HOW MANY, WHAT AND WHY? VISUAL MEDIA STATISTICS ON SMARTPHONES AND TABLETS

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ABSTRACT

The focus of our research is on improving mobile image and video browsing interfaces. To get a better idea about real world mobile photo and video scenarios and to base our research on real world numbers we performed a survey of photo and video usage on smartphones and tablets. In an online survey we asked 215 participants of the German speaking region about their mobile image collections, their usage patterns, and their motives and intentions when capturing photos. Our results show, among other things, that users store considerable more photos on smartphones than on tablets, that the majority of our participants use their smartphone as primary camera and that users are unlikely to organize their photos on their mobile devices in any way. Moreover, the most popular motives are people, holiday photos, events, and landscapes. Furthermore, it is more popular to capture photos for private than for sharing purposes. We also report about various correlation hypothesis that we tested in the gathered data.

Index Terms— Surveys; smartphones; tablets; photos; videos

1. INTRODUCTION

The latest statistics on major photo sharing sites, such as Flickr [1], clearly show that the era of traditional point-and-shoot cameras is over: the vast majority of uploaded photos are captured on smartphones. This trend is also confirmed in the annual reports of the largest European photo-printing company [2]. The reasons are comprehensible; smartphone camera-sensors have reached a quality level that is sufficient for many users. Many smartphones even include high-end camera capabilities like optical image stabilization and phase-detection auto focus. Furthermore, the storage capacity on today's devices is more than sufficient for most users. Paired with high portability of mobile devices, smartphones are a very attractive camera replacement.

In research the capabilities of smartphones and tablets are of interest too and their use is subject of many works. Moreover, their capabilities are utilized in research domains with other focuses. In our own research we focus on efficient and enjoyable image and video browsing interfaces on smartphones and tablets and extend for example the work shown by Schoeffmann et al. [3]. Therefore, the objective of our survey is to provide valuable insights about usage patterns that can inform the large design and research community ([4], [5]) interested in improving interfaces for photo and video management.

The paper is structured as follows: first we show related research and continue by describing how the survey was setup. We report participant characteristics and proceed by describing the gathered data. We evaluate storage space distribution, manufacturers and operating systems, count of stored photos and videos, sources of the media, media organization, motives and intents, usage of specialized photo apps as well as participants backup intervals. After that we discuss significant group differences as well as our findings about associations in our data and finish with a conclusion about our findings and future work.

2. RELATED WORK

Related surveys were already performed by other researchers but they lack either in terms of the information provided or in terms of timeliness. For example, a similar survey was conducted 2011 by Thakur et al. [6] but with a focus on smartphone usage at the workplace. About 90% of their participants stated that they would use their phone at least once a week to take photos. They state that 45% had more than 100 photos stored on their smartphones with an additional 3% having more than 1000 images stored on their device. Another study that focused on camera phones was performed by Kindberg et al. in 2005 [7]. At that point in time smartphones were rather uncommon but feature phones already had built-

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in cameras. The average amount of images on the devices was around 44 images. In another work, Kindberg et al. [8] discuss the different use cases for camera phones in a social context. They identified two major categories in terms of shared photos: photos that are shared immediately and photos that are shared later (face-to-face).

Puikkonen et al. [9] presented a study about video creation with mobile phones where participants reported that they use their mobile phones for video creation only once or twice per month. They also noted, that a mobile phone could replace their pocket camera if the resolution became good enough. Two surveys that were performed by Suite48Analytics further show that among 1004 interviewed more than 76% store more than 25 photos on multiple device types (smartphones, computers, etc.) [10]. Furthermore, they show that among 1000 interviewed consumers in North America 58% of the participants who have taken at least ten photos in the last three months exclusively used their smartphone to record them [11]. Compared to their last study 18 months ago this is an noticeable increase of 57%. They also note that 33% of their respondents use a combination of smartphone and digital camera and that 5% in addition regularly take photos with their tablets.

Our survey results complement these earlier findings with more recent statistics and insights regarding photo and video usage patterns on modern smartphones and tablets.

3. THE ONLINE-SURVEY

The study was designed as an online web-based survey for the German-speaking region. We distributed our online survey on various internet portals and by using mailing lists. The questions were grouped in three parts. The first part included questions regarding photo and video usage on smartphones. The second part was largely a repetition of questions from the first part for participants that also had a tablet. The third and final part collected demographic data. Before participants continued from the smartphone to the tablet part they were asked if they were also in possession of a tablet. If not, the questions in the tablet category were skipped and participants were directly transferred to the final demographic part of the survey. Having at least a smartphone was a prerequisite in order to participate.

In total 215 smartphone owners participated of who 125 were female and 90 were male. Of all smartphone owners 82 participants additionally owned a tablet (38 female, 44 male) and therefore also completed the tablet-centric part of the survey. The average age of our participants was calculated as 29.9 (s.d. = 9.0), with a male average age of 31.6 (s.d. = 9.8), and a female average age of 28.7 (s.d. = 8.2). In case of participants who also were in possession of a tablet the average age was 31.6 (s.d. = 10.3), with female average age at 30.2 (s.d. = 9.6) and male average age at 32.8 (s.d. = 10.9).

4. RESULTS

Participants were asked a diverse set of questions. We report on device storage capabilities, device manufacturer, operating system ratio, count of photos and videos stored on the devices, origins of the stored images, motives and intents, organizational habits as well as backup intervals. Furthermore, we asked them how long they already had the devices in use.

4.1. Ownership

In case of smartphones our data indicates that most participants already had them for more than two years (70.2%) or one year (20.0%) in their possession. Other participants owned their smartphones between six months and one year (6%). Only 3.7% of our participants had their smartphone for less than six months (3.7%). We can therefore say that among our sample set the majority of participants are already used to their device and should have had enough time to get accustomed to their functions.

In terms of tablets the figures changed noticeably. In general, the ownership of tablets was shorter compared to the numbers of smartphones. In fact, only 37.8% owned their tablet for more than two years. When summed with participants that owned their device for more than one year (34.1%) the ratio is more than 18% less than what was the case at smartphones. Also, the percentages of people that possessed their tablets for shorter times are much higher in comparison to smartphones. Participants who indicated that they had their device between six months and one year are around 15.9%. Finally, the amount of users that owned their tablet for less than six months is 12.2%.

4.2. Storage Space

In case of smartphones, 20% of our participants had devices with 8 GB of storage space. The majority (39.5%) owned devices with 16 GB of storage, which was expected, as this option is the standard configuration for many smartphones. Another 14.4% indicated that their device offered 32 GB of storage and 2.3% had a device that could offer 64 GB of storage space. Interestingly, a considerable number of 18.6% of our participants were not able to tell how much storage their smartphone offered at all. We also offered the option to manually enter a custom storage amount while the options of 8, 16, 42, 64 GB and *unknown* were already predefined answers. The group of participants who took advantage of that option was rather small at around 5.1%.

In case of tablets, the majority of participants also chose 16 GB as answer (28%) but this time closely followed by the option of 32 GB (26.8%). Also, the amount of devices supporting 64 GB of storage space was higher than what was the case at smartphones with 15.9%. The option of 8 GB was chosen by 7.3% of the participants followed by the option of 128

GB at 4.9%. A very small number of participants further indicated that their device could offer 256 GB of storage space. A notable 15.9% were unable to tell us how much space their device offered.

4.3. Manufacturers and Operating Systems

Most smartphones of participants were produced by either Samsung (33.5%) or Apple (33.0%), followed by LG (9.8%), Sony (9.3%) and HTC (8.4%). Other manufactures amounted together for 6.2%. The most reported smartphone OS was Android with 62.8% followed by iOS with 32.1%, Windows Phone with 2.3% and Blackberry OS with 0.5%. Furthermore, 2.3% of the participants noted that they were not aware what operating system they had installed on their device.

In case of tablets, the most were manufactured by Apple (58.5%) followed by Samsung (14.6%), Asus (11.0%), Medion (4.9%) and Microsoft (3.7%). The percentages of other manufacturers of which each one was below 1.5% can be summed to 7.2%. Dominant operating system on tablets was iOS with 51.2%, followed by Android with 30.5% and Windows with 8.5%. Another 9.8% noted that they were not aware of the name of their tablet operating system.

4.4. Stored Photos and Videos

Participants were also asked to tell how many photos and videos they had stored on their devices. In case of smartphones, we calculated an average image count of **440.3** (s.d. = 503.3) with a minimum value of 0 and a maximum value of 2166.0. The average was calculated after removing outliers with Tukeys outlier labeling method [12] and an adjusted multiplier of 2.2 [13]. Furthermore, an average video count of **10.6** (s.d. = 12.4) with a minimum value of 0.0 and a maximum value of 58.0 was calculated after the same outlier reduction method was applied. In case of tablets an average image count of **113.5** (s.d. = 189.6) could be calculated after outlier reduction, with a minimum value of 0.0 and a maximum value of 826.0. An average video count of **4.6** videos (s.d. = 6.9) was calculated after outlier reduction, with a minimum value of 0.0 and and a maximum value of 25.0.

4.5. Media Sources

In the survey participants were also asked if they use their devices for taking photos and in which intervals they add new photos. In case of smartphones 67.9% of the participants noted that they primarily shoot new photos with the smartphone (see Figure 1a). Another 30.2% indicated that they preferred in most cases a normal camera for photo shooting. The amount of people that never used their smartphone for making a photo was relatively small with 1.9%. Additionally, the time interval for new photos created with their smartphones was rather short, as can be seen in Figure 1c. Most participants noted that they would make new photos on a weekly (52.1%) or daily (19.9%) basis. We also asked the participants from where most of the stored images on their smartphone originated from. The majority (88.6%) reported that most of them were shot directly with their devices. The second option (from instant messaging services) was far behind with only 6.2%. Other options like syncing photos from a PC, a camera, a USB-stick, from the internet or emails or from cloud services were all individually below 2%.

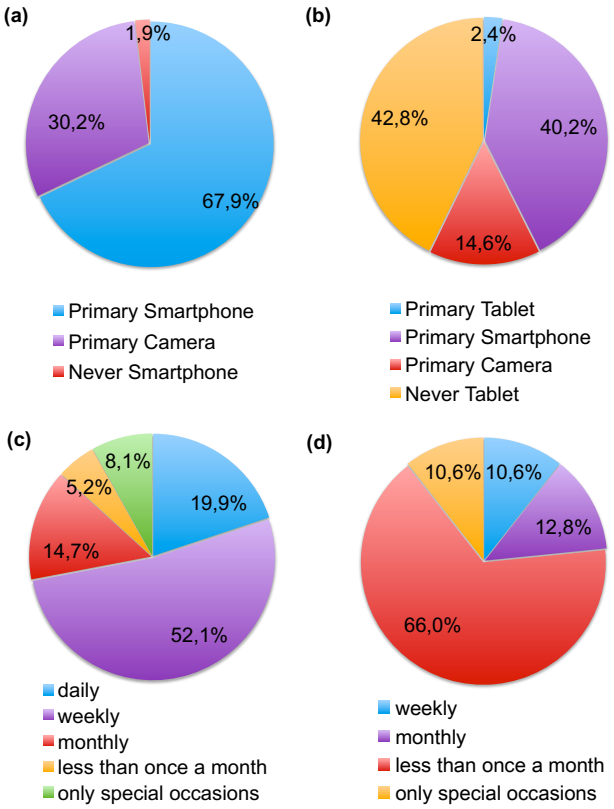

Fig. 1. Answer distributions for questions about camera-usage of smartphones (a) and tablets (b) as well as for intervals of taking new photos in case of smartphones (c) and tablets (d).

The numbers were completely different for tablets. Only 2.4% used their tablet as primary device for photo shooting. Photos were shot in most cases with their smartphones (40.2%) or with a dedicated camera (14.6%), as can be seen in Figure 1b. Also, 42.7% indicated that they never shoot any photos with their tablets. In terms of time intervals participants indicated that they would use their tablets less than once in a month for making a photo (66.0%, see Figure 1d). We asked the same question about file origins the tablet owners and got a more diverse set of answers. The four dominant origins of images on tablets were directly shot with the tablet (29.0%), synced from a PC (21.0%), copied from USB-stick or camera (19.4%), and synced from a cloud service (19.4%).

Method	Share
Never	56.2%
Rarely	14.3%
Certain cases	14.3%
Regularly	6.7%

Method	Share
Never	56.5%
Certain cases	21.0%
Rarely	12.9%
Regularly	9.7%

Table 1. Users manually organizing photos on smartphones (left) and tablets (right).

4.6. Image Organization and Photo App Usage

We also asked participants if they would organize their images in manually created folders or albums. It seems that in case of smartphones manually organizing photos is quite unpopular, with 56.2% of users noting that they would never do something like that. Another 22.4% noted that they did it rarely, 14.3% would do it for certain, special images, and only 6.7% do it on a regular basis (see Table 1). In case of tablets we got a quite similar pattern of answers. Most participants do not organize their images on their tablets (56.5%) or only in certain cases (21.0%). Furthermore, 12.9% noted they would do it rarely and 9.7% said they would always organize their images in such a way on their tablet.

We also asked participants if they would use any special photo apps to organize their photos, which does not seem to be the case on smartphones, with 94.8% choosing "No" as answer. They same is true in case of tablets with 96.8% not using any kind of such apps.

4.7. Motives and Intents

Besides technical and demographic parameters we also investigated popular motives and intents of photographers. The questionnaire presented ten different options for popular motives including *people*, *holiday pictures*, *events*, *landscapes*, *animals and pets*, *buildings and architecture*, *shopping and product photos*, *food and eating*, and *flowers*. An additional open question allowed for entering motives that were not covered by our ten categories. Answers were presented in an ordinal scale, i.e. *never*, *rarely*, *sometimes*, *often*, and *very often*. Most popular motive was *people* with an average **2.69** in between *sometimes* (2) and *often* (3). However based on the confidence intervals for the average value it can be seen that the motives *people*, *holiday pictures*, *events* and *landscapes* are generally more popular than the others, but no significant difference between them can be supported in our data. On the other hand *buildings*, *shopping*, *food* and *flowers* are significantly different to each of the four above mentioned as the confidence intervals do not overlap (see Figure 2). *Other* is actually below 1 in average, meaning that it ranges between never (0) and rarely (1).

While additional motives were not as popular as the main categories, there was an interesting category mentioned. 28 out of 199 participants noted that they were taking photos of *documents, notes, blackboards and flip charts*, to capture and store text or graphics of documents. 8 more participants noted *funny, humorous and strange* (in an entertaining sense) motives, while 7 participants noted *cars* as a popular motive for them.

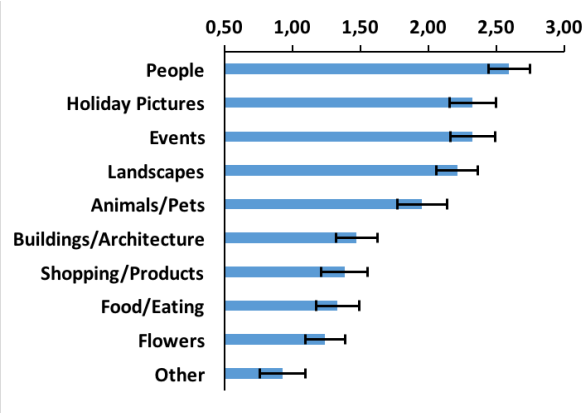

Fig. 2. Motives of users sorted in descending popularity (0..never, 1..seldom, 2..sometimes, 3..often, 4..very often).

Besides the popular motives we asked for the intent or the intended use of the pictures taken. Most popular intent was *for myself* with an average of **3.12** in between *often* (3) and *very often* (4). Based on the confidence intervals, it was significantly more popular than *to show somebody* (e.g., showing off) and *to preserve the moment* (see Figure 3). This is a non-obvious results and leads to the conclusion that in the age of social media still a significant part of the images taken on a mobile phone are intended for personal use only. Other intents that involve sharing like *to share the moment* (avg. 2.26) and *selfie* (avg. 0.88) are also significantly less popular intents. When examining additional intents not covered by the main categories, we discovered *to document something* as most popular. This goes along with the earlier findings on the motives additional to the ones given in the questionnaire, where taking photos of documents was often mentioned by participants.

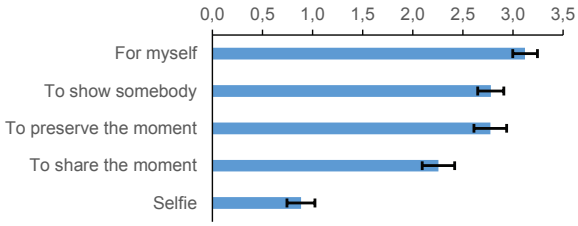

Fig. 3. Intends of users sorted in descending popularity (0..never, 1..seldom, 2..sometimes, 3..often, 4..very often).

Interval	Share
<once a month	34.0%
Automatic	24.1%
Never	23.6%
Monthly	11.3%
Weekly	4.7%
Daily	2.4%

Interval	Share
Automatic	35.5%
Never	27.4%
<once a month	21.0%
Monthly	8.1%
Weekly	6.5%
Daily	1.6%

Table 2. Backup-Interval for smartphones (left) and tablets (right).

4.8. Backup Interval

The last question was about participants' backup strategy. We let them choose between the options *automatic*, *daily*, *weekly*, *monthly*, *less than once a month* and *never*. When asked in case of smartphones most participants marked the options *less than once a month* (34.0%), *automatic* (24.1%), *never* (23.6%) and *monthly* (11.3%). In case of tablets the most submitted option was *automatic* (35.5%) followed by *never* (27.4%) and *less than once a month* (21.0%). The data is summarized in Table 1.

5. DISCUSSION

We discuss two significant differences in terms of stored images between groups that we discovered during data analysis - a difference in gender and a difference between manufacturers and operating systems. Furthermore, we report about correlation hypotheses that we tested in our gathered data.

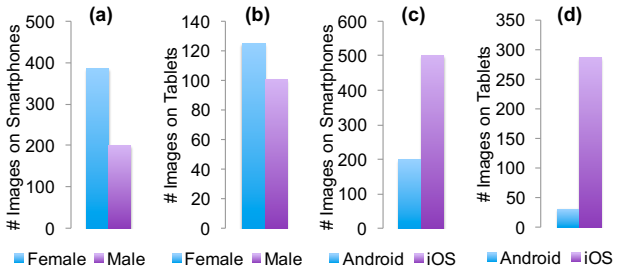

Fig. 4. Median photo count between platforms for smartphones (a) and tablets (b) as well as between Android and iOS for smartphones (c) and tablets (d).

5.1. Gender Differences

We analyzed whether there are statistical significant differences between female and male participants in terms of stored images on their smartphones. We only looked at cases where participants actually had images on their devices. Since our data does not show a normal distribution as a visual inspection with a Q-Q-Diagram showed, we chose to analyze the data with the Mann-Whitney U test, as it does not require a normal distributed dataset and is the non-parametric alternative to the otherwise typical independent t-test. However it has the requirement that the distribution of both groups are similar in shape, which was the case as a visual inspection revealed. The median count of photos was statistically significantly higher for females (384.0) than for males (200.0) as can be seen in Figure 4a, $U = 4217.0$, $z = -2.650$, $p = 0.008$.

We repeated the test for tablets with the same precondition but this time the median amount of photos was not statistically significantly different between females (125.0) and males (100.0) as can be seen in Figure 4b, $U = 495.5$, $z = 0.219$, $p = 0.827$.

5.2. Differences between Manufacturers and Platforms

We also looked at the differences between the operating systems in terms of stored images on smartphones and tablets. In our smartphone analysis we excluded *Windows Phone* (five participants) and *Blackberry OS* (one participant) since their results would not be representative enough given the low number of participants. Therefore, we focused on a comparison between *Android* and *iOS*. Similarly to the analysis above, the data does not show a normal distribution for which reason we chose the Mann-Whitney U test for statistical evaluation. We found that the median photo count was statistically significantly higher for iOS (500.0) than for Android (200.0), $U = 2913.0$, $z = -3.932$, $p < 0.001$. In case of tablets, the Mann-Whitney U test showed that the median photo count was statistically significantly higher, for iOS (286.0) than for Android (30.0), $U = 188.0$, $z = -2.561$, $p = 0.01$. Please see Figure 4 for a visualization of the median values for smartphones (c) and tablets (d).

5.3. Correlation Hypotheses

We also investigated the gathered data for different kinds of relations between various factors. Although we could not detect any meaningful associations the lack of those could still be of interest for certain researchers in the field. To investigate possible relations we first performed a visual inspection on the appropriate data for monotonic increasing or decreasing graphs, as they are a preference for performing a Spearman's Correlation test. When this visual inspection failed we dismissed the hypothesis of a relation between the factors.

We discovered that there seems to be **no relation between stored photos and storage sizes of the devices**, **no relation between how many images people have on their devices and how often they backup their device** and that there is apparently **no relation between organizational habits and how many images are on the device**.

Furthermore, we looked at a possible relation between the interval in which users take new photos and the amount of images on the devices. One could argue that a short interval should indicate a larger amount of images on the device.

Nevertheless, in our data we could not find an indication that supports this claim. **No association between the recording interval of new photos and the photo count on the devices was visible**.

Participants were also asked if they used any special photo apps for managing their photo collection. As discussed above the number was relatively low. We wanted to figure out if the photo count was any indication for the likeliness that users took advantage of such apps but **our data did not show that any such relation exists**.

6. CONCLUSION

We can summarize our average user as being 30 years old, owning an Android smartphone with 16 GB of storage, with 400 stored photos and ten stored videos. The user makes new photos regularly with her/his smartphone on a weekly basis and is not likely to backup and organize her/his media collection. In comparison to the findings of [6] in 2011 we discovered that 70% (an increase of 25%) of our participants had more than 100 photos on their smartphones and 19% (an increase of 16%) had more than 1,000 photos on their devices. Contrary to the belief that tablets deliver a better experience for viewing images and watching videos, participants in fact stored considerably less media on their tablets than in comparison to their smartphones. Furthermore, participants with iOS devices seem to have significantly more images stored on their devices than participants with Android devices. We also observed that in case of smartphones there was a significant difference between women and men. Female participants had significantly more images on their devices than men. Moreover, regardless in terms of the amount of images, users seem to rarely organize their photos in any way. This means there should be potential for works that try to optimize the browsing process in such unorganized collections.

As for user intentions and motives we found that the most popular motives are non-surprisingly those for which the cameras have been optimized. Manufacturers of course know since several years that people like to take photos of people and landscapes, at holidays and at events. However, the notion of document scanning and preserving notes and text with the camera seems to be a popular use case too, which has not yet been addressed at large. Focusing on the actual goal or intent of users we found with our study that not everything is meant for sharing. While lately most of the manufacturers and many of the researchers have focused on social sharing of images and automated image upload to the cloud, there is still the recognition of private and not-shared photos.

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