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Investigating the Impact of an Intervention that Increases Users' Awareness of Phubbing

Bachelor Thesis in Media Informatics at Ulm University

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Abstract

Smartphones have become an integral part of everyday life. They offer numerous benefits but also bring challenges, such as Phubbing, where people use their smartphones in the presence of others, ignoring the social interaction. While previous research highlights the negative effects of Phubbing, there is a lack of solutions to address this problem. Therefore, in this thesis I present an approach that aims to reduce Phubbing by raising awareness of smartphone use through real-time interventions. In a two-week field study with 20 participants, an app was used to identify Phubbing moments and intervene the subjects that they are Phubbing through a pop-up notice. The results showed that the interventions raised the awareness of the participants of their smartphone behavior and therefore reduced Phubbing. This study contributes to the scientific discussion by demonstrating a possible solution to reduce Phubbing and improve social interactions.

Contents

1 Introduction

The majority of society probably believes smartphones play an essential role in their daily lives. They offer numerous advantages such as global networking or entertainment and have become indispensable as modern, digital Swiss army knives. At the same time, they also bring with them certain challenges. One of these is Phubbing. Phubbing describes a widespread behavior in which a person uses their smartphone in the presence of others, ignoring the social interaction.
In 2012, Przybylski and Weinstein published a study that found a negative impact of cell phones on interpersonal relationships simply by their presence, even when the device was not being used [28]. It should be noted that the study is older and that the general social perception and behavior toward cell phones have changed a lot because of their exponential development and use. Nevertheless, this does not minimize the relevance of the topic, it rather underlines the need to examine the influence of smartphones on our social interaction more deeply today. If the mere presence of a smartphone can have an impact on the quality of social relationships, how strong is the influence of active smartphone use? This question highlights the importance of Phubbing and how to deal with it.

It has been shown that Phubbing can harm the quality of personal conversations and the resulting social bonding [5]. In addition, those affected (phubbed persons) often have negative feelings as a result [17]. My personal experiences also confirm these negative effects. If quality time together is interrupted because the other person is again and again looking at their smartphone, it can be difficult to have real conversations that strengthen the connection. You also feel pushed aside, as there seems to be something more important than the interaction.
These personal experiences, as well as the negative effects that have been confirmed in studies, highlight the need to take a closer look at the problem of Phubbing and, in particular, make a method to prevent it. Although there are already several studies on the consequences and possible causes of the phenomenon ([17], [26], [19], [8], [1], [7]), there are no published reactive approaches to solving it yet. This paper will therefore examine an initial concept for a way to reduce Phubbing.

Studies have shown that Phubbing often does not happen consciously and that many

people do not intend it ([1], [5]). A decisive factor for the success of therapy in changing unconscious behavior is creating awareness of these actions [27]. Therefore, I think that a first success in the prevention of Phubbing could be to raise the Phubbers awareness of their behavior. This idea leads to the central research question of this study:

Research Question (RQ):
What impact can an intervention have that increases users' awareness of Phubbing?

To investigate the RQ, I conducted a two-week field study with N=20 participants. I developed an application that ran in the background of the participants' phones to monitor their usage behavior during social interactions. The app recognized Phubbing moments based on social distance and smartphone usage and then informed participants with a pop-up (intervention) that they were in a social interaction. In questionnaires, which were triggered in response to a Phubbing event, participants answered questions about their last social interaction. I recorded the unlocking and usage times of 609 smartphone use during social interactions, for which I collected 85 completed questionnaires. In addition, a 10-15 minute individual interview was conducted with each subject at the end of the study.
By analyzing the recorded smartphone usage times (during a social interaction) with and without intervention, the questionnaires and the statements of the individual interviews, a sharpening of awareness of smartphone usage behavior during social interactions and a reduction of Phubbing through the use of the interventions could be determined. Therefore, I suggest using the interventions as support of the system to raise awareness of the own behavior and reduce Phubbing moments. In addition, the results guide how such interventions could look like.

Contribution Statement:
This work contributes to the scientific community in the following way:

- Raising awareness of the smartphone usage behavior during a social interaction through interventions in real-time (based on testimonials of study participants).
- The reduction of Phubbing behavior through interventions and by raising awareness of one's own smartphone use (based on data and testimonials of study participants).

2 Related Work

In this chapter, the phenomenon of Phubbing and the existing research in this area is summarized. I will look at the origins of the term, its social relevance, and the effects of this behavior. I will also consider the reasons for Phubbing and present possible strategies that could help to prevent this behavior.

2.1 Phubbing

Phubbing is made up of *"phone"* and *"snubbing"*. To be phubbed means that someone in your company is ignoring you by using their mobile phone. This can happen when your conversation is interrupted because the other person is using their phone, or when someone is near you but is looking at their phone instead of communicating with you [31, p. 1]. The word was originally invented by the Australian company McCann on request from Macquarie Dictionary as part of a linguistic experiment [22]. The fictional campaign started under the title *"Stop Phubbing"*, described a phenomenon that was already known in many places but had no name. This was followed by numerous publications and media reports that used this new term to discuss Phubbing behavior.

Relevance, Risks and Effects of Phubbing

Vanden Abeele et al. analyzed the frequency of Phubbing moments during 10-minute one-on-one conversations and found that Phubbing is not an isolated single-case phenomenon, but an omnipresent pattern of behavior [37].
In the general perception, Phubbing is described as disrespect and disinterest, which often leads to the affected person experiencing a feeling of social exclusion and abandonment. Several factors influence these effects, including the reason for the phone use, the duration and frequency of use, the group size, the politeness of the Phubber and the personal relationship between the conversation partners [17].
Especially in deep interpersonal relationships such as between family members [26], friends [19] or in romantic partnerships [8], a connection between Phubbing and a perceived reduction in the quality of conversation or relationship intimacy was found.

Reasons for Phubbing

To develop strategies that can reduce Phubbing, especially studies that investigate the reasons for this behavior are interesting.

Phubbing primarily happens in environments where smartphone users are often alone [17]. In addition, there is no correlation between a person's Phubbing behavior and their assessment of the Phubbing behavior of their conversation partner [19]. Perhaps that could indicate that Phubbing often happens unconsciously and often even clashes with one's own ideals. This assumption is also supported by Aagaard, who interviewed students on this topic in his study [1]. The evaluation of the interviews showed that many people find Phubbing annoying but do it anyway, even if they don't intend to. This discrepancy of unintentional distraction by the smartphone is described as digital Akrasie and is attributed to possibly poor technological behavior.
Lutz and Knop name Phubbing itself as a possible predictor of Phubbing [19]. In the paper's study, it was observed that Phubbing can be contagious and that this behavior can easily spread within social groups. Furthermore, the study did not find any other clear reasons that could be used to predict Phubbing behavior. Less Phubbing indeed happens in interactions with higher value, but it is not possible to predict the frequency of Phubbing based on the low value of the interaction.
A decisive factor for Phubbing is smartphone addiction. The combination of high technological progress (instant messaging, smartphone as an entertainment medium) and psychological aspects (loneliness, stress, anxiety) can lead to excessive smartphone use and result in smartphone addiction. This addiction then becomes visible during social interactions in the form of Phubbing [7].

Avoidance of Phubbing

The findings of the previous section show that the main reasons for Phubbing are very deep-rooted. It often happens automatically out of habit and without awareness [1]. However, many people do not want to phubb or be phubbed, which emphasizes the urgency (and possible willingness) to solve this problem.

One approach to reducing smartphone use in a social context is to provide small nudges. A study showed that a simple hint to keep the smartphone in a box and not to use it during the entire visit to a pub was enough to get participants to voluntarily put their smartphone aside. This suggests that even small measures can have an impact on usage [6].
Preventing smartphone addiction is another key to reducing Phubbing. The required self-control can be supported by the introduction of rules, regulations, or information [7].

"Mindphone", an app that promotes mindfulness and self-control, also showed positive results. Users had to state why they wanted to use the smartphone every time they unlocked the screen, which led to a more conscious use of technology and significantly reduced screen time [36].
The results of the studies presented suggest that Phubbing, smartphone use in a social context or smartphone use, in general, could be reduced if users are taught to use their smartphones more consciously. This can be achieved through external measures such as system restrictions [36], voluntary action on request [6] or information [7]. The successes of the methods tested indicate that smartphone users are willing to adopt such approaches.

As there is no well-established method to prevent Phubbing, it still remains a challenging problem. My work offers an initial approach at solving this problem.

3 Implementation of the Study App

In order to investigate the effects of the interventions, which should raise the awareness of users for Phubbing, I have written an app that aims to detect and analyze Phubbing. To do this, several specific functions and requirements must be fulfilled, which are presented in the *Requirements* section. Afterward I will describe the technical realization of the app in the section *Implementation*.

3.1 Requirements

The app should not only detect and document Phubbing but also actively intervene in the process in order to sensitize users to their Phubbing behavior and investigate the effects of such interventions.

Detection of Phubbing

To investigate the research question in a realistic scenario, the primary aim is to identify Phubbing in the first place, which consists of two components: *Detection of a Social Interaction* and *Detection of Smartphone Use While this Interaction*. As the app should interact with the user at the moment of Phubbing, it should also be noted that Phubbing detection must be performed in real-time.

Detection of Social Interaction

The app must be able to detect social interactions between the test subjects. This function is crucial, as Phubbing is only relevant in the context of such interactions. There are already two approaches for the detection of social interactions via smartphone, which are discussed in more detail below.

Analysis of Social Interactions Through Mobile Phones Matic et al. have analyzed how cell phones can be used to detect social interactions [20]. For this purpose, the parameters "interpersonal distance" and "relative body orientation" were evaluated. Interpersonal distances were calculated based on the *Received Signal Strength Indicator* (RSSI) values of cell phones carried by test persons. By classifying these distances, it

was decided if the interaction was close enough to be social. The RSSI values were measured using the Wi-Fi signal of the devices. Alternatively, it is also possible to record the values via Bluetooth. By analyzing and evaluating the relative body orientation, which could be recorded via sensors integrated into the smartphone, it was possible to differentiate between formal and informal situations. The classification of interpersonal distance, which exists in social interactions, is done with the help of the proxemics of Hall shown in Table 3.1 [14].
It should be added, that the study was limited to 6 static Android phones. Access to the RSSI values via Wi-Fi or Bluetooth was possible because the MAC addresses of the mobile devices were known and the system was adapted to this. Without knowledge of the MAC address, it is not possible to access the RSSI values of an Android cell phone. This limitation makes realistic use for larger studies difficult.

Corona-Warn-App A method that is more implementable in the real world for determining social distances via cell phones is the "Corona-Warn-App". It was published by the Robert-Koch-Institut (RKI) during the Covid-19 pandemic to break chains of infection. SAP and Deutsche Telekom AG were involved in the development. It is a contact tracing app that informs users if they have been in contact with infected persons (close contact). "Close contact" is detected and classified via *Bluetooth Low Energy* (BLE). Every smartphone that has the app installed sends a temporary identifier (rolling proximity identifier). Beacon technology is used for this. At the same time, the app scans for identifiers from other mobile devices. If a beacon with an app-internal identifier is detected, this suggests a contact. The distance of the beacon (calculated using the RSSI values) and the duration of its presence are sent to a server (database). There, the type of contact (close/not close) is classified based on the data. Users can register a diagnosed COVID-19 infection in the app. This message is sent to the server and all "close" contacts that are stored there will be informed [33].

Overall, while both methods provide valuable tools for detecting interactions, the limitations identified in the approach of Matic et al. (see *Analysis of Social Interactions Through Mobile Phones*) highlight the need for more adaptable and scalable solutions. Beacon technology, as used in the Corona-Warn-App, proves to be a promising method to overcome these limitations and provide a practical framework for detecting social interactions via smartphones in different environments. I adopt the classification of social distances from the proxemics of Hall [14].

type of distance	from	to
intimate distance	< 0.45 m	0.45 m
personal distance	0.45 m	1.2 m
social distance	1.2 m	**3.6 m**
public distance	3.6 m	> 3.6 m

Table 3.1: Proxemics of Hall [14]

Detection of Smartphone Use While Social Interaction

In addition to recognizing social interactions, the app must also be able to detect the use of smartphones during these interactions. As soon as these two conditions - social interaction and simultaneous mobile phone use in real-time - are fulfilled, the app can identify Phubbing.

Show Interventions for Phubbing

Another central function of the app will be to show and hide interventions when phubbing is detected. These interventions will be the system's support to make users know that they are using their mobile phone although they are in a social interaction. To evaluate the effects of the interventions, there will be two conditions: the control mode without intervention and the treatment mode with intervention. The app must be able to display both modes and react suitably by either displaying interventions or not.

Data Collection on Phubbing Behavior

A key component in investigating the effects of the interventions will be the collection of data on the Phubbing behavior of test subjects during a study. This will include recording data points, such as the number of mobile phone use during a social interaction and the duration of each use. In addition, the app should be able to record the type of use (e.g. messaging, social media, etc.) and the type of social interaction (e.g. conversation, eating together, etc.). This is therefore important, as the context of use could potentially influence Phubbing behavior.

3.2 Implementation

In order to be able to investigate what effects a system behavior can have that raises awareness of Phubbing among users (RQ), I have implemented an application that is described in the following.

To start with, I present the definition of the technical requirements for the app (Table 3.2). Figure 1 visualizes the rough flow and function of the technical requirements 1-5 and 8. A detailed description of the individual functions follows below. For more specific implementation details, see the project's technical documentation. The app is written in Kotlin for Android systems.

The app should ...
1. let the smartphone act as a transceiver to **advertise beacons** with a specific key via BLE
2. let the smartphone **scan for beacons** with a specific key via BLE
3. **decide**, based on the distance of a positively scanned beacon, **if it is within *social distance* (SD)**
4. **register and unregister *social interaction* (SI) in realtime** if there is another phone/beacon within SD
5. **initiate interventions** if the participant uses the smartphone during a registered SI (or not: depends on condition)
6. **initiate questionnaires** to the participant if the smartphone was used during a SI
7. **track the Phubbing behaviour**
8. **run in the background** for the whole study duration

Table 3.2: Technical requirements of the study app. See *Real-Time Contact Detection* (1, 2, 3, 4), *Interventions* (5), *Data Collection* (6, 7) and *Service* (8) for more details on how it works.

Real-Time Contact Detection

For this first part of the implementation (requirements 1 to 4), it is necessary to define what a SI is from a technical point of view.

Social Interaction (technical definition) Two, or more subjects - who have the app installed on their smartphone - are in a SI when their smartphones are at a distance from each other which is smaller than the fixed defined benchmark of 3.6 meters (SD from proxemics of Hall, see Table 3.1).

The determination of such a SD or interaction shows parallels to the Corona-Warn-App (background and more information in *Requirements: Detection of Social Interaction*).

They used beacon technology via BLE for the implementation of this social contact detection. This method has already proven successful in the everyday use of smartphones during the coronavirus pandemic (when the app was used). This is why I used this technology for contact detection.
For a better understanding, I would like to explain the technologies - which I will use based on the Corona-Warn-App - in more detail:

Bluetooth Low Energy (BLE) BLE is a variation of Bluetooth technology that was specially developed for use in devices with low power usage. While classic Bluetooth is designed to transmit large amounts of data over long distances, BLE has been optimized to transmit small amounts of data over short distances while using as little energy as possible. Additionally, BLE devices can be connected more quickly and easily than classic Bluetooth devices (without pairing) [4]. Since only a short distance is required for social contact detection, and low power usage of the device is also an advantage, the properties of BLE are ideal for applications of this type. BLE has been supported on Android devices since version 4.3 (Jelly Bean).

Beacon-Technology Beacons are a technology that sends advertisements via BLE. They define a radius around themselves so that devices that scan for these beacons can detect when they enter or leave the radius. They are mainly used in public spaces (museums, department stores, etc.) to send customers offers or information that they can access on their smartphone (e.g. in an app).

The app is installed on the smartphones between which a possible SI is to be detected. Smartphones simulate a beacon by transmitting (sending) advertisements with an app-internal identification number, named *Universally Unique Identifier* (UUID) via BLE. At the same time, they search for beacons with this identification number. Once they have found a beacon, they are located within the radius of a smartphone that also runs the app. The RSSI values of the beacon can be used to calculate the distance to it. If these are inside of the SD, the detection of the beacon (other smartphone) is registered as a SI.

I will use the *AltBeacon* library to implement the beacon technology in my application. It is an open-source project by Radius Networks and has already been used by more than 16.000 mobile applications. Including brands such as McDonalds, KFC, and Disney World. By default, the library is designed for AltBeacons but can be adapted to various other formats such as iBeacon (from Apple) or Eddystone (from Google) at any time.

Requirement 4 shows a difference to the Corona-Warn-App: the app in this study

should register the detection of social interactions in real-time. Therefore I used a Live-Data Boolean. All parts of the app can update or read the social status at any time. 30 seconds after the smartphone has left the beacon radius of the other smartphone, the social status boolean is set to false. This minimum delay compared to real-time is based on a compensation function that corrects device-specific false alarms.

Interventions

If study participants unlock their smartphone while they are in treatment mode, and a SI is registered, the app shows an intervention. Interventions are pop-ups that appear above the display. The intervention shows a text that informs users that they have unlocked their smartphone during a SI. Users can read the time and status bar, but can no longer operate the smartphone without closing the intervention. It is closed and set to null by pressing the button or by locking the screen. The button with which it can be closed can not be clicked until 3 seconds have passed since the intervention was created. There is only one instance of the intervention which will be created new after closing it. Figure 3.1 shows how this intervention will look like.

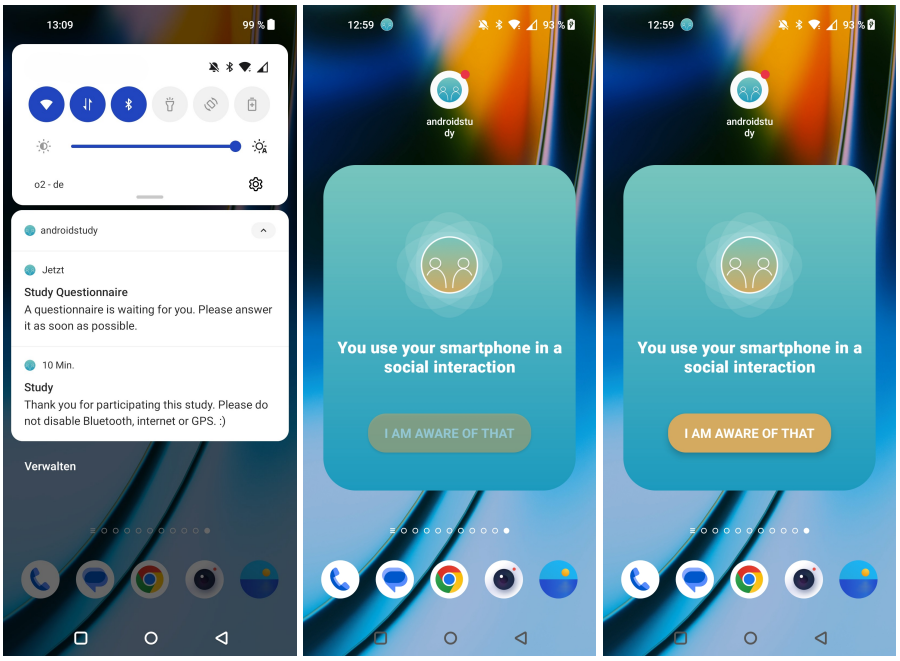

Figure 3.1: Study app from the subject's perspective: display of interventions (Figures 1, 2), display of notification for a questionnaire (Figure 3)

According to Klein, frequent Phubbing is perceived as more annoying than a single, longer period of smartphone use [17]. Therefore, the interventions are shown directly when the screen is unlocked and not after a given period. This allows users to be prevented from Phubbing before they do it.

Data Collection

Quantitative data will be collected in order to evaluate the effectiveness of the interventions in relation to the RQ. This data is tracked automatically and also requested from test subjects in the form of questionnaires.

Automatic tracked data

The app sends the tracked data to a cloud database (*Firebase Firestore* by Google) in real time. Internet access (WLAN or mobile data) is required for this. The data can be exported with the help of GUI clients like *Firefoo* or *Rowy* (e.g. as CSV).

When the app registers a SI, which means that a beacon with the study-internal UUID has been detected, it saves the current time as "start of interaction" and the timestamp as "sessionID" in the app memory. If the defined beacon radius is left, this time is saved as the "end of interaction". A new data document is now created with "session ID", "start of interaction", "end of interaction", "date of interaction start", "date of interaction end" and "subject ID" and sent to the app's Cloud Firestore project (see Figure 3.2).
When the app detects that the screen was unlocked (through a screen-unlock-broadcast-receiver which is always active), it checks if a SI is registered at the moment. If yes, it saves the current time as "start of phone use" and starts the accessibility service, which saves the names of the apps that will be opened from now on as a list called "apps used". As soon as the screen is closed again, a new data document is created with "start of phone use", "end of phone use" (time when screen was closed), "subject ID", "condition" (current condition) and "apps used" and sent directly to the app's Cloud Firestore project (see Figure 3.3).

Questionnaires

After each end of a SI, which means that the defined beacon radius is left, the app saves the current time plus 5 minutes as the next "time to show questionnaire" and sets a boolean called "show questionnaire" to true. To be reversible it sets "show questionnaire" to false if a new SI will be registered within the next 5 minutes. If now the screen is unlocked (through a screen-unlock-broadcast-receiver which is always active)

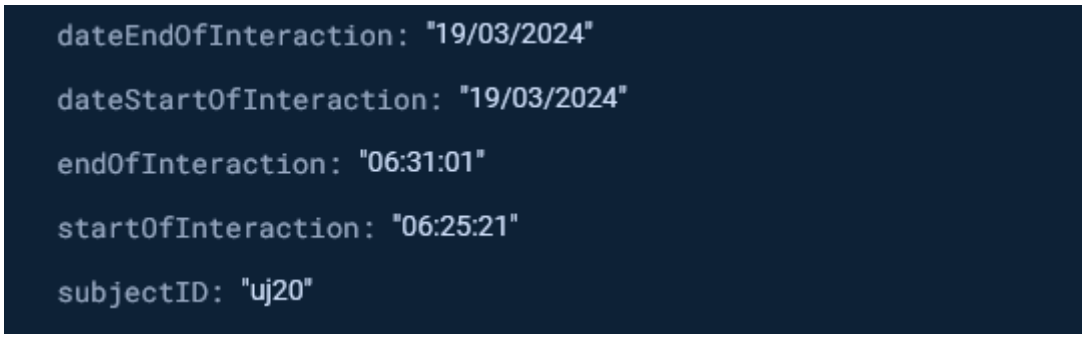

Figure 3.2: Example of a "social interaction" data document which will be sent to the app's Cloud Firestore project. Document name is "uj20 1710826261883", which is the current timestamp, also called "session ID".

Figure 3.3: Example of a "phone use" data document which will be sent to the app's Cloud Firestore project. It was registered in the session which is shown in figure 3.2.

it checks if "show questionnaire" is true, and if "time to show questionnaire" is reached. If yes, test subjects will receive a notification. This informs them that a questionnaire is waiting for them. The decision to send the notifications only after unlocking the screen and not directly after a timer ends, which sounds more obvious, is based on the fact that timers have not proven to be reliable in this app. This may be because the service is constantly running and other jobs therefore take a back seat. A link is opened by clicking on the notification. This link is also filled with "subject ID", "session ID" (last interaction) and "condition" (current condition). This data is then automatically sent to the open questionnaire and does not have to be completed by the study participant. If the notification is accidentally closed without having completed the questionnaire for the

last session, it can be opened at any time via the "questionnaire" menu item in the app. The questionnaires are created with *LimeSurvey*.

Foreground Service

A foreground service is a special Android development service that performs operations in the background but is permanently visible to users. The visibility is realized with a notification within the status bar of the smartphone.
During the development of the app, I noticed that the standard foreground service for Android developers can no longer access the location (which is needed to detect beacons) of the device in doze mode. For the real-time detection of social distance, it is essential to continue running in doze mode. For this reason, I use the foreground service provided by the AltBeacon Library, which continues to run stably and recognize beacons even if the smartphone is in doze mode [29]. Also, the duration of the scanning periods can be customized and the time between the scans.

4 User Study

To evaluate the RQ of this thesis by using the app (see chapter *Implementation* or section *Apparatus*) I conducted a user study, which is presented in the following sections.

4.1 Apparatus

As a tool for the study, I developed an Android application that runs as a service in the background. To recognize the social interactions of the study participants, I implemented and modified the AltBeacon service. In this context, the app continuously transmits an internal study beacon with a range of approximately 20 meters. At the same time, the app scans for other study-internal beacons at intervals of 10 seconds. If such a beacon is detected the distance is calculated. If this distance is less than 3.60 meters (SD), a SI is logged. Opening and closing the smartphone is recognized by an unlock-receiver integrated into the service, which is permanently running. If a SI and the unlocking of the smartphone are registered at the same time, this is recognized as Phubbing behavior. As soon as no more beacons are found in the SD, the SI is ended. Five minutes after the last interaction, a notification is noted that leads to an online questionnaire the next time the screen is unlocked (see last in Figure 3.1). At the end of the two-week study, the beacon service and unlock receiver automatically deactivate and participants are asked to uninstall the app after completing the final questionnaire, which is now available in the app.

In order to investigate the effects of the intervention on the study participants, it was implemented and tested for one week in condition B, the treatment mode. During this phase, if Phubbing behavior is detected, an intervention is immediately shown on the display, which can be closed via a button after a waiting time of three seconds (see Figure 3.1). Condition A serves as a control mode without intervention and also runs for one week. Depending on which condition the app was running in at the start of the study, it automatically switches to the other condition after one week.

4.2 Study Design

Since the basic idea of my study is to increase mindfulness in smartphone use and this has similarities to the *Mindphone* study [36] I already mentioned in Related Work (with the difference that I am looking at raising awareness in a social context to reduce Phubbing), I orientated my study on their study design. I adopt the study design in the form of a two-week within-subject field study and the collection of qualitative data through final interviews with each subject. During the study, the app tracked usage times and other data, for collecting quantitative data. Additionally, using the Experience Sampling Method (ESM), participants were required to complete questionnaires when they used their phones while social, gathering quantitative data too. There were two conditions. The allocation and order of the conditions were counterbalanced.

4.3 Procedure

The study ran for a total of two weeks and followed a structured schedule, as shown in Table 4.1. At the beginning, both participants of a study pair met for the first session. After a brief introduction by the study leader, the participants were informed about the study. To minimize potential bias, the participants were told that they were about to test a distance tracker app. The participants installed the app on their Android devices and registered for the study under supervision, where they had to provide demographic data. After the participants had signed a declaration of agreement to the use of their data, they started the app (see Figure 4.1).
The main part of the study was divided into two phases: 7 days in control mode (condition A without interventions) and 7 days in treatment mode (condition B with interventions). The order of these conditions was counterbalanced for the groups as specified in the *Group Allocation Table*.
At the end of the study period, a final meeting with each participant individually, without their group partner, took place. At this meeting, the app was uninstalled and an open, audio-recorded, 10-minute interview followed. Finally, the participants received a participation payment of 10 euros and signed a confirmation for this. This marked the end of participation in the study for the test subjects.

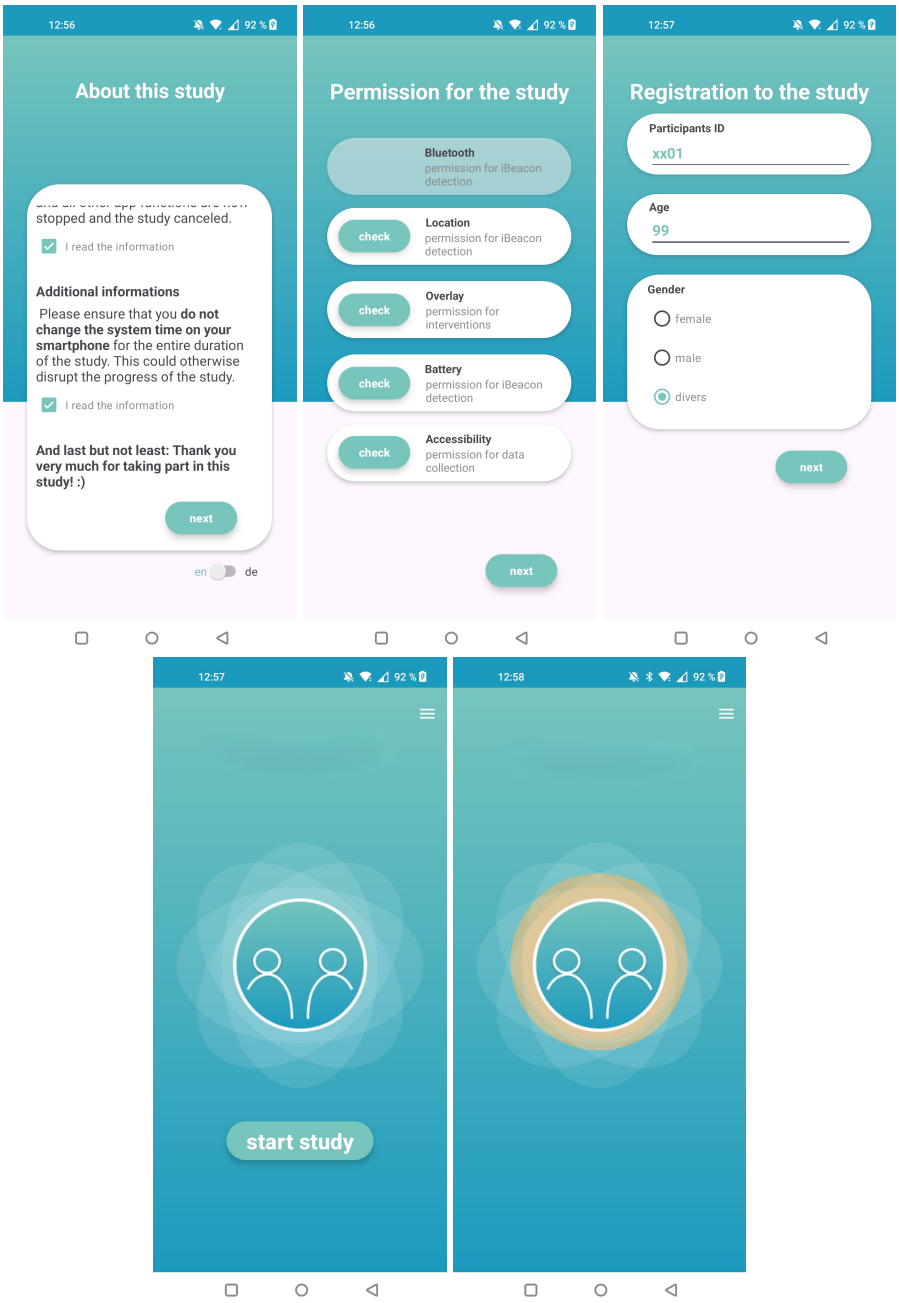

Figure 4.1: Study app from the subject's perspective: Initialization process with study information, permissions and subject registration (Figures 1-3), start of study (Figures 4, 5)

scheduled duration	agenda
10 min	Installing the app and study registration
7 days	Running app in condition A/B
7 days	Running app in condition B/A
15 min	Final interview, uninstalling the app and payment

Table 4.1: Scheduled agenda for the two weeks participation of the study.

week 1 (W01)	week 2 (W02)	group allocation
control mode	treatment mode	1, 3, 5, 7, 8
treatment mode	control mode	2, 4, 6, 9, 10

Table 4.2: Allocation of conditions in counterbalanced within-subject study design.

4.4 Participants

I used an advertisement to recruit participants. To avoid factors such as quantitative (rather than qualitative) social context, I only asked teams who did not live together. Only teams that see each other more than twice a week were considered for reliable data collection. Out of N=20 participants, 20 participants completed the study. The participants (female=10, male=10) were between 21 and 56 years old (mean age= 31.45, SD= 8.99) (see table *Study Participants* for details). All participants who completed the study received a payment of 10 euros.

4.5 Measurements

In the following, I will describe the data collection during the study. This includes quantitative data collected through automatically tracked information in the app (passive) and through questionnaires (active), and qualitative data obtained from interviews. Both qualitative and quantitative data were collected in the study. The qualitative data provides possible explanations for the results of the quantitative data and enables a deeper understanding of the reasons and correlations behind it. By combining both types of data, a more comprehensive picture could be drawn of the impact of the interventions on the subject's Phubbing behavior or their awareness in this regard.

Passive Data Collection

During the two-week study phase, the app collected the following data: the start and end of a SI, the unlocking and locking of the screen within a SI, and the names of the

apps that were opened during these interactions (see *Automatic Tracked Data* for more technical details). This data is selected so that it can be used to calculate the duration of a SI and smartphone usage within each interaction. The app recorded this information and sent it directly to the database.
These information is necessary to conclude the Phubbing behavior of the subjects with and without the interventions. By recording the duration of the smartphone usage and the apps used, it is possible to analyze how frequently and intensively the subjects used their smartphones within a SI. This makes it possible to evaluate the effects of the interventions on Phubbing behavior and to see if the measures lead to a reduction of smartphone use in social contexts.

Questionnaires

While the study was running, the test subjects received a notification with a link to an online questionnaire after they had used their smartphone during a social interaction with their study partner (see *Questionnaires* for more technical details). The questionnaires were used to record the subject's subjective experiences to be able to compare them later between treatment and control mode.
In order to test the reactance of the study participants to the interventions provided by the system, they answer questions from the *Reactance Scale of Human-Computer Interaction* (RSHCI) by Ehrenbrink and Möller [11]. The reason for considering reactance as a measure is the question of how users feel restricted in their freedom by the interventions. A high level of reactance could lead to lower acceptance of the interventions. Measuring reactance can help to identify problems in this regard and thus allow improvements to be made. Following the research already conducted by Vanden Abeele et al. on the topic of Phubbing (see *Related Work*), I adopted the question sets about *Perceived Conversation Intimacy* (PCI)[1] and *Perceived Distraction of Self and Other* (PDSO)[2]. PCI measures how connected conversation partners feel during the interaction. This is relevant as an increase in conversational intimacy could indicate that the interventions reduce Phubbing and as a result, the quality of conversations is improved. PDSO assesses if one perceives a distraction. A reduction in this would indicate that the interventions are effective and that the participants feel less disturbed by Phubbing. To get a possible picture of the subject's self-perception, they are asked about their Phubbing behavior, using the *Phubbing Scale* (PS) by Karadağ et al. [16]. The subjects also had to indicate their *Perceived Inclusion of Self in Other* (PISO) (by Aron et al. [3]) between themselves and their study partner after each interaction

[1] *Fear of Intimacy Scale* by Descutner and Thelen (question 1-3) [9], *Miller Social Intimacy Scale* by Miller and Lefcourt (question 4-5) [23] and *Emotional Intimacy Scale* by Williams (question 6) [38]
[2] *Attentional Allocation Scale* by Harms and Biocca [15]

by marking their current perceived proximity to each other and specify the *Context of the Social Interaction* (CSI) in a free text field. Recording the context can possibly show when test subjects particularly tend to use their smartphones even when in social company.

After the last day of the study, the app sent the test subjects a notification which led to a final questionnaire. This contained the *Mobile Phone Usage Addiction Scale* (Smartphone Addiction Scale:= SAS) questionnaire by Karadağ et al. which was intended to collect a self-rating of the user's general smartphone addiction [16]. In addition, the *Kind of Relationship* (KR) in which the two test subjects of a group were at the time of the study had to be specified. Several answers could be selected from the answer set "friendship", "family relationship", "romantic relationship", "classmates/fellow students", "work colleagues" and "other". The type of relationship can be relevant to see in which types of relationships Phubbing is more common.

Interviews

At the end of the two-week study phase, I conducted a final interview of 10-15 minutes with each participant individually. The questions used in the interviews (see Table *Interview Questions Set*), contained questions about "Experiences With Phubbing", "Ratings About Smartphone Use During Social Interactions", "Experiences With The Interventions" and "Ratings About Interventions". The selection of the four question areas enabled me to get a comprehensive picture of the effects of Phubbing and the interventions. This is important to draw significant conclusions about their effectiveness and to provide points for future research on other measures.

The questions about "Experiences With Phubbing" were designed to get an in-depth understanding of the subject's subjective perceptions and experiences of Phubbing. The "Ratings About Smartphone Use During Social Interactions" were conducted to capture the subject's attitudes and opinions to identify norms and expectations of general smartphone use during a social context. The questions about the "Experiences With The Interventions" were important to understand how the subjects experienced the tested measure to reduce Phubbing. The questions to "Ratings About Interventions" are conducted to expand this picture with a subjective rating of the subjects and enable to conclude the strengths and difficulties of the tested measure.

4.6 Data Preparation

For evaluating the qualitative data, resulting from the final interview, a reflexive inductive thematic analysis was conducted based on the audio recordings (transcription with *Whisper* from OpenAI). Subsequently, the codes generated from the analysis (in *Dovetail*) were collected and organized on a digital whiteboard (in *Mural*) and clustered. In total, 213 codes were generated, resulting in 17 clusters, which were grouped into topic areas, including the participant's experiences with Phubbing, with the interventions and their opinion of smartphone use in social interactions general.
The quantitative collected data, which include the tracked social interactions, the smartphone usage during these and the answers of the online questionnaires, exported as raw CSV files were processed and graphed by using the Python library *Matplotlib*.

5 Results

The results of my user study are reported below, starting with the outcomes of the quantitative data analysis, which includes the Automatic Tracked Data of the application and the results of the surveys. Next, the results of the interviews are presented, which enables a qualitative data analysis.

5.1 Quantitative Data

5.1.1 Automatic Tracked Data (Passive Data)

The following graphs refer to the data sets that were automatically recorded by the app during the two-week study period. They included duration and timing of a SI; duration, timing, and study condition (was an intervention shown or not) of smartphone use during social interactions and the apps used during social interactions. All graphs show the comparison between control and treatment mode.

Graphs *(a) Total Duration of Phone Uses while Social Interaction* and *(b) Average Duration of Phone Uses while Social Interaction per Person* are based only on the evaluation of smartphone usage time during social interactions, while *(c) Total Duration of Phone Uses while Social Interactions (in Relation to Session Durations)* and Average Duraction of Phone Uses while *(d) Social Interactions per Person (in Relation to Session Durations)* show the usage times in relation to the durations of the respective social interactions. (a) and (b) represent the duration of all uses in the same proportion, while for (c) and (d) the average of all duration of uses per subject was calculated and presented. This allows to visualize deviations of individual subjects from the average, which may be relevant to understand how the duration of use of each subject varies.
Graph *(e) Percentage Duration of Phone Uses while Social Interactions* also compares all Phone Uses during Social Interactions based on the study condition, but clustered into 5 temporal ranges: 0-15 seconds, 15-30 seconds, 30-60 seconds, 1-5 minutes, anything over 5 minutes. This categorization is based on the results of Andrews et al., who analyzed the daily duration of smartphone usage. Specifically, they classified uses of less than 15 seconds as so-called "checking behaviors", defined as short, goal-oriented interactions, such as checking text messages, notifications, or other information

(e.g. time) [2]. The presentation of the measured times in (e) refers in each case proportionally to all uses registered in the respective study condition in order to smooth out the difference in the number of unlocks ((A): 329, (B): 280). While the duration of uses was relatively evenly distributed in the control mode of the study (0-15 sec: 27%, 15-30 sec: 13.1%, 30-60 sec: 13.1%, 1-5 min: 31.3%, >5 min: 15.2%), [1] it is noticeable, that uses of less than 15 seconds were almost doubled in the treatment mode (57.9%), but uses lasting longer than 1 minute fell by half (1-5 min: 15%, >5 min: 4.6%). [2]
Graph *(f) Frequency of Apps Used while Social Interactions* visualizes frequency of the type of the apps (classified by Google Playstore Categories) that subjects opened while they where in a social interaction with their study partner. The graph also compares control and treatment mode and shows the results of the app types as a percentage of all other opened apps in a study condition. While "only unlock" (only the screen was locked and no app was opened during the entire use, in (B) saw intervention and closed screen again) is 35% in control mode, it rises to almost double (56%) in treatment mode. But it should be noted that if an app was already open and the screen is unlocked, it is also categorized as "only unlock", making a clear evaluation of "only unlock" difficult. As this case can also happen in control mode, the difference should still be noted. But apps of the type "messenger" were used by half less in treatment mode than in control mode (A: 16%, B: 7%).

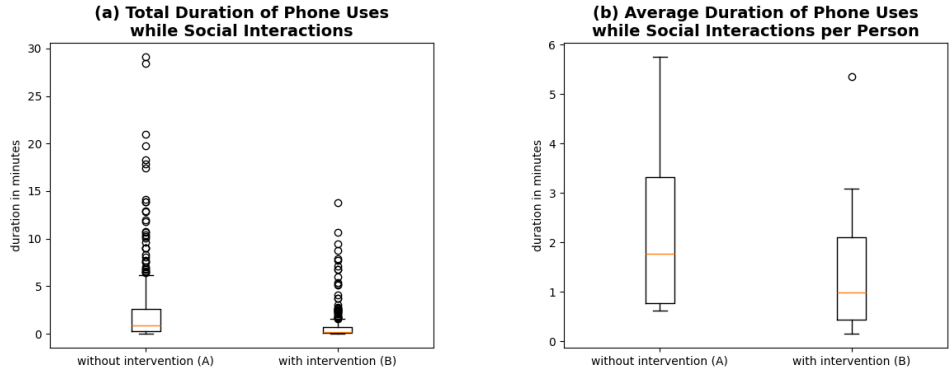

Figure 5.1: Graphs (a) and (b) show the duration of phone usages during social interactions in total, average per person.

[1] SD and Mean of control mode in seconds: 0-15 sec: SD: 4.4, M: 7.3, 15-30 sec: SD: 4.2, M: 22.2, 30-60 sec: SD: 8.9, M: 45.5, 1-5 min: SD: 58, M: 129, >5 min: SD: 338, M: 600
[2] SD and Mean of treatment mode in seconds: 0-15 sec: SD: 3.9, M: 5.4, 15-30 sec: SD: 4.7, M: 22, 30-60 sec: SD: 7.2, M: 41.5, 1-5 min: SD: 45, M: 120, >5 min: SD: 142, M: 465

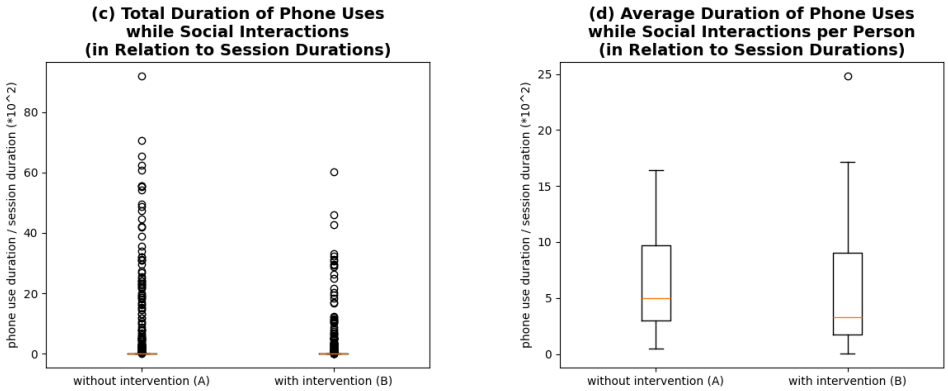

Figure 5.2: Graphs (c) and (d) show the duration of phone usages during social interactions in relation to the duration of the social interaction in total and average per person.

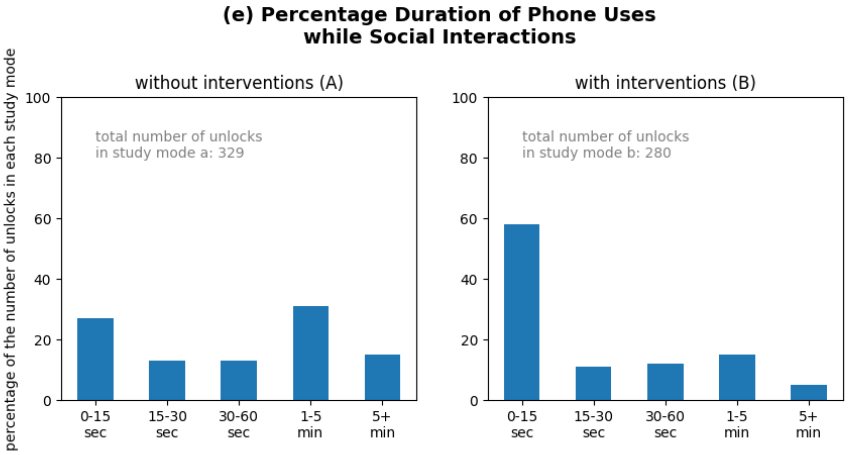

Figure 5.3: Graph (e) shows the percentage duration of all phone usages during social interactions classified in temporal ranges.

5.1.2 Data of the Questionnaires (Active Data)

The following graphs are based on the results of the questionnaires, which the test subjects were asked to complete after they used their smartphone during a SI. A total of 85 questionnaires were completed (A: 38, B: 36), 11 of them had to be rejected. The number of questionnaires is less than the registered social interactions, which is because the participants were not forced to complete the questionnaires and could skip them if they wanted to.

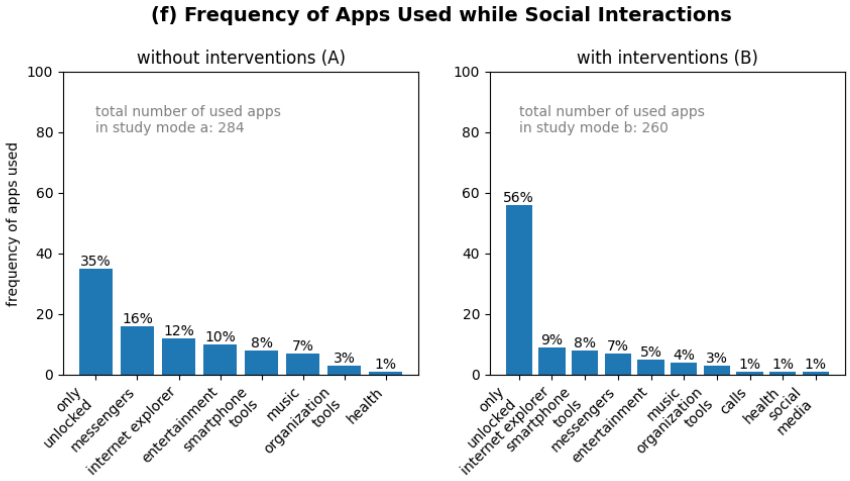

Figure 5.4: Graph (f) shows the frequency of the kind of apps which subjects opened while using their phone during a SI. The graph only shows the evaluation of the data from 8 of the N=20 participants.

Chart *(g) Frequency of the Types of Social Interactions (Activities) while Using Phone* refers to the collected answers of CSI. The activity types are specified as a percentage of all other indicated activities. The graph shows that more than half of all social interactions (in which smartphones were used) took place during shared meals or coffee breaks (53%). Other interactions were chilling together (19%), talking (10%), other activities such as cooking or shopping together (9%) and working side by side (7%).
The graphs (h) to (m) show the results of the questions to *RHCI, PCI*, *PDSO*, *PISO and PS*. Concerning the results for RSHCI, it should be noted that I realized only when the study was running that the comparison did not work here because the system was not visible to the test subjects in the control mode of the study and therefore could not be assessed. This graph should therefore only be read on one side (with intervention (B)).
Graph (n) refers to the questions of *SAS* from the final questionnaire that had to be answered once at the end of the study. It can be seen from this that the participants all classified themselves in the middle range between non-addicted and addicted with a mean value of 3, which means that most of them see themselves as rather non-addicted to smartphones.

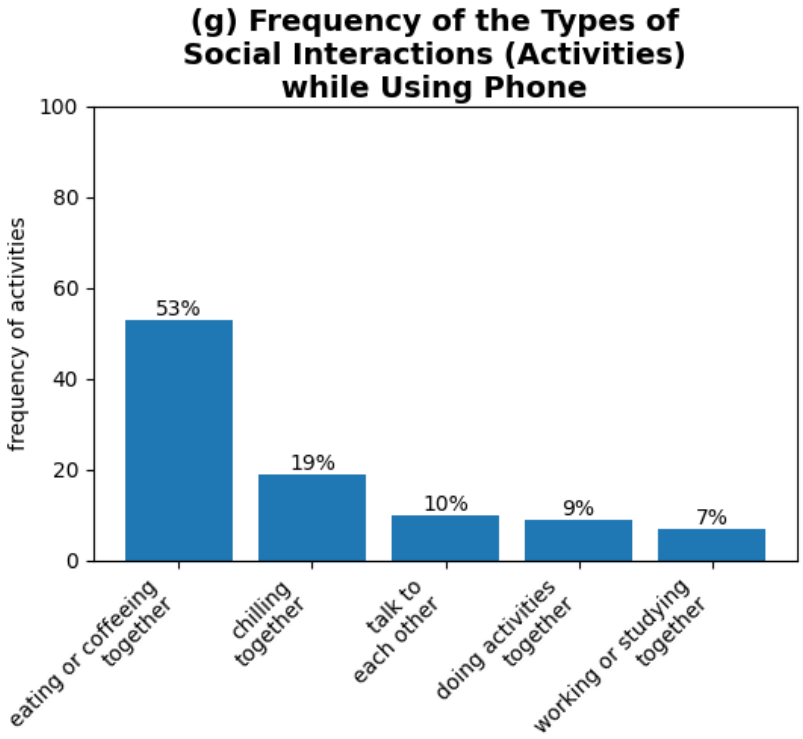

Figure 5.5: Graph (g) shows the frequency of the context of the social interaction during which the study participants had used their smartphone.

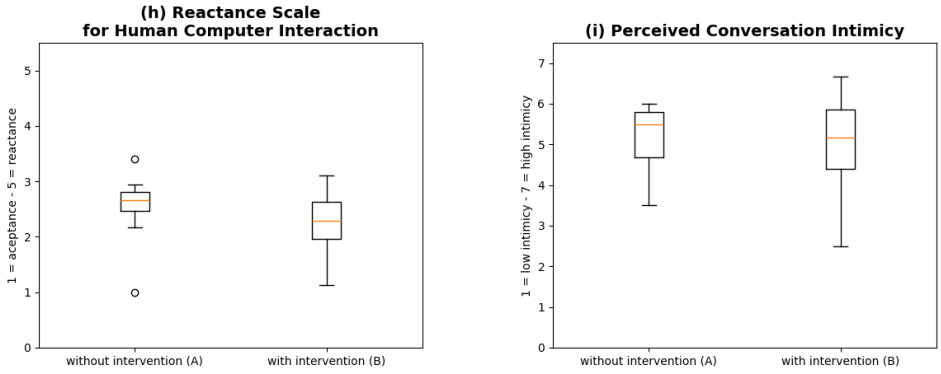

Figure 5.6: Graphs show the results for RSHCI (h) and PCI (i) (see *Questionnaires* for description of the scales).

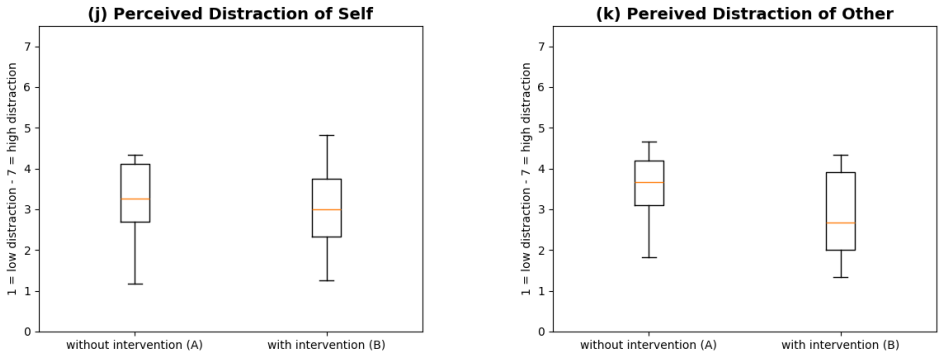

Figure 5.7: Graphs show the results for PDSO ((j), (k)) (see *Questionnaires* for description of the scales).

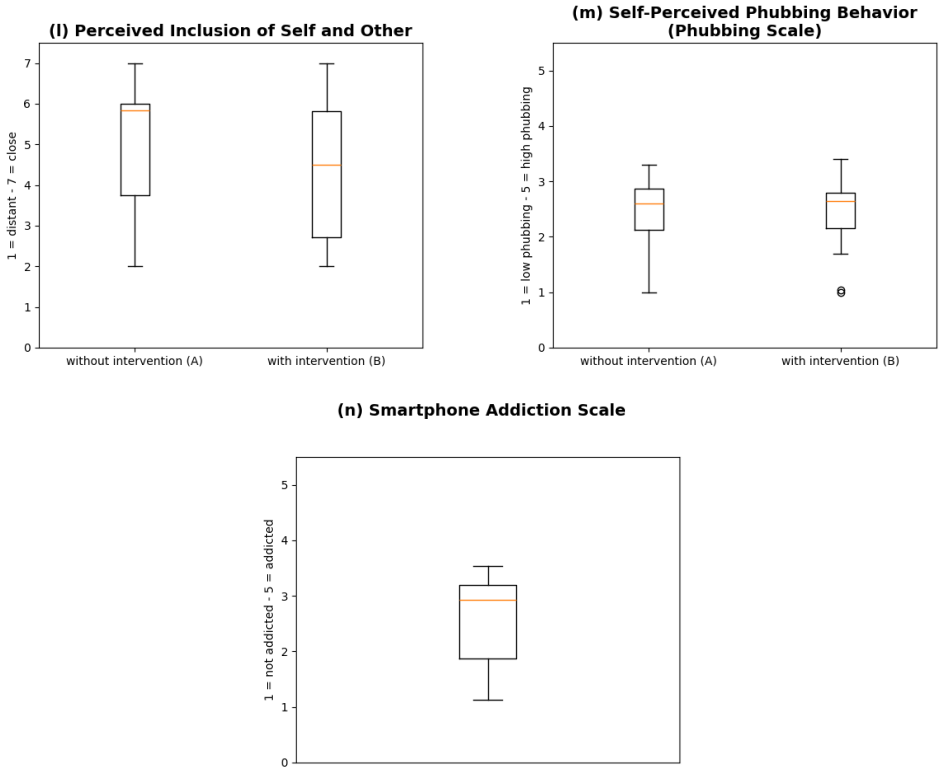

Figure 5.8: Graphs show the results for PISO (l), PS (m) and SAS (n) (see *Questionnaires* for description of the scales).

5.2 Qualitative Data

In the following subsection, I present the results of the qualitative data collected in open interviews with all 20 study participants. The results are divided into four chapters according to the groups that emerged from the previous clustering mentioned in section *Data Preparation*. The first chapter provides insights into the experiences that test subjects have had with Phubbing. It takes a closer look at the social contacts in which they have experienced Phubbing and how they usually react to it. The focus is also on the effects that Phubbing has on the individual test subjects. The following section deals with how test subjects generally rate the use of smartphones during social interactions. What behavior do they find acceptable and what is not acceptable at all? The third chapter examines the possible effects of the interventions in terms of usage behavior and awareness. The last chapter deals with the evaluation of the effectiveness of the interventions from the perspective of the test subjects. It analyses if the interventions were perceived as too little or appropriately intrusive and if they have an effect in the long or short term. Suggestions for improvement for the future application of the interventions are also discussed.

5.2.1 Experiences with Phubbing

Of the 20 participants, 14 could recall having been phubbed before. Subject 9B cannot remember being phubbed, but he does remember one concrete situation in which he phubbed a study colleague himself. In the same way, 8A cannot remember being phubbed but admits to sometimes reading Reddit posts on his smartphone when he is bored with a conversation. His study partner 8B stated that she had been phubbed by people in her close circle.

Experiences in Various Reference Groups

The majority of respondents stated that they had been phubbed by friends (10 out of 14) or family members (7 out of 14). Five subjects experienced Phubbing in their romantic relationships. Respondent 5B stated that she thinks Phubbing happens mostly in romantic relationships. Another subject, 1B, noted that Phubbing is particularly common in younger generations and in the over-50s, which she attributes to the lack of established norms of behavior when using smartphones in social interactions. Respondent 8B pointed out that it was logical to remember Phubbing by close people in the first place. As it is because you feel most attacked when you are ignored by someone you are telling something important to, which is more often the case with people close to you. On the other hand, if the Phubber is not close to you, it is perceived as less bad.

Reactions on Being Phubbed

12 of the 14 test subjects with Phubbing experience said that in most cases when they felt phubbed, they would talk to the other person and ask them to put down their smartphone. They would then respond in most cases. 6A said that he often has to ask a particular friend to put the phone down while they are talking. Sometimes he then agrees, and sometimes he gives fake reasons, such as creating a music queue on Spotify to stay on his phone, only to hang out on social networks like Snapchat again afterwards. 10B also often had the experience in a group of friends that his request for everyone to put their mobile phone away was not listened to. This is why he no longer wants to meet up with these people, as this behavior annoys him. 10B also said that he only says something when people regularly phubbed him during a conversation. 2A also agreed that she only says something when she has the feeling that it is now too much and she feels completely ignored. And 1A said that he would only say something if it was a person from his inner circle. Similarly, 5B said that she would have to know the person very well to address any Phubbing behavior. Otherwise, she would simply wait and do nothing. 1B also just waits until the person puts their mobile phone away again, except if the issue is very important. Then she would say something. 6B said that he usually repeats his question when people are so distracted by their smartphone that they don't answer him. But if that happened frequently, he was getting annoyed. 10A said she would never say anything. She would simply use her cell phone too. 4A and 7B also stated that they use their smartphone in reaction to being phubbed. 7B says she simply uses it because *"staring at someone who is on their phone is wack."* 4A says she sees such behavior as a free pass for the same behavior. Similarly, 7A stated that he did not say anything because it was normal for him to be phubbed and therefore he accepted it. But he only understood it to a limited level. The feeling that often results from this behavior, that the person he is talking to is somewhere else, is definitely negative for him.

Effects of Being Phubbed

When asked how they felt when they were phubbed, all 14 test subjects made a statement that could be categorized under the category *"negative feeling"*. These included *"ignored"*, *"annoyed"*, *"less appreciated"* or *"not taken seriously"*. 8B stated that she felt rejected and irritated. 1B said she had the negative feelings primarily because there was a lack of attention. And social interaction is basically about paying attention to each other. 7A said he felt ashamed because he didn't realize that his conversation partner's priority was somewhere else than the conversation but he was still trying to get attention. 6A said: *"It makes me feel stupid. It's not nice when you want to spend time with someone and the other person is on their smartphone the whole*

time." 7B said that people who don't phubb probably get to know each other better as they are more involved in the conversation. Because if someone is always on their mobile phone, there is a barrier between them, which makes it more difficult to get to know each other. This is in line with the statement made by respondent 6A, who said that if a person he had just met was on his mobile phone all the time, he would have no desire to continue meeting this person. Respondent 7B, who stated that she had been phubbed by friends in the past, said that she was mainly annoyed by this and then remembered these friends in the same way. 3A also retrospectively remembers a person more negatively when they have been phubbed by them. 10B even goes so far as to say that he's no longer interested in meeting up with friends who are constantly looking at their mobile phones.

5.2.2 Smartphone Use during Social Interactions

To be able to reduce behavior systematically perceived as Phubbing, or to check if the interventions can achieve this, it is necessary to classify general smartphone use during social interactions more precisely. To this, I asked the study participants which smartphone usage behavior they perceived as acceptable or unacceptable in this regard. 3A says if she is talking to someone and that person is chatting with someone else on their mobile phone, she thinks it sucks. But a short look to check who has written or if it's important is totally okay. 3B also says that a short look at your mobile phone, because you've just received a message, is completely okay if you communicate this to the other person in the form of *"Hey, I just got a message, I need to check my phone for a second."* But if you suddenly pull out your cell phone in the middle of a conversation, he finds it a very rude gesture. Unless you use it together, of course.
10B says that smartphones generally disturb the contact between people. *"Even if it just lies there and blinks and you realize that the other person would like to look at it now. Maybe they still have enough self-discipline or politeness not to do that, but you still notice that they look at it quickly and think: What is this, is this more important than the conversation here?"* But he rates a quick look at it as okay, only if it's not that often. A longer use should always be communicated in any case, because even if the other person tries to continue talking, they are not really there. And that is then awkward.
Subject 7B also says that especially long and uncommunicated use is not okay. But if you only look at your phone for a very short time (half a minute to a minute) and say: *"Jo, I just need to quickly answer an important message or something"*, she usually doesn't care at all. In the same way, 1A also said that he thinks an announced, targeted, short use is fine. But if someone is looking at their mobile phone all the time, it's just annoying. 6B, on the other hand, thinks that if the other person looks at their mobile phone but can still participate in the conversation at the same time, that would be acceptable. But if he

then simply stopped talking to him, that would not be okay. Subject 7B also thinks that smartphone use would be okay if you have the feeling that the person is still interested in the conversation. That's why you should always communicate this.
2A also says it always depends on the situation. *"A short message check or a quick look at something that interests both of us is perfectly okay. But if it's permanent, or longer, or the person no longer responds at all, it can be really disturbing and a bit annoying."* On the other hand, the respondent emphasized that using smartphones together, e.g. by showing each other memes or playing chess jointly, could also encourage social interaction.
6A also thinks that it's okay if it happens within a range where it's okay. For example, checking your phone every ten minutes for a short time. But if the other person is on their mobile phone for longer and you have the feeling that you are not important or that the time you spend together is not valued, or if you have to repeat sentences, he starts to think: *"Okay, put the cell phone away now, please."*
Respondent 8B answered that she finds it impolite in a conversation if the other person looks at their mobile phone when she says something really important or it happens often. Otherwise, she thinks it is okay to look at your phone while you are talking to each other. She can't just rate it like that, as she is always concerned with the context. *"You obviously have more understanding if someone is reading an urgent message than if they are watching some stupid video on TikTok."* 9A's statement in this regard underlines the importance of context in evaluating the acceptability of smartphone use during a conversation. He said that if a message is important and is sent in a targeted manner, this is okay. *"But if you start (wildly) texting or talking on the phone even though we're having a conversation, then that's very rude. It's even disrespectful to a certain degree."*
6A thinks it is especially impolite to look at a smartphone when eating together. Making phone calls meaning-while is also *"hardcore rude"*. People should either get up and go out the door or push the call away. 10B also thinks that during a shared meal, you don't take out the newspaper and read it, but talk to each other. That's why you shouldn't look at your phone. 3A even has a special rule in the family that smartphones are not allowed at the table.

Non-/Acceptable Smartphone Use During Social Interactions

In summary, the results of the individual interviews with the test subjects showed that smartphone use during time spent together is primarily perceived as *"impolite"*, *"disrespectful"*, *"annoying"*, *"disturbing"*, *"shitty"*, *"unpleasant"* and *"not okay"* under certain circumstances. But a short, targeted, communicated smartphone use (e.g. answering a message) is completely acceptable for most people. Also shared use. What is not seen as okay, on the other hand, is long, uncommunicated or highly

frequented use. For some test subjects, the context also determines if they find a use okay or not: If the content of the conversation is very important, for example, it is not okay. The reason for using the smartphone is also a deciding factor. Answering an important message is much more understood than used for entertainment reasons. It has also been noticed that there is agreement that a smartphone has no place at a meal together.

5.2.3 Effects of the Interventions

The results in this section relate to the interview questions on *Experiences with the Interventions* and *Ratings About Interventions* (see question set in Table 2).

Put Away Smartphone

9 of the test subjects reported that they had put their smartphones away as a result of the interventions. For example, respondent 10B said that he felt caught when he saw the interventions and so he put his mobile phone directly away again. 10A also said that she put her smartphone away as soon as she saw the intervention and felt better as a result. 3B was surprised when he saw the intervention for the first time. *"And then I realized that I looked at my mobile phone during the conversation, which is rude and something you don't want to do yourself."* He then avoided looking at his mobile phone any longer. When 3A saw the interventions, she also thought to herself *"Ah yes, that's right!"* (I am in a social context but looking at my phone) and put her phone away. She also noticed that her study partner laid his phone down due to the interventions.
6A said that the intervention sometimes came when it was really Phubbing, but sometimes it didn't quite fit. At the right moment, however, he felt caught and put the mobile phone away. But sometimes he also thought: *"Yes, nice memory. I still want to use it."* 2A also decided when she saw the interventions, depending on the situation, if she really needed the mobile phone now. For example, to look at something together or was it just an unconscious grab at the phone. In the second case, she then put it away again. These statements are followed by what respondent 1B said. She said that she only felt caught when she was really Phubbing someone. She then put the mobile phone aside instead of reading a message, for example. She said that she acted this way because she would find it annoying if the other person looked at their mobile phone now. 7B admitted that she was sometimes annoyed by the app because she had to wait 3 seconds before she could use the mobile phone again. But often this led to her simply putting the mobile phone aside and thinking: *"Then I'll just use it later."* She found that this helped her to use her mobile phone less in social interactions. She reported having observed that her study partner even put the mobile phone away as a preventative action because he knew that the message would soon be displayed.

Subjects 1A and 5B simply clicked the interventions away and carried on, as it only popped up when they wanted to research something that contributed to the conversation (weather, event, etc.). 5B also noticed that her study partner put the mobile phone away as soon as he saw the intervention. Respondent 5A, on the other hand, stated that the interventions did not cause him to stop looking at his mobile phone. Although he was a little annoyed by them, he did not feel disturbed by his use, as he was very good at ignoring things.

More Conscious Smartphone Use

Some of the study participants reported that they had gained a better awareness of their smartphone use in society since taking part in the study as a result of the interventions or the information they received in the interviews.
Respondent 1B said that the interventions made her reflect on her behavior and since then she has decided not to use her mobile phone in many situations. She now usually just leaves it in her trouser pocket. 3B also explained that since the study, he generally pays more attention to when and how often he and others use their mobile phones. He found that people use their mobile phones more often than they think, even while they are in a conversation. *"And yes, then you are shocked for a moment. But you're also glad to get the message, because then you become aware of it again, in a way,"* he said. Similarly, test subject 10A reported that the experience with the app's interventions helped her to be more aware of her behavior when using smartphones in social contexts. 6B reported that he did not necessarily feel caught out, but after seeing the intervention twice, he decided: *"Okay, I'll just not answer my mobile phone now, because then the message (intervention) won't come."* He didn't want to be the *"bad guy"* in the study who was permanently on his mobile phone. However, he noted that he might not care about the message after a while and simply click it away. But at the beginning, the app would definitely make you use your smartphone more mindfully in social situations. Study participant 7B sees the interventions as a way of controlling Phubbing behavior or unconscious smartphone use, as the additional barrier (delay, clicking away) can encourage a conscious decision to use it. She gave the example that her mother always keeps her cell phone in her backpack and so only uses it when she really wants to, which leads to her automatically using it less. The participant noted that the interventions made her think about the necessity and timing of her smartphone use. Waiting until the phone was available to use helped her to become aware of unconscious use and to stop it. 7A and 8A also said that the app could help them to become more aware of their usage or Phubbing behavior, the study shows that interventions to promote more conscious smartphone use in social contexts can be effective by motivating users to reflect on their behavior and change it if necessary.

5.2.4 Rating of the Interventions

Perception of Intrusiveness of the Interventions

Some test subjects particularly liked that the interventions had no real prohibitive character and could simply be clicked away at any time, allowing them to use their phones. For example, 10A stated that she did not feel restricted by the app and was not annoyed by the minimal limitations on use caused by the interventions. 2A said that she liked the interventions as they did not prohibit anything, but were just a hint. You could ignore it or be reminded to put your phone away. Of course, the interventions can trigger an unpleasant feeling of being caught, which may make people feel a little patronized, explained respondent 1B. But the option of simply clicking away the interventions counteracts this. 7A said that he often only unlocked his phone consciously and in a planned way during the study. The 3-second delay was acceptable for him to bridge these *"false alarms"* (conscious use), but he would have liked to have had the option to white list specific apps, such as his diabetes app. But in general, he believes that any small inhibition and delay of unconscious habits can help to become more aware of cell phone use and reduce Phubbing. 7B also found the restrictions to be just right. The 3-second wait allowed her to decide if she really wanted to use the phone or put it aside again. She would not have wished for anything more aggressive in the form of a longer waiting time, as sometimes you have to look at something very urgent, like when the train is coming, for example, or a topic you're talking about. The respondent also added that forcing people to wait is probably the most effective way to counteract Phubbing. Only education and a hint would have little effect, as many people do not recognize their behavior or do not perceive the effects of it. *"As long as you're not directly affected or you're not aware of it, then you still don't care. But if you are forced to wait a short time, as the app does, it has the most impact."*

Some test subjects felt that the interventions were not intrusive enough to really work. For example, 5A said that he could simply click away the notifications and therefore ignored them. He suspected that a more aggressive intervention, which locks the phone for a few minutes after a number of warnings or asks extremely annoying questions so that you say: *"Okay, this is too exhausting now!"* and putting the phone away, could be more effective. 6A also thought the interventions were not intrusive enough for him. He felt that the overlay was pleasant but did not sufficiently break him out of his routine. But he is sure that Phubbing could be effectively reduced through fine-tuned and individualized interventions. Adapting the measures to individual usage behavior patterns could lead to the complete avoidance of excessive smartphone use in society. Respondent 4B suggested that the interventions should appear again and again on the display during longer use to be more effective. 6B said it is difficult to say which variation of the restriction works better, as it depends on how much you allow your mobile phone

to dictate to you. He found the app's current restrictions fine for himself but pointed out that users who install the app to reduce their Phubbing behavior would probably also have more intense Phubbing behavior. It could therefore make sense to allow more aggressive measures, up to and including blocking mobile phones. The important thing, he said, is to be able to choose the variation of the restrictions yourself.
Some test subjects, on the other hand, found the interventions too invasive and wanted less intrusive measures. For example, 8A said that a simple pop-up without delay and without the need to click it away would be enough for him. 9A also said that a short reminder without delay would be enough for him to realize that he is in a social setting. 9B sometimes found the waiting time annoying when he wanted to look something up quickly, but admitted that a simple small message could easily be overlooked and the notice could therefore be clicked away.

Overall, it was found that the ideal intrusiveness of the interventions depends on the individual preferences of the users.

Assessment of the Long- and Short-Term Effects of the Interventions

Several participants find the interventions helpful in the short term. In particular, 3A and 6B underlined the immediate positive effects of the interventions. Respondent 9A also believes that the learning and educational effect of the interventions would probably be most effective in the short term.
Participants 1A, 3A, and 6B doubt that the interventions are effective in the long term. 3A and 6B report that although the app helped them to look at their mobile phones less during the study period, they can imagine that a habituation effect could sneak in after a certain time. At some point, they might then be conditioned to simply blindly push the intervention away. Test subject 2A said that because of the individuality of people and the short study duration of two weeks, she could only speculate about long-term effects, but that the app's interventions could also help to promote more conscious mobile phone use in the long term. *"That I'm simply a bit more aware of when I use it at all and when I don't"*, she said.
7B thinks that the interventions are effective against Phubbing in both the long and short term, as even after habituation, you still have to wait three seconds. If her intention to use the mobile phone was not important, she would not feel like waiting in the long term either and would put the phone down again. The impact of the delayed usage option would still be large enough to reduce unnecessary smartphone use during social interactions.

To summarize, opinions are divided on the possible long-term effect of the interventions, while the short-term effect is experienced by many respondents as positive.

Education About Phubbing and Support Through Interventions

Subjects emphasized the importance of education and awareness raising to prevent Phubbing. Subjects 8A and 8B pointed out that it is important to be aware of the problem and to recognize that Phubbing disturbs the other person and is against good manners. 10A and 2A also believe that many people do not realize that Phubbing is a problem and that education can help. However, 2A also states that pure information is often ignored, while personal experience is often more sustainable and can raise awareness of an issue. She therefore sees the interventions as a supporting tool for education. This was shared by respondent 2B, who sees the interventions as additional support to initiate the process of becoming aware of one's behavior. She believes that the topic of Phubbing and a possible problem must first be communicated more widely and made visible.
Respondent 10B sees the need to educate young people in schools about the use of smartphones, similar to drug or gambling prevention. He also underlined the importance of raising young people's awareness of the effects of smartphone use on the dopamine balance and resulting addictive effects. He sees the app as part of a more comprehensive educational program to teach the sensible and reflective use of smartphones in a social context. 3B would also like to see more general awareness-raising campaigns on the use of smartphones (e.g. also as a tile in the feed of social media). He would not limit this to Phubbing alone, but would generally educate people against excessive use because he sees Phubbing as a symptom of this.
Test subjects 1B and 3A would like to see a kind of behavioral etiquette (*Knigge*) for smartphones to promote respectful interaction with others. *"Well, I think, to bring out the classic Knigge, you say sorry when you sneeze or something like that, there are rules of behavior. And I think they should exist in the same way for dealing with smartphones,"* says 3A. 1B sees the interventions as a way of giving people such a code of conduct. 4B is also in agreement and believes that better education could help to counteract Phubbing.

To summarize, the test subjects emphasized the need for comprehensive education about Phubbing and the use of smartphones. They see the app as an effective tool for raising awareness of this problem and promoting respectful behavior.

Improvements

Some participants made suggestions for improvement and comments on the interventions and the study.
A central technical suggestion for improvement came from participant 9B, who said that social interactions should be specified more precisely. He suggested that the app could

integrate the ambient volume (microphone) to differentiate, for example, face-to-face conversations (real interaction) from sitting next to each other and doing nothing. Another technical suggestion came from 3A, who noticed that the service did not restart automatically after her mobile phone went off during the study because the battery ran out. She proposed that this should happen automatically when the system is restarted. 7B and 7A wanted the ability to switch interventions on and off for specific people or situations. 7B also expressed the wish to be able to put special apps that he would always like to have access to (e.g. diabetes app) on the white list. Respondent 6B said that he would find a less neutral color scheme for the interventions interesting.
In addition, 3B and 7B were annoyed by the questionnaire, which they found more annoying than the interventions themselves. 5A found the questionnaire on reactance strange, as the app did not take any action in control mode but he was still asked about frustration in this regard. He then indirectly transferred this to the questionnaire and was annoyed by this.

These various suggestions and feedback from the participants are intended to improve the user experience of the app and adapt it better to different social contexts.

6 Discussion

To investigate how an intervention can influence users' awareness of Phubbing, I conducted a study over a two-week period with 20 participants. The study consisted of two conditions, each running for one week: control mode without intervention and treatment mode with intervention (counterbalanced, within-subject field study). Participants were asked to meet at least twice a week for social interaction. The interventions informed the participants via a pop-up on their display when they phubbed their counterpart (unlocked the smartphone during a social interaction) and could be closed after 3 seconds via a button. In the following, I will discuss my findings based on the results of this study. First, I will highlight the urgent need for interventions or supportive measures to prevent Phubbing. Next, I will analyze the effects of the interventions on the subjects and discuss when they could be most effectively implemented. Finally, I would like to evaluate the effectiveness of the chosen form of intervention in this study and discuss potential adjustments.

6.1 Necessity of the Interventions

All participants stated that they felt bad when they were phubbed (see *Effects of Being Phubbed*). They described their feelings as ignored, annoyed, less appreciated or not taken seriously. Social interactions are based on paying attention to each other, and the lack of this leads to negative emotions such as rejection and frustration. Some even feel ashamed when they realize that the person they are talking to probably has other priorities. The (solo) use of smartphones during social interactions creates a barrier that makes socializing and maintaining relationships much more difficult. This statement is underpinned by Klein, who describes that being phubbed can cause feelings of social exclusion for people affected [17].
Some respondents also reported that they had lost interest in meeting up with friends who phubbed them. This illustrates the extent to which Phubbing can negatively impact the quality and durability of relationships. Therefore, there is an urgent need to take measures to prevent this behavior.

Support of the System to Prevent Phubbing

Many respondents stated in the interviews that they often address the topic directly when they feel phubbed, e.g. with sentences such as *"Hey, put your mobile phone away when you talk to me!"* (see *Reactions on Being Phubbed*). But these reactions often only take place with close friends or in particularly important conversations. Some test subjects also experienced that their requests were ignored. In other cases, they chose to say nothing to avoid conflict and waited or used their smartphone instead too. Already Lutz and Knop found out that Phubbing is contagious and that phubbed people often use their smartphones in a reaction to it too [19]. Such passive reactions make clear that the responsibility to take action against Phubbing should not be left only to the Phubbed, as it has been handled so far, it should also be the responsibility of the Phubbers.
One possible solution could be technological support for the system, such as interventions that can help to avoid situations in which nothing is said. Participants stated in the interviews that the interventions made them think much more about their smartphone use during social interactions. This feedback shows that such interventions have the potential to influence the behavior of the Phubbers without having to put the Phubbed in the uncomfortable position of having to address the problem by themselves (which should not be their job at all)[1]. Many participants approved the support of such systems to prevent Phubbing and see the interventions as a successful, but still expandable, implementation of this idea (see *Education About Phubbing and Support Through Interventions*).

Phubbing Among Close People

Based on the statements of the interviews, it was found that Phubbing occurs primarily among close people (family, friends), often in relationships (see *Experiences in Various Reference Groups*). It is assumed that Phubbing as a subconscious behavior is strongly integrated into everyday life and is therefore particularly widespread among people who spend everyday life together. This assumption is also based on personal experience.
Since the negative effects of Phubbing on intimacy and the quality of conversation have been found in close relationships in particular ([19], [26], [8]), these considerations emphasize the need for interventions as a targeted measure against Phubbing.

[1] [9B] emphasized the usefulness of implementing measures on the device side, as people who feel phubbed sometimes do not have the courage to address this. The interventions could therefore help to avoid situations in which nothing is said.

Smartphone at the Eating Table

When I asked the test subjects about the acceptance or non-acceptance of smartphone use in social contexts, it became clear that especially at the dining table, smartphones are perceived as extremely annoying (see *Smartphonne Use During Social Interactions*. This is surprising, as chart *(f) Frequency of Apps Used while Social Interactions* shows that, according to the questionnaires, the respondents most frequently use their smartphones during shared meals or coffee breaks. It is therefore highly possible that this uses were also perceived as disruptive and therefore as Phubbing.
The conflict between the strong rejection of smartphone use at the dining table and the frequent use in exactly this context, points to a discrepancy between individual behavior and social norms. This visible discrepancy, which Aagaard also found in interviews with young people [1], underlines the necessity of measures against Phubbing.

6.2 Effects of the Interventions

Better Awareness of Own Phubbing Behavior through Interventions and Education

Many respondents experienced more conscious smartphone use as a result of the interventions. They said that this led them to pay more attention to their own usage patterns. Some subjects also reported that the additional barrier provided by the interventions led them to make conscious decisions about when and how to use their phone (see *More Conscious Smartphone Use*). The importance of education to prevent Phubbing was also underlined because many were not aware of the disruptive behavior and the associated problem. Therefore, the interventions are seen as a valuable tool to support education, as they provide personal experiences and in this way raise awareness (see *Education About Phubbing and Support Through Interventions*).

The study shows that targeted interventions (during the Phubbing moment) and educational programs can increase people's awareness of their Phubbing behavior. Participants reported more conscious use of their smartphones in social interactions and attributed this to the interventions and information they received as part of the study.

Reduction of Phubbing

The study shows as well as increasing awareness of Phubbing, the interventions also effectively reduced actual Phubbing moments.
Many respondents agreed that short smartphone use by the other person, such as checking a message, was okay (as long as it did not become excessive, of course) (see *Non-/Acceptable Smartphone Use During Social Interactions*). Graph *(e) Percentage Duration of Phone Uses while Social Interactions* shows a visible decrease in long uses and an increase in short uses (behavior checks) of less than 15 seconds when subjects saw the interventions. In addition, test subjects stated that they put their mobile phones aside more often or prevented themselves from using them in the first place as a result of the interventions (see *Put Away Smartphone*).

This result is confirmed by chart *(f) Frequency of Apps Used while Social Interactions.* In treatment mode, participants unlocked their screen more often without using an app (56%) than in control mode (35%). This indicates that they used their smartphone less after seeing the intervention. The categorization 'only unlocked' makes a precise evaluation difficult (see last comment in *Automatic Tracked Data (Passive Data)*), but overall this finding suggests that the intervention effectively reduced the use of apps that disturb social interactions.

In summary, these results suggest that the interventions shortened the usage times and reduced those uses that test subjects perceived as disruptive, impolite, and a Pubbing moment.

6.3 Form of the Interventions

The results of the interviews with the study participants provided important findings on the design of interventions. Two key aspects were emphasized: the degree of freedom that the interventions allow and the possibility of individualization in order to meet the different needs of users.

Context Dependency of the Interventions

The interviews showed that the perception of Phubbing strongly depends on the context of the interaction and the using behavior. For example, short looks at the smartphone to check messages or shared use are generally accepted. In contrast, longer, uncommunicated or frequent use is perceived as disrespectful, especially if it distracts from important conversations. Participants also stated that urgent messages are more

tolerated than used for purely entertainment purposes. These differences depend on the situation in which smartphone use is perceived as disruptive or impolite (see *Smartphone Use during Social Interactions*).
One problem in this regard, unfortunately, is that the app's current method for detecting Phubbing (distance + use) (see *How the Phubbing-Behavior-App works*) does not take this context dependency in consideration, as it potentially perceives any mobile phone use as Phubbing, which was criticized by some test subjects (see *Improvements*). However, this point of criticism was eased by the fact that participants stated that these false positives, which could be triggered when e.g. using a mobile phone together, could be tolerated by the fact that the interventions could simply be clicked away at any time (see *Perception of Intrusiveness of the Interventions*). Overall, the participants appreciated the flexibility of the app, which allowed them to ignore the interventions as necessary and continue to use their mobile phones without restriction. They perceived this as less patronizing.

These points summarized: The perception of Phubbing is very situational. Until Phubbing detection functions more sensitively, it is essential to maintain the degree of freedom (ability to click away) of the interventions. This makes it possible to decide for the user themselves, depending on the situation, if a use is Phubbing or not.

Individualized Interventions

The perception of the intrusiveness of the interventions varied strongly between the test subjects (see *Perception of Intrusiveness of the Interventions*). Some appreciated the ability to simply click them away, while others found stronger measures more effective, such as complete phone blocking. Some perceived the measures as too invasive and preferred more discreet notices without delay (click away directly).

Overall, it appears that the ideal level of intrusiveness depends on individual preferences. Subject 6A is convinced that Phubbing could be effectively reduced through fine-tuned and individualized interventions. *"Adapting the measures to individual usage behavior patterns could lead to a complete avoidance of excessive smartphone use in society"*, he said. Interventions should therefore be customizeable to take different user needs under consideration.

6.4 Limitations and Future Work

Limitations

Due to technical limitations, I was only able to implement and test an Android application. This limited the number of participants, as devices with iOS, EMUI, and MIUI were excluded. Extending the app to iOS would be a benefit, as iPhones are widely used and the recruitment of test subjects was made more difficult by the limitation to Android. iOS is the second-largest mobile operating system after Android.[2] As the study always requires two people, more combinations of test subjects would be possible.[3]

Future Work

There are several starting points for the further development of the concept of interventions that emerge from the discussion and the results of the study.
One important aspect is the introduction of individually adaptable interventions for each user to meet the different needs and reactions to intrusiveness (see *Individualized Interventions*).
Another possible approach is not to display interventions when the device is unlocked, but during the use of certain apps. It should also be possible to create a whitelist of apps for which no interventions should appear, such as diabetes apps (see *Improvements*).
It was found that Phubbing occurrs mainly among close persons (romantic relationship, family, friends, see thougts on this in *Phubbing Among Close People*). Since many close people (e.g. romantic relationship) live together, a further development to improve the accuracy of Phubbing detection could open up this subject group.[4] In addition, more precise detection could possibly counteract the context dependency of the interventions and reduce smartphone use that is not perceived as Phubbing (see *Context Dependency of the Interventions*). This could be achieved, for example, by recognizing conversations via the microphone (see suggestion from [9B] in *Improvements*).
Another potential use of the app function, or beacon technology in general, would be to recognize certain situations in the area of digital detox. For example, learning spaces or workplaces could be equipped with beacons. If the smartphone is then used intensively there, interventions could be sent or certain apps could be blocked.

[2] iOS market share of 27.73% global and 33.15% in Germany, Android market share of 71.5% global and 65.81% in Germany (as at 2024 *[34]*, *[35]*)
[3] Android - Android, iOS - iOS, Android - iOS
[4] Phubbing detection was based on social distance and simultaneous smartphone use. Therefore, couples who lived together were not recruited for the study, as they often have a small distance to each other, but not all of these situations directly represent a social interaction (see *Participants*).

7 Conclusion

Overall, this paper presented the results of a two-week field study with N=20 participants investigating Phubbing behavior and awareness. By implementing an Android application that ran in the background of the personal smartphones of participants, I was able to detect Phubbing moments and alert participants to their behavior via pop-up notifications. The results suggest that such interventions can increase awareness of one's own Phubbing behavior and effectively reduce the frequency of Phubbing moments.

The study showed that the awareness of the participants for their smartphone behavior was raised through targeted interventions, which led to more conscious and respectful use. Participants put their smartphones away more often or only used them only short when they were reminded by the interventions. These results underscore the necessity and effectiveness of technological support to reduce Phubbing behavior and improve social interactions.
In addition, the results of the study define the importance of contextual and flexible interventions that give users the freedom to respond to situational circumstances appropriately. Furthermore, it became clear which usage behavior is perceived as Phubbing in the first place, which provides a kind of classification of smartphone use in social contexts that offers valuable insights for future measures to prevent Phubbing.
Future work should focus on improving the precision of the Phubbing detection and on adapting the intervention methods to individual needs to develop even more effective measures for a wider user group.

I, therefore, conclude that Phubbing behavior can be effectively reduced through individualized, targeted and context-dependent interventions.

group	subject	age	gender	kind of relationship	android version
1	**1A**	29	male	romantic	13
	1B	28	female	romantic	10
2	**2A**	21	female	family	9
	2B	56	female	family	13
3	**3A**	29	female	romantic	10
	3B	35	male	romantic	14
4	**4A**	51	female	work colleagues	13
	4B	30	female	work colleagues	14
5	**5A**	37	male	romantic	11
	5B	36	female	romantic	10
6	**6A**	25	male	fellow students	14
	6B	25	male	friends	10
7	**7A**	29	male	friends	11
	7B	22	female	friends	12
8	**8A**	35	male	romantic	14
	8B	32	female	romantic	12
9	**9A**	26	male	friends	14
	9B	22	male	friends	14
10	**10A**	26	female	romantic	9
	10B	35	male	romantic	10

Table 1: Demographic data of studyparticipants

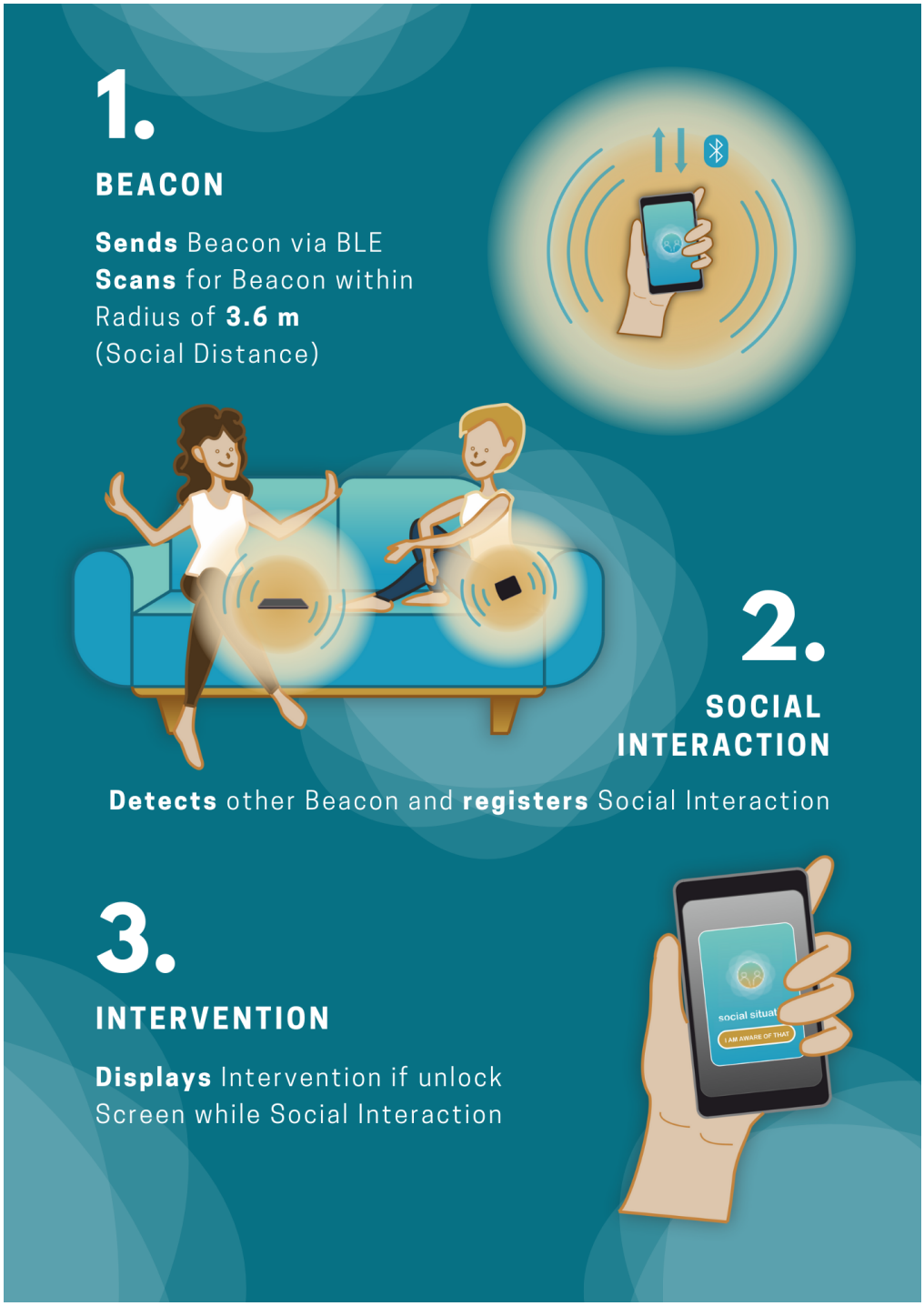

Figure 1: How the App works.

Experiences With Phubbing

1. Do you know what "Phubbing" is?
2. Have you ever been phubbed?
3. If yes, who phubbed you?
4. If yes, how did you feel when you were phubbed?
5. Have you ever phubbed someone? If yes, tell me about it.

Ratings About Smarphone Use During Social Interactions

1. Why do you use your smartphone when you meet up with people?
2. What do you do on your smartphone when you use it while you are in a social situation (e.g. meeting up with friends)?
3. How do you rate if somebody uses their smartphone during a conversation?
4. Which using behavior would you rate as acceptable?

Experience With Interventions

1. How did you feel when you saw the message on your smartphone?
2. How did you behave?
3. Do you have any wishes and suggestions that you would like to make now?
4. Did the app work? What technical problems did you encounter during the study?

Ratings About Interventions

1. What do you think the app's messages did to you?
2. How would you design the app's messages?
3. Imagine that the functions of the app in this study would be permanently installed on smartphones in the future (with a few runtime optimizations, of course). What do you think this would have an impact on the use of smartphones by people with each other?
4. How would you counteract phubbing?

Table 2: Collection of possible questions which could be ask in the interviews

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Declaration

I hereby declare that this thesis titled:

Investigating the Impact of an Intervention that Increases Users' Awareness of Phubbing

is the product of my own independent work and that I have used no sources or materials other than those specified. The passages taken from other works, either verbatim or paraphrased in the spirit of the original quote, are identified in each individual case by indicating the source. I further declare that all my academic work was written in line with the principles of proper academic research according to the official "Satzung der Universität Ulm zur Sicherung guter wissenschaftlicher Praxis" (University Statute for the Safeguarding of Proper Academic Practice).

Ulm, 22.08.2024 .....

Ronja Lehle