another memory test one week later.

### *4.1 Design*

The design used for this experiment is a 2x2 within-subject design, with two independent variables (stimuli: moving painting vs. sport fragments & task: observe vs. film). The observe condition functioned as a control condition. The dependent variables were the scores on a 10-minute delayed recall test (first test done after 10 minutes of the experiment) and a 1-week delayed recall test (second test done after 7 to 14 days after the experiment).

### *4.2 Participants*

We recruited 33 participants (18 female, 14 male and 1 non-binary/third gender) of which 30 also made the second test. There were six age groups: 18-20 (6.1 %, n = 2), 21-24 (48.5 %, n = 16), 25-30 (30.3 %, n = 10), 31-35 (9.1 %, n = 3), 36-40 (3 %, n = 1), 40+ (3 %, n = 1) and all participants were from the premises of a European University. The three participants that didn't do the second test were 2 males (age 21-24 and 36-40) and 1 female in the age groups 21-24.

Furthermore, it was tested how familiar the participants were with either the sport fragments or paintings via self-reporting. Of the participants 19 didn't recognize any paintings or fragments, 14 recognized one or more paintings (most of them had either seen them before in a book or museum but none of the participants said they knew them by heart) and 2 participants recognized one sport fragment.

### *4.3 Materials*

All participants were provided with a Samsung Galaxy A52+ smartphone by the researcher to film the paintings and video fragments. The smartphone lock and home screen were both set to empty black backgrounds, with the exception of the widget for the built-in camera app on the home screen. The slideshow was shown on a 21.5" desktop screen on a standing desk inside a small somewhat soundproofed booth (see Figure 1). We chose to use a standing desk and not provide participants with a chair to simulate more natural filming behaviours.

The slideshow provided the participants with instructions at the start of each animation and the order of the animations within every block was counterbalanced using a Latin Square, which resulted in six different slideshow orders. In three of these orders the participant would start with filming and in the other three start with observing, with further tasks alternating between filming and observing. Every animation was accompanied by a title that was used to identify the animations in the subsequent tests.

The first memory test was a multiple-choice test (taken after a 10-minute break) that consisted of 24 questions (two for every animation), with four options (one correct and three incorrect) given per question. The pair of questions per animation were given in succession as to stay close to the method used by Soares and Storm (2018). The 12 questions that were asked about the paintings in the first and second test were also copied from their study. The second test was taken after 7 to 14 days and contained the same questions as the first test but with changed question order and different answer order. Participants had 10 minutes for each test and all questions had to be answered.

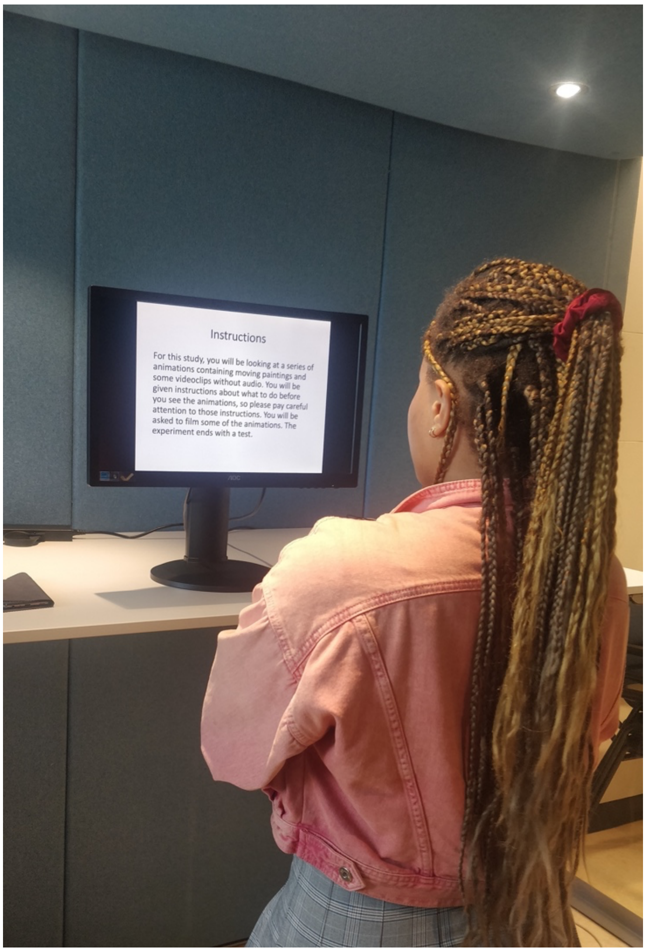


*Figure 1: Participant going through the slideshow.*

### *4.4 Procedure*

To start the experiment participants were instructed on what they had to do during the experiment and gave their informed consent. After this, they were given time to practice filming with the experiment phone. They were instructed to film in the same way as they would on their own phone in daily life, except for that the animations and title had to be in the frame of the phone in its entirety and they were not allowed to use the zoom function of the phone.

After the practice round, the participants would be taken to a small booth which contained a desktop screen with the slideshow. The slideshow provided further instructions and the participants went through the slideshow by themselves. The researcher sat next to the booth and was there to make sure the experiments went as instructed and made notes on the way the participants filmed during the experiment.

The first block started with moving paintings that were based on a previous study by Soares and Storm (2018). In contrast to Soares and Storm's study, the paintings were moving and only part of the painting was visible at all times. Every painting animation started with the animation zoomed in at the lower right corner and would, over the span of 15 seconds, move to the lower left corner, upper left corner and finally end at the upper right corner (see Figure 2). In doing so, the participants had to watch the whole animation to see the entire painting. It was chosen to only use animations and not still images in this study as this would create a more realistic scenario for when people film outside laboratory settings. It would not make sense to film a static object in real life, since a photo can capture the same information in a more efficient way and is quicker to take.

The second block consisted of six sport competition fragments that were pre-selected to be not too recognizable (e.g., the finale of a soccer world cup has a high chance of being seen by multiple participants and is therefore less useful) and high resolution (at least 720p). For the six chosen fragments, 12 questions were made and tested in a pilot (N = 8) on usability for the test. The results of the pilot caused 7 questions to be replaced or adjusted (see appendix for an overview of the pilot results).

All animations were exactly 15 seconds in duration and were followed by a 2 second interstimulus interval (black screen) before new instructions were shown. Participants could go to the next slide after reading the instructions by hitting space on a keyboard that was next to the desktop screen. The slides with animations would automatically jump to the next slide. Every block provided the participants with an example of the type of animation they would be seeing and an example of the type of question they could expect in the memory tests.

After finishing the slideshow, the participants returned the experiment phone to the researcher and were encouraged to do something for themselves for 10 minutes. Following this break, the participants returned to the booth to complete a multiple-choice memory test on the computer, followed by a small questionnaire in which they would be asked demographic questions and to provide their email. They were also asked whether they recognized any of the paintings and/or sport fragments. Finally, the participants received a second memory test in their mailbox 7 days later, which could be filled in online from home.

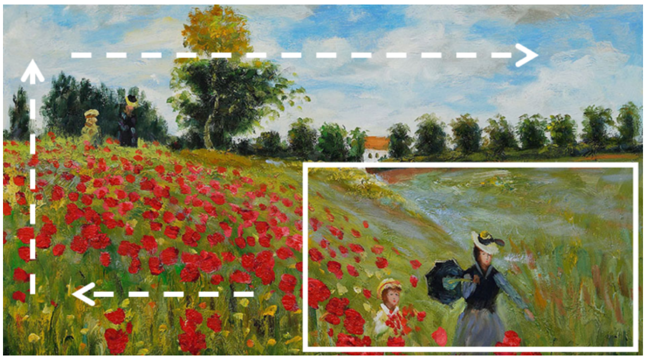

*Figure 2: Path of zoomed in window of painting. The path takes 15 seconds to finish.*

## 5. Results

In this section we will attempt to answer our research questions. Our statistical methods were decided based on pre-tests such as the such as Shapiro-Wilk tests of normality and Levene's tests of homogeneity of variance. These tests are not reported here for the sake of brevity.

*5.1 Filming and memory impairment*

To answer our first research question, we wanted to know if filming resulted in a measurable memory impairment compared to observing. To do this, we first tested whether the task type (filming or observing) had a significant influence on the results of the 10-minute delay test by performing a Cochran Q test. This test was chosen as the task type is a within-subjects repeated factor and the score is a dichotomous variable recorded per question, with a "1" encoding a correct answer and a "0" encoding a wrong answer. The Cochran Q test displayed no significant difference in memory scores 10 minutes after the experiment, between the observe and filming task types ($\chi^2$ (1) = .018, $p$ = .892) (RQ1). Filming thus didn't impair the memory of participants in a memory test done after 10 minutes.

We used however two different stimuli in our experiment. One was a zoomed-in still image of a painting that moved across the screen, the other was a short video. We were interested to see whether the type of stimulus had an influence on memory scores, as it is possible that only certain stimuli create a memory impairment effect when filming. To test this, we did two more Cochran Q tests. The first test measured whether task type had a significant influence on the moving paintings scores. However, no significant difference was found in the memory scores of the 10-minute delay test between the observe and film task type for the moving painting stimulus ($\chi^2$ (1) = .057, $p$ = .812) (RQ2). We did the same for the second test but focused now only on the scores of the sport videos. Here again, no significant difference was found between the task type on the scores of the 10-minute delay test for the videos ($\chi^2$ (1) = .000, $p$ = 1.000) (RQ2). This means that static stimuli which are moved across the screen (moving paintings) don't impair the memory of participants more than video stimuli when tested after 10 minutes.

To ensure that prior knowledge isn't skewing our data we also performed a Cochran Q test to compare the scores of the 10-minute delay test of answers where participants indicated they had prior knowledge versus the answers for which this was not indicated. This showed that prior knowledge did indeed have a significant effect on the scores for the 10-minute delay test ($\chi^2$ (1) = 12.371, $p$ = < .001). Of the questions that were answered with prior knowledge 68.4 % were answered correctly versus 47.2 % for no prior knowledge.

Because of this finding we did another Cochran Q test for the effect of task type on the 10-minute delay test scores, but filtered out all the questions that participants said they had prior knowledge for. This showed no significant effect for task type on the 10-minute delay test scores without prior knowledge ($\chi^2$ (1) = .018, $p$ = .894). We thus found that, even though prior knowledge does make participants score significantly higher in the memory test after 10 minutes, this effect isn't strong enough to influence the scores of all participants taken together.

*5.2 Filming behaviours*

During the experiment we noticed that people had different ways in which they film. Notably, some participants filmed in portrait mode whilst others used landscape mode and not everyone looked at the same screen while filming. This could have an influence on the memory scores of the participants. For instance, in landscape mode participants could film the animations from a closer distance while having the animation and title in frame, than when they film in portrait mode.

Because participants were observed to always stick to one (of two) filming mode for the entire experiment, we could treat filming mode as a between-subjects factor. Therefore, to test whether filming mode could be of influence for a memory impairment effect we performed a Pearson Chi-Square test of independence. However, no significant association was found between filming mode (portrait or landscape) and the participants' scores in the 10-minute delay memory test ($\chi^2$ (1) = .857, $p$ = .355). This means that the way people captured a video (portrait / landscape) did not influence their ability to recall any details about it 10 minutes later.

The other variable we were interested in was whether participants' screen looking behaviours had a significant influence on the memory of the participants. Participants were observed to (for the most part) look on the smartphone screen when filming, mostly look at the PC screen when filming (only sometimes looking back on the phone) or to share their attention equally between screens. To divide these behaviours, we created the following categories: (Mostly) Phone, (Mostly) PC and Equal PC & Phone. Some participants varied in screen looking behaviour between animations, which made us write the behaviour down per animation instead of per participant. To examine whether the screen participants looked at while filming had a significant influence on their scores in the 10-minute delay test, we performed a Pearson Chi-Square test of independence. This showed no significant association between participants' screen looking behaviours and their scores on the 10-minute delay test ($\chi^2$ (2) = 5.065, $p$ = .079).

We are however also interested in whether there is a difference in memory impairment between the two different stimuli (moving paintings and videos), therefore we wanted to know whether the screen participants looked at influenced memory for the stimuli differently. To test this another Pearson Chi-Square test of independence was performed for the screen looking behaviour on participants' scores for moving paintings. The test showed a significant association between the type of screen(s) that participants looked at ((Mostly) PC, (Mostly) Phone or Equal PC & Phone) and the moving paintings scores for the 10-minute delay test ($\chi^2$ (2) = 11.794, $p$ = < .05). In particular, a Chi-Square post hoc analysis showed that participants answered correctly significantly more frequent for the "(Mostly) Phone condition" (62.3 %), than the "(Mostly) PC" (37.9 %) and "Equal PC & Phone" (37.5 %) conditions (Beasley & Schumacker, 1995) (See Figure 3).

Finally, we also performed a Pearson Chi-Square test of independence on the screen looking behaviours of participants' memory scores for the sport video stimulus. As expected, this test showed no significant association between the type of screen(s) participants looked at and the sport video scores for the 10-minute delay memory test ($\chi^2$ (2) = 3.438, $p$ = < .179). This means that, only for the moving painting stimulus, participants looking on their smartphone screen while filming, recall more details of the paintings after 10 minutes than participants that looked mostly at the computer screen or equally between both screens while filming.

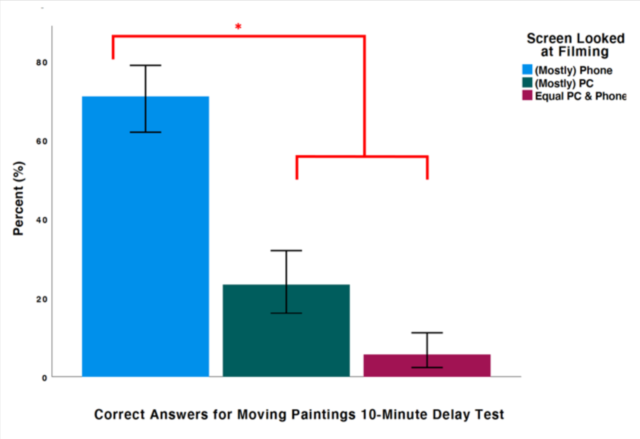


*Figure 3: Participants looking at the phone screen scored **significantly** better for moving paintings than participants looking mostly at the computer screen or equally between both screens.*

*5.3 Filming and memory retention*

Because a week elapsed between the first and second memory test, we would expect to see a significant memory loss of the viewed animations. To test if this is the case, we performed a Wilcoxon Signed-Rank Test between the scores of the 10-minute delay memory test and the 1-week delay memory test. The test revealed, in line with expectations, that there is a significant drop in the recall scores of the participants 1 week after the experiment (Mdn = 10.5, loss of 20 % after one week), as opposed to 10 minutes after the experiment (Mdn = 12) (Z = -2.359, p < .05) (see Figure 4). Participants thus remembered less details of the animations after a week had passed.

To ensure that there is no belated memory impairment effect that filming causes, we replicated the first test with the score of the 1-week delay test. This Cochran Q test displayed no significant difference between task types (observing vs. filming) for the score after 1 week ($\chi^2$ (1) = .158, $p$ = .691) (RQ1). This means that filming also didn't impair the memory of participants in a memory test done after one week.

We however observed that the screen the participants looked at, did significantly influence their memory scores after a 10-minute delay for the moving paintings stimulus. We want to see if this memory effect continues after 1 week. To test this, we performed a Pearson Chi-Square test of

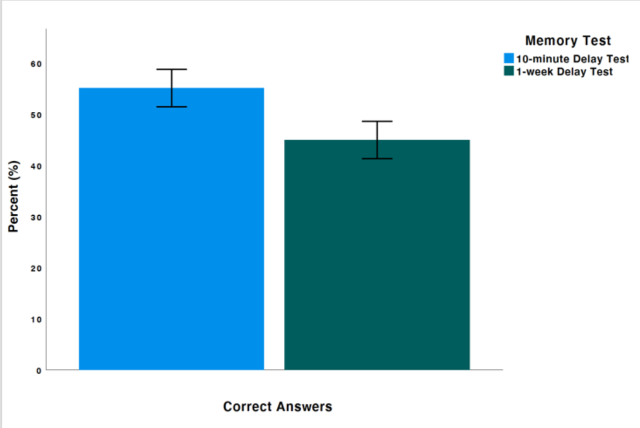


*Figure 4: **Significant** drop in correct answers between memory test after 10-minutes and memory test after 1 week.*

independence for the screen looking behaviours of the participants and the 1-week delay scores. This showed a significant association between the type of screens participants looked at ((Mostly) PC, (Mostly) Phone or Equal PC & Phone) and the moving paintings scores for the 1-week delay test ($\chi^2$ (2) = 9.532, $p$ <. 05). For both the moving paintings and sport fragments, the participants gave a correct answer when they looked (Mostly) at the PC 35.9 % of the time, 50 % for (Mostly) Phone and 26.9 % for Equal PC & Phone.

To further examine this effect, we did another Chi-Square test of independence for the 1-week delay scores of only the moving paintings and sport fragments. We first tested the 1-week delay scores for the moving paintings, which showed a significant association between the screen looking behaviours ($\chi^2$ (2) = 19.180, $p$ = < .001). In particular, a Chi-Square post hoc analysis showed that participants answered significantly more often correct for the "(Mostly) Phone" condition (60 %), than the "(Mostly) PC" (29 %) and "Equal PC & Phone" (21.4 %) conditions and that the "(Mostly) PC" condition also significantly

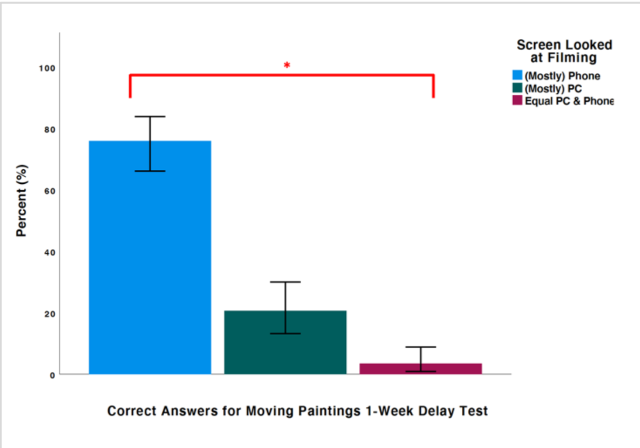


*Figure 5: Participants looking at the phone screen scored **significantly** better for moving paintings than participants looking at the computer screen. The participants who looked on the computer screen scored also **significantly** better than the participants who looked at both screens equally.*

scored higher than the "Equal PC & Phone" condition (Beasley & Schumacker, 1995) (See Figure 5). The second test examined the scores of the 1-week delay test for the sport videos, which did not show any significant association between screen looking behaviour and the 1-week delay scores of the sport fragments ($\chi^2$ (2) = .410, $p$ = .815). The results of these two tests showed that looking at the smartphone screen made participants recall more details of the moving painting animations after a week, than when they looked at the computer screen most of the time or equally between both screens. Furthermore, the participants who looked at the computer screen most of the time were able to recall more details of the moving paintings after a week than the participants who equally looked between both screens.

## 6. Discussion

The goal of this study was to investigate whether filming causes a similar memory impairment effect as taking pictures. By studying this we hope to also get more insight into how and why memory impairment effects happen for media capturing as a whole.

### *6.1 Filming and memory impairment (RQ1)*

Our first question was whether filming causes a similar memory impairment effect as PTIE, for which we found no proof. Because of this finding it becomes less likely that PTIE is caused by attentional disengagement. After all, to film something, participants need to engage with the smartphone and check whether the scene they're filming is in the frame in a similar manner to taking a picture. Since there was no memory impairment detected that was caused by filming, this type of distraction is unlikely to be the (main) cause of PTIE.

Another theory that was suggested to explain PTIE is automatic offloading (Soares and Storm, 2018). The idea of this theory is that our brain relies on the memory card of our capture device to remember what we captured. Filming can be done on the same type of device as taking pictures and videos can similarly be saved to the device memory card. However, no memory impairment effect was found for filming. If PTIE only happens when taking pictures, automatic offloading must then logically also only happen when taking pictures. Future research would thus have to investigate why our brains possibly make a difference between filming and taking pictures when offloading (part of) our memory.

A more likely theory for PTIE is however that filming is more emotionally engaging than taking pictures and therefore doesn't cause a memory impairment. If this is the case, it would mean that PTIE is caused by an emotional response (or the lack thereof) that the participant feels in response to taking a picture. This could also explain the differences found in memory impairment between the studies by Barasch et al. (2017) and Niforatos et al. (2017). The participants in Barasch et al.'s study might have been more interested in the virtual tour they took, than the participants that took the campus tour in Niforatos et al.'s study, however more research is needed to definitely pinpoint emotional disengagement as a cause for PTIE.

That said, we did not have a control group that took pictures of the animations to ensure no unwanted effects were caused by the stimuli. It thus is possible that something else is responsible for not finding a memory impairment effect during this study. More research into the effects of filming on memory is needed to definitely prove that filming doesn't cause any memory impairment.

The second part of the first research question investigated whether filming could cause a delayed memory impairment effect. No evidence was found that this is the case but, while no delayed impairment effect could be detected in the data, the difference in memory scores between the different screen looking behaviour categories did become more profound after a week. A possible explanation for this is that the switching between screens when watching the animations disrupts the memory encoding process but more research is needed to give a more conclusive explanation.

### *6.2 Stimuli and memory impairment (RQ2)*

Our second research question looked into whether the type of stimulus that is being captured has an effect on memory impairment. In general, there wasn't a significant difference in score between the two stimuli tested (moving paintings and videos). It was only when we examined the filming behaviours of the participants that we found that there is a significant difference in memory score for the moving painting stimulus between participants who looked mostly on the smartphone screen and participants who looked mostly at the computer screen or equally between both screens. The likely reason for this finding is that participants who looked on the phone screen missed fewer details and/or events by looking away. Many of the participants that were in the 'mostly looking on smartphone screen' category never looked up from the screen while filming, whereas in the other two groups (participants who looked mostly at the computer screen and participants who looked an equal amount on the computer and smartphone screen) participants were often observed to quickly look at the other screen a couple of times. This makes sense when we remember that the participants were instructed to keep the animations plus titles in the frame the entire time while filming. The participants who were watching the computer screen had to look at the phone a couple of times to make sure the animations were still in frame, which meant they missed a small part of the animation every time they looked away. This however doesn't explain why this effect was stronger for the moving painting stimulus. Our guess is that this happened because the moving painting stimulus moved across the screen without letting participants see the same bit of painting twice. If the participants then miss a detail in the painting, they won't be able to see it later on in the animation, whereas the details in the video stimulus could be visible for a large part of the animation (e.g., the background colour of a wall, which is multiple times in frame during the video).

*6.3 Additional Findings*

Some of the participants commented that the reason why they looked at the computer screen rather than the smartphone is that they 'want to be in the moment' when they film. Some of the participants even mentioned that they believed they would remember less of what they filmed by watching the smartphone screen when filming. The results of this study would however suggest that this is a common misconception. People might be better off by just watching their smartphone screens when filming and thereby being able to watch the filmed event more consistently.

Furthermore, since no memory impairment effect was found for filming, this type of media capture could be a preferable to taking pictures in cases where we want to remember the captured event or object.

## 7. Limitations

Henkel found in her 2014 study that zooming in or out prevents PTIE from happening. It's thus possible that the explanation for the cause of PTIE lies in the 'stillness' of the scene. In this study, filming wasn't done on static images because it wouldn't be logical to film a still scene in real life. In these cases, it would be more convenient to take a picture. However, it is possible that filming would also cause PTIE when the object and background being filmed don't move and the image on our (phone) screens are thus relatively static for the duration of the filming. Alternatively, it's possible that taking a picture of a moving object could also prevent PTIE from happening. This should be looked at in further research.

Furthermore, we choose to let participants film the way that felt most natural to them. This was done to create a more natural filming experience but this also makes it harder to control certain variables. For instance, this experiment could be repeated with clear instructions for participants on where to look while filming, so the effect of distraction can be controlled for in the data.

Moreover, future research could study more natural filming behaviours in participants by repeating this study in a real-life setting, such as a museum. While PTIE was able to be replicated in lab settings in prior research, filming might be less suited for a lab study than taking pictures. This study was done in a lab where the screen that the animations were portrayed on was relatively small, which might have affected the filming behaviours of the participants. For instance, an event being filmed in real life might not have a clear border between the event and the background, whereas a computer screen does enforce a clear border between the animation and the background.

Lastly, many participants commented that they had guessed a lot of the questions. This could also be seen in the median number of correct questions for the first memory test (after 10 minutes) which was exactly chance. However, there was still a significant drop in correct answers between the first and second test, which is in line with what one would expect due to natural memory loss over a week.

## 8. Conclusion

In this study we investigated whether filming could cause a memory impairment effect similar to the one seen when taking pictures and secondly, whether the type of stimulus being captured could influence memory impairment. While no memory impairment effect was found that was caused by filming, there was a significant difference in memory scores found that was caused by participants filming behaviours. In particular, participants that mostly looked on their smartphone screen during filming had significantly better memory of the moving painting animations than participants that looked more at the computer screen or equally between both screens and this effect even got stronger after a delay of one week. In other words, it appears that filming induces no negative effects on memory recall and looking at the smartphone screen when filming does, contrary to popular believe, not cause any negative consequences for memory either. In fact, looking at the smartphone screen when filming might even be preferred.

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## Appendix

**Paintings used:**

- London Bridge by Derain
- The Poppy Field by Claude Monet
- Red Room by Henri Matisse
- The Bathers by Seurat
- Dance Class at the Opera by Edgar Degas
- Lake Como by Robert Finale

**Sport videos used:**

- Tennis - Indian Wells Quarter Finals 2021
  https://www.youtube.com/watch?v=82vGTlCEcrU&t=83s
- Gymnastics - British Gymnastics Championship 2017
  https://www.youtube.com/watch?v=kySTBJRxD1Y
- Handball - World Championship 2021 (Denmark vs Egypt)
  https://www.youtube.com/watch?v=LHmqJbwKuYw&t=992s
- Table Tennis - 2016 NCTTA Nationals Women's Singles Final
  https://www.youtube.com/watch?v=5TuyvUx7qig&t=1037s
- Archery - Men's Individual Final Olympics Rio 2016
  https://www.youtube.com/watch?t=475&v=rzj4FFi7wt8&feature=youtu.be
- Long Jump - Women's Qualification Olympics Rio 2016
  https://www.youtube.com/watch?v=fB7OEnXb9z0