TO PHUB OR NOT TO PHUB: UNDERSTANDING OFF-TASK SMARTPHONE USAGE AND ITS CONSEQUENCES IN THE ACADEMIC ENVIRONMENT

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UNDERSTANDING OFF-TASK SMARTPHONE USAGE AND ITS CONSEQUENCES IN THE ACADEMIC ENVIRONMENT

Research paper

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Abstract

This study was inspired in part by calls for research to explore the ubiquitous phenomenon of phubbing in the academic environment. The goal of our study is to explore the phenomenon of phubbing and its consequences among students. Combining observations, questionnaires, quasi-experimental research design and focus groups interviews, our findings suggest that students phub a substantial amount of lecture time and often underestimate the effect this behavior has on their learning process. The quasi-experimental study shows that the number of times a student looks at a smartphone during the lecture is negatively related to the visual attention, while the total duration of smartphone use worsens the auditory attention. Follow-up analysis of the focus group interviews uncovers the causes of the phenomenon and possible preventive measures. The study thus contributes to a growing body of IS research on undesirable consequences of ICT use and provides implications for IS practitioners, simultaneously calling for a better solution of the problem commonly witnessed by the universities: the improvement of the educational process and student performance in the digital society.

Keywords: Smartphones, Phubbing, ICT in Education, Multitasking.
1 Introduction

Increased availability of portable digital technologies made it a matter of course that information and communication technologies (ICTs) accompany our daily lives. Especially smartphones, with over 2 billion users worldwide, have become our everyday companion (Statista, 2016). Smartphones are used everywhere – at home, at work, at the playground, and even in the classroom when students are supposed to learn something new. In general, smartphones and other ICTs can be used to improve the education process, e.g. by providing better simulations and models (Concord Consortium, 2016), enabling learning (Coursera, 2016; Glovico, 2016) and facilitating better assessment (Kessler, 2010). In fact, lecturers experience the advantages of ICTs, reporting a positive impact on the educational process in 75% of the cases (Alex, 2007).

However, there is some evidence demonstrating that when it comes to learning, ICTs such as smartphones are a double-edged sword. If used inappropriately, devices in the classroom can cause distraction for learners (Fried, 2008; Jacobsen and Forste, 2011; Rosen et al., 2013; Gupta and Irwin, 2016) and their peers (Fried, 2008; Sana et al., 2013). Particularly smartphones, with 98% penetration rate among 18-24 aged people in developed countries (Nielsen, 2016), represent the major risk, since the combination of perceived ease of use, portability and a broad range of features and functionalities increase the chances that learners will engage in off-task behaviors (Wood et al., 2011).

Frequently referred to as “phubbing”, ignoring the conversational partner in favour of one’s own smartphone (Karadag et al., 2015; Chotpitayasunondh, 2016) has recently become a common behaviour among teenagers and adults, permeating child-parent communication (Radesky et al., 2014), work environment (Roberts, 2015) and romantic relationships (Coyne et al., 2011; McDaniel and Coyne, 2016; Roberts and David, 2016; Krasnova et al. 2016). In contrast to other settings, the educational environment often implies one-to-many communication, for instance in the form of front lecturing. This particularity of academic environments creates favourable ground for phubbing to be practiced. In fact, holding a lecture has become a real challenge for many professors who have to hold a lecture in front of learners, many of whom are glued to their glowing screens. Both academics and teachers are puzzled by how to deal with the excessive smartphone use in the classroom: “Even when I know I’ve created a well-structured and well-paced lesson plan, it seems as if no topic, debate, or activity will ever trump the allure of the phone” (Barnwell, 2016). The most controversial is the fact that more than 80% of students (Berry, 2015) believe this to be an acceptable practice and perceive it as an established “new norm” (Chotpitayasunondh, 2016).

Against this background, the goal of our study is to explore the phenomenon of phubbing in the academic environment. In contrast to previous studies that often use survey data (e.g. Levine et al., 2007; Jacobsen and Forste, 2011; Rosen et al., 2013), we combine observations (Study 1), questionnaires (Study 1, 2), a quasi-experimental design (Study 2) and focus groups interviews (Study 3) to assess the prevalence of smartphone use during lectures, to investigate the patterns and motivations behind this behaviour and estimate the effect on educational outcomes. Moreover, comparing observed and self-reported data enables us to assess the magnitude of the estimation bias, when it comes to personal assessment of smartphone use.

The remainder of the paper is organized as follows. In the following section, we summarize related work and derive hypotheses that link personal study-unrelated smartphone use with the learning performance. In the next step, we present results of our qualitative study based on observations (Study 1), followed by the quasi-experiment (Study 2) and focus groups interviews (Study 3). Our results suggest that students spend substantial amount of time on their smartphones during the lecture. These findings justify further exploration of the effect of phubbing on visual and auditory attention during lectures. Analysis of the focus groups deepen our understanding of the causes of the phenomenon and allow us to derive possible preventive measures. Opportunities for future research and implications of our findings for IS research and practitioners are discussed in the concluding section.
2 Theoretical Background

Modern universities increasingly rely on ICTs to enable the construction of individual and collective knowledge (Holland and Judge, 2013). Since modern society is permanently online and permanently connected (POPC), the immediate and ubiquitous access to knowledge via the Internet has gotten so easy that our own knowledge (for example of some facts) plays a rather subordinate role (Vorderer, 2015). Following this new trend, the majority of universities provide students with permanent Internet access (Eduroam, 2016). While fostering learning, availability of free and unlimited Internet access also stimulates by-side smartphone activities during the class. We hypothesize that:

**H1: Phubbing is a widespread phenomenon in the academic environment.**

Several studies investigate the effect of the smartphone usage in the class on learning, linking the observed dynamics to the multitasking phenomenon (Table 1). In general, multitasking is defined as practicing more than one activity simultaneously (Pashler, 1994). In contrast to machines, humans are inclined to exhibit a “cognitive bottleneck” constraint in their decision-making (Welford, 1967), which shows up in slower performance of the secondary task (Levy and Paschler, 2001; McCann and Johnston, 1992; Pashler et al., 2008; Schumacher et al., 2001; Welford, 1952). Following this logic, smartphone use in the classroom for study-unrelated purposes is expected to negatively influence the academic success. According to research, short-term education outcomes are likely to suffer first (Table 1). For example, texting was found to have a detrimental effect on memorizing the lecture material (Ellis et al., 2010; Wood et al., 2011; Froese et al., 2012), although some studies have not confirmed this proposition (Rosen et al., 2011; Wood et al., 2011). A ringing phone during the class may affect not only the smartphone owner him/her-self but also fellow students, leading to lower scores on a comprehension test and missing corresponding information in the lecture notes (Shelton et al., 2009; End et al., 2009). Moreover, cell phone use has been shown to slow down the responses on the lexical decision task (Shelton et al., 2009).

<table>
<thead>
<tr>
<th>Study</th>
<th>Device</th>
<th>Method</th>
<th>Measured SP activity</th>
<th>Performance-related variables (Relationship)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ellis et al. (2010)</td>
<td>SP</td>
<td>E</td>
<td>Texting</td>
<td>Lecture-based quiz score (-)</td>
</tr>
<tr>
<td>End et al. (2009)</td>
<td>SP</td>
<td>E</td>
<td>SP Rings</td>
<td>Comprehension test (-) Lecture notes (-)</td>
</tr>
<tr>
<td>Froese et al. (2012)</td>
<td>SP</td>
<td>E, S</td>
<td>Texting</td>
<td>Lecture-based quiz score (-)</td>
</tr>
<tr>
<td>Junco and Cotten (2012)</td>
<td>SP and other ICTs</td>
<td>S</td>
<td>FB use Texting Emailing Talking on SP Using IM</td>
<td>Overall college GPA (-) Overall college GPA (-) Overall college GPA (n.s.) Overall college GPA (n.s.) Overall college GPA (n.s.)</td>
</tr>
<tr>
<td>Rosen et al. (2011)</td>
<td>SP</td>
<td>E</td>
<td>Texting</td>
<td>Recall test (-/n.s.)</td>
</tr>
<tr>
<td>Shelton et al. (2009)</td>
<td>Phone</td>
<td>E</td>
<td>SP Rings</td>
<td>Quiz score (-) Response speed on lexical decision task (-)</td>
</tr>
<tr>
<td>Smith et al. (2011)</td>
<td>SP and other ICTs</td>
<td>E</td>
<td>SP conversation Texting</td>
<td>Memory Task (-) Memory Task (-)</td>
</tr>
<tr>
<td>Thornton et al. (2014)</td>
<td>SP</td>
<td>E</td>
<td>SP presence</td>
<td>Digit cancellation task (n.s.) Additive cancellation task (-)</td>
</tr>
<tr>
<td>Wood et al. (2011)</td>
<td>SP and other ICTs</td>
<td>E</td>
<td>Texting</td>
<td>Memory quiz (n.s.)</td>
</tr>
</tbody>
</table>

Table 1. Association between smartphone activities and learning performance: overview of selected studies. Note: SP-smartphone, E-experiment, S-survey, n.s. – not significant.
Furthermore, Thornton et al. (2014) demonstrate that tasks with greater attentional and cognitive demands are extremely sensitive to any distractions, including the mere presence of the smartphone. Regarding the long-term academic performance (e.g., overall GPA), evidence on the influence of smartphone use remains mixed, as reflected in Table 1. Based on self-reported data, texting and engagement with Facebook when doing homework is negatively associated with college GPA, while for other activities, such as emailing, talking on the phone or using instant messaging no significant impact has been found (Junco and Cotton, 2012). Taken together, while research results remain mixed, there is growing evidence about the negative impact of smartphone use on the performance on tasks that require attention.

Learning theory (Dunn, 1983; Dunn, 1984; Reinert, 1976) suggests that there are three learning modalities: visual, auditory, and kinaesthetic/tactile abbreviated as VAK (Barbe et al., 1981). Fleming (1995) extended this model to VARK by adding the “reading/writing” construct. Multiple tests of the VAK/VARK model in past research suggest that the majority of students are multimodal (i.e. use several channels simultaneously) in their learning (Prithishkumar and Michael, 2014). In a traditional lecture setting, two forms are mainly prevalent: namely visual channel, achieved through lecture slides, and auditory channel, accomplished by the talk of the lecturer. We suggest that the use of smartphones during lectures affects students’ attention through the aforementioned channels. In line with the past research, we approach phubbing via two dimensions:

1) quantitative (e.g. Rosen et al., 2011), defined as the number of times the smartphone is accessed; and 2) qualitative (e.g. Junco and Cotton, 2012), defined as the total duration of the phubbing session during the lecture.

We hypothesize that:

\[H2a. \text{The number of phubbing sessions reduces visual attention.}\]

\[H2b. \text{The total duration of phubbing activities reduces visual attention.}\]

\[H3a. \text{The number of phubbing sessions reduces auditory attention.}\]

\[H3b. \text{The total duration of phubbing activities reduces auditory attention.}\]

3 Study 1: Understanding Real Behaviour and Self-Perceptions

In order to test our hypothesis H1, we conducted structured observations to assess the frequency of student phubbing activities during lectures in a purposive sample of bachelor students at one German university in summer term 2016. A lot of studies are conducted in either an experimental setting or use self-reports for data collection (Table 1). While these methods can be appropriate for several application areas, smartphone use may be different in artificial experimental setups as opposed to real environment. First, the habituation to the smartphone may be the reason of decreased control and poor recall. Second, classroom smartphone use may be perceived as socially undesirable (since it may signal disrespect to the lecturer), which may lead to underreporting. In this case, naturalistic observation which does “not interfere with the people or activities under observation” (Angrosino, 2005, p. 730), yields more reliable data. Observations are a standard method used across a variety of disciplines. This method is especially common in the context of smartphone use, since this activity is often conducted in public places and users often underestimate the time they engage in it. Indeed, a number of past studies use observation as a primary method of data collection to study smartphone use and addiction (e.g., Radesky et al. 2014; Thompson et al., 2013)

In the beginning of the observations, two observers took a seat in the middle of the lecture hall. Each of them selected three target seats while the lecture hall was still empty to be able to choose a student without selection bias; if the left-most seat stayed empty the person right from it was chosen. Observers monitored students seating in the range from row 7th to row 11th (median = 9th row). This was done to assure that we capture an “average student”. The following parameters were recorded: gender, age, smartphone position in the beginning of the class, presence of other devices (e.g. notebook or tablet);
start, end and type (e.g., browsing, texting) of each phubbing action as well as the reaction of neighbors.

At the end of the lecture, we asked the observed student to fill in a questionnaire in a paper form about his or her own estimated smartphone use and some demographic information, which allowed us to compare self-assessment with the observations’ findings. The following questions were asked in a closed format: 1) For how long did you use your smartphone during this lecture? 2) For what purpose did you mainly use your smartphone during the lecture? 3) Could you follow the content of the lecture? 4) Did you get distracted by your smartphone? 5) If yes, how much? 6) Did your neighbor’s behavior encourage you to use your smartphone? 7) Guess: How often did you use your smartphone during the lecture? 8) How strong was your interest in the topic of the lecture? 9) How did you find the lecture style of the professor? (to capture satisfaction with the style of lecture presentation), and 10) Why did you use your smartphone during the lecture?

3.1 Sample

We collected 60 observations (32 women vs. 28 men), which can be viewed as a rather balanced distribution considering the random choice of the target student. The average age in the sample is 20.5 years (min = 18 y.o, max = 27 y.o.). For the majority (more than 80%) it was the second semester at the university.

According to the Mann-Whitney U test, no significant differences were found between females and males in absolute phubbing time (z=-0.326, Prob >|z|=0.744) and relative phubbing time as a percentage of the lecture duration (z=-0.652, Prob >|z|=0.514). The subject of the lecture does not yield significant discrepancy in phubbing behavior based on Kruskal-Wallis Test with $\chi^2(2) = 6.777$, p=0.034 for absolute phubbing time and $\chi^2(2) = 5.311$, p=0.07 for relative phubbing. Since the data significantly deviated from a normal distribution (Shapiro-Wilk test p<0.05 for both absolute and relative phubbing time), we used a non-parametric test.

Generally, the observations took place over the entire lecture duration. Therefore, the mean observation time accounted for 1 hour 22 minutes. Sometimes the observation had to be stopped earlier because of unexpected events: observed student has left or the lecture was finished earlier by the lecturer. 91.7% of the observed students had their smartphones already visible on the table from the very beginning and often started the class with their smartphones in their hand. For the majority (85%) the smartphone was the only device present on the table; three students had tablets and six students had laptops additionally on their table.

3.2 Activities: What Do Students Do on their Smartphones?

Our observations show that on average students practice phubbing activities about eight times during a lecture (mean=7.98; median=8). The least heavy users only accounted for two smartphone sessions, whereas the heaviest users made 21 queries into their smartphones. Since observers were sitting almost directly behind the target students, it was possible to note the specific uses of the smartphone. One single “phubbing session” often contained several actions, e.g. someone was browsing first, then got a message and continued to type a message. Table 2 shows the number and the share of students observed doing different activities on their smartphone during the lecture as well as the frequency and duration of phubbing actions.

The most interesting result shown here is that during lectures, texting and browsing are practiced by 91.7% and 90.0% of students respectively. A typical student from our sample devoted around 16 minutes of their smartphone time to messaging. Browsing or social network activities accounted for longer time periods and took around 20 minutes. Although the third favored action observed is looking at the screen in order to check the time or for updates (58.3% of observations), it takes only about 25 seconds on average. This can be explained by the rather small amount of time needed to complete
these tasks. Focused reading was noticed among 38.3% of students with the average duration of about six minutes. Seven students (11.7%) used smartphones for playing games, spending around 4 minutes on entertainment. Activities such as photo shooting and reading were either related (e.g., photo of the professor’s notes) or not related to the course (e.g., videotaping for Snapchat). Taken together, phubbing activities not related to the learning process (i.e., texting, browsing, looking and playing) sum up to 40 minutes for an average student, thus occupying one-third of the lecture time.

Researchers also examined the surrounding of the observed students to see if any cascading behavior took place, i.e. students being triggered to use their smartphone by the smartphone use of other fellow students. In 23.3% of cases (14 observations) an observed person had no neighbors, whereas 22 students (36.7%) had peers sitting next to them. Of those, 30.0% of their fellow students (18 students) used their smartphone extensively, whereas 5.0% were not phubbing and for 1 observation it was not possible to get any results.

<table>
<thead>
<tr>
<th>Use</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Looking</td>
<td>The student catches a quick glance at the screen for checking the time or if there is a new message without unlocking the phone.</td>
</tr>
<tr>
<td>Texting</td>
<td>The student types something on the smartphone screen; usually a message at WhatsApp, Facebook or an e-mail.</td>
</tr>
<tr>
<td>Browsing</td>
<td>The student swipes the finger from bottom to top of the smartphone screen to browse the internet; usually Facebook, Instagram, etc.</td>
</tr>
<tr>
<td>Photo</td>
<td>The student takes a picture with the smartphone; either of the notes from the professor or of himself at Snapchat.</td>
</tr>
<tr>
<td>Reading</td>
<td>The student scrolls down and carefully reads for example the news or study-related articles.</td>
</tr>
<tr>
<td>Playing</td>
<td>The student taps on or swipes with his finger over the smartphone screen for playing a game.</td>
</tr>
<tr>
<td>Calculator</td>
<td>The student uses the calculator application to solve an arithmetical problem.</td>
</tr>
<tr>
<td>Other</td>
<td>Listening to the voicemail.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency of action</th>
<th>Share of all actions (N=480)</th>
<th>Mean time in min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Looking</td>
<td>79</td>
<td>16.5%</td>
</tr>
<tr>
<td>Texting</td>
<td>234</td>
<td>48.8%</td>
</tr>
<tr>
<td>Browsing</td>
<td>224</td>
<td>46.7%</td>
</tr>
<tr>
<td>Photo</td>
<td>12</td>
<td>2.5%</td>
</tr>
<tr>
<td>Reading</td>
<td>71</td>
<td>14.8%</td>
</tr>
<tr>
<td>Playing</td>
<td>22</td>
<td>4.6%</td>
</tr>
<tr>
<td>Calculator</td>
<td>7</td>
<td>1.5%</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

Table 2. Ever-observed phubbing activities during the lecture. Note: mean time in minutes – average duration among all 60 observed students.

3.3 Questionnaire

After the observation, 56 of the monitored students filled out the questionnaire. The reason for the four missing responses are the cases when students left the class earlier or rejected the request. 22 respondents (39.3%) estimated the time phubbed during the lecture correctly (Figure 1), which we defined as being accurate to up to 5 minute difference. Surprisingly, two-third of them are “heavy phubbers” who spent more than half an hour with the device in total. This speaks for a conscious behavior, meaning that these students are in general aware how much they used their smartphone. While 21.4% of respondents were too self-critical and underestimated their phubbing behavior, other 41.1% of respondents definitely underestimated their smartphone use, among which 14.3% underestimated the time they used their smartphone for about 10-20 minutes. These differences in self-report vs. real behavior further support the importance of field data collection when it comes to capturing individual smartphone use, e.g. with the help of observations.
Responding to the question whether it was possible to follow the lecture (7-point Likert scale; 1=yes, 3=partly, 7=no), 10.7% agreed they could do so. 28.6% claimed that they were able to partly comprehend the material and 17.9% reported they could not follow the professor’s presentation.

The majority of respondents (55.4%) referred to the smartphone as a distraction during the lecture whereas 44.6% reported they were not disturbed. Those 31 students who felt distracted by their smartphone had to express to what extent they were distracted. Here, most students were only distracted a bit (around 50.0%) or barely (around 30.0%). However, the respondents did not shift the responsibility for their smartphone use to a neighbor: 50 of 56 respondents reported no influence on their smartphone behavior by the fellow students nearby.

For the next two questions, we controlled for the general attitude towards the subject and the satisfaction with the presentation style of the lecturer, which might have the potential to (at least) partly explain the phubbing behavior of respondents. Self-reported interest in the subject was low for the majority of respondents (60.8%), which can be partly attributed to the fact that mandatory courses were in the focus of our study. Presentation style of the lecturer was perceived as “rather good” or “good” in 37.5% of cases (see Table 3). To investigate whether the presentation style is related to the smartphone use we compared the average phubbing time for students who reported to be interested in the subject. We observe practically no difference in time spent on the smartphone regardless of the presentation style: both groups used their smartphone around 17 to 18 minutes. In case a student was not interested in the subject, we see a difference in the smartphone use: the average phubbing time was more than 25 minutes when the presentation was evaluated as good compared to 37 minutes when the presentation style was evaluated otherwise. As such, interest in the subject, hence own curiosity, seems to be a decisive factor.

<table>
<thead>
<tr>
<th>High satisfaction with a presentation style</th>
<th>Low satisfaction with a presentation style</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (%)</td>
<td>Average phubbing time</td>
</tr>
<tr>
<td>High interest in the subject</td>
<td>14 students (25.0%)</td>
</tr>
<tr>
<td>Low interest in the subject</td>
<td>7 students (12.5%)</td>
</tr>
</tbody>
</table>

Table 3. Average phubbing time and student assessment of the own interest in the course and the presentation style of the lecture.
Finally, we directly asked students about the reasons of their smartphone use during the lecture. The main reasons for phubbing according to the questionnaire are low satisfaction with the presentation style (60.7%), boredom (55.3%) and urgent message (51.8%). As already mentioned, there is a strong connection between the lecture style and boredom. The lower the satisfaction with the lecture style, the more boredom is reported, and the more easily respondents get distracted by their smartphone. These findings are in line with Lee et. al (2014) who state that smartphones are mainly used to get over boredom and so this is one of the main reasons why students engage in phubbing. All in all, the findings from Study 1 suggest that phubbing is common to the academic environment, thus confirming H1.

4 Study 2: Phubbing and its Influence on Students’ Performance

In Study 2 we empirically assessed whether the use of smartphones during lectures decreases the visual and auditory attention of students.

4.1 Quasi-experimental Design and Flow

For the quasi-experimental study (William et al., 2002), a 90-minutes lecture in Business Informatics at a large German university in the middle of the summer term 2016 has been chosen. The procedure included a two-part survey offered both in electronic and paper form. The first part of the survey was distributed at the beginning of the lecture with the notice that it was used to assess the quality of the lecture. It contained questions related to all former lectures regarding students’ general satisfaction with the lecture (“How satisfied are you with the lecture in general?”), the perceived usefulness of the lecture (“How useful do you find this lecture in general?”), the general learning growth (“How much do you usually learn in this lecture?”), the presentation style of the lecturer (“How do you find the presentation style of the lecturer?”) and the general well-being and stress level of the student (“How do you feel?”, adopted from Kross et al. (2013)) and the motivation (“How motivated are you right now to study for this lecture?”). Questions were estimated on a scale ranging from zero to one hundred with latter being the best value. We used one-item scales for each question since keeping the questionnaire short was a priority considering the limited time frame of the lecture.

The second part of the survey took place at the end of the class and contained the same questions but related to the current lecture (e.g., “How much have you learned in today’s lecture?”). We additionally asked questions with respect to smartphone use in terms of the general duration of smartphone activities (“How often have you used your smartphone during the lecture?”) and frequency of smartphone sessions (“How many minutes have you used your smartphone during the lecture?”) during the lecture. Furthermore, an open question was included where students had to state for what reason they used the smartphone (“Be honest: If you have used the smartphone during the lecture, why have you done this?”). Additionally, students had to state for what purpose (“How much of this time (in percentage, %) did you spend with one of the following applications? (Messaging, Social Networks, Non course-related use of Internet, Course-related use of the Internet, Games)” they used their smartphone. Finally, to check the relation between the surroundings and the person’s intention to use a smartphone (Fried, 2008; Sana et al., 2013) we asked: “Have students in a direct proximity used the smartphone during the lecture?"

The educational outcomes – visual and auditory attention – were assessed by checking two pieces of information incorporated in the lecture and transmitted via only one channel. First, during the class a lecturer told a story about a Ph.D. student from Indonesia and further referred to the example 3–4 times repeating the country of origin. Auditory attention was measured by asking “Where does the former professor’s Ph.D. student come from?” Second, on the slides which are usually designed in blue-white colours, a scheme in pink appeared to describe customer relationship management (CRM). This peculiarity was, however, intentionally not pointed out orally. We therefore asked later: “What colour did the CRM scheme have?” Both questions implied open answer and were then coded to binary variable
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(1 - correct answer; 0 - false answer). At the end, we used student-selected unique identifiers to match both parts of the survey.

4.2 Sampling and Descriptive Statistics

A total of 77 respondents took part in our survey of the available 130 possible participants. 52% of the respondents in our sample are female. Almost all students (92.2%) reported that they used their smartphone during the lecture. Looking at the evaluation of student well-being and stress level at the beginning and at the end of the lecture we see only slight changes in well-being (the score of 69.8 in the beginning, and the score of 64.4 at the end) with a negative direction; whereas the stress level seems to be rather constant on average (the score of 57.1 at the beginning vs. the score of 56.6 at the end). Furthermore, in comparison with all former lectures, the present one was evaluated more positive in terms of its perceived usefulness (the score of 56.3 vs. 75.3), the satisfaction with the lecture (the score of 57.2 vs. 68.2), the presentation style of the lecturer (the score of 63.4 vs. 67.6) and the learning growth (the score of 49.8 vs. 56.8).

Regarding the smartphone use across gender during the lecture, we notice almost no difference in terms of frequency of smartphone use. However, when it comes to the duration of smartphone activities male students appear to spend more time with their smartphones compared to their female counterparts (see Figure 3, left). Asking for the purpose (why students used the smartphone), the survey responses are generally in line with the results of study 1. The reported purposes are messaging (42.3%), followed by non-course-related use of Internet (18.6%), course-related use of Internet (13.5%), social network use (12.4%), and games (2.0%) (see Figure 2, right).

Additionally, almost all respondents reported that fellow students in their proximity used the smartphone during the lecture (72.4%), whereas only around 6.6% reported that they did not notice any phubbing next to them. However, 21% of respondents were not able to give an answer to this question.

Answering the question “If you have used the smartphone during the lecture, why have you done this?” respondents mainly reported texting as their main reason (43.5%), followed by boredom (18.8%) and concentration issues (14.9%). Some respondents also used the smartphone as a substitute for a watch (hence used it to check time) (6.9%), to read news (8.9%) and also for course-related activities (5%). Around 2% of the respondents also reported the use of their smartphone during the lecture as a result of it being a habit.

4.3 Results

To test the hypotheses proposed in Section 2, we did a logistic regression analysis for both visual and the auditory attention outcomes, since both variables were coded as binary (Table 4). Apart from that
we also controlled for the well-being, fellow students’ smartphone use, motivation, stress level and gender of the student, as well as the lecture evaluation variables (i.e., usefulness, presentation style, satisfaction, and learning growth).

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Visual Attention</th>
<th>Auditory Attention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient β</td>
<td>Std. Error</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.233</td>
<td>1.377</td>
</tr>
<tr>
<td>Frequency of Smartphone Use</td>
<td><strong>-0.186</strong>*</td>
<td>0.089</td>
</tr>
<tr>
<td>Duration of Smartphone Use</td>
<td>0.032</td>
<td>0.035</td>
</tr>
<tr>
<td>Stress</td>
<td>-0.001</td>
<td>0.012</td>
</tr>
<tr>
<td>Motivation</td>
<td>-0.022</td>
<td>0.018</td>
</tr>
<tr>
<td>Usefulness</td>
<td>-0.012</td>
<td>0.019</td>
</tr>
<tr>
<td>Presentation Style</td>
<td>0.007</td>
<td>0.020</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>0.014</td>
<td>0.026</td>
</tr>
<tr>
<td>Learning Growth</td>
<td>0.001</td>
<td>0.014</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.575</td>
<td>0.493</td>
</tr>
<tr>
<td>Fellow Student Use of Smartphone</td>
<td>0.051</td>
<td>0.395</td>
</tr>
<tr>
<td>Nagelkerke Pseudo R-squared</td>
<td>0.187</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Results for regression coefficients, standard error and significance of the logistic regression (*p < 0.05*).

We observe that the frequency of smartphone use significantly reduces the visual attention. This indicates that the smartphone interactions that take place during the lecture – even if they are only brief – do have a negative influence on how well a student can follow the slides presented during the lecture (H2a confirmed). The coefficient for the total duration of the smartphone use was statistically insignificant (H2b rejected).

In contrast, auditory attention is negatively influenced by longer smartphone sessions. In other words, the more time respondents spend with the smartphone the less they are able to correctly memorize the content presented orally (H3b confirmed). No significant impact of the frequency of smartphone use on the auditory channel has been found (H3a rejected).

In summary, results of the logistic regressions show that the number of times a student looks at a smartphone during a lecture is negatively related to his or her visual attention. It is reasonable because the number of times one is distracted from the lecture slides results in one missing some visual information. Second, the total amount of time a student devotes to a smartphone is negatively related to auditory attention. As such, the longer a person uses the smartphone, i.e. the deeper the involvement with the smartphone is, the less attentively one is able to listen to the lecturer.

5 Study 3: Using Focus Groups to Explore Reasons of Phubbing among Students and Opportunities to Reduce It

In order to gain better understanding into students’ phubbing behavior, its antecedents and reactions, two focus group interviews were conducted at one German university in November 2016. This method
allows researchers to “tease out the strength of participant’s beliefs and subtleties about the topic that may be missed in individual interviews” (Campbell, 1988). Based on the literature overview and discussion among the authors, the following three items targeting phubbing in the academic context were generated and included in the protocol:

1) Do you check the smartphone or entertain yourself with the smartphone during lectures? What could be the reasons for this behavior?
2) In your opinion, how do smartphone activities during a lecture influence the performance? Does checking the smartphone help you to relax quickly? Or do you feel negative consequences of distraction, e.g. it is difficult to follow the lecture?
3) Do you think it is possible to reduce phubbing during lectures? Why? If so, how is it possible?

Two focus group interviews were organized, with 8 students (2 males and 6 females) in the first group and 6 female students in the second one. For analytical purposes, both focus group results were combined into one dataset. According to the short questionnaire completed in the beginning of the discussion, the majority (78.6%) of respondents study Business Informatics and are 26 to 30 years old; all others (21.6%) study Business and are 21 to 25 years old. All respondents have a smartphone; however, half of the sample got it after their 20th birthday. Five respondents (35.7%) have owned the device since they are 16 to 20 years old, and two respondents got used to smartphones as teenagers as they were 11 to 15 years old. Most frequently smartphones are used for emails and social media (64.3%) and most of the respondents (57.1%) check it several times an hour.

Our first research question aimed to elicit the prevalence of phubbing during lectures. Our data suggests that it is common that students use their smartphone during the lecture (P2.6: “Of course I do it, I mean, sometimes it’s more, sometimes it’s less”), with two exceptions (P1.5. and P1.3) where a radical way to preclude this was chosen: P1.3 “...I live at the campus ... so I just left the phone at home for two hours so that I don’t get in the situation I want to take it out”. When specifying the reasons, it is possible to differentiate between the kickoff and protracted absorption triggers. Initial unlocking of the smartphone is usually rooted in concentration problems (P2.6 “very often I’m off...I’m just not concentrating anymore but I’m really trying not to do it”), P2.4 “it is just about the self-control which is not that present sometimes”) or the sense of boredom during a lecture (P1.4 “if the lecture is not so interesting...” (P1.8, P2.3- the same). Apart from content, the presentation style matters as pointed out P1.7, “there is an interactive kind of lecture that doesn’t really give you the chance to look at the smartphone that often and there is this ... ehm ... frontal version of lecture where you .. like disconnected from the teacher”, which is in line with our findings from Study 1. In contrast, lasting phubbing may be arranged in advance illustrated by P2.6 : “it has to do with private things I’ organizing like...ahm...meeting friends or checking what I have to...to buy in the evening (laughing)....or ahm...like...what other things have to be ...it’s not really entertainment...” Similarly, P2.1 said “it’s more like what I have planned... If I have thing very urgent ... or something I have been thinking over a whole day: I need to write that person, I need to write this, I need to write that. ...it’s just because I have things that I need to do on my phone, then...it doesn’t matter if it [lecture] was interesting or boring”, disputing the importance of style and content of the lecture. Even if enduring phubbing was not intended, after a quick check, students are swamped by the multifunctionality of the device and permanent updates leading to absorption with the smartphone, summarized by P2.4: “...you switch on your phone and then...oh... I have a message and then I’m tagged somewhere on a new picture or let’s take a look who is this so (laughing)...so yeah...it really can be such a sequence of unwanted actions actually...”

Referring to the second research question about the influence of phubbing during lectures on performance, students admit decreasing attention and debunk the myth about multitasking. For example, P1.3 reported: “I think I pay less attention to the lecture...I cannot listen if I am writing a text message, you think you can but actually you can’t”. Similar ideas are expressed by P1.2. (“you lose information”), P2.2. (“cannot keep up with the lecture anymore”), P1.7 (”...can’t focus on the contents that
are presented, in the moment you are distracted...”), P2.5. (“the performance goes down... like... definitely goes down”). However, some respondents claim that phubbing won’t influence the final grade for the class because they will catch up later. For example, P1.3 suggests “…if I don’t pay full attention in the lecture I know I have to go through the information again when I learn for the exam” or P2.6. “…and you have to do more at home (laughing)”. In general, as P1.7. mentioned: “a negative effect in inefficiency! ... that leads to the consequence that you have to focus on the content another time”.

Finally, we asked participants to reflect on possible ways to reduce phubbing during lectures. “If smartphone is on the table already (smiling), it’s very easy to have a quick look in your messages, and so on” responded P2.6 and therefore it was proposed to leave smartphones in the bag (P2.6, P1.4, P1.7) or to switch on the flight mode because it is “a good solution to not receive anything...not to be distracted by push messages”, as noticed P1.7. The majority agrees that “restriction won’t work well” as P2.1 said. At the same time, P2.4 explains that even in the absence of the signal a student “finds something [P2.6 is nodding her head] ...he can draw [laughing]... just use old-school methods to entertain yourself...there are plenty of [laugh]”. P2.4 experienced that students “just substituted it [smartphone] with their laptops... they just did the same thing with Candy Crush and whatever stuff on the laptops”. Instead, P2.1 and P1.4 encourage increasing awareness and “tell them what effect it would have” (P2.1). However, students find the best way to reduce phubbing is to “fight fire with fire”, namely, to develop a smartphone application and thus “integrate functions of the smartphone into the whole lecture, for example surveys” (P1.7). Similarly, P1.2 proposed: “I thought about using questionnaires...so that everyone in the lecture has to seek answers a,b,c,d like in the “Who will be a millionaire?”: This will give “an instant feedback on the topic of the lecture...how many [students] understood...” Thus participants perceived a need for more interaction between a lecturer and students during the class which, accounting for the ubiquitous addiction to devices, could be established through the smartphone.

6 Discussion, Implications and Concluding Remarks

This work demonstrates that phubbing is common in academic settings. Three studies showed that students use their smartphone a substantial amount of lecture time and may underestimate the effect this behavior has on the learning process. The results of study 1 show that study-unrelated activities like texting, browsing, looking at the screen and playing take about one-third of the lecture time. Regarding study-related activities on the smartphone, e.g. looking up an unknown definition or using calculator, students allocate 1% of time. However, the majority of respondents are aware of the time lost, although some “heavy users” strongly underestimate time spent with the smartphone with a more than 10-15 minute error. Almost one third of the observed students claimed they were able to follow the presented material only partly, thus admitting the diminishing concentration, while more than 50% answered that they able to (partly) follow the lecture.

The results of quasi-experimental study 2 suggest significant adverse effects of phubbing during lecture on attention and learning. As such, the number of times a person looks at the smartphone screen is negatively related to visual attention. This effect seems to take place because frequent distraction from the lecture slides naturally leads to the loss of the visual information. The amount of time a student devotes to the device is also negatively related to his or her auditory attention. Our argument is that long smartphone sessions usually imply deeper involvement with the activity which means students listen to the lecture less carefully.

The results of study 3, designed as focus groups interviews, in combination with surveys embedded in study 1 and study 2 offer insights into why students practice phubbing, how they perceive the effects of phubbing, and whether it is possible to prevent it. As such, low interest in the lecture, low satisfaction with the presentation style of the lecturer as well as self-control issues are the main reasons for off-task smartphone activities. Although negative effects on instant educational outcomes were admitted, the majority of respondents believe phubbing at the lecture does not influence the long-term out-
comes, namely the exam grade, since they plan to go through the material once again. To prevent the excessive smartphone engagement, it is recommended not to put the device on the table leaving it in the bag or switching on the flight modus in order not to be distracted by constantly incoming messages and newsfeed updates.

Our findings have implications for IS practitioners mainly targeting mobile app providers and smartphone producers. To the best of our knowledge, there exist only few applications addressing the phubbing issue at school, at work or at home (Flipdapp.co, 2017; Xerofone.com, 2017). Narrowing the perspective to the learning environment, students (study 3) believe the best way to solve the problem is to create a smartphone application that allows to give an immediate feedback to the lecturer on the material understood and thus helps to keep attention (Dyer, 2016). Another opportunity is an application that monitors phubbing activities and makes students aware of the total amount of time spent inefficiently during learning (Goldman, 2015). Moreover, raising awareness about the scale of phubbing in the educational context may be desirable.

This study was inspired in part by calls for research to explore the ubiquitous phenomenon of phubbing in the academic environment, previously studied in the romantic (e.g., McDaniel and Coyne, 2016; Roberts and David, 2016; Krasnova et. al., 2016) and family context (Radesky et al., 2014). Our aim was to understand the phubbing behavior of learners in the academic context, as well as to gain a better understanding of its antecedents and consequences. However, the current study comes with limitations that open exciting venues for future research. First, our investigation can be extended to a broader range of subjects and type of classes to include seminars and tutorials, thus increasing the reliability of the results. Moreover, our findings are especially valid for academic institutions that have large classes and a high level of smartphone adoption among students. Finally, to extend our results, a more comprehensive model describing phubbing influence on learning can be tested in future studies.
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