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Critical Factors for Successful Mobile Applications

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Business Informatics

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Alexander Fischl
Matrikelnummer 0825323

am Institut für Softwaretechnik und Interaktive Systeme
an der Technischen Universität Wien

Betreuer: Univ.Prof. Dipl.-Ing. Dr.techn. Hannes Werthner

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Critical Factors for Successful Mobile Applications

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in

Business Informatics

by

Alexander Fischl
Registration Number 0825323

to the Institute of Software Technology and Interactive Systems
at the Vienna University of Technology

Advisor: Univ.Prof. Dipl.-Ing. Dr.techn. Hannes Werthner

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(Signature of Author) (Signature of Advisor)

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Alexander Fischl, Römergasse 77/17, 1170 Wien

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Abstract

With the steady growth of the mobile apps ecosystem, a vast number of IT startups have been founded to create innovative services. Those startups usually face manifold strategic questions concerning the app conceptualisation and development, that often cannot be answered without data from the market. This work discusses critical aspects related to the lifecycle and adoption of mobile applications (apps), and obtains quantitative data concerning these aspects directly from the Austrian target market.

A non-representative explorative online survey was conducted among 278 smartphone owners, exploring facts that range beyond proprietary high-level market statistics. Apart from questions on the users' smartphone features use, the operating system choice, and app buying behaviour, several topics of high relevance for app developers are addressed, such as app installation barriers, the users' app engagement, social networking attitude, privacy resentments, and security awareness.

This broad picture is explored using descriptive and inferential statistics, testing for relationships between those attributes, and for significant differences between user segments, and the two major ecosystems, *iOS* and *Android*.

The results confirm the gap between the *Android* and *iOS* platforms regarding their monetisation potential. Further, they suggest, that common assumptions on the users' privacy awareness need to be questioned. As a by-product from exploring results concerning the integration of social networks, red flags indicating a considerable *Facebook*-weariness of users were encountered, showing a negative sentiment against *Facebook*, even from its active users.

Kurzfassung

Das kontinuierliche Wachstum des mobilen App-Ökosystems bringt zahlreiche Startups hervor, die sich auf die Entwicklung innovativer mobiler Dienste spezialisieren. Mit der App-Konzeption und -Entwicklung unweigerlich verbunden ist eine Vielzahl strategischer Fragestellungen, die nur durch Daten des Absatzmarkts beantwortet werden können. Diese Arbeit identifiziert kritische Faktoren bezüglich des Lebenszyklus und der Anwenderakzeptanz von mobilen Apps, und erhebt quantitative Daten vom österreichischen Smartphone-Anwendermarkt.

Es wurde eine nicht-repräsentative Studie unter 278 Smartphone-Besitzern erstellt, in der Zusammenhänge und Fakten eruiert wurden, die über proprietäre High-Level-Marktstatistiken hinausgehen. Neben allgemeinen Fragen zur Nutzung bestimmter Smartphone-Features, der Betriebssystemwahl, und des App-Kauf- und Zahlungsverhaltens, werden Themenfelder beleuchtet, die von hoher Relevanz für App-Entwickler sind. Dazu zählen u.a. anwenderseitige Installationsbarrieren, das Feedback- und Rezensionsverhalten, die Einstellung zu sozialen Netzwerken, zur Privatsphäre, und das Sicherheitsbewusstsein.

Dieses breite Themenfeld wurde mit Hilfe von deskriptiven und inferenzstatistischen Methoden untersucht, um Korrelationen zwischen Attributen, und signifikante Unterschiede zwischen Anwendersegmenten und den beiden marktführenden App-Ökosystemen, *iOS* und *Android*, zu erkunden.

Die Ergebnisse bestätigen den Unterschied im Monetarisierungspotential zwischen den *Android*- und *iOS*-Plattformen, und deuten weiters darauf hin, dass gängige Annahmen über die Anwender-Einstellung zu Privatsphäre und Sicherheit in Frage gestellt werden müssen. Als Nebenprodukt der Untersuchung der Ergebnisse zu sozialen Netzen, wurden Hinweise auf eine *Facebook*-Ermüdung erkannt, die sich in einem sehr negativen Sentiment gegenüber *Facebook*, selbst bei aktiven *Facebook*-Anwendern, niederschlagen.

Contents

1 | Introduction

1.1. Motivation

With the steady growth of the mobile applications (*apps*) ecosystem, a huge number of IT start-ups jumped on the bandwagon to create innovative smartphone-based services, challenging today's Web 2.0 market leaders who struggle to integrate the mobile tier into their existing business models. During the conceptualisation and implementation of a new service, a mobile app startup typically needs to make manifold strategic and operative decisions. Questions arise, such as "how many users are willing to pay for an app?", "shall we focus on *iOS* or *Android*?", "is privacy a big issue for our users?", "shall we integrate our community app with *Facebook*, or build entirely upon the *Facebook Social Graph*, or stay independent altogether?", "on what advertising channels should we focus?", "how do people find new apps?", "how many users do we lose before the app installation step?", "shall we specialise, or generalise our service?", and so forth and so on.

To answer those questions, app startups can gather information from various sources: top-level market research from the large market intelligence companies, like *Gartner, IDC, Forrester*, and the *GfK Group*, the basic download and monetisation statistics from mobile app stores[1], as well as statistics from IT and telco equipment vendors, and government agencies. Moreover, there are various businesses specialising in analytics for live apps, such as *Flurry Analytics* (2013), or *Adjust.io* (2013). However, proprietary market intelligence is expensive, and there is a considerable lack of up-to-date statistics on mobile app adoption and actual app usage behaviour concerning the local market in Austria. The statistics available do not delve into more details than the overall market size, mobile penetration, the users' demographics, the market share of different technologies, platforms, and operating systems, and the download counts, or monetisation rankings of various apps. Hence, a more holistic picture of users, especially early adopters, needs to be drawn, integrating various attributes derived from the mobile app lifecycle, that startups consider as highly relevant.

Consequently, the goal of this work is to identify the most pressing questions concerning the mobile app lifecycle and app adoption, that a startup entering the Austrian market faces during its first one or two years, and to answer those questions through empirical research on app users. Thereby, all kinds of mobile app-based services are addressed, such as ambient or social discovery, quantified self, communications, and location-based community applications, all of which are massively gaining ground due to the diffusion of powerful smartphones.

[1] Such as *Google*'s *Google Play* and Apple's *App Store*.

1.2. Aim of this Work

This thesis addresses the following particular topics that are interesting candidates for explorative research:

- What is the current fraction of smartphone *users,* who are actively downloading and using mobile apps, among all smartphone *owners*? What are the main reasons not to use apps altogether?
- What is the app installation interval of smartphone users?
- What keeps users from installing new apps?
- How many users pay for apps? Are there any barriers to payment?
- How important is privacy to the users, and how do users rank privacy against other aspects, such as the usefulness, design, and performance of applications?
- How engaged are mobile app users? How many of them review and rate apps, and how many provide feedback to the apps' developers?
- What is the general attitude of users concerning *Facebook* integration?
- Do users perceive the requirement of a *Facebook* login within a new mobile community app as a benefit, or a drawback?
- Are there any significant differences in all of the aforementioned aspects between users of the two market leading platforms, *iOS* and *Android*? Which aspects are presumably influenced by the age and gender of a user?
- What information do mobile app startups need concerning their target audience?

Identifying the startups' key questions, gathering answers to these questions empirically from the Austrian market, and combining them with the advice drawn from business model and entrepreneurship literature, concrete strategies could be derived that are useful to innovators in the mobile apps business.

A particularly interesting question to be addressed by this work is, if the conventional e-commerce paradigm of the users' privacy-awareness and trust-focus (Hoffman et al. 1999) can still be upheld when looking at app adopters, or if there is a paradigm shift towards users that are no longer paying attention to the growing amount of potential privacy hazards. One expects that there is a negative correlation between the age of the users, and their acceptance of mobile applications and privacy hazards, as it seems to be the case with Web-centred social software. Furthermore, a common tenor is, that a structural difference exists between both of the leading app ecosystems: *Apple iOS* users should be far more used to purchasing apps, while there should be a significantly higher percentage of *Google Android* users that are not utilising or even knowing the *Google Play* application market, as *Android* phones are currently becoming a commodity among mobile devices.

1.3. Methodology

An empirical, non-experimental, explorative methodology is applied to address the issues just raised. Figure 1 provides an overview on the research model:

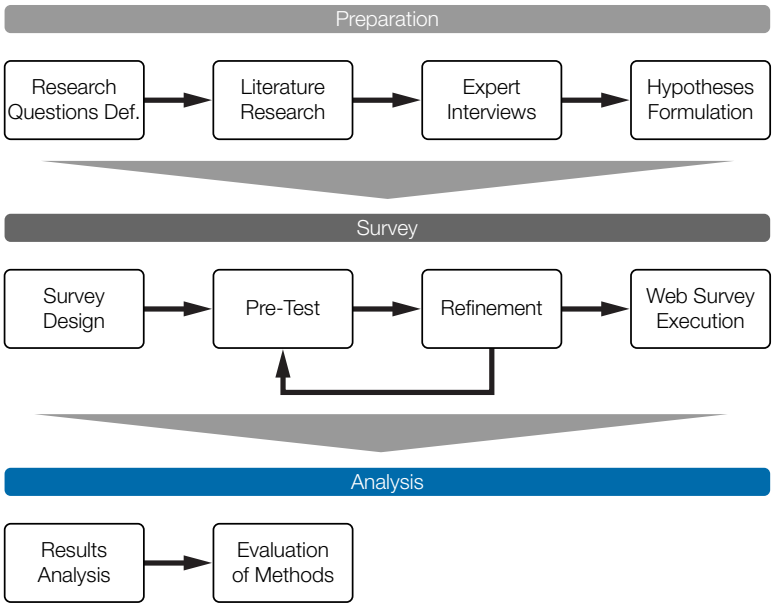

Figure 1: The research model, depicting the three stages of this work: preparation, survey, and results analysis.

The work is split into three main stages: in the beginning, the problem and scope is defined, related literature is reviewed, expert interviews are conducted, and the hypotheses are formulated. Market-related questions that are fundamental to mobile app startups are gathered through reflecting on my own experience as an app developer. Furthermore, academic research is reviewed to check, if those questions are already answered, with a focus on the Austrian apps market. Subsequently, the resulting research questions are transformed into a proposal for an online survey among Austrian smartphone owners. Particularly, app users shall be addressed to provide information on their phone and app usage behaviour, and attitude concerning the research questions gained from the previous step. On the basis of this survey proposal, qualitative expert interviews are conducted with app startups to refine the questions.

In the second stage, an online survey is designed to support or reject the hypotheses with primary data from the market. The survey itself is carried out in four steps: after the initial design of a Web questionnaire, it is pre-tested on a few participants, and improved iteratively. In turn, the survey is executed, vouching for a sample of at least 200 participants. To achieve a sample of this size, the survey is promoted through various channels: social media, online advertising, e-mail, and so forth.

In the final step, the resulting data is analysed using statistics software, and discussed with regard to the hypotheses. Possible patterns and correlations are explored through methods from

descriptive and inferential statistics, and particularly, null-hypothesis significance testing (NHST) is performed upon the research hypotheses. Here, the likely case that the sample is not representative for the overall population, and pitfalls of quantitative research have to be kept in mind at all times, such as common method variance, single sources bias (Albers et al. 2009, pp. 137-152), low statistical validity of the measurements of the constructs, and alpha and beta errors of significance testing. Therefore, a reflection and evaluation of the employed methods is performed before drawing any conclusions.

1.4. Structure of this Work

Chapter 2 starts with the introduction of important terms and definitions of this research area. Various user- and app-lifecycle related aspects, that are fundamental for the adoption of mobile apps, are outlined. Thereby, it motivates the topics for the mobile apps users survey.

Chapter 3 focuses on qualitative interviews conducted with several mobile app development specialists, to incorporate their points of view into this work. Consequently, the interviews' outcome and its implications on the online survey are discussed. On the basis of the previous theoretical discussion, and the expert interviews, the research hypotheses are derived.

Chapter 4 and 5 deal with the design, implementation, and the results of the quantitative market survey, representing the main goal of this work. Furthermore, the statistical instruments for exploring the data are discussed. Chapter 6 reflects on the methods employed, discussing potential fallacies, and particular findings regarding the execution of the survey. Finally, chapter 7 concludes with the results' implications on today's startups, and outlines possible strategies to take advantage of these findings.

2 | Background and Related Work

We start this chapter with a discussion of important terms and definitions, that help to define the scope of the planned work. Furthermore, research related to this work, as well as current facts on the mobile apps ecosystem are summarised.

2.1. Terminology and Definitions

2.1.1. Feature Phones, Smartphones, Tablets

Smartphones designate the newest epoch in mobile communications. Fling (2009, p. 1) summarises the evolution of mobile phones briefly as follows:

- The brick era (1973–1988), characterised by big, clumsy devices, such as the legendary *Motorola DynaTAC.*
- The candy bar era (1988–1998), spawning more lightweight, compact devices, that were vital for the international breakthrough of mobile phones. Later, these devices enabled additional breakthrough applications, such as short text messaging (SMS).
- The feature phone era (1998–2008), further extending the applications of mobile phones by providing media player, camera, e-mail, and Web browser features.
- The smartphone era (2002–present), pushing forward into the direction of powerful multipurpose mini-computers with a sophisticated operating system, app development frameworks, and thereby, extensibility through third-party apps.
- The touch era (2007–present), starting with the appearance of the *iPhone* as a gamechanger, concentrating on touch-based input on high-resolution screens, a sleek hardware and UI design, and enabling applications of a completely new nature, through additional sensors.

Strictly speaking, it is not that easy to separate the feature phone era from the smartphone era, similar to the problem of categorising a song into a particular music genre. If a phone provides a high-resolution touch screen, powerful processor, sophisticated operating system, app development frameworks, WLAN and packet data connectivity, various sensors and interfaces[1], and is embedded into an ecosystem powered by app stores, then it can certainly be called a smartphone.

Another apparent issue is the distinction between smartphones and tablets: while the *iPhone*, as one of the first smartphones by today's meaning, and the *iPad*, representing the application of

[1] Such as GPS, compass, gyroscopes, accelerometer, camera, and so forth.

the *iPhone*'s principles onto tablet computing, can both be distinguished clearly by the presence or absence of telephone features, this is not so easy within the domain of *Android*. For example, the *Samsung Galaxy Tab* tablet does not lack telephony features, and could thus be viewed as a somewhat oversized smartphone. As size is the only difference here, this distinction becomes problematic, since smartphones gradually featured bigger screens over the last years, and there were also smaller variants of tablets introduced in this period. Figure 2 illustrates the difference between smartphones of two generations, and a seven-inch tablet. While the *Nexus S* smartphone featured a screen size of four inches (10.16 cm) in 2010, smartphone screens gradually became bigger: the *LG Nexus 4*, *Google*'s current flagship from 2013, features a 4.7" (11.94 cm) screen. The *Galaxy Tab* shown is the WiFi version, but is also available with a GSM SIM card slot for telephony.

Figure 2: Screen size comparison between Android-based smartphones and small tablets. From left to right: Samsung Google Nexus S (2010, 4.0" screen), LG Google Nexus 4 (2013, 4.7" screen), and the Samsung Galaxy Tab (2010, 7" screen).

2.1.2. Mobile App

A mobile app is a piece of software, created for one of the various mobile platforms, such as *Android*, *iOS*, or *Blackberry*. In contrast to traditional desktop software, mobile apps need to account for the peculiarities of mobile computing:

- Very limited screen sizes, text input capabilities, and computing resources, compared to the average desktop.
- Special operating system paradigms concerning multi-tasking and resource management.[1]
- The context a user is using the app within, that is, a constantly changing location and environment.
- Frequent loss of Internet connectivity.

Meier (2012, p. 38) further mentions limited RAM, limited permanent storage capacity, limited battery life, high network latency, and high costs associated with data transfer as typical constraints for mobile development. Due to these limitations, app developers need to take much care about the efficiency of an app, to keep it responsive.

There are three different types of mobile apps:

- So-called “native” apps that use an application framework or SDK to generate platform-specific code, enabling apps to utilise the respective platform’s particular hardware and API features to a maximum extent. The huge effort of the development of an app often required small startups to choose what platform to start with. Due to nowadays competitive pressure, especially for social apps, it is almost mandatory to support at least the *iOS* and *Android* platforms. This made cross-platform development frameworks enter the scene, such as *Appcelerator’s Titanium* (Appcelerator 2013), *PhoneGap* (Adobe 2013), or *Unity* (Unity Technologies 2013) for game development. These frameworks greatly simplify the process of creating native apps for almost all existing mobile platforms.
- Furthermore, there are apps based on HTML5, running inside a Web browser like traditional Web 2.0 platforms, but being optimised for mobile devices. This has the benefit, that an app developer can build a single app for the growing amount of different platforms, without the effort of having to code multiple native apps. The disadvantage of Web-based apps are their various limitations concerning the user experience, as well as their very limited ability to support offline use.
- Finally, there are so-called “hybrid” apps, which combine both aforementioned concepts, being developed as HTML5 Web apps, but shipped inside native app containers for the various platforms. Such hybrid apps can provide additional features and hardware access, that only native apps provide, while reducing the required development effort. However, differences in browser implementations on the various platforms can partly outweigh the benefits of hybrid apps.

[1] Such as the operating system being allowed to kill a running app process at any time to free memory resources.

Further discussion on this topic can be found, e.g., in Eboli (2012). From the perspective of an uninformed user, a well-designed hybrid app can barely be distinguished from a native app. In this study, we will not discriminate between those various types of apps. However, the effort required to create native apps for multiple platforms motivates the research questions concerning differences in user behaviour between the leading app ecosystems.

2.1.3. Online Communities and Social Networks

Surely as vital in nowadays mobile computing, as the smartphones' hardware and software, is the evolution of social networking, which became a big driver for mobile applications. Or from another point of view, smartphones are somehow all grist to the social Web's mill. The combination of both affords radically new chances, services, but also risks, having a huge impact on society. One of the most important developments in this regard, was the addition of geospatial context to social networking, offered by the GPS- and network-based positioning features of smartphones.

In this study, I will account for the key role of social networks by collecting data on various social networking aspects relevant from an app developers' perspective. However, for now we just need to establish the difference between social networks and online communities, which are often confused. Succinctly, the main difference between social networks and communities lies in the role of connections between users (Howard 2010, p. 12). Social networks are centering on the individual user, and focus on one-to-one relationships – in a community, relationships between users are only secondary, as a community focuses on a collective theme or action (Howard 2010). To increase the confusion, social networks can offer community features, such as the *groups* facilities within *Facebook*.

The difference between social networks and communities needs to be taken into account, when performing research on user behaviour in this field. It might turn out to be a problem, for example, when asking people if they use a social network, as they might also think about communities then, being unaware of a difference. Additional confusion is caused by services and apps such as *Foursquare*, or *Instagram*, the latter being a hybrid between a photo-sharing community and a social network.

Furthermore, the concept of SLNs (Social Life Networks), as the proclaimed next generation of social networks, is worth mentioning. Jain and Sonnen (2011) summarise SLNs as an open technology framework, combining social network and communications features with support for the user's daily lives, by integrating other services and feeds into the network, such as news, events, healthcare, transport, and so forth.

Social Login

Social networks are tightly knit to mobile apps[1] through so-called "social login" facilities, sometimes also referred to as "social sign-on". The premise is, that a significant amount of users are

[1] The same applies to Web 2.0 applications.

using one of the leading social networks, like *Facebook*, *Google+*, or the microblogging community *Twitter*. Such an account could then be used to authenticate the user in the context of other Web 2.0 services or mobile apps. Networks like *Facebook* therefore provide such authentication facilities via their API.[1] Offering an app login through *Facebook* is preferable from a developers' point of view for the following reasons:

» There is no hassle for a user to enter his contact details for registering with the app, which would otherwise violate today's "lazy registration" best practice pattern of user experience design.

» The user is authenticated by *Facebook*, subject to *Facebook's* real name policy, and abuse prevention mechanisms. This provides at least some basic sense of trust to the other users.

» The app can ask for further permissions to obtain information on the user, such as his or her list of friends, which is very valuable for apps that can build unique features on top of *Facebook*'s *Social Graph*.

» Content sharing between the app and *Facebook* becomes possible without any further ado (given the user grants the app a permission to do so). This is a key aspect for new apps that rely upon viral spreading via social networks instead of expensive advertising.

Especially regarding the first point, it makes sense for many platforms to offer a *Facebook* login. Apps with community features, such as the music streaming service *Spotify*, and recently, the popular flea market app *Shpock*, initially required a *Facebook* account for using the service. In the case of *Shpock*, they employed the network of the users' *Facebook* friends for the ranking of offerings, and improving the trust on the platform. However, this *Facebook* coercion can backfire, as it virtually locks out entire segments of users: those without a *Facebook* account, and those refusing to link their *Facebook* profile with the third-party app.

From a users' point of view, there are also disadvantages of a social login:

» Status spam. As mentioned, apps and services can use the *Facebook* connection also to publish information on the user's app activity to the user's *Facebook* timeline. This should aid the user's self-portrayal, but also motivate the user's friends to join the service. An example for this is *Spotify* publishing the tracks a user is currently listening to, into the user's *Facebook* activity feed. While today, this must be activated explicitly by the user, one or two years ago many apps did so by default, resulting in a flood of activity, that many considered to be irrelevant and annoying.

» Real name policy. For an app, it might be an advantage, that *Facebook* and *Google+* are pursuing a strict real name policy. For a user who does not want to link the activity from every app or service to his real identity, a compulsory social login might be a considerable problem. In this case, a user might choose to violate the *Facebook* TOS, and register a "fake" *Facebook* account for the app.

» Unclear implications of the link between the app and *Facebook*. Not only due to the ever-changing nature of *Facebook*, even very involved users may lack an understanding, what

[1] Often based on the OAuth 2.0 protocol (OAuth 2013).

the implications of a connection between a given app and *Facebook* are, particularly, what data the app can gather from *Facebook*.[1] Moreover, it might be unclear, what the app may publish to the user's *Facebook* profile and timeline.

The relevance of the social login will become more apparent later in this chapter, where the typical app lifecycle is discussed.

2.2. The Mobile Apps Ecosystem

The mobile apps ecosystem involves the following stakeholders:

- Smartphone device manufacturers, such as *Samsung*, *LG*, *Apple*, *HTC*, *Motorola*, *RIM*[2], and *Nokia.*
- Mobile operating system vendors, such as *Google* (*Android*), *Apple* (*iOS*), *Nokia* (*Symbian*), *RIM* (*Blackberry*), and Samsung (*bada*).
- Application store operators.
- Mobile applications developers.
- Telcos/mobile network operators (MNOs).
- End users.

One can also view the entire mobile ecosystem in layers: From top to bottom, there are services, applications, application frameworks, operating systems, platforms, devices, aggregators, networks, and operators (Fling 2009, p. 14). In this work, we will just deal with app developers, operating systems, platforms, and devices.

What distinguishes the mobile app ecosystem from the traditional desktop computing market, is the availability of app stores, acting as an intermediary between software developers and end users. The former can publish apps on such stores, which the latter can purchase or freely download, and install on their devices. In terms of the business model, and economic theory, this app store-based software distribution model represents a so-called "multi-sided platform", connecting the markets of mobile phone users and mobile app developers, to generate positive network effects[3]. App stores are typically integrated into the respective operating systems via apps themselves, offering the convenient browsing of apps within the stores, and management of the users' already purchased apps.

2.2.1. The Market Leaders: Android vs. iOS

The various app ecosystems are somewhat different in nature. For example, *Android* is an open source smartphone and tablet operating system developed by *Google*. *Google* operates its own

[1] Even though the user needs to explicitly confirm the *Facebook* access privileges requested by the app.

[2] *Research in Motion*.

[3] Benefits that arise through more people participating in the platform; cf. Katz & Shapiro (1985).

app store, the *Google Play*[1] store, and cooperates with various hardware manufacturers (*Samsung,* and *LG* lately) to develop a dedicated series of devices, the *Nexus* series, for showcasing the features of its latest *Android* release. Due to the system being open, an app store is technically not required: users can also load an app individually from a developer's Web page as APK file[2], and install it on their devices.[3] Furthermore, various alternative app stores exist, which offer similar facilities. The most prominent example here is the *Amazon Appstore for Android*, from the well-known e-tailer *amazon.com*.

In contrast to *Android*, apps for the *iOS* ecosystem are solely available from *Apple*'s *App Store*. It is not possible to install apps on *iOS* from any other sources, unless the user has "rooted"[4] his or her phone. *Apple*'s *App Store* offers the advantages of enabling user trust, and app quality control, at the cost of possible censorship, and developer fees charged for participating in the platform. The closeness of the *iOS* platform has further implications: download and monetisation statistics of *Apple*'s *App Store* cover almost the entire ecosystem, which is not true for the *Google Play* store.

Because *Android* is open source, many hardware vendors customise it to offer special features, and adapt it to their specific hardware. An example for this is the *Sense* UI from *HTC*, or *Samsung's TouchWiz*. Thus, the *Android* ecosystem is more heterogeneous, separating *Google*'s "stock" *Android* from the customised OEM *Android* versions, running on an even greater variety of different hardware. OpenSignalMaps (2012) visualised the fragmentation of the *Android* market impressively, along the dimensions of device models, brands, different API levels, screen resolutions, and so forth.

Last but not least, customised *Android* versions exist, that are not developed by hardware manufacturers. The most prominent example is *CyanogenMod*, a community-developed *Android* distribution.

Needless to say, that the mobile app ecosystem, and the appearance of app stores, has spawned comprehensive research. Quick overviews on the success factors for mobile app stores are provided e.g. by Cuadrado (2012), and Yamakami (2011). A more extensive study on non-public app market statistics from the different platforms is given by d'Heureuse et al. (2012), while the implications of the paradigm shift in the distribution of mobile applications are discussed by Ghezzi et al. (2010).

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[1] Formerly called "*Android Market*".

[2] *Android* Application Package File.

[3] The installation of unsigned apps from other sources is also referred to as "sideloading".

[4] "Rooting" refers to circumventing the protections or limitations of proprietary hardware/software platforms, e.g., to enable the installation of pirated software, or allow to access functions on the operating system or hardware layer.

2.3. The Mobile App Lifecycle

Let us now deconstruct the lifecycle of a mobile app. In this work, “lifecycle” does not refer to the execution of an app inside the *Android* virtual machine, but to the stages of user adoption. Figure 3 depicts a typical process for an app that is downloaded from an app store. As mentioned, on open platforms like *Android*, apps can be installed independent from an app store. Nevertheless these stores are the common, most convenient way to connect app publishers with app users.

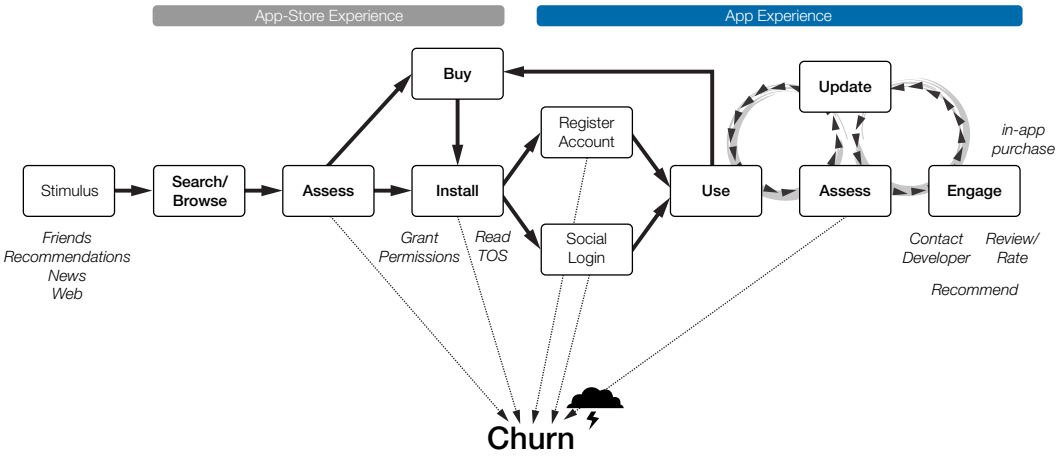

Figure 3: A simplified lifecycle of mobile app use, depicting the typical case of an app installation through a mobile app store. The process starts with the user’s intention, or a stimulus, to search for an app, and ideally ends with long-term usage, or even strong engagement. There are various stages where churn[1] can occur, especially within the critical transition between installation and use. The term “app-store experience” is lent from Griffith (2011).

The app lifecycle presented above arose naturally through thinking about the several steps a user has to take, to find and install a new app. Later, I extended this process with the reason – the stimulus – that triggers the user’s intention to install an app. Furthermore, I assumed a priori that, concerning app adoption, two types of users can be distinguished: regular, pragmatic users, and users, that show *engagement*, that is, behaviour that is not directly related to the utilitarian value of using the app itself. Such engagement could be app reviews, app recommendations to the user’s friends, or the provision of feedback to an app’s developer. From my point of view, also in-app purchasements can be regarded as a flag for a high app involvement of users.

The proposed lifecycle shall now be put into relation to other similar efforts. For example, in 2011, *MTV Networks* conducted a survey among approx. 1,300 app users, defining an app lifecycle to comprise of four stages: discovery, adoption, trial, and either abandonment, or long-term usage[2] (MTV Networks 2011). These stages can be mapped onto the proposed lifecycle as follows: “adoption” refers to the installation, “trial” to use and assessment, “abandonment” to churn, and “long-term usage” to continuous use, or even higher engagement. In the following, the stages of the lifecycle are discussed in more detail.

[1] Also referred to as “customer attrition”.

[2] These stages somewhat correspond to the diffusion process from Beal and Bohlen (1957), that comprises of awareness, interest, evaluation, trial, and adoption.

Stimulus

The stimulus to search for a specific app, or a type of app to solve a problem, shall not be discussed too extensively here. It could be a personal recommendation, news article, or a particular "customer pain" arising.

The questions for this work, in the context of the stimulus, are:

» How do people typically find new apps?

» What channels are most important to the users, for finding new apps?

Search/Browse

In the context of this work, this particularly refers to the searching or browsing through app stores. If users are not searching for a specific app that was recommended to them, they are typically confronted with thousands of apps, needing to decide which one to pick. This brings us directly to the next stage, the assessment. Usually, both of these stages are closely entangled.

Assess

Having found one or more apps, a user needs to decide if he or she wants to install any of them. This decision is based on many factors. Apparently, the presentation of the app, the reviews from other app store users, the ranking within the store, the download counts, the price, trust, and several other aspects play a role here. In this study, we shall select some of these aspects for further investigation.

Candidate questions to be answered are:

» How important is the presentation of an app within a store (design, texts, logo)?

» How important is the ranking of the app within the app store's search results?

» How relevant are reviews and ratings for the users' decision?

» What makes people reconsider installing an app?

Buy

Some apps need to be bought altogether, some provide limited free functionality, offering additional paid features[1]. According to Gordon (2013), 90% of all apps are free, and the current average app price is below one dollar. Typically, apps do not cost much, to keep the psychological barriers to purchasement low. The current paradigm is to monetise apps rather through in-

[1] So-called "freemium" services, a portmanteau of "free" and "premium", coined by Jarid Lukin in a comment to Wilson (2006).

app purchasements than through one-off fees: at the time of this writing, in-app purchasements generate 76% of all revenue in *Apple*'s *App Store* (Koekkoek 2013). This makes perfect sense, as apps can employ very persuasive advertising, to make users pay small amounts that sum up over time. Furthermore, there are no facilities built into app stores, that allow to try out an app before buying it.

Theoretically, it is not very complicated to buy an app through one of the various app stores – all that is required, is a credit card, and faith in the store's security. Nevertheless, these are considerable barriers for some users, which leads us to further research questions:

» How many people have already purchased an app?

» How many people have already purchased something from within an app?[1]

» Are there any common barriers to app buying? If yes, which ones?

» What is the users' average monthly spending on apps?

Install

After the user has decided to install an app, its installation is normally performed without any further ado. The smartphone downloads the app through the store, unpacks and installs it, at the touch of a button. On *Android*, another intermediate step is needed though: the user must accept the app's list of required access privileges. If he or she refuses to do so, the installation is aborted. Depending on the platform, a user also needs to review an app's terms of service (TOS), and privacy policy.[2]

Thereby the following questions arise:

» Are there any significant privacy resentments keeping users from installing an app?

» Do users care about the TOS and the list of required access privileges?

Register Account or Social Login

While there are many tools that do not offer any personalisation, most user-centred apps require to create at least a basic account, e.g. by specifying the user's nickname and a password, providing an email address, or permitting access to his or her telephone number on the device. Other apps rely upon a so-called social login, as already discussed in section 2.1.3. Within the registration or social login step, many users refuse to continue – from my personal experience, some apps lose up to 40% of users right after installation, before first use. This is why some apps defer the registration to a later point in time, which is commonly referred to as "lazy registration". The premise is, that this way, users have already invested time into the app, got accommodated to it,

[1] So-called "in-app purchasements".

[2] For *Android* apps, the privacy policy is already available on the app's description page within the *Google Play* store. Apps typically display the terms and conditions in the registration step after installation.

and hopefully understood its value proposition, so they are more likely to take the hassle of registering. Another factor here is trust, which should increase, the more a user gets used to an app.

In the context of social logins, the following questions are interesting to be answered:

» How many app users are using social networks? What social networks do they use?

» What do users think about a compulsory social login?

» Do users use their real name on *Facebook*?

One might ask, why the fraction between total app downloads/installations, and users who register an account, is not among the research questions – this is due to the fact, that such a metric can be measured almost directly by each developer, as both user account registration and app download counts are easily obtainable. This work focuses on the potential reasons for users not proceeding with the registration.

Use

The use step is almost self-explanatory. What is important here, is that there are many obstacles before it. Given that the user's need to search for an app is triggered (stimulus), which must not be taken for granted, there are many barriers that separate app users from non-users. Furthermore, as already mentioned, many apps come as free apps with basic functionality, and a paid premium offering. Thereby, a link between use and buy is depicted in Figure 3, taking users into account, who upgrade to a paid version.

Resulting questions:

» Is there a significant fraction of smartphone users not using any apps on their phone?

» What apps do users consider as most indispensable for their daily lives?

» Do users prefer apps specialised on specific use cases, over feature-laden apps?

Assess (Trial)

This step designates the continuous assessment of an app, while the user is using it. The step's outcome is either sustained use (retention), more engagement, or attrition (churn). There is an endless amount of potential factors that are relevant for users to decide, if they continue to use an app. The questions I considered as most interesting in this regard, are:

» How do users rank various app aspects against each other, such as design, features, battery usage, prestige/exclusivity, and privacy preservation?

» When offering a stable app with less features, and an app with more features, but also more potential bugs, what would users choose?

» Would users continue to use a community app, if their friends and existing contacts are not registered there?

» Are some users actually preferring communities that are full of strangers, for making new friends?

» Do users consider the linking of an app to *Facebook*, to enable sharing, as a benefit, or a drawback?

Update

Software is not static, it typically grows and improves over time. Thereby, updates are an inevitable step in an app's lifecycle. Updates are released for feature enhancements, or bug fixing, and naturally occur very frequently in early-stage applications. The app store delivery model greatly simplifies the update process, as users are actively notified by some platforms (e.g. *Android*), that a new app version is available. The user can review the description of the update, and install it upon the touch of a button. Typically, the transition between app versions is seamless, as most developers strive to keep or migrate the users' data to the newer app version, and to maintain active login sessions. Any little hassle, like requiring the user to log in again, or asking for further access privileges, can lead to churn.

Thinking about the update step from an app developer's viewpoint, the following questions arise:

» Choosing between seldom, major updates, and frequent, small ones, what do users prefer?

» Are users setting updates to automatic, or do they prefer to manually install them?

Engage

Last but not least, this stage separates normal users from users that are strongly involved with the product, e.g. through reviewing and rating the app, recommending it to other people, buying features or items through in-app purchasement, and actively providing feedback to the developer for improvements. This is very beneficial for the success of an app, because user feedback is vital for the development process, and as already discussed, reviews and ratings are aiding the decision of other users to install an app.

Thereby the resulting questions to be answered are:

» How many users rate or review apps? What motivates users to review an app?

» What is the balance between positive and negative reviews?

» How many users actively contact the developers of apps for qualitative feedback, such as feature suggestions?

Having motivated the main research questions through the app lifecylce, we can now proceed to review related work, and differentiate this thesis from efforts in the same area of research.

2.4. Related Work

2.4.1. Market Research

Concerning facts on the mobile ecosystem, there is much international market research to draw from, particularly studies from large research companies, such as *Gartner*, *IDC*, and *Forrester*. A common tenor of these statistics is the rapid, sustained growth of the worldwide smartphone penetration, as well as the clear market leadership of *Android* in terms of shipped devices, followed by *iOS* on the second rank. For example, the latest worldwide statistics from *IDC* indicate that smartphones have surpassed feature phones in terms of shipments (IDC 2013b), and that *Android* and *iOS* together combine for more than 90% of the worldwide smartphone OS market (IDC 2013a).

However, while many market statistics deal with the global, US, Asian, or other markets, little public data on smartphone usage and app adoption is available particularly for Austria. What sets the Austrian market apart from many other countries, is the extremely high mobile penetration, which amounted to 120% already back in 2008 (RTR 2008). This, among other factors, made Austria an ideal testbed for mobile operators.

In 2012, *Google* launched a worldwide survey among smartphone users, named "Our Mobile Planet" (*Google* 2012), that resulted in data for over 40 countries, with Austria among them. *Google*'s survey, stating to base upon a representative sample of 1,000 Austrian participants, deals with various topics, particularly the use of smartphones themselves, and less with app development-specific issues. Among the compiled facts are, how many people actively use their smartphones, how many users won't leave their home without a smartphone, the places where they use it, how many of them access the Internet on their phone at least once a day, how many people search on their smartphones, inform themselves on products and services using their smartphone, watch videos, use location-based services, and so forth and so on.

Of more interest to app developers, are the following results of *Google*'s survey (*Google* 2012):

- The smartphone penetration of 36% for the first quarter of 2012, rising from 21% a year before.
- An average amount of 25 apps installed on the users' phones, with 10 apps used within the last 30 days.
- Frequent social network use, as 42% of the respondents visit a social network at least once a day, and 72% visit social networks in general.
- The fraction of 24% of all users who already made a purchasement of a product or service via their smartphone.
- The existence of barriers to e-commerce, such as security concerns.

Another source of market statistics is *StatCounter* (2013), which focuses on Web statistics collected from more than three million Web sites. *StatCounter* aggregates various statistics by country, gained through the headers of HTTP requests, such as the distribution of mobile operating

systems and mobile browsers in Austria.

However, what all of the aforementioned public statistics lack, is the exploration of the data along further dimensions, such as the users' gender, operating system, and age. Most of the data is presented in a highly aggregated form. A major goal of this survey is to fill this gap, and provide data on a more detailed level, to find out, if there are any remarkable differences within subgroups of the entire population.

2.4.2. Diffusion of Innovations Theory

In 1903, Gabriel Tarde published the book "The Laws of Imitation" (Tarde 1903), describing the propagation of innovations through society, thereby laying the foundations of the so-called "diffusion theory". In 1962, Everett Rogers propagated this theory in his well-known book "Diffusion of Innovations". He aimed to explain the process, drivers and barriers concerning the adoption of new technologies by individuals, and defines the term "diffusion" as follows:

> "Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. It is a special type of communication, in that the messages are concerned with new ideas." (Rogers 2010, p. 5)

Moreover, Rogers describes the so-called "innovation-decision process" of an individual in five steps: knowledge, persuasion, decision, implementation, and confirmation (Rogers 2010, p. 20). Again, these steps can be related to the app lifecycle introduced previously. Knowledge corresponds to the stimulus, persuasion to the installation, decision to the assessment (trial), and implementation to the use stage. The outcome of the innovation-decision is either adoption, or rejection of an innovation; however, the adoption is not an irreversible decision: at the confirmation stage, an individual attempts to reinforce the decision made, which can also lead to abandonment, that is, churn (Rogers 2010, p. 184).

However, as its name implies, the diffusion of innovations theory is only applicable to innovations. "Innovation" is thereby defined as "an idea, practice, or object that is perceived as new by an individual [...]", regardless, if it is "objectively" new (Rogers 2010, p. 11). Until a few years ago, smartphones and tablets themselves fell into this category; and today, innovative mobile apps are covered by this definition.

Last but not least, Rogers describes five categories of adopters: innovators, early adopters, early majority, late majority, and laggards, the distribution of which forms the well-known bell-shaped product diffusion curve[1] (Rogers 2010, p. 247). In order to successfully put a new service onto the market, it is vital to get the few innovators and early adopters aboard. The innovators actively search for new products, accumulate knowledge regarding the innovation, and act as opinion leaders for the following, considerably larger early majority (Rogers 2010, p. 201).

[1] In the context of today's high-tech marketing, this curve is also called "technology adoption lifecycle".

Almost 30 years later, in 1991, the diffusion of innovations theory was picked up again by Geoffrey Moore, who argued that for discontinuous innovations[1], there is a chasm between the early adopters and the early majority (Moore 1991, p. 15). This chasm needs to be overcome to facilitate the success of a game-changing product; particularly, a critical mass of consumers needs to be acquired, so that the "further diffusion becomes self-sustaining" (Rogers 2010, p. 343).

The undisputable importance of the social dimension for the diffusion of innovations is reflected in the research questions of this work, incorporating several items that particularly deal with the social networking behaviour and attitude of the users, as described in the *social login* and *assess (trial)* steps of the app lifecycle in section 2.3, and consequently, present in the survey's *social network aspects* question block, that will be discussed in chapter 4.

2.4.3. Technology Acceptance Research

Apart from diffusion research, a vast amount of effort has been taken to distil common factors that are beneficial or detrimental to the adoption of IT systems and software in general, resulting in paradigms such as the very popular Technology Acceptance Model (TAM) from Davis (1985, 1991), shown in Figure 4, that built upon the theory of reasoned action (TRA) from Fishbein and Ajzen (1975, 1980).

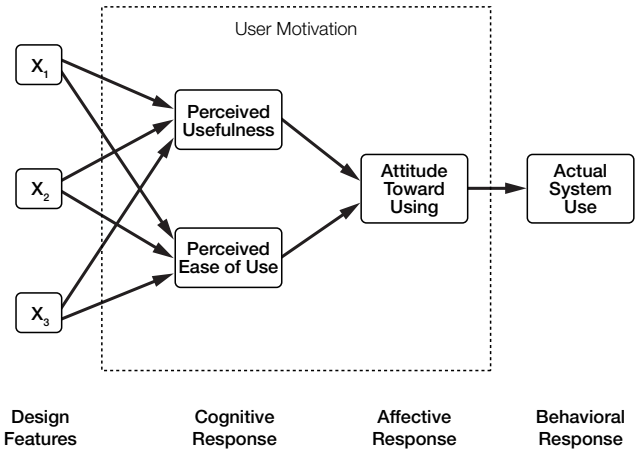

Figure 4: The original TAM model by Davis (1985, p. 24), outlining the causal link between an information system's various design features on the left, and the user's actual use, as a behavioural response, on the right. The perceived ease of use and perceived usefulness are supposed to be two factors of considerable impact on the user's attitude towards using a system. This attitude then manifests itself in the actual system use.

Models like the TAM were developed to apply standardised scales from behavioural research to establish underlying factors for the use of an information system, such as the perceived usefulness, perceived ease of use, and later, perceived enjoyment (Davis et al. 1992). All of these factors are presumed to influence the user's attitude toward using a system, which then manifests itself in actual use behaviour. Thereby these models provide well-tested constructs to facilitate

[1] Also referred to as "disruptive innovations" nowadays, c.f. Christensen (2003).

quantitative research on user acceptance regarding all kinds of information systems. As of today, numerous models similar to the TAM are available, from refinements like the TAM2 (Venkatesh and Davis 2000) and TAM3 (Venkatesh and Bala 2008), the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003), to models that are tailored to explore user acceptance particularly in the field of mobile apps; for example, Maghnati et al. (2013), who tested further factors, such as an application's aesthetic, playfulness, service excellence, and consumer return on investment, upon their influence on usage attitude.

Unfortunately, the TAM, and thereby, many of its offsprings, have also been criticised due to some shortcomings, such as the omission of important external factors (like the user's age and experience), and the low practical effectiveness of the model (Chuttur 2007, p. 16). Also, the social dimension that is fundamental to diffusion research is almost completely absent in the original TAM model. Last but not least, as van der Heijden (2004) outlined, a distinction between hedonic and utilitarian information systems needs to be made, both of which exhibit a different significance of the perceived usefulness and perceived enjoyment constructs.

In contrast to the TAM, this study does not have the ambitious goal to construct a model to explain the intention – and thereby predict the behaviour – of a user. Rather, it just aims to identify, describe, and measure a broader set of determinants that are supposed to influence a user's attitude and behaviour. Considering the shortcomings of the TAM, the proposed survey deals with a wider range of attributes extracted from the various stages of the app lifecycle. But one needs to keep in mind, that however detailed the set of presumed determinants for the user's behaviour may be, there will always remain a tradeoff between a model's completeness, and feasibility. Constructing a causal model, and measuring the significance of the determinants for user adoption, would exceed the scope of this work, if performed with the necessary care. However, this study generates data that can later be used for such efforts. For example, many of the attributes addressed by the questions from the assessment (trial) stage, as well as other questions, can be related to TAM-based models, as depicted by Table 1.

What is obviously missing in the proposed survey with respect to the TAM, is the measurement of the users' intention to use a concrete app. The data planned to be obtained through this study just measures the overall app usage, and installation frequency. This encompasses all different kinds of apps, from basic utilities, to games, and social apps. If one aims to measure significant factors for the adoption of apps, the questions would rather have to deal with a concrete app, or type of app, asking the user specifically about his or her intention to use it, and furthermore, actual use experience.

Moreover, this study measures external factors, such as the users' age, gender, education – but also, the chosen smartphone operating system, which is not accounted for even in more comprehensive models, such as the UTAUT.

Survey Attributes	Model Determinants	Model	TAM Construct
Features, stability	-	TAM	perceived usefulness
Design, stability	-	TAM	perceived enjoyment
Reviewing and rating behaviour	subjective norm	TAM2	perceived usefulness
Prestige, exclusivity	image	TAM2	perceived usefulness
Smartphone features adoption, app use frequency, buying interval, app engagement	self-efficacy, experience	TAM, TAM3	perceived ease of use
Security and privacy concerns	computer anxiety	TAM3	perceived ease of use
Friends using the app, social network attitude, *Facebook* integration preferences	subjective norm, social influence	TAM2, UTAUT	perceived usefulness
Installation barriers, payment barriers, privacy concerns, performance	technical barriers, such as installation/configuration/ performance problems	Verkasalo et al. (2010)	perceived enjoyment, perceived usefulness

Table 1: Mapping the attributes of the proposed survey questions to similar constructs from the Technology Acceptance Model (TAM) and its offsprings.

2.4.4. Research on Privacy

Among the previously discussed research questions is, if users are aware of privacy and security hazards, how they rank privacy against other aspects of apps, and what factors influence the users' privacy awareness. A common tenor is, that a considerable difference in privacy awareness exists between male and female users, and that younger people are less cautious concerning privacy, than older people. Much research has been conducted in this field, sometimes coming to different conclusions. An early non-representative study by Brown and Zukowski (2007) revealed, that there is a correlation between (South African) Internet user's information privacy concerns[1] and demographic factors, such as age and education. Later studies such as Williams et al. (2009), or Brandzaeg et al. (2010) show, that younger people seem to be more aware of the privacy hazards of social networks and Internet use. Moreover, one expects, that there are country-based differences in privacy concerns, which is confirmed by studies such as Wang et al. (2011). Therefore, it will be interesting to verify these results for the Austrian region.

[1] IUIPC, a framework to measure these concerns by Malhotra et al. (2004).

3 | Expert Interviews

After defining the research questions, interviews with several app startups were carried out, in order to improve the planned survey with their rich experience, and incorporate their specific market challenges into this work. Table 2 outlines the four interview sessions.

The interviewees are experts in the field of mobile applications: *Finderly* is a young startup creating a mobile flea market app called *Shpock*, that is among the most rapidly growing Austrian apps, downloaded over 120,000 times as of January (TechCrunch 2013), and 500,000 times as of May (derStandard.at 2013). *MySugr* is an Austrian app-startup helping diabetics to improve their daily life, achieving the top medical app status in six countries with approx. 80,000 users, as of July 2013. *9yards* is a small venture with two years of experience in developing innovative apps for businesses, as well as proprietary projects. Finally, *ThinSlices* is an experienced, Romania-based app foundry.

Company	Interviewee (Function)	Location	Length	Recorded
Finderly GmbH / Shpock	Co-founder / CEO	Vienna / startup's office	60 min.	yes
mySugr GmbH	Co-founder / QM	Sektor5 coworking space	30 min.	yes
9yards GmbH	Co-founder / CFO	Sektor5 coworking space	60 min.	yes
ThinSlices SRL	CEO	Skype	30 min.	no

Table 2: Overview on the expert interviews conducted.

Prior to the interviews, I mailed the catalogue of research questions to every participant, to focus and ease the discussion. This made the interviews more efficient, allowing to concentrate on the facts that were regarded as most important by the interviewees. The list of questions is provided in appendix C.

3.1. Requirements

Not different to other social research methods, interviewing also bears some ethical issues to be considered, especially concerning the transparency of all facts related to the interview, and the interviewees' privacy. Fortunately, this research did not involve any sensitive personal questions, or anything else that might trigger emotional distress on the interviewees' side.

3.1.1. Interview Structure

The interviews were conducted as semi-structured interviews (Bernard 2012, p. 182), meaning that the topics to be addressed were pre-defined, but the exact verbing of the questions, and the focus were subject to the specific situation.

Each interview commenced with a short introduction, covering the following essential aspects:

» An introduction to the research goals and research design.

» A notice on the confidentiality of the interview, assuring the interviewee, that all information he or she provides, is solely used for this work.

» Asking, if the interviewee minds, that the interview is recorded for reference, with the option to interrupt the recording at his or her discretion.

» A notice, that written notes are taken in the course of the interview.

» Assurance, that there are no right or wrong answers to the interview questions, and that the interviewee may refuse to answer questions he or she is not comfortable with.

» Asking, if details about the interviewee and the organisation may be included in this work.

To maximise the outcome of the limited interview time, I have put the questions of interest into a short interview guide (Bernard 2012, p. 182) to be followed through.

3.2. Results

The three face-to-face interviews were recorded for later reference, using a professional field recorder[1]. The recordings were not transcribed, as they served just as an additional backup to the written notes taken. All in all, the interviews provided valuable feedback concerning the relevance of the survey questions. Most interviewees said, that the survey results would be of considerable interest to them, and contain some information they cannot get through the common app market statistics available, including app store metrics, and particular app analytics software. Especially, the following facts were judged to be of great interest:

» How users find new apps, and if they actively search for them.

» What apps are most important to the users.

» If the users have ever paid for an app.

» What keep users from installing an app.

» The rating, reviewing, and general feedback behaviour of the users.

To maximise the response rate of the planned survey, the overall amount of questions needs to be reduced as far as possible. Based on the expert feedback of the startups, some topics were removed from the survey:

» If the user is happy with his smartphone OS choice.

» If the user uses his real name on *Facebook*.

Other questions were reformulated iteratively within the course of the interview phase.

[1] *Marantz professional PMD620* solid state recorder, using the built-in stereo microphone array.

3.2.1. Detailed Discussion

The outcome of the interviews is elaborated in more detail in this section. Questions that did not yield any particular feedback during the interview rounds, will not be dealt with here any further. For reference, appendix C lists the entire proposal for the online survey questions.

To carry out the interviews, the suggested survey questions were split up into six blocks that are topically related from a developer's point of view.

Block A - Basic Questions on the Use of Smartphones

This block deals with the user's behaviour concerning the purchasing of his or her smartphone, and the use of its built-in features. Most notably, the interviewees confirmed that the users' smartphone purchasing interval (question A-3) is of interest, because among other reasons, it is a major problem on *Android* that a wide range of outdated devices exists in the field, causing support problems. One interviewee noted, that it would also be interesting to check, which users are rather purchasing their smartphones themselves, and which ones are using the expiry of their mobile network operator contracts for obtaining a new phone for free, or subsidised by the operator.

Concerning question A-2, the operating system choice of the user, one interviewee said, that it would be interesting to check, if the user has ever switched the platform. If yes, the user should indicate the platform he or she switched from, and what the reasons therefor are. If not, the user shall be asked, if he or she is comfortable with the OS choice, and if he or she is considering to switch. Asking the other interviewees about this, they indicated less interest in this aspect: one interviewee noted, that the OS and hardware are closely entangled, and, e.g., that many users won't care for *iOS*, because the *iPhone*'s hardware is the deciding factor for them. Eventually, I marked this question to be removed from the survey due to the length constraints.

A vital input from one of the startups was to specifically clarify, if the survey applies both to private and business users, and that in the case a respondent uses both a private and a business smartphone, it must be stated in what respect the user shall answer the survey's questions. To remedy any confusion about this, I have added an appropriate hint at question A-2 (question SM01 in the final survey).

Block B - In-Depth Information on Apps Usage

This block addresses active users of apps, asking for information on their basic app use and purchasing behaviour. Question B-1 deals with "built-in" apps of the phone, such as the music player, camera app, and so forth. One interviewee criticised, that "built-in" would somehow also cover the *Facebook* app that is pre-installed on many devices. Despite this viewpoint was not shared by the other interviewees, I reconsidered the scope of this question thoroughly, and concluded that built-in apps could be regarded rather as smartphones' features from the users' perspective. As features usage is already examined by question A-5, I adapted the latter, and removed B-1.

A similar problem was spotted at question B-3, which deals with the most important apps for the users' daily life. An interviewee noted, that a distinction needs to be drawn between those apps and the smartphone's built-in features, such as phone, SMS, calendar, and email.

Question B-4, asking how often a user downloads or tries out new apps, produced the feedback, that the active and passive trying out of an app should be separated – "passive" meaning, that the user is pushed to try out new apps by friends. This is partially covered by Question B-5 already, that intends to measure the channels a user finds new apps from, such as personal recommendations, media, or app store browsing. Here, one interviewee identified the amount of time a user spends browsing the app store to be a potential question candidate.

Concerning the next question, B-6, dealing with the sources a user downloads apps from, one interviewee noted, that third-party app stores would deserve to have their own category here. Due to the length constraints, I had to drop this question entirely from the later survey.

Question B-7 was judged to be one of the most essential ones. The interviewees stated serious interest in its outcome, due to the need to monetise their applications. It was added, that also the barriers to payment, which I have unintentionally omitted in the proposal, were of interest, such as the user having no credit card. The separation between app buying and in-app purchasements was noted to be a vital aspect, given the fact that the apps with most turnover in *Apple*'s *App Store* statistics are free apps. Similarly, question B-8 asks the user directly on his or her willingness to pay. One interviewee stated, that the question could provide typical price categories to be chosen, and furthermore, ask if the user has any maximum price limit for purchasing an app. Later, I decided to remove this question altogether; again, due to the survey length limit. Moreover, the question would have needed to be reworked, asking users about their concrete past spending rather than vaguely about their willingness to pay.

A general remark within this block of questions was, that it would be interesting to ask, if users jailbreaked[1] their phone, and if they use illicitly copied apps. Finally, an interviewee suggested to take the entanglement between Web apps and mobile apps into account, that is, checking how vital a mobile app is for a given Web 2.0 product. An example given by the interviewee was the question, if the Web mail service *Gmail* would lose users, if there was no mobile app for it. This is a very interesting topic, however I left it out of this research, as it is more aimed at Web businesses, and of less use for mobile app-centred startups that have no primary Web app background. Another proposed question was asking for the last time the user downloaded a paid app.

[1] Jailbreaking refers to the circumvention of restrictions imposed by the closed *iOS* platform, that is, allowing to install unsigned apps, and gain higher privileges. This can be compared to the already discussed "rooting" of *Android* devices.

Block C - User's Security and Privacy Attitude, Installation Barriers, Development-relevant Aspects, and App Involvement

This block combines several aspects concerning the user attitude and behaviour, that might constitute barriers to the installation or use of an app. Furthermore, it measures the engagement of app users, referring to their active feedback, reviewing and rating.

Question C-2 deals with privacy resentments in the course of an app installation. Some comments were made by an interviewee here, that care needs to be taken concerning the different implementation of privacy controls on *Android* and *iOS*. On *iOS*, the user is typically not confronted with access permissions settings in the course of the app installation.

Similarly, question C-3 asks users about the subjectively perceived risk to install malware. One respondent proposed to check, where users' security resentments are most typically arising from.

The question on the users' terms and conditions reading behaviour, C-7, was found to be relevant, however it was noted, that the question should be narrowed down to a specific context. Therefore I added the context of an app installation to the final wording of the questionnaire. The experience of one interviewee showed, that the terms and conditions are viewed by app users more often than someone expects.

One interviewee commented, that the outcome of the app aspects ranking question C-8 was of particular interest to him. Question C-9 deals with the functionality and value proposition of an app. A respondent noted, that the paradigm shift from the desktop to mobile operating systems is obvious here, as on the desktop, software strives to provide as much functionality as possible, while the mobile app development paradigm is to stay lean, providing only a core set of features, and maximising the usability and performance of an app.

Regarding question C-12, two of the interviewees noted that within their apps, they already include feedback tabs with open text inputs and satisfaction indicators, to ease the feedback process and collect the current users' sentiment as a metric.

Finally, question C-13 was discussed, focusing on the preferred app update interval and amount of changes. Here, an interviewee suggested to add a question that asks users how often they update their apps manually, or if they set the updates to automatic (on *Android*).

Block D - Presentation / Reputation / App Website

This block deals with the presence of the app developers and the app itself on the Web, as a complementary medium. One respondent noted concerning question D-1, that it would be interesting to check, how important the name of the app-developing company is for a potential user. On the other hand, question D-2, dealing with the relevance of Web sites for apps, was not regarded as interesting. One of the interviewees argued, that he viewed an app Web site as essential anyway, because the Web site will be used by app users searching for support. Furthermore, he noted that Web-based support software, such as *UserVoice*, is well-adopted by the app's users.

Block E - Information on Social Network / Online Communities Attitude

These questions, dealing with the users' opinion and behaviour concerning social network and online community integration, were thoroughly discussed, as most of the interviewees stated their interest in the outcome; however they did not have much to add here. Question E-4 was stated to be particularly interesting by one of the respondents, so I have marked it not to be removed in the step of cutting down the survey length.

Block F - Standard Demographics

The interviewees did not show any interest in adding any further variables to the demographics section, and it was only briefly discussed at the end of the interviews.

Other observations

Concerning the payment topic in general, another interesting comment was made by one of the interviewees, suggesting that the survey could also aim to verify the common proposition, that free goods or services are considered as less worthy than paid ones, which is in contrast to the popularity of free Web services like *Google Mail* or *Google Maps*.

An additional question was proposed during the discussion of the privacy topic: it was suggested to let the survey participants rate well-known companies like *Google* or *Apple* upon their privacy protection and trustworthiness, to measure if the user's perception is skewed in this regard.

Regarding social network interconnection, another suggestion was to check, if there is some data that users would categorically reject to share on *Facebook*, such as data from medical apps, and if users would also have a fundamental problem just linking the usage of such apps to *Facebook*.

In the course of the interviews, also the research hypotheses were discussed. The following section outlines the outcome.

3.3. Hypotheses

Based upon the questions derived in section 2.2, the related work, practical experience, and the expert interviews, the following a priori hypotheses (Bortz 2006, p. 379) are postulated to be tested through the online survey.

H1. There is a considerable gap between “passive” smartphone *owners*, and *users* who are actively downloading and using mobile apps.

H2. The majority of users is not aware of privacy hazards that arise with apps.

H3. There is a positive relation between the privacy concerns of users and their age, meaning that younger users are less aware regarding privacy hazards.

H4. Users of the *iOS* ecosystem (*Apple iPhone*, iPad) are generally less aware concerning privacy, compared to *Android* users.

H5. A significantly greater fraction of *iPhone* users is actively downloading apps, compared to the *Android* platform.

H6. *iPhone* users are generally more willing to pay for apps than *Android* users.

From now on, the aforementioned hypotheses will be referred to by their respective number. Summarising the expert interviews, some of the hypotheses could be backed by the practical experience of most of the interviewees, some were inconclusive: unsurprisingly, all interviewees acknowledged the growing gap postulated by hypothesis H1, due to the undisputable trend of the *Android*-based smartphones commodification.

Concerning H2 and H3, there were different estimates on how privacy-aware users are. One interviewee argued, that this is a very considerable factor, especially for applications in the quantified self segment, and that users will pay attention to apps with excessive use of permissions, or bad privacy reputation. Some argued that most probably the majority of users feel safe using their mobile phones, especially on *iOS*, and would not care about privacy, otherwise the huge popularity of apps with bad privacy-preserving reputation, such as the *Facebook* app, could not be explained.

Concerning hypothesis H4, an interviewee noted that on *iOS*, the implementation of privacy-maintaining controls within the apps is solved much better, thus there should be lower resentments on this platform.

Virtually all app developers interviewed also acknowledged a difference in the monetisation potential between *iOS* and *Android*, backing hypothesis H5 and H6. While *Android* extends its user base rapidly, the interviewees argued that *iOS* entered the game much earlier, and shows considerably more turnover for their applications, than the respective *Android* app variants, which might be due to the overall user experience, and app quality assurance carried out by *Apple* in its ecosystem. At the time of the interview, not all companies interviewed were engaging both in the *iOS* and *Android* apps markets: one of them launched their app on *iOS* first, after extensive research on the market potential of both platforms. Only recently, they added a native *Android* app to their offering.

4 | Quantitative Survey of Smartphone Users

In this chapter, the design and implementation of the online survey to gain primary market data from smartphone users, is described. The proposed questions (cf. section 2.3 and appendix C), that were revised through the expert interviews in chapter 3, are now converted into an online questionnaire, adhering to guidelines from social research.

4.1. Survey Structure and Design

The questions proposed in sections 2.3 were categorised from the viewpoint of the app lifecycle, which is not optimal regarding the flow of an online survey. Therefore I rearranged them, dividing the entire survey into nine blocks of related questions: Miscellaneous introductory questions (block AG), smartphone usage (SM), app adoption (NV), app searching behaviour (SE), security & privacy attitude (SC), development-related aspects (DE), app involvement (IN), social network aspects (SO), and social demographics (SD).

Figure 4 depicts the mapping of topics from the app lifecycle into the respective survey blocks.

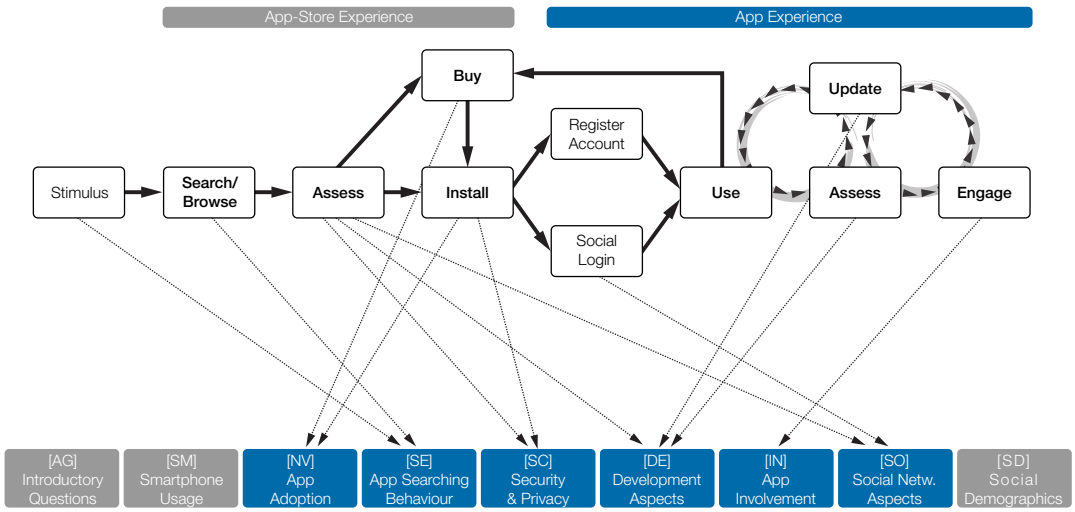

Figure 5: Relation between the app lifecycle on the top, and the proposed survey question blocks on the bottom. The latter are ordered from left to right upon their appearance in the questionnaire.

Based on this structure, each question, its type, scale, and potential pitfalls are discussed in this chapter. Furthermore, the questions and their respective variables shall be related to the hypotheses, as shown in Table 3.

Hypothesis	Description	Question / Item ID
H1	There is a considerable gap between smartphone owners, and users who are actively downloading and using mobile apps.	NV05
H2	The majority of users is not aware of privacy hazards that arise with apps.	SC02_02
H3	There is a positive correlation between the privacy concerns of users and their age, meaning that younger users are less aware regarding privacy hazards.	SC02_02, SD06
H4	Users of the *iOS* ecosystem (*Apple iPhone*, iPad) are generally less aware concerning privacy, compared to *Android* users.	SC02_02, SM01
H5	A significantly greater fraction of *iPhone* users is actively downloading apps, compared to the *Android* platform.	NV02, SM01
H6	*iPhone* users are generally more willing to pay for apps than *Android* users.	NV03, SM01

Table 3: Overview on the hypotheses support of the survey questions. An list of all items based upon their ID is provided in appendix F.

4.1.1. Guidelines for the Questions Refinement

Phrasing questions in a way that they are easy to comprehend, and bear as little ambiguities as possible, is a major challenge. The following guidelines for questioning need to be considered (Diekmann 2003, p. 410—413):

1. Questions should be short, easy to comprehend, and sufficiently precise. Avoid complex terminology and foreign words.
2. Questions should be in a neutral language, not trying to curry favour with the audience.
3. Avoid double negations.
4. Answer categories should be disjoint, complete, and precise enough. Ambiguous categories should be avoided.
5. Avoid value-laden terms, e.g. positively or negatively connoted words.
6. Avoid multi-dimensional questions.
7. Avoid indirect questions.
8. Avoid suggestive questions.
9. In multi-item batteries, questions should have alternating polarities, to detect participants with high response acquiescence.
10. Do not overstrain the participants.

Further extensive guidelines for the design of Internet surveys can be found in Dillmann (2011).

4.1.2. Target Audience

Generally, the target audience of this survey is not limited to any particular demographics. The only constraint is, that users need to possess a smartphone, and use apps, to be able to complete the main part of the survey. The survey was primarily targeted at users from German-speaking countries (DACH region, cf. question AG01). Therefore, only a minority of participants were expected to use the English survey version.

4.1.3. Item Scales

Concerning the answer scales, I chose types that are straightforward to deal with in the later results analysis. Moreover, the questions and their scales should not sacrifice crucial information, and be easy for the participants to cope with. These requirements led to the selection of the following types of questions and scales:

» (Single) selection: asks a user to choose one out of several exclusive options. Here, several scales were employed, such as dichotomic scales[1], nominal scales, ordinal scales (Bortz 2010, pp. 12—21), and Likert scales (Likert 1932). Concerning the Likert scales, I employed five levels, which has proven to be preferable in social research (Bortz 2006, p. 181). The resulting neutral middle item of a scale with an uneven amount of items however causes an ambivalence-indifference problem, meaning that respondents who cannot state a preference, or are unfamiliar with the topic, might choose the item in the middle, indicating indifference. Such an answer could also mean ambivalence, e.g. if the respondent finds both ends of the scale somewhat applicable (Bortz 2006, p. 180).

» Multiple choice: this question type allows the user to select multiple items, if applicable. Each item is mapped onto its own nominal scale variable, indicating the selection, non-selection, or non-answering of the respective item.

» Ranking: the ranking question type, which was used only once in the survey, asks users to order several items upon the users' preferences. Hence, each answer to the ranking question represents a totally ordered[2] set of items. The numeric ranks of each individual item can be regarded as an ordinal or interval scale allowing to derive statistics from all answers, such as the median rank for each item. For example, the ranking question DE03 presents eight items, asking the user to rank the items upon their subjective importance. Thus, each item receives a rank between one (most important) and eight (least important). This question type does not allow to indicate indifference, as assigning one rank to more than one item is not possible.

» Polarity: the survey also includes polarity scales[3] (Bernhard 2012, p. 298) (Bortz 2006, p. 185) (Diekmann 2003, p. 235), which present the user with two different statements or qualities at both ends of the scale. The user must then indicate his or her position on the scale. In this survey, I have employed polarity scales for just two items that aim to meas-

[1] For example, yes/no questions.

[2] Cf. Drmota et al. (2008, p. 39).

[3] Also referred to as "semantic differential" scales.

ure the user's preference in a tradeoff situation, for example, frequent, minor app updates versus seldom, major updates. As with the Likert scales, I used five levels for these items, leaving it open for the user to select a "neutral" middle item, not enforcing any preference.

» Numeric input: enables the user to enter or select values, such as his or her age. Here, interval or ratio scales are typically employed.

» Open text input: text input fields allow the user to provide qualitative feedback, such as textual comments, as well as arbitrary items for the "other" categories of single selection or multiple choice questions.

4.1.4. Missing Values and Incomplete Survey Treatment

Most questions were marked as mandatory, with only a few of them providing "I don't know", "Other", or "I don't want to answer" options. This remedies the problem of item-nonresponses that are *Missing Not At Random* (MNAR), which could introduce bias (Albers et al. 2009, p. 119). Furthermore, it eliminates the need to deal with methods of missing value imputation.

A major problem with online surveys are interruptions and discontinued surveys – participants may become exhausted, annoyed, or running out of time before completing the survey. I employed the following countermeasures to lower the amount of incomplete responses:

» Keeping the overall length of the survey to an absolute maximum of 10 minutes.

» Providing a realistic estimate of the average time required for completing the survey on the survey front page.

» Asking a maximum of four questions on a single page, and not more than 25 questions in total.

» Using different question types, to make the survey more entertaining and less monotonous.

» Paying close attention to the time that participants spent on the individual survey pages (which is tracked by *SoSci Survey*), and dropouts by page during the pre-test phase.

» Enabling the display of a progress indicator on the top of each page.

Surveys that have not been completed, were chosen to be completely discarded before the results analysis.

4.2. Discussion of the Survey Questions

In the following, the nine blocks of questions from Figure 5 will be discussed more thoroughly concerning their wording, scales, and potential fallacies. The tables show the final phrasing of the questions and answer items from the English version of the survey.

4.2.1. Miscellaneous Introductory Questions (AG)

These questions serve two purposes: first, they are used to filter the population of interest. Secondly, they serve as a "warmup" for the rest of the survey (Diekmann 2003, p. 414). It is important, that they are easy to answer, motivating people to continue. The first page of the survey included only the two questions concerning smartphone ownership and country of residence.

Category	Question No.	Type
AG	AG01	Selection
Question Text		
Do you own a smartphone? Hint: A smartphone typically provides computer features, such as a high-resolution display, touch screen, installation facilities for new applications (apps), Internet access, and so forth. Examples: *Android* phone, *iPhone*, Blackberry, etc.		
Answer Options		
Yes / No		

Table 4: Quick summary for question AG01.

Question AG01 is pretty self-explanatory, and serves as a filter question for the main part of the survey. People who do not own a smartphone will be skipped to the demographics questions at the end of the questionnaire.

Despite it may sound easy for a user to decide if a phone is a smartphone, a closer look reveals that this might not be the case for every respondent: For example, to distinguish a smartphone from a feature phone, technical terms have to be used, that not everybody is familiar with. This is especially a problem concerning the aim of this study to explore the fraction of people using their smartphone as a smartphone, that is, actively using and installing apps – the other part of the smartphone owners might be unaware of the features of a smartphone, and what apps exactly are. I tried to solve this problem naming features that are pointing into the direction of smartphones (but are not sufficient to define them), especially the touch screen, apps, and Internet connection. For participants with a lower technical literacy, examples such as the *iPhone* shall ease this decision.[1]

Note, that this survey aims to explore the use of mobile devices providing Internet, a touch-based OS, and app stores, which could also apply to tablets, that are steadily gaining market share. However, I chose to leave tablets out of the survey, as it would make the alignment of the results

[1] This is one of the benefits of the high diffusion of the *iPhone* as an icon for this category of hardware.

with related, smartphone-user-targeted studies more difficult. The major force in the mobile apps domain are smartphones at the moment, despite in a few years this will most likely completely change. Particularly interesting in this regard is, that the distinction between tablets and smartphones is very small, and both are technically converging. As already discussed in section 2.1.1, the only real distinction between phones and tablets e.g. in the *Android* ecosystem is the size of the screen, which implies ergonomic differences when using a tablet as a phone.

Category	Question No.	Type
AG	AG02	Selection
Question Text		
From which country are you from? Please enter the country you live in. (Principal residence)		
Answer Options		
Austria Germany Switzerland Other (Text input)		

Table 5: Quick summary for question AG02.

As the survey is primarily aimed at people from Austria, question AG02 should have been a filter question to end the questioning for non-Austrian residents. However, I chose to enable every user to complete the survey regardless where he comes from. The reason for this is, that it has been unclear before the start of the survey, if it might reach over borders and gain a significant amount of respondents from other countries, which would be interesting for comparisons between those different samples. Especially as I promoted the survey online via social networks, people from Germany or Switzerland might have joined in.

4.2.2. Smartphone Usage (SM)

Category	Question No.	Type
SM	SM01	Selection
Question Text		
Which operating system is running on your smartphone? Hint: In case you use *multiple smartphones* (e.g. for business and private use), please answer all questions in the following pertaining to the phone you primarily use.		
Answer Options		
Google Android		
Apple iOS (*iPhone*)		
Microsoft Windows Mobile/Windows Phone		
Blackberry		
Palm/WebOS		
Other (Text input)		
I don't know		

Table 6: Quick summary for question SM01.

Question SM01 is vital for clustering responses, as there are big differences between the various app ecosystems, particularly the market leaders, *iOS* and *Android*. Not long ago, many startups needed to decide which operating system to support; nowadays, apps require support for at least both *Android* and *iOS* anyway, which is particularly true for social apps.

The OS also serves as a good control to check if the sample of this study roughly resembles the statistics of the respective OS vendors, which cover the entire market.

Concerning the question itself, the same problems as with question AG01 apply: a considerable fraction of smartphone users might be unsure which operating system their smartphone is running on. There might be confusion between the vendor of the OS (*Apple* vs. *iOS*) or the manufacturer of the smartphone (*Android* vs. *Samsung,* and particularly *Nokia* vs. *Symbian*). I provided both the OS vendor and OS name to ease the users' decision. Especially the *Nokia/Symbian* option might confuse the small fraction of people using a current *Nokia* phone with the *Windows Mobile* OS, but omitting *Nokia* might also confuse the fraction of Symbian users who are not aware of their operating system (e.g. the *Nokia E series*). As the market share of *Android* and *iOS* leaves other operating systems far behind, I did not put any further effort into solving this problem – more explanatory text might have added confusion for the majority of users.

Results for *Nokia*/*Symbian* phones should thus be taken with the necessary grain of salt.

Category	Question No.	Type
SM	SM02	Likert scale (five levels)
Question Text		
Which functions of your smartphone do you use? Hint: If you are unaware of some functions, or if your smartphone does not provide them, choose the “never” option.		
Answer Options		**Scale (Frequencies)**
Phone SMS E-mail Chat Maps/Navigation/Directions Web browser Camera Media player (music, video) Payment (NFC, Paybox, etc.)		Never Rarely Occasionally Frequently Very frequently (daily)

Table 7: Quick summary for question SM02.

Question SM02 is intended to assess, how a user basically makes use of the phone: is he or she using all of its features, or rather using the smartphone only for plain mobile telephony and SMS? Items such as payment also provide interesting insights that could later be aligned with the app purchasing behaviour. The features provided as answer items are by no means complete, and also leave out apps themselves, which are dealt with later in the questionnaire.

The frequency scale is a bit problematic – what does “rarely”, or “frequently” mean in this regard? As a guideline, I added “daily” to the “very frequently” level for better orientation. The lower levels remain more or less subjective and should be treated as such.

Category	Question No.	Type
SM	SM04	Selection
Question Text		
How often do you buy a new smartphone on average? Hint: If your current smartphone is your first one, please just estimate how often you are going to buy a new smartphone in the future.		
Answer Options		
More often than once a year Once a year Every 1 to 2 years Less often than every 2 years Only as soon as my current phone gets broken/unusable		

Table 8: Quick summary for question SM04.

This question is motivated from my subjective experience on the different intervals, that people buy new hardware. The assumption is, that early adopters, especially demanding power users, tend to buy new hardware more frequently, while more “pragmatic” users should buy their hardware much more seldom, or even replace their current phone only when it becomes virtually unusable (due to insufficient specifications, or hardware faults). The answers to this question alone will most likely not tell much about the respondent’s usage behaviour, as an underlying factor could be budget constraints, or ecological considerations, but combined with other variables, the answers could provide additional information to confirm or reject hypothesis on user archetypes.

4.2.3. App Adoption (NV)

Category	Question No.	Type
NV	NV05	Selection
Question Text		
Do you use third-party apps on your smartphone? Hint: Apps are software applications you can install on your smartphone. Third-party apps are e.g. games, tools, and social networking apps, that you have either installed by yourself, or are not pre-installed by the manufacturer of your phone.		
Answer Options		
No apps 1 to 5 apps 6 to 10 apps More than 10 apps		

Table 9: Quick summary for question NV05.

Question NV05 serves as a filter for the rest of the survey – in case a user does not use any third-party apps, he or she won’t be presented with app-related questions. One could argue that some aspects might still be interesting if a user uses only built-in apps, but the primary aim of this survey is to generate insights on potential adopters of apps, and people who are not using one single third-party app, but only pre-installed apps so far, won’t be able to say much about their attitude concerning the questions in the following. A very interesting aspect in this regard is question NV06, which asks users who answered “no apps” here, about any particular reason for their choice.

A challenge concerning the question was to communicate how “third-party” apps was meant: the distinction between pre-installed and third-party apps was made mainly because pre-installed apps, such as a browser or navigation app, can be regarded more or less as a feature of the smartphone. A user does not need any Internet connection or awareness about an app store, or the nature of apps themselves, to use those built-in apps.

What might be remarkable here is the scale of the answer items, given the fact, that there are many users who are actively using 50, 100, or even more apps. The reason why the items were divided into those classes, is that the question mainly serves to distinguish app-users from non-

app-users, and that I assume it particularly difficult for a user to state, if he or she uses 25 or 50 apps, without counting them. Also, one needs to keep in mind that the amount of apps people utilise will most likely follow a power-law distribution. A few users will use a very high amount of apps, but the majority will use one to 10 apps, or no apps at all. A better measure for usage intensity are the questions on installation frequency that are provided later.

Category	Question No.	Type
NV	NV06	Multiple choice
Question Text		
Is there a reason why you do not use third-party apps? Hint: Multiple answers possible.		
Answer Options		
I do not know how to install new apps No internet access / data subscription No time for that No need for Other reason (Text input)		

Table 10: Quick summary for question NV06.

This question is only shown if a respondent answered not to use any third-party apps at question NV05, checking for any specific reasons for this. For participants not using third-party apps, this is the last question on the apps topic, after which they are forwarded to the demographics questions at the end of the survey.

Category	Question No.	Type
NV	NV01	Free text
Question Text		
What third-party apps do you consider an indispensable part of your daily routine? Hint: Apps are applications that you can install on your smartphone. Enter up to four apps that are most important to you (most important first). Note: Please only enter *third-party* apps that were added by you, and not pre-installed by the manufacturer of the phone. Examples: „qype“, „qando“, „*Facebook* App“, „WhatsApp“, „ÖBB Ticket“, „ebay App“, „amazon app“, etc. Do not enter any apps that are pre-installed as a basic feature of your phone (e.g. mail, maps, browser, calendar, etc.). If you do not use any apps, or less than four apps, just leave the respective fields blank.		
Answer Options		
Four open text entry fields		

Table 11: Quick summary for question NV01.

Question NV01 was motivated by an interview with one of the startups. Originally, I intended to ask users about their favourite app. Based upon the feedback from the startup interview phase, the question was refined to provide answer facilities for more than one app, and is also restricted

to third-party apps, to avoid the majority of users stating common apps such as “Web browser”, “camera”, or “maps”. The question aims to get further insights on the types of apps a user uses most frequently: be it social networks, media apps, small tools, games, or a combination of them.

A problem here is, similar to the previous third-party-apps-related questions, that it needs a lot of explanatory text, that might confuse some users, or not be read at all.

Another obvious problem is bias: to get the right answers, I provided examples of some widely-known applications, so that users provide concrete application names, and not application categories. This will surely lead to many people entering the provided examples more likely, than if they were required to remember all apps they use. I took this risk and tested in the pre-test phase, if there will be sufficient discriminatory power in the answers, or if the users will just replicate the examples.

Finally, questions asking for the top X items are problematic, as users who use a vast amount of tools without any particular favourite, will have problems deciding upon a few here. However, this is one of the few questions where users could leave the answer fields blank, in case they are not applicable.

Category	Question No.	Type
NV	NV02	Selection
Question Text		
On average, how often do you install new apps on your smartphone?		
Answer Options		
I’ve never installed a new app		
A few times a year		
Once a month		
Several times a month		
Several times a week		

Table 12: Quick summary for question NV02.

Question NV02 aims to provide further insights on the users’ apps usage intensity. It is probably not a good replacement for asking a user how many apps he actively uses in total (as some users could use dozens of apps, but hardly ever install a new one), but it should generally correlate with NV05 (overall apps usage), and also indicate some causality into one direction: high values for NV02 should also yield high values for NV05.

The answer scale was chosen to provide reasonable steps between users who never installed a new app, and users who install apps multiple times a week, which can be considered as heavy users.

Category	Question No.	Type
NV	NV03	Multiple choice
Question Text		
Have you ever paid for an app? Hint: Multiple answers possible. If you answer *no* and there is a special reason, you may *optionally* enter it in the text box besides (e.g. “no credit card”).		
Answer Options		
Yes, for buying the app Yes, while using the app (For features, credits, etc.) No, because (Open text input)		

Table 13: Quick summary for question NV03.

Question NV03 deals with a very essential aspect for the success of mobile app startups: while there are many statistics on the overall amount of turnover, or purchased apps on various app stores, this question ought to provide further insights by dividing apart one-time purchases from in-app purchasements. Also, a direct comparison between both of the leading mobile OS eco-systems becomes possible. Last but not least, it should be more interesting to measure the percentage of users who ever paid for at least one app, than inferring a percentage by dividing the total turnover by the amount of users, calculating the average payments by user. Those mean values might be skewed due to the long tail of the power law distribution.

A user answering to have purchased an app or something from within an app, means to have crossed some barriers to payment. Users who have not yet purchased anything, are asked to provide some comments, if there is any specific reason they did so.

Category	Question No.	Type
NV	NV04	Selection
Question Text		
Do you think it is better to use a single app with many different features, or many different apps, tailored to specific use cases?		
Answer Options		
One app with many features Many specialised apps		

Table 14: Quick summary for question NV04.

This question is one of the lesser objective ones: it might be hard to answer it in general, and there should not be too much interpretation made out of the results. The motivation for this question is to roughly measure if there is a general user sentiment concerning app specialisation: would they rather prefer multi-purpose apps with a vast amount of features, or rather use a variety of small apps for specific purposes? This decision is often encountered during the planning phase of a business model – how much diversity should a new service provide? While a common tenor is to provide a very focused value proposition, often there are discussions arising out of the best-

practices found in software engineering, to generalise services as far as possible. I expect that most users will vote for specialisation, but it is very interesting to see real figures, and check if the decision is clearly made towards specialised apps, or if there is a considerable amount of users preferring more broad, general services for a variety of purposes.

4.2.4. App Searching Behaviour (SE)

Category	Question No.	Type
SE	SE01	Multiple choice
Question Text		
How do you typically find new apps?		
Answer Options		
Personal recommendations (friends / relatives)		
Browsing app stores (*Google* Play / *Android Market*, *App Store*, etc.)		
App Web sites		
Media (newspapers, trade press, magazines)		
Search engines (*Google*)		
Other, namely (Text input)		

Table 15: Quick summary for question SE01.

Question SE01 aims to explore the primary channels a user finds new apps from. Multiple answers can be selected; I expect that friends and media will turn out to be the most dominant means of app searching and finding.

A pitfall regarding this question was the “app stores” answer option: app stores are surely the primary means for most users to *install* new apps, but are they the means to actually *find* new apps through browsing? Therefore I employed the terms “browsing” here, but this point could easily be misunderstood. The same goes with the “app Web sites” option, which is a bit hard to clarify without adding bunches of explanatory text.

4.2.5. Security & Privacy Attitude (SC)

Category	Question No.	Type
SC	SC02	Likert scale (five levels)
Question Text		
How strongly do you feel about the following issues of apps concerning your security and privacy?		
Answer Options		
Sometimes I'm unsure whether an app is harmful or not (virus, trojan etc.)		
I'm afraid that apps use my personal data without my knowledge or consent		
Levels: strongly disagree / disagree / undecided / agree / strongly agree		

Table 16: Quick summary for question SC02.

From my personal point of view, this is one of the most interesting aspects concerning apps adoption. Therefore I paid a lot of attention to formulate the question in an appropriate way to yield meaningful results. The wording of the question is very critical – I have improved it in the pre-test phases, until the respondents answered it without indicating confusion in the feedback fields.

The first question measures a problem of security, in particular the risk of installing malware, while the second one asks users to indicate if they trust apps to respect their privacy.

For measuring this, a standard Likert scale was employed, from one (strong disagreement) to five (strong agreement). It is planned to assess if there are any differences in the answer distribution based on age, gender, and mobile operating system.

Category	Question No.	Type
SC	SC04	Selection
Question Text		
In the course of an app installation, do you normally read the terms & conditions of use, and privacy policy?		
Answer Options	**Scale**	
Terms and Conditions / Terms of Use	No	
Privacy Statement	Yes, I flip through it	
List of the required access privileges	Yes, I read it carefully	

Table 17: Quick summary for question SC04.

Question SC04 was initially motivated to provide some feedback for startups to assess how much effort to put into documents like the general terms and conditions, privacy policy, and so forth. Initially it was intended just as a single question, but motivated by the interview with a startup, I split it up into three items, taking into account especially the difference between the policies and the actual list of access privileges.

However, it needs to be noted, that the two leading operating systems provide different access list facilities: on *Android*, a user is presented with a list of all required access privileges during

the installation process. He may choose to accept the permissions requested in their entirety, or reject them, which leads to the cancellation of the installation process. On *iOS*, users may individually grant and revoke access permissions for an app, each time an app requests a specific permission for the first time; so technically, there is no permissions list in the course of an app installation. Hence there should not be any answers concerning such a list from *iOS* users. However, I expect that some users might interpret the question as asking if they generally pay attention to the permissions an app requests, which is not too different from the original motivation for this question.

4.2.6. Development-related Aspects (DE)

Category	Question No.	Type
DE	DE02	Likert scale (five levels)
Question Text		
What does most likely keep you from installing an app you have found?		
Answer Options		**Scale**
Low ranking in the app store (position in search results)		Strongly disagree
Poor rating (“stars” / reviews)		Disagree
Privacy concerns / fear of viruses		Undecided
Poor presentation (bad description texts, icons, screenshots, etc.)		Agree
		Strongly agree

Table 18: Quick summary for question DE02.

Different to many studies that measure reasons why users install specific apps, this question shall actually find out the opposite: what keeps users typically from installing a new app. While drivers for high app installation counts are more or less known (e.g. a top 10 rank in an app store[1]), the barriers to installation are something equally important for app developers. People who won’t install an app cannot be not found in any app statistics – they typically also won’t review or rate the app. The “you have found” phrase in the question, while seemingly redundant, has been added deliberately to emphasize the stage of the assessment step, between search and installation, as discussed in section 2.3. Also important to note, is that the “privacy concerns / fear of viruses” item mixes privacy and security aspects. It just serves confirmatory purposes, as both security and privacy concerns were already independently measured in question SC02. As an answer scale, a standard Likert scale was chosen, measuring the respondent’s agreement with the individual items.

[1] Normally, a top 10 rank in an app store is the result of high app download counts. Such a top 10 position again has considerable positive feedback effects on the download counts. Thereby, many companies try to achieve such a rank without “real” user downloads, by investing into their own app on the stores. Calculations on the break-even point for buying one’s own apps are a simple, but questionable formula. Such manipulations of the top apps statistics are not endorsed by the platform providers, but on the other hand, create additional turnover for them.

Category	Question No.	Type
DE	DE03	Ranking
Question Text		
How important are the following aspects of an app to you? Hint: Please rank all of the eight aspects according to their importance.		
Answer Options		
Privacy protection Prestige/exclusivity Good design Customer support Speed/performance Friends are using the app Usefulness/features Low energy consumption		

Table 19: Quick summary for question DE03.

A different, and a bit problematic question type is the ranking used for question DE03. It asks users to rank eight different factors upon their subjective importance. This has the advantage, that a scale with eight steps is formed for each question, providing particularly interesting feedback at the extremes of the scale.

But there are also disadvantages to it: in *SoSci Survey*, the ranking is implemented via an easy-to-use drag & drop interface. This could cause problems with users filling out the survey on mobile devices, where this might not work that well.

Furthermore, users who are indifferent concerning the importance of two or more aspects cannot express this – they are forced to rank those aspects in a particular order. This can be seen as a drawback, but also as an advantage.

To reduce bias in the results, the initial order of appearance of the answer items is randomised for every respondent. This is the only ranking question in the survey, and also the only question, where I employed item display randomisation.

Category	Question No.	Type
DE	DE04	Polarity (five levels)
Question Text		
What do you think is better concerning apps? Hint: Decide on a gut level, what is more appealing to you. (Left vs. right side)		
Answer Options		
Fewer features, but stable vs. more features, but more bugs Frequent, minor updates to the latest version vs. seldom, major updates to the current version		

Table 20: Quick summary for question DE04.

Again, this is a question which is hard to answer and very subjective – it aims to extract a general sentiment along the features-vs-stability dimension, and the preferred update frequency.

In the course of the interviews, one startup suggested to ask users if they actually have their installed apps updated regularly, as the startup experiences quite many users still sticking to lower versions.[1] This question would have been interesting to ask too, but I have eventually left it out due to the overall constraints on the length of the survey. Also, one would need to distinguish between further cases then, as some users have set updates to be automatically downloaded and installed.

The question presented in DE04 is completely transparent concerning manual and automatic updates.

4.2.7. App Involvement (IN)

Category	Question No.	Type
IN	IN01	Selection
Question Text		
Have you ever rated an app, or written a review within an app store?		
Answer Options		
No / yes / yes, often		

Table 21: Quick summary for question IN01.

Due to the survey length constraint, this question mixes both ratings and reviews – however, it is an interesting estimator concerning the general app involvement of users, and in combination with question IN02, their primary motivation for reviews or ratings. Especially the “yes, often” answer items should be insightful, indicating a considerable involvement of users.

There is a common belief that users who are unsatisfied with a product, tend to inform much more people about their bad experience, than users who are happy with it. Question IN02, shown in Table 22, aims either to confirm or challenge this belief, providing multiple answer facilities based on the users’ past behaviour.

Initially, I just intended to ask users if they subjectively tend to give rather good ratings or rather bad ratings. Through the startup interviews, I improved the question to make it easier to understand and the results more meaningful by asking more about measurable past behaviour, than subjective attitude.

[1] The app versions that are currently deployed can be conveniently monitored by common app analytics software.

Category	Question No.	Type
IN	IN02	Multiple choice
Question Text		
If yes (Question IN01): I have already rated one or more apps, because ... (multiple answers possible)		
Answer Options		
An app was particularly bad. I did NOT like an app. I liked an app. I particularly liked an app. The app has prompted me to do so. The app has promised me a bonus for it.		

Table 22: Quick summary for question IN02.

The only problem here is to make it clear to the survey participants, that they should indicate anything that applies to their situation – e.g. that they have already rated one app because it was bad, but also another app, because they particularly liked it.

However, just arising out from this multiple selection, many facts can be extracted: did more users rate an app because they liked it, than rate an app because they did not? How many users are more negative (rating because of disliking, without rating because of liking), than positive? Did some users already rate an app because of incentives promised by the app?

Category	Question No.	Type
IN	IN03	Selection
Question Text		
Have you every contacted the developers of an app concerning a problem or suggestion for improvement?		
Answer Options		
Yes / No		

Table 23: Quick summary for question IN03.

Another issue that was pointed out to be particularly interesting during the startup interviews, is the fraction of users who have already contacted the developers of an app concerning an improvement, or general feedback. While a startup can easily measure this for its own clients, and e.g. implement in-app-feedback possibilities, this question could provide benchmarks concerning the overall feedback ratio of given user segments, independent from particular apps.

A sacrifice due to the simplicity of this question is, that is does not distinguish users with a high involvement, providing feedback regularly, from users who provide feedback seldom, or have done so only a single time.

4.2.8. Social Network Aspects (SO)

Category	Question No.	Type
SO	SO01	Multiple choice
Question Text		
Do you use a social network? Hint: If applicable, please select the networks that you have actively used lately (no unused accounts). Multiple selection is possible.		
Answer Options		
Facebook *Google+* Twitter Myspace / LinkedIn Xing Foursquare Other (3 open text input fields)		

Table 24: Quick summary for question SO01.

Without a doubt, the social networking behaviour is a key aspect for most app developers. Apart from startups who develop communities themselves, existing networks such as *Facebook* are particularly relevant in terms of authentication (single sign-on) facilities, enabling users to log in to an application by solely using their *Facebook* accounts, without registering a new one.

Question S01 asks users if they actively use one or more social networks, with the emphasis on "actively". They are instructed not to select networks they have not used recently. Various of the most popular networks are provided, with an option of entering up to three additional ones in open text input fields.

As already explained in section 2.1.3, a problem concerning the question is to clearly define a social network, even using examples. Is the photo app *Instagram* a social network, or is it just a socially-enabled photo sharing community, mostly used as an add-on to other social networks? Based on various criteria, *Instagram* has some elements of communities (where user relationships do not matter), e.g. the tagging, but also some elements of a social network (where user relationships matter), e.g. the friend list and private profile features. Furthermore, many users are unaware of the distinction between social networks and communities. In any case, this does not matter that much concerning this question, as my primary interest was the engagement of users with the market leaders in social software.

Question SO01 also serves as a filtering question: if users answer that they use at least one social network, they are presented with question SO02, and if they use *Facebook*, they are presented with the *Facebook*-specific question SO03 in the following.

Category	Question No.	Type
SO	SO02	Selection
Question Text		
What do you find more important concerning social networks? Hint: This question is not so easy to answer. Let your gut feeling decide.		
Answer Options		
That all of my friends / colleagues are in my network That I get to know new people		

Table 25: Quick summary for question SO02.

The background of this hard-to-answer question is pure curiosity on the attitude of users concerning the adoption of social networks. If someone designs a new social network, he or she might ask him- or herself if it is actually a drawback that, due to the chicken-egg-problem, an early adopter will most likely not find any of his or her existing friends there – or if this is sometimes even desirable? The intention of the question is to separate respondents with a tendency to early-adopterism from people who will adopt a social network only, if their existing friends or contacts are aboard.

The explanatory power of this question is probably very low, but there is the possibility that interesting correlations can be made out here in the later analysis phase of this work. There could be an underlying factor that has influences on the answers to this question and several others.

This question could help developers to assess if they would rather integrate their new community with one of the existing leading ones, or if they are specifically targeting the (presumably low) fraction of users who are keen to find new communities that are full of interesting strangers.

Category	Question No.	Type
SO	SO03	Selection
Question Text		
Do you think that new communities should be linked to *Facebook*? Hint: Example: You install a new photo app that offers community features (interaction with other users, similar to Instagram, flickr, etc.). Do you find it better if you can share content from this app with your *Facebook* friends, or should the new community rather be completely independent?		
Answer Options		
Independent from *Facebook* (no sharing possible) Connected to *Facebook* by request (sharing possible) I don't know		

Table 26: Quick summary for question SO03.

This question is only presented to users who indicated that they use *Facebook*. It is intended to further refine the picture concerning the users' attitude on the integration of *Facebook* into new online communities. During the pre-test phase, many users complained about the question's

meaning to be hard to grasp. The question was heavily reworked and an explanation with a concrete example added to improve the situation.

The two answer options let the user choose if he generally prefers an app or community to be linked with *Facebook*, e.g. to facilitate content sharing, or if he prefers it to be completely independent. This could also be an indicator for an increasing *Facebook*-weariness of users.

Noteworthy, this is one of the only two questions where an "I don't know" answer option is provided.

Category	Question No.	Type
SO	SO04	Selection
Question Text		
Would you use an app that strictly requires a *Facebook* account? Hint: There are apps that require you logging in via a *Facebook* account, otherwise they cannot be used. Do you use such apps/would you use them?		
Answer Options		
Yes, no problem Yes, if there's no alternative No, absolutely not, because (open text input)		

Table 27: Quick summary for question SO04.

Question SO04 deals with an absolutely critical issue: networks such as *Facebook* provide third-party app developers with facilities to authenticate their users without requiring them to create a separate account for the app. Section 2.1.3 already discussed the pros and cons of such a so-called "social login". The motivation for question SC04 should now be obvious: finding out, how many people, regardless if they are already *Facebook* users or not, would install an app that won't work without a *Facebook* account, and how many would get lost through this requirement.

In contrast to a simple dichotomous yes/no answer scale, I split the "yes" answer item into two categories: those users who won't mind a *Facebook* login, and those who would only unwillingly use an app requiring one. The third option is for people who reject a *Facebook* login categorically.

There can be various reasons for users to reject *Facebook*-enabled apps: from privacy concerns to a lack of understanding, what the link between the app and *Facebook* exactly does. Therefore, the "no" answer provides an optional open text input field for entering comments on the user's decision.

The particular fraction of people who are active users of *Facebook*, and choose the "no" answer option, is of great interest, as during the startup interviews, it turned out that not only an unknown amount of users refrains to use apps with a mandatory *Facebook* login, but also many of them give very bad one-star app ratings in the app stores, which causes additional damage to early-stage startups.

4.2.9. Social Demographics (SD)

The final part of the survey are questions on the demographics. Typically, those questions are either put right at the start or at the end of a survey. I chose to put them at the end, to prevent participants becoming suspicious being asked about those details first. Despite some studies indicating slightly lower discontinuation rates if demographics are asked for in the beginning, the general tenor in literature is to better ask them at the end (Jakob et al. 2009, p. 125) (Diekmann 2003, p. 415).

Category	Question No.	Type
SD	SD05 / SD06	Selection / Numeric input
Question Text		
Please enter your age and gender.		
Answer Options		
Female/male Age (numeric input field)		

Table 28: Quick summary for question SD05 and SD06.

The standard demographics question concerning age and gender does not need any further elaboration. For the age classification, I chose a numeric text input field, as this enables analysis using different age binnings, in order to compare the demographic structure of this survey to censuses and other studies.

Category	Question No.	Type
SD	SD07	Numeric input
Question Text		
From which region are you from? Hint: Please enter the two first digits of your zip code. (E.g. 11, 80, 51) You do not need to enter the country prefix.		
Answer Options		
Numeric input of first two digits of zip code.		

Table 29: Quick summary for question SD07.

This question is also common to many surveys, enabling one to check for differences e.g. between urban and non-urban populations, and to assess the country coverage of the survey.

Category	Question No.	Type
SD	SD08	Selection
Question Text		
What education do you have? Hint: Please select the highest level of education you have achieved so far.		
Answer Options		
No graduation Compulsory school / high school / middle school Apprenticeship High school diploma University / college / academy Other graduation/degree (open text input)		

Table 30: Quick summary for question SD08.

Table 30 shows another standard question concerning demographics. *SoSci Survey* provided a template for the items, which were tailored to the German education system. I have redefined the classes reflecting the Austrian model, as the survey was primarily targeted at the Austrian market. A problem remained translating and mapping the answer items to the English survey version, as English-speaking audiences might have completely different school system backgrounds.

Category	Question No.	Type
SD	SD10	Multiple choice
Question Text		
What is your occupation?		
Answer Options		
Pupil Apprenticeship Student Employee / Worker Self-employed / entrepreneur Unemployed Other		

Table 31: Quick summary for question SD10.

Initially, this was deemed to be a single selection question – however, the pre-tests yielded considerable feedback of respondents who wanted to make multiple selections, e.g. students who are also self-employed, or part-time employees.

Category	Question No.	Type
SD	SD11	Drop-down selection
Question Text		
What is your approximate monthly income? This refers to the amount which consists of all revenues, and remains after deduction of taxes and social insurance; the amount that is available to you monthly as a bottom line. (Related to you individually, not your household. Revenues include net salary, income from self-employment, pocket money, grants, etc.)		
Answer Options		
Several income levels plus “I don’t want to answer” option		

Table 32: Quick summary for question SD11.

This question was included in the pre-tests, but removed for the main survey run due to the considerable amount of people choosing the “I don’t want to answer” option. There are some widely debated resentments in Austria to reveal one’s monthly income, so I decided to leave this figure out instead of risking wrong answers, people feeling uncomfortable, or exiting the survey right before the finish.

Category	Question No.	Type
SD	SD12	Text input
Question Text		
Would you like to add some remarks for the better understanding of your answers? Hint: If you noticed anything negative while participating in this survey, or a point where the questions were not clear to you, or made you feel uncomfortable – please drop us a few words.		
Answer Options		
Open text input		

Table 33: Quick summary for question SD12.

This question, including the explanatory text, was provided by a template of the *SoSci Survey* software. I left it in the survey, as it is generally a good idea to offer feedback facilities on a higher level.

4.3. Online Survey Implementation

4.3.1. Survey Tool Selection

When it comes to the implementation of a Web-based questionnaire, there are various alternatives to choose from. Countless professional survey services are available, with slightly different features and payment models. The most popular I have evaluated in-depth are *SurveyMonkey* (2013), *SoGoSurvey* (2013), *FluidSurveys* (2013), *SoSci Survey* (Leiner 2013), as well as newer offerings, such as *KwikSurveys* (2013). Furthermore, a powerful and free Open Source survey management solution, *LimeSurvey* (2013), is available.

To rule out performance problems caused by hosting a *LimeSurvey* installation by myself, and to avoid possible bugs that could arise due to specific Web server and database configurations, I finally decided to employ the *SoSci Survey* service. Among its benefits are the focus on academic research, and advanced features such as pre-test support, internationalisation, filters and rating question types offered even in the free academic plan.

There are only two drawbacks I encountered with *SoSci Survey*: some online survey software providers account for the growing segment of mobile users, offering optimised layouts[1] for mobile phones, while *SoSci Survey* unfortunately does not provide a separate layout, or any device-dependent adaptations. I have tested the survey on a common smartphone[2] and found it basically usable, but very inconvenient to fill out. This is a considerable problem for a survey targeting smartphone users; but due to the lack of feasible alternatives, I decided to stick with it.

Another problem of *SoSci Survey* is, that it does not allow to include custom markup into the HTML *head* section of the start page, thus not allowing to set *Open Graph*[3] tags. This means that the content preview of the survey, when shared on social networks, cannot be customised. This hinders the spreading of the survey considerably, especially as no custom preview image can be set. On *Facebook*, sharing the link of the survey yielded only a plain text story in the news feed.

4.3.2. Layout

Concerning the graphical appearance of the survey (style sheet), I used one of the templates provided by *SoSci Survey* that I found most appealing, and adapted it a bit, due to the link colour being virtually invisible on the pages' background. A screenshot of the first survey page is provided in Figure 6.

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[1] Particularly, so-called "responsive" layouts, enabling browsers to adapt the pages' appearance to the screen size of the respective device, thereby avoiding excessive zooming and panning.

[2] Samsung Nexus S GT-I9023 (800 x 480 px display resolution) with *Android* 4.1.2 Jelly Bean, *Android* Browser.

[3] Basically, the *Open Graph API* of *Facebook* allows to categorise content and control the embedding of it into the social network and *Facebook*'s underlying *Social Graph*.

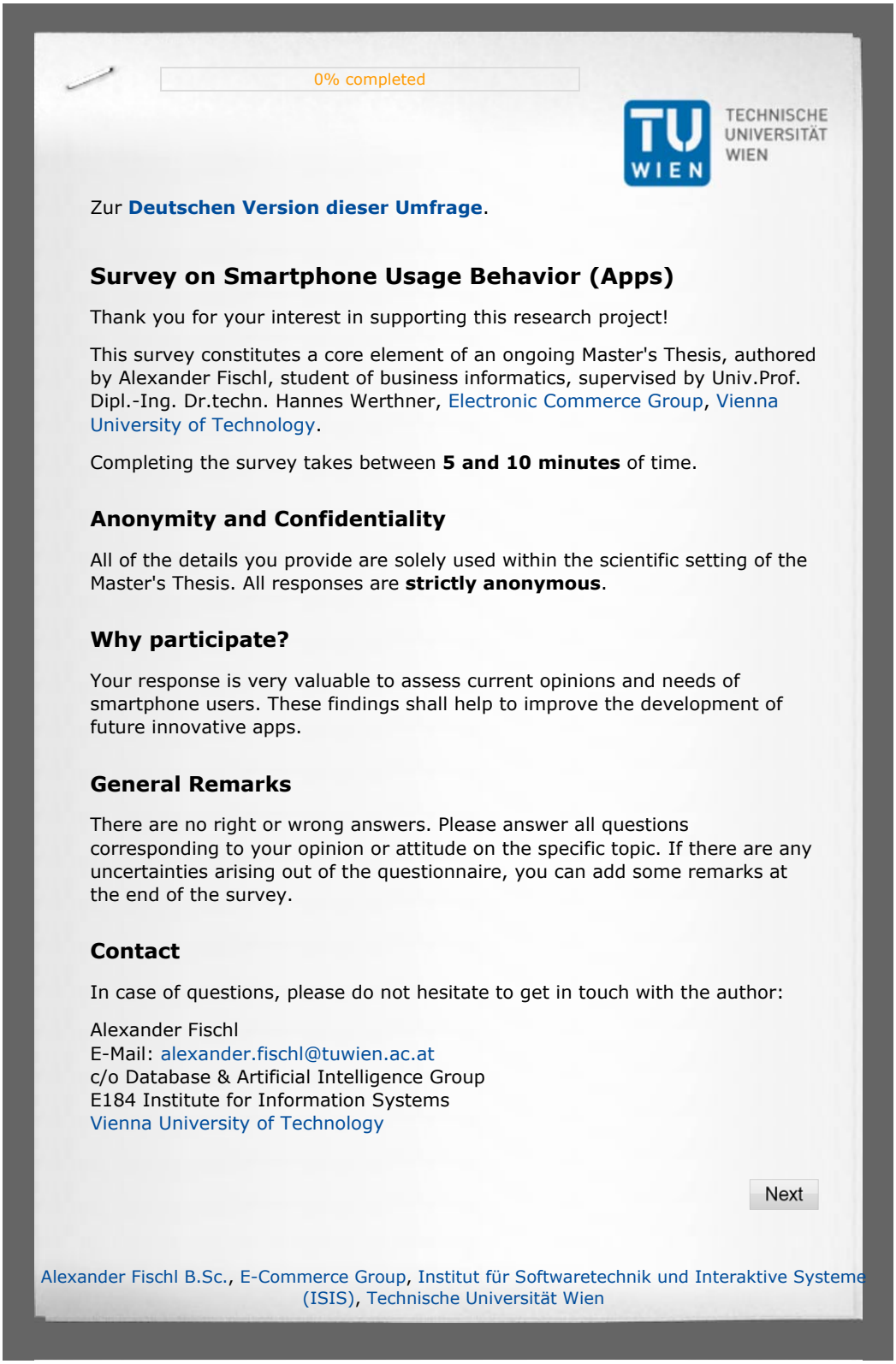


Figure 6: Screenshot of the introductory page of the survey.

Here, another vital element of the survey can be seen: to explain what the survey is about, who is responsible for it, and what the results are used for. This shall allay anonymity concerns, and assure the respondents, that there are no right or wrong answers. Furthermore, a link to the English or German version of the survey is provided at the top of this introductory page.

4.3.3. Variables Coding

SoSci Survey eased the coding of variables tremendously, as it provides a convenient structure to create variable categories, designators, and define the coded item values. Moreover, it separates the definition of questions and variables from their appearance in the questionnaire, which saved a lot of time optimising the flow of the survey.

4.3.4. Pre-Test

A questionnaire can bear many problems that become apparent as soon as the first respondents are confronted with it. To find possible pitfalls in the survey, e.g. if questions are not formulated precisely enough, or if there are any misunderstandings or insecurities caused by them, every survey should be tested on a limited initial audience. Additionally, the pre-test phase can be used to check if the question items have a high or low internal validity, e.g. through calculating the Cronbach's Alpha (Cronbach 1951) for each set of items that measure the same latent construct.

The *SoSci Survey* software provides special features for a pre-test period: one can restrict access to the survey setting a pre-test password, and during the pre-test, an additional text field is displayed at the end of every survey page, encouraging participants to provide feedback. This feedback field is shown in Figure 7. The remarks from the pre-test can then be summarised by survey page or interviewee.

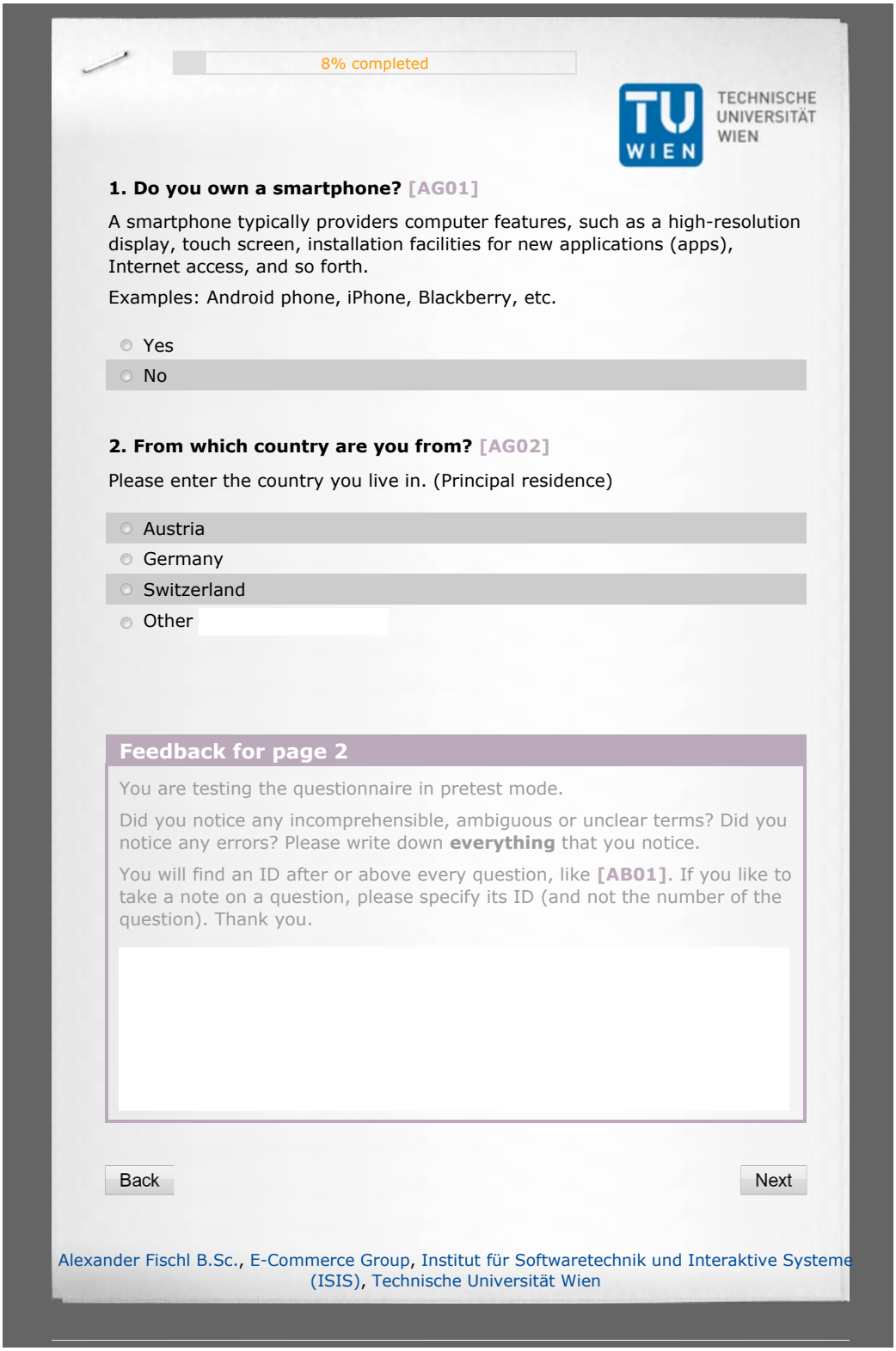


Figure 7: Screenshot of the first survey page, during the pre-test period. On the bottom, an open feedback input field is visible, where users can enter remarks for each page.

Furthermore, *SoSci Survey* allows to record the time a participant needs to fill out a page. This is particularly useful to assess the overall length of the survey, and to filter out responses that were entered suspiciously fast. The pre-test phase is summarised by Table 34.

Phase	Method	No. of Interviews
1.	Supervised	1
2.	Unsupervised	21 (+1)
3.	Unsupervised	4

Table 34: A summary of the pre-test phase. Response figures in brackets denote incomplete responses.

Pre-testing the survey was done iteratively by three phases. In phase one, "supervised" refers to a known interviewee filling out the online questionnaire, while I stayed nearby for assistance. "Unsupervised", as in phases two and three, refers to the completely anonymous participation of respondents in remote locations.

Pre-Test Phase One

In this phase, I had one voluntary participant fill out the form while I stayed in close proximity, to monitor any problems she might have. The respondent was a 25 years old female, owning a smartphone, and actively using apps. Her smartphone user profile is of a pragmatic kind – she can not be categorised as an early adopter or a highly-involved app user. Only very occasionally she downloads new apps, and uses her smartphone mostly for Web browsing, email, maps, and voice telephony. Furthermore, she does not have a *Facebook* account.

All in all, the procedure took 21 minutes, including the discussion of the survey items and potential improvements of the questionnaire. Apart from suggestions for minor changes of the wording, the following feedback was gained from the respondent:

While answering question NV01, she pointed out that these fields should be made optional, in case someone does not have four favourite apps. Actually, these fields were already of an optional type, so I added an explanatory hint directly above the text input fields. Consequently, I asked her, if the text of the question was too complicated, but she negated this.

At question DE04, a question with a polarity profile scale, she was confused by the appearance of the scale-indicating graphics above the answer radio buttons. Therefore I have replaced these bars with ones that look similar to balance indicators found on common audio equipment, showing two ramps originating from the centre. She responded, that these were much better to understand. Regarding question SO02 she noted, that this question only makes sense for people using a social network. Indeed, I have forgotten to add a filter to this question, based on the social network usage question SO01; a problem I corrected afterwards.

Finally, she suggested that the single choice occupation question SD10 should be set to a multiple choice type, as she was both a student, and employed. I adapted this question accordingly.

Concluding, the changes from this phase were very minor. It was positive, that the respondent was able to complete the survey without too much explanation, and that she seemed not to have any problems understanding the technical questions. Furthermore, the time she needed to complete the survey was within the self-imposed limits.

Pre-Test Phase Two and Three

After this initial qualitative feedback, I invited several people to fill out the form and provide feedback on the comprehensibility of the questions. This yielded 21 complete survey responses, plus one incomplete response, representing a dropout of just five percent. In total, 39 remarks were entered into the pre-test comments fields. The feedback gained was incorporated into the survey, and another pre-test run was made, to check if the questionnaire improved. After noticing from the next four responses, that the previous problems vanished, and no new ones appeared, I finished the pre-test stage.

The following feedback was gained from the aforementioned steps, leading to slight adaptations of the questionnaire:

One respondent commented on question SM02, that some of the listed smartphone “features” could be used either by employing the base functionality of the phone, pre-installed apps, and also, third-party apps. Additionally, he or she asked, how the instant messaging app *WhatsApp* could be categorised in this regard. Actually, this question was intended to ask for the tasks users perform with their smartphones, not the exact way they perform them. To double check if there were any problems with this question, I generated histograms summarising the other responses. As the results looked sound, I decided to leave the question unchanged.

Another respondent noted at question NV05, that he or she had difficulty guessing how many apps he or she had installed on the phone. In fact there seemed to be a misunderstanding, as the text actually asked for the number of apps a user actively uses, which should be a bit easier to guess. However this problem was anticipated, especially for users who use more than five apps. As already mentioned, this is why the installation frequency question NV02 is provided for a more precise measurement of the app adoption.

At question DE02, one user asked for the difference between the “low ranking” and the “poor rating” items. To solve this, I described both items further, using “position in search results” for the ranking, and “stars / user reviews” for the rating.

The rating question DE03 also yielded a comment: one respondent criticised the term “responsiveness” to be too technical, upon which I changed it to “speed / performance”.

Question SO03, dealing with the *Facebook* connection of apps, seemed to be the hardest one to answer. It received numerous comments by participants who did not fully understand its meaning. Thus I completely reworked it by two iterations, and included an illustrative concrete example employing a “new photography app”, which could be associated with a well-known service such as *Instagram*.

Other general remarks made by the users were:

» One respondent suggested to add a question that asks if a user rather uses a mobile app, or the corresponding Web application of a given service. He or she stated that sometimes he or she prefers a Web application due to privacy reasons.

» Another participant commented at question SO01, that the formerly popular social network *StudiVZ* was no longer existing. Technically, the network is still online, but due to its low popularity I removed it from the predetermined answer options. In the rare case a respondent uses *StudiVZ*, this could be manually entered into the open social network input fields anyway.

» Interestingly, one pre-test participant noted that apps could also be installed on "non-smartphones", providing older *Nokia* phones as an example. Additionally, another respondent asked within a comment, if the study also covered tablet users. This ambiguity has already been extensively discussed in the introduction of this work, and remains as a problem that cannot be completely solved.

Another important finding from the pre-test phase was, that the average time needed to complete the survey did not exceed the chosen maximum limit of 10 minutes. Last but not least, the pre-test phase revealed that a considerable amount of participants chose the "I don't want to answer" item at the income question SD11, rendering this parameter useless. I considered removing just this "no answer" option to force users to answer, but refrained to do so because of the risk of false answers or survey discontinuation. Therefore I removed question SD11 altogether.

4.4. Sampling

One of the main problems of empirical research is the one of proper sampling. A market survey among smartphone users is a classical case of inferential statistics, where only a subset of the overall population is drawn, to infer the properties of the whole (Raab-Steiner 2010, p. 13). There are various methods and guidelines available concerning proper sampling, because this is a critical step where a lot of problems can occur, leading to biased results. Generally it is desired to draw a sample as big as possible, and as evenly distributed across the entire population, e.g. drawing the samples perfectly random. In practice, this is often not possible, as e.g. I have no means to contact any Austrian smartphone user, subject to an even probability. A feasible alternative is the snowball sampling principle, also referred to as "chain referral" (Bernard 2012, p. 168), which is unfortunately regarded as the weakest method to draw any conclusions for a bigger population. Snowball sampling is useful for populations that are hard to reach (Bernard 2012, p. 168), which is not the case with smartphone users.

Alternatively, the population considered can be narrowed down to a more specific group, e.g. smartphone-owning University students from Vienna, aged between 18 and 35. This statistically more valid approach however sacrifices the general usefulness of the results.

Furthermore, one needs to decide on the amount of parameters to be measured by the survey. The more parameters are considered to be relevant, the more the sample size needs to be increased to acquire enough data for performing drill-downs on specific item values.

To facilitate results that are as valid as possible, I chose to employ the following strategy:

- Use different channels for the survey promotion, each assigned with a "reference" value in the survey URL. This reference parameter is stored by *SoSci Survey* into the results database, allowing to distinguish participants coming from the various channels. If there are extreme outliers or obvious biases in some of these sub-populations, they could be discarded altogether.
- Promote the survey using new means of communications that are able to target almost the entire population of interest, namely *Google Adwords* and *Facebook Adverts*.
- Get various relevant organisations to forward the survey to their customers, e.g. app start-ups, 3G network providers, and smartphone hardware manufacturers.
- Align the results' demographics with official statistics, censuses, and other related commercial surveys, such as the Austrian "*Our Mobile World Survey*" by *Google* (2012). If there is a huge difference in the demographic distribution of the sample compared to other statistics, the case weighting feature of the employed statistics software, *IBM SPSS,* could be used to compensate for this.

However, it needs to be kept in mind, that it is virtually impossible to create representative online surveys, due to coverage problems, item-nonresponses, and interrupted or discontinued surveys (Jakob et al. 2009, p. 126). Furthermore, there is still a lack of a generally accepted methodology to recruit online survey participants in a random fashion, without resorting to – similarly questionable – offline recruiting methods (Jakob et al. 2009, p. 146). Further bias is introduced due to the people's willingness or unwillingness to participate in the survey.

Minimum Sample Sizes for Significance Testing

For the planned significance testing, there are recommended minimum sample sizes to keep the error of the statistical methods, that will be discussed in section 5.1, sufficiently low. A table of sample sizes for selected significance and effect levels, to achieve a test power[1] of at least 0.8 ($\beta = 0.2$), is provided in Cohen (1992), and Bortz (2006, p. 628). At a 0.05 significance level, the sample size for comparing the means of two independent groups, subject to a medium effect size[2], should be at least $n = 50$, and moreover, $n = 64$ for testing the significance of the correlation coefficient[3]. For testing upon smaller effects, samples of up to $n = 310$ for the means, and $n = 614$ for the correlation, would be required. In this study, achieving the goal of at least $n = 200$ participants, would yield a more than acceptable sample size for the exploration of medium effects.

[1] The concept of test power is discussed in more detail in section 6.4.2.

[2] Defined by a Cohen's *d* of approx. $d = 0.2$. The effect size is derived from the difference in means, and the samples' standard deviations: $d = (\mu_a - \mu_b) / \sigma$ (Cohen 1992, p. 157).

[3] A medium effect refers to a correlation of approx. $r = 0.3$, a small effect to $r = 0.1$ (Cohen 1992, p. 157).

4.4.1. Promotion / Channels of Distribution

For inviting participants to the survey, the following channels can be considered as most appropriate, for a student without access to panel groups, or aid from market research agencies:

» E-Mail to personal contacts.

» E-Mail to the entire faculty.

» News feed message on private *Facebook* timeline.

» Posting an invitation to *Facebook* groups related to the topic.

» Posting an invitation to various Web forums and discussion groups.

» Trying to multiply the audience by getting startups to spread the survey to their followers.

» Getting major companies to promote the survey.

» Leaving flyers with a link to the survey in crowded places.

Apart from that, I also considered a somewhat new means for the promotion of a survey:

» Running advertising campaigns on *Google* (*Adwords*) and *Facebook* (*Adverts*)

Most of the above-mentioned means of promotion are of an online type, except the distribution of printed flyers. I have not employed the latter, as the goal of this campaign was to motivate people to participate in an online survey, whereas people on the road usually do not have a desktop PC nearby. Furthermore, the survey does not work well on mobile phones, as already mentioned. I expected that most people won't keep the flyer to participate in the survey at a later time. On the other hand, I could have left some flyers in Internet cafés, or Internet rooms at universities, where desktop workstations are available, but this would have created more bias towards students. This is also the reason why I did not have the faculty of informatics mail the survey invitation to all of its members.

Primarily, I concentrated on online advertising through *Google* and *Facebook*, and getting companies to post a link to the survey on their *Facebook* pages. Figure 8 shows one of the *Facebook* ads, and Figure 9 a text ad placed on *Google*.

Discussing the design principles applied for creating these ads would exceed the scope of this work – "brevity is the soul of wit", lent from Shakespeare's *Hamlet*, shall be mentioned as the way to go for any kind of advertising. The outcome of the online advertising campaigns is discussed in more detail within the evaluation, section 6.4.1.

Figure 8: One of the designs for the Facebook Advert, and image ad for Google Adwords. Other design variations (not shown) mainly differ in resolution and aspect ratio, to accommodate for different ad placements. The background photo, showing a typical smartphone, was taken with a DSLR camera by myself.

TU-Umfrage zu Smartphones
www.soscisurvey.de/tuw2013/
Jetzt mitmachen! Anonyme Umfrage der TU Wien für bessere Apps.

TU-Umfrage zu Smartphones
www.soscisurvey.de/tuw2013/
Jetzt mitmachen! Anonyme Umfrage der TU Wien für bessere Apps.

Figure 9: Screenshot of the Google Adwords text ads. Top: version next to the search results, bottom: version for the top of the search results.

In addition to the ads on *Google* and *Facebook*, I contacted the social media teams of the Austrian divisions of *Samsung*, *Nokia*, and *Hutchison Drei*, kindly asking if they would promote the survey on their *Facebook* timeline. Most of them responded that they could not offer this due to their social media policies, but would tolerate me posting the link by myself. This implied a very limited reach, as users' posts on official *Facebook* pages are moved into a "recent post by others" category, which has limited visibility to everyone else.

LG Austria was the only company who offered to re-post ("share") my survey link, which made the survey invitation more or less visible to their approx. 38,700 subscribers, as shown in Figure 10.[1] While I expected this to trigger dozens of interviews, it yielded exactly 25 survey participants.

[1] Strangely enough, due to them not wanting to share the link themselves, but having me post the link, and then re-posting it, *Facebook* automatically moved my original post from the "recent post by others" category to the *LG* timeline too, in a very prominent fashion.

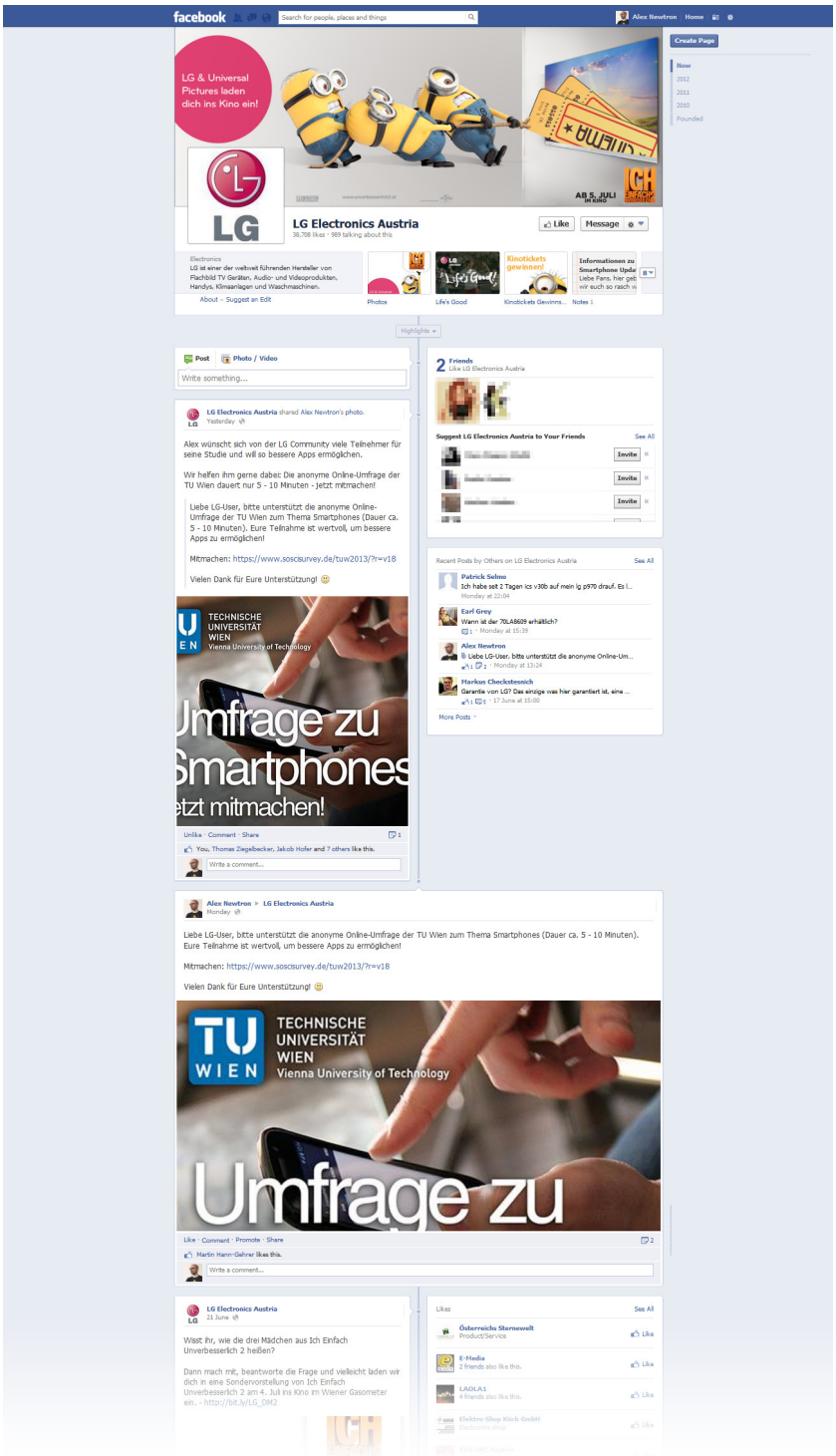


Figure 10: Screenshot showing the posting of the survey invitation onto LG Austria's timeline, the latter having approx. 38,700 subscribers (likes).

4.4.2. Monitoring

An advantage of the *SoSci Survey* tool is, that one can monitor the return of completed questionnaires in real-time, to see if the measures of promotion are effective, as shown in Figure 11. Furthermore, I performed multiple intermediary downloads of the response dataset, to check if the results look valid, and if the demographics' distribution develops as intended.

Fragebogen	Datensätze abgeschlossen / gesamt / Klicks		
Umfrage zum Smartphone-N smartphone1	305	362	974
Gesamt	**305**	**362**	**974**

Einzelstatistik zu Aussteigsseiten
Bitte oben den entsprechenden Fragebogen anklicken
Umfrage zum Smartphone-Nutzungsverhalten

Letzte bearbeitete Seite	Datensätze abgeschlossen / gesamt	
Seite **12**	305	305
Seite **10**	0	1
Seite **7**	0	7
Seite **6**	0	9
Seite **4**	0	5
Seite **3**	0	17
Seite **2**	0	18
Gesamt	**305**	**362**

Insgesamt wurden 974 Aufrufe (Klicks) für diesen Fragebogen aufgezeichnet (einschließlich versehentlicher doppelter Klicks, Aufrufe durch Suchmaschinen, ...).

Figure 11: Screenshot of the SoSci Survey real-time return statistics page, showing the amount of completed surveys, the total amount of surveys started, click rates, and drop-off counts per page. At the time of this screenshot, 305 surveys were completed, from a total of 362 started surveys. In the lower section, the drop-off statistics are shown. Most people left the survey on page two and three.

Last but not least, I integrated *Google Analytics*[1] into the survey's introduction page, as well as into page one of the questionnaire, and the survey's final page. This enabled conversion tracking for *Google Adwords*, and to gain insights on the origins of people just clicking to the survey, without starting it, as these figures were not provided by *SoSci Survey* itself. This way, I could observe the costs-per-started-survey, and costs-per-completed-survey ratios on *Google Adwords* in real-time. The efficiency of the online advertising campaigns is discussed in more detail in chapter 6.

[1] *Google Analytics* generates Web statistics, through a Javascript snippet inserted into the Web pages to be monitored. It tracks users' hits to those pages, their IP address, and employs a cookie to enable the *Analytics* servers follow the users' navigation paths and session. No actual survey response payload, or other non-anonymous content was transmitted to *Google*.

5 | Findings

5.1. Methods Applied

Before presenting the results themselves, the instruments from descriptive and inferential statistics, chosen for exploring the dataset, are quickly outlined.

5.1.1. Mean, Median, Mode, Variance, Standard Deviation

The well-known measures of central tendency and dispersion found in descriptive statistics are useful to acquire a first overview on the data (Bortz 2006, p. 371). The arithmetic mean designates the centre of gravity of a distribution, while the median, more robust to outliers, marks the point separating the 50% higher values from the 50% lower values. The mode indicates the highest value in the probability mass function, in other words, the discrete value with the most occurrences in the population.

5.1.2. Pearson Correlation Coefficient (Pearson's R)

The Pearson correlation coefficient, also referred to as product-moment correlation, measures the linear dependence between two interval or ratio scaled variables. It is calculated as follows:

$$r = \frac{s_{xy}}{s_x \cdot s_y}$$

Equation 1: The Pearson's correlation coefficient of two variables, representing the fraction between the covariance and the product of both variances.

A value of zero for *r* means no linear dependence, one indicates a perfect positive dependence, and minus one a perfect negative one. The correlation coefficient is invariant concerning linear transformations of each variable, and thus independent of scaling factors or units of the data (Bortz 2010, p. 156).

A correlation between two variables does not imply a causal relationship between them. However, a correlation of zero can be used to falsify a hypothesis on causality between those variables, because causality implies a correlation between variables (Bortz 2010, p. 159). Studies based upon correlations alone are subject to a low internal validity (Bortz 2006, p. 518).

For ordinally scaled data, the rank correlation by Spearman can be used.

5.1.3. Spearman's Rank Correlation Coefficient (Rho)

In contrast to the Pearson correlation coefficient, the Spearman coefficient shows the dependence between two ordinally scaled variables, or between an ordinally and an interval scaled variable. For ranked variables with values from one to n, the Spearman's Rho is identical to the Pearson correlation (Bortz 2006, p. 508) (Bortz 2010, p. 178).

It is calculated as follows:

$$r_s = 1 - \frac{6 \cdot \sum_{i=1}^{n} d_i^2}{n \cdot (n^2 - 1)}$$

Equation 2: The Spearman rank correlation coefficient r_s. d_i are the rank differences between the two samples.

Equation 2 does not take ties (duplicate ranks) into account; thus ties should not exceed a ratio of 20% of all ranks. The more complex case involving a higher amount of ties, is discussed in (Bortz 2010, p. 179). Statistics software such as *IBM SPSS* automatically performs the necessary calculations without any further ado.

A test statistic for judging upon the significance of the Spearman correlation is provided by Equation 3:

$$H_0 : \rho_s = 0 \qquad t = \frac{r_s \cdot \sqrt{n-2}}{\sqrt{1 - r_s^2}} \qquad (n \geq 30)$$

Equation 3: A t-test statistic for testing the significance of r_s. The null hypothesis H_0 postulates a correlation of zero, thereby this test statistic measures a significant difference from zero.

5.1.4. Student's t-Test

The t-test, a method from Null-Hypothesis Significance Testing (NHST), is a common instrument to test hypothesis concerning the mean of one sample, or comparing the means of two different samples (Bernard 2013, p. 593) (Bortz 2007, p. 120). The test statistic (t-value) is subject to a Student's t distribution. This is preferable in terms of small samples, as the t distribution takes their higher variance into account (Bernard 2012, p. 156). Thus one property of the t-test is, that it can be used on small samples (n > 30), with an underlying normal distribution, and unknown variance. It operates on interval-scaled data.

A typical application of the t-test is to compare the mean values of normally distributed samples. In this case, a null hypothesis is formulated that the two means of the samples are equal. Consequently, the alternative hypothesis assumes that the means differ.

$$H_0 : \mu_1 = \mu_2 \qquad H_1 : \mu_1 \neq \mu_2$$

Equation 4: Null hypothesis and alternative hypothesis for the two-sample t-test

Therefore, a two-sided test[1] is applied, which yields a p-value for the significance level of the null hypothesis being true. The t-test can be applied to two samples of the same, or of a different size. In the case of this survey, the sample sizes will usually differ. The definition of the test statistic for two independent samples[2] is given by Equation 5:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{S_{X_1 X_2} \cdot \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Equation 5: Test statistic of the Student's t-test for two independent samples of different size with equal variances.

$$S_{X_1 X_2} = \sqrt{\frac{(n_1 - 1)S_{X_1}^2 + (n_2 - 1)S_{X_2}^2}{n_1 + n_2 - 2}}$$

Equation 6: Combined (pooled) standard deviation estimator for the t-test with unequal samples sizes and equal variances.

The assumptions of this test are equal variances of the two samples. Because their size differs, a common variance needs to be estimated. Equation 6 shows the calculation of an unbiased estimator for this variance.

Finally, Equation 7 depicts a test statistic without the assumptions of equal variance. Therefore, the denominator combines the two different sample variances s_1^2 and s_2^2, again yielding an unbiased estimator for the combined sample standard deviation.

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Equation 7: Test statistic of the Student's t-test for two independent samples of different size with unequal variances.

If the calculated t-value exceeds the critical p-value that is tabulated for the chosen significance (e.g. $\alpha = 0{,}05$), the null hypothesis needs to be rejected.

Concerning the conclusions drawn upon such tests, special care needs to be taken concerning

[1] Also referred to as "two-tailed" test.

[2] The t-test can also be applied onto two dependent samples, in a slightly different fashion.

alpha and beta errors, as outlined by (Albers et al. 2009, p. 207). This is discussed in more detail in chapter 6. Due to being widely used, the t-test is offered out of the box by the *SPSS* software.

5.1.5. Mann-Whitney U Test

The Mann-Whitney U test (Mann 1947) is an interesting, more robust alternative to the Student's t test, being not based on the assumption, that the underlying samples are normally distributed. Another advantage of the U test is, that it can be applied to ordinal data, just taking the ranks of the data into account.

The value of U can be calculated as follows:

$$U = n_1 \cdot n_2 + \frac{n_1 \cdot (n_1 + 1)}{2} - R_1 \qquad U' = n_1 \cdot n_2 + \frac{n_2 \cdot (n_2 + 1)}{2} - R_2$$

Equation 8: Calculation of the U value. n_1 and n_2 are the respective sample sizes, R_1 and R_2 the rank sums of the samples.

U and U' are the values corresponding to both samples. Their value depends on the sum of their value ranks, and the overall sample size. The maximum value of U is $n_1 * n_2$, the minimum is zero.

$$U + U' = n_1 \cdot n_2$$

Equation 9: Another identity of the U values for both samples.

For sample sizes larger than 10, a standardised test statistic can be calculated that is approximately normally distributed. To achieve this, estimators for the mean and variance of U need to be derived.

$$\mu_U = \frac{n_1 \cdot n_2}{2} \qquad \sigma_U = \sqrt{\frac{n_1 \cdot n_2 \cdot (n_1 + n_2 + 1)}{12}}$$

Equation 10: Estimators for the mean and variance of U.

Looking at Equation 9 and the mean in Equation 10, it can be seen that the values of U and U' are distributed symmetrically around their mean. Taking the mean and variance, the following z statistic can be calculated, as given by Equation 11.

$$z = \frac{U - \mu_U}{\sigma_U}$$

Equation 11: Calculation of the z statistic by normalising U, assuming that U is normally distributed for larger samples.

The significance of this value can be judged upon by looking up the critical value in precalculated tables for the normal distribution. If the absolute value of z exceeds the critical value, it is significant, and the null hypothesis needs to be rejected.

For smaller sample sizes, dedicated tables are provided for checking the significance of U. The null hypothesis is rejected, if the value of U is below the tabulated critical value (Bortz 2010, p. 132). Similar to the t-test, the U test is also provided out of the box in *SPSS*.

5.1.6. Visualisation

For the visualisation of the data, a variety of options are available, amongst which I have chosen primarily histograms, bar charts, stem-and-leaf-plots (Bortz 2006, p. 373), box-and-whisker-plots, and scatterplots (jittered dot plots (Bortz 2006, p. 373)) to aid the analysis. It has to be noted, that due to the correlation coefficient only indicating linear relationships, visualisations such as scatterplots are bearing much more information that can be interpreted in explorative data analysis (Bortz 2006, p. 373). Relying solely upon the statistical measures of central tendency, can lead to erroneous assumptions.

5.2. Statistics Software

The general requirements on software and hardware, concerning the anticipated size of the survey dataset, are not too high: there are just about 30 variables, and a few hundred rows of data, which is no problem for any of the tools available. Potential candidates for the data processing, analysis, and visualisation are the following types of software:

» Common spreadsheet software, such as *Microsoft Excel*, or its open source pendant *LibreOffice Calc*. Their advantages are, that they are inexpensive (or free), and easy to use. They also provide the statistics functions required for the planned data exploration and significance testing. However, a major drawback is their humble chart generation functionality. Without macro programming, I expect it to be very cumbersome using *Excel* to generate and export the dozens of charts for the results discussion, especially when aiming for a consistent style. Moreover, due to the way that *Excel* treats data as columns, and not as variables and derived variables, there might be a heightened risk to commit errors during the analysis.

» Specialised statistics packages, such as *IBM SPSS Statistics* (IBM 2013), and *GNU R* (R Project 2013), which both seem to be more suited to the task. SPSS being the de-facto standard, and thereby expensive, professional statistics tool, appears to be the ideal candidate for this survey: it allows to define variables and their coding, and to separate the scale level descriptions and survey item labels from the respective variables' values. Furthermore, it provides comprehensive statistical analysis functions, from easy-to-generate descriptives, over ANOVA and regression analysis, to the non-parametric tests required. Last but not least, it eases the handling of multiple response sets (such as multiple choice items coded into several dichotomic variables), and allows to generate and export all

kinds of charts in an efficient fashion. *R* on the other hand, is a very powerful package, offering all statistical analysis functions imaginable, but however does not provide an easy-to-use GUI,[1] and requires more effort concerning the creation of well-formatted charts. Furthermore, it does not provide an out-of-the-box separation between survey item values and their description.

» Data exploration, machine learning, and knowledge analysis software, such as *Weka* (University of Waikato 2013). The primary aim of the latter is to explore relationships within the data, find patterns, and perform typical tasks found data mining, such as classification, clustering, and regression. Instead of facilities for statistical analysis, *Weka* provides a wide range of common machine learning algorithms, such as decision trees, support vector machines, self-organising maps, k-means clustering, and so forth. Last but not least, it features several means of visualisation, such as histograms and jittered dot plots. In the context of this survey, *Weka* would be a nice addition to the other tools, due to its different nature.

» Data cleaning tools, such as *Google Refine* (OpenRefine 2013), that is a powerful, open source, browser-based application for quick data assessment and reconciliation. It is based on so-called *facets* for the quick selection of data records upon multiple dimensions, and can also be used to enrich the data by querying external databases. Important to note, it operates on the client's local desktop without uploading data to *Google*'s servers, which would otherwise be a problem, considering privacy.

Considering the strengths and weaknesses of the aforementioned tools, I chose the following ones to allow for an efficient workflow: *Google Refine* for the data cleaning, *Weka* for the data exploration, and *IBM SPSS* for the later statistical analysis and charts generation.

5.3. Results

Having selected the methods and tools to explore the obtained data, we can now proceed with discussing the most interesting results by applying these instruments practically.

5.3.1. Preprocessing and Data Cleaning

Before importing the data into *SPSS* and *Weka*, I validated and cleaned it using *Google Refine*, specifically, to filter out responses that were incomplete, or completed within a too short timespan, or featured any other dubious inputs. To improve the validity of the data, guidelines published by government agencies are available, such as the quality guidelines of *Statistik Austria* (2012). It is suggested there, to check data both on a micro level, referring to each individual record, and on a macro level, through aggregates and key performance indicators. The micro level checking is also referred to as "micro editing" (Statistik Austria 2012, p. 37). In the case of the survey, I performed the micro editing by looking at the data, and filtering based upon measures, such as each user's page and overall survey completion times. Similarly, I performed "macro editing", keeping an eye on the demographics while the survey was running, and checking the distribution

[1] Except from the *Gretl* (2013) GUI, that is focused on econometrics.

of several attributes on their plausibility, e.g. the features usage intensity, operating system, and comparing them to the *Our Mobile Planet* survey by *Google* (2012). The relation of this survey's demographics to *Google*'s survey is discussed in more detail in section 5.3.4 - "Smartphone User Demographics". Fortunately, the overall quality of the dataset seemed to be high at this point, just one dataset was identified to contain an invalid user response (age of "99").

SoSci Survey provides a variety of data export options, e.g. plain CSV, *GNU R*, and *SPSS formats*. The CSV files could be loaded into *Excel* without a problem, and also the *SPSS* import worked without any further ado. However, it was more difficult to import the CSV file into *Weka*, as the latter had problems recognising the delimiter for textual answer items (double quotes). Consequently, I manually adapted the CSV file, until *Weka* was able to parse it. I employed *Weka* mainly to get a first overview on the data, as it provides quick visualisations of the dataset's attributes. However, it was difficult to spot any particular relationships visually, as the survey contains many discrete attributes with five levels and less, which makes particularly the jitter plots hard to read. Figure 12 and Figure 13 show two of the visualisations generated. After checking for any obvious patterns, I imported the data into *SPSS* for statistical analysis.

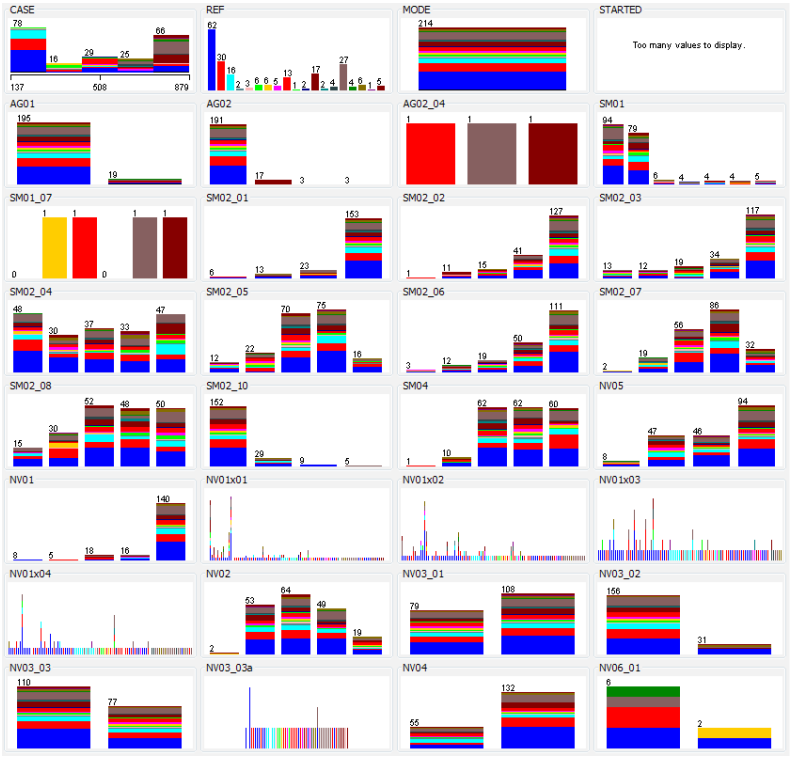


Figure 12: Exploring attribute classes of an intermediary dataset (~ 200 participants) in the Weka Explorer. The attributes are summarised as histograms, with the colour indicating the values of the referrer (REF) attribute. This enabled me to explore, if some of the survey promotion channels correlated with the users' answers. Such a correlation would show up as a distinct separation of colours between several bars within the same histogram. On the other hand, a "random" mix of various colours, that is, referrers, within individual bars represents the normal case.

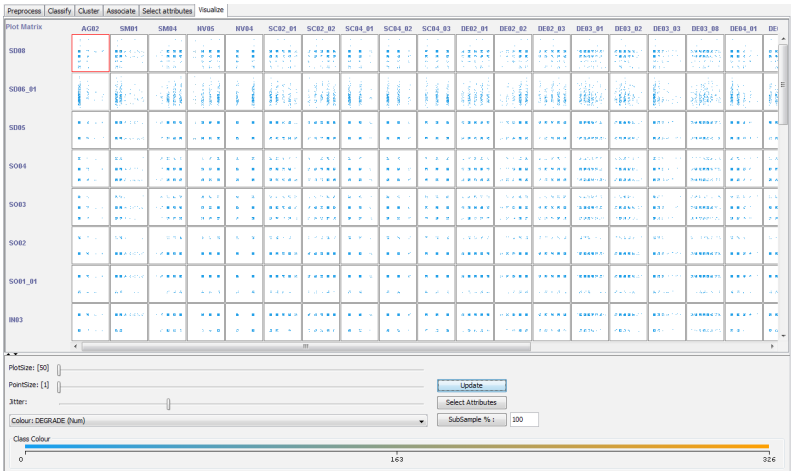


Figure 13: Exploring nonlinear relationships through jittered scatterplots in the Weka Explorer. All attributes are plotted against each other here. The nominal, categorical, and five-level scale attributes make it pretty hard to assess correlations though. For continuous attributes, or scales with more levels, a linear correlation would show up as a dot cloud shaped like a rising or falling line (ideally, a diagonal line). The advantage of such jitter plots is, that theoretically, also non-linear relationships become visible, such as square or exponential relationships.

5.3.2. Return Statistics

Let us begin the results discussion with the gross survey completion statistics, shown in Table 35:

Item	Count / Value
Clicks to survey	974
Surveys started	362
Surveys completed	*307*
Completion rate	85 %
Discarded: incomplete (item-nonresponse)	-55
Discarded: invalid / suspicious data	-1
Complete responses net	*306*
No smartphone	-28 (9% of 306)
Smartphone owners net	*278*
No third party apps	-13 (5% of 278)
App users net (using at least one third-party app)	*265*

Table 35: Return statistics showing various measures for the survey. Surveys that have only been partially completed, are completely discarded for the results analysis. The "clicks" value includes hits by search engine bots, and my own clicks to the survey's front page for testing.

The completion ratio of 85% can be considered as good for a voluntary online survey. Of the 362 surveys started, just 57 were incomplete. I discarded all incomplete results, except two of them, where participants just did not click the final "next" button to finish the survey on page 12 (where they could leave general remarks). Thus 55 responses were filtered out, as well as one suspicious response, were an age of "99" was specified.

Interesting to note, that there was only one survey filled out using the English version offered.

5.3.3. Overall Demographics

Responses from other countries were not filtered out a priori. An overview on the participants' countries is provided by Figure 14.

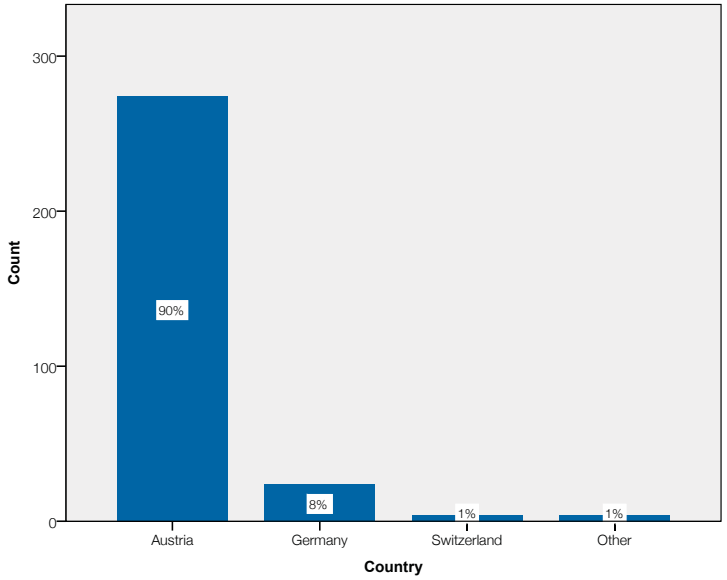


Figure 14: Countries of residence of the survey participants (Question: AG02, n = 306).

As expected, most participants originated from Austria (274), with Germany (24) and Switzerland (4) following. Only a few responses (4) were collected from other countries' residents.

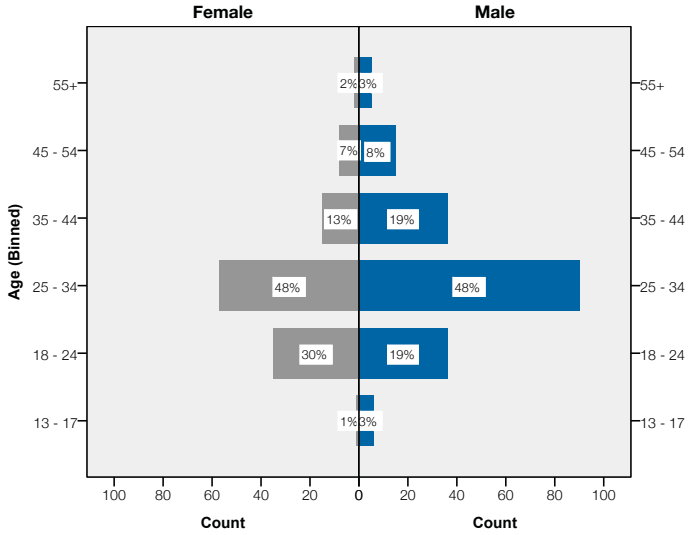


Figure 15: Age and gender of the survey participants (Questions: SD05/SD06, n = 306). Age is binned into common classes.

The age and gender of all participants, summarised by Figure 15, shows a typical distribution for an online user population. This can be related to other statistics, such as the demographics of *Fa-*

cebook users, that can be measured almost exactly[1]. Figure 16 shows stats from the *Facebook* ad targeting tools, extracted and aggregated by Allfacebook.de (2013)[2].

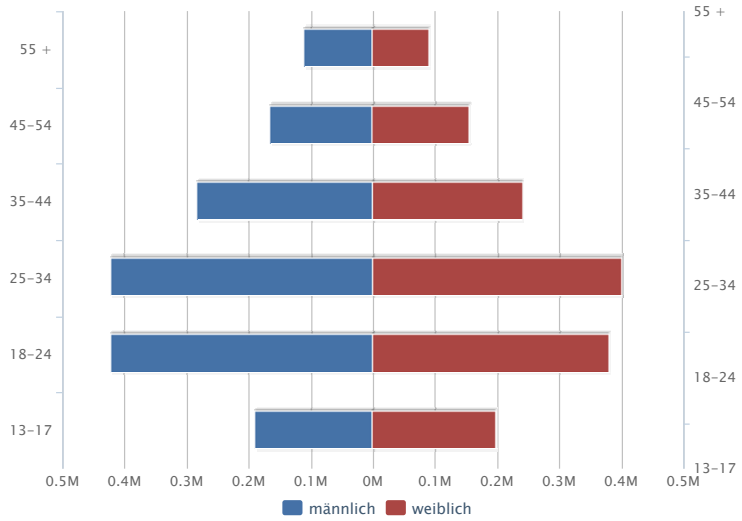


Figure 16: Current Facebook user demographics for Austria. Left half: male, right half: female users. Taken from: Allfacebook.de (2013)

Comparing the *Facebook* statistics with the overall return statistics of the survey[3], they basically seem to be not too different: the majority of users is in the age class between 25 and 34, with slightly more male users than female ones. Considering the demographics of the survey, male users aged between 25 and 34 are overrepresented, and following, older and younger age classes slightly underrepresented. This bias needs to be taken into account when interpreting the survey's results.

For comparing the demographics of smartphone owners, other related surveys will be discussed later. The distributions of education and occupation are provided by Figure 17 and Figure 18.

[1] Due to the whole population being known. However, inconsistencies subject to duplicate accounts, or incorrectly entered personal details need to be taken into account.

[2] These statistics have to be interpreted with caution, as they are not official *Facebook* statistics, and subject to a measurement error. However, given that in Austria, approx. three Million users are registered with *Facebook*, the aggregated demographics might resemble the active online population in general.

[3] Please note, that the X axis (male / female) is reversed in the *Facebook* statistics.

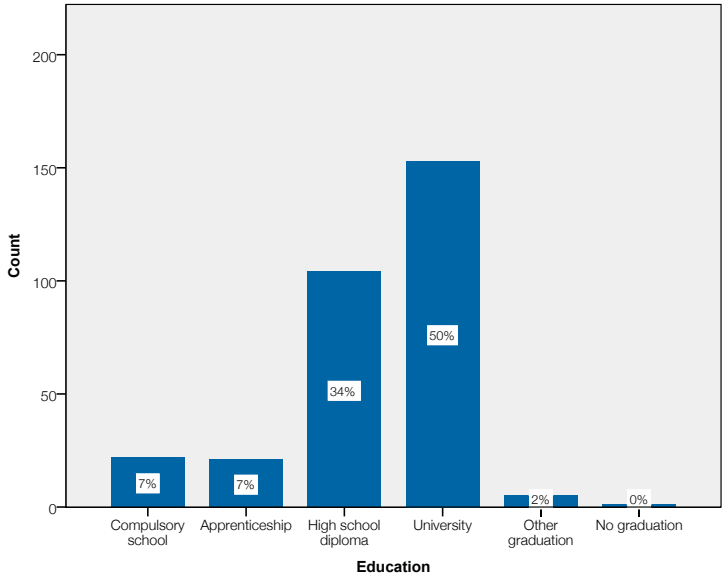


Figure 17: Education distribution of the survey participants (Question: SD08, n = 306).

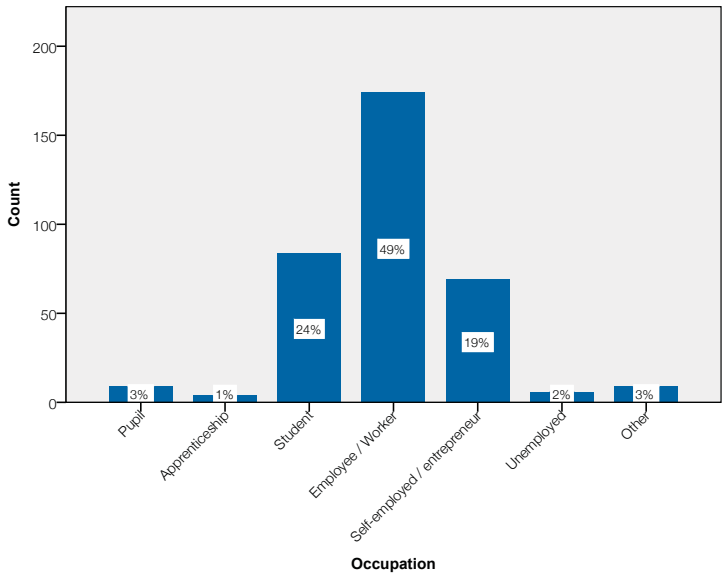


Figure 18: Occupation of all survey participants (Question: SD10, n = 306, multiple choice).

Pretty self-explanatory, most participants have a university degree, followed by persons with a “Matura” or “Abitur”, the Austrian and German counterparts to a high school diploma. Concerning the occupation, students, employees and workers are most prevalent. Based upon feedback from the pretest phase, the occupation question is of an MC type, so there is an overlap between classes. Table 36 shows the discussed demographics in a cross tabulation for more detail.

		Gender											
		Female						Male					
		Age (Binned)						Age (Binned)					
		13 - 17	18 - 24	25 - 34	35 - 44	45 - 54	55+	13 - 17	18 - 24	25 - 34	35 - 44	45 - 54	55+
		Count	Count	Count	Count	Count	Count	Count	Count	Count	Count	Count	Count
Education	Compulsory school	0	4	1	1	0	0	6	2	3	3	1	0
	Apprenticeship	0	0	2	1	0	1	0	4	6	2	3	1
	High school diploma	0	13	15	1	2	0	0	19	27	7	3	1
	University	0	14	32	9	5	1	0	10	49	18	4	2
	No graduation	1	0	0	0	0	0	0	0	0	0	0	0
	Other graduation/degree:	0	0	1	1	0	0	0	0	0	0	2	1
Occupation	Pupil	1	1	0	0	0	0	5	2	0	0	0	1
	Apprenticeship	0	0	1	0	0	0	2	0	1	0	0	1
	Student	0	21	12	0	0	0	0	21	23	1	0	1
	Employee / Worker	0	12	37	10	3	0	0	14	52	21	9	2
	Self-employed / entrepreneur	0	1	5	4	4	1	0	7	26	10	4	3
	Unemployed	0	0	1	0	0	1	0	2	1	0	0	0
	Other	0	0	4	0	0	0	0	1	0	0	0	1

Table 36: Cross tabulation for gender, age, education and occupation of all participants (n = 306). Figures represent absolute counts.

5.3.4. Smartphone User Demographics

Out of the 306 participants, 278 indicated that they own a smartphone. The demographics of this subset are quickly outlined in the following.

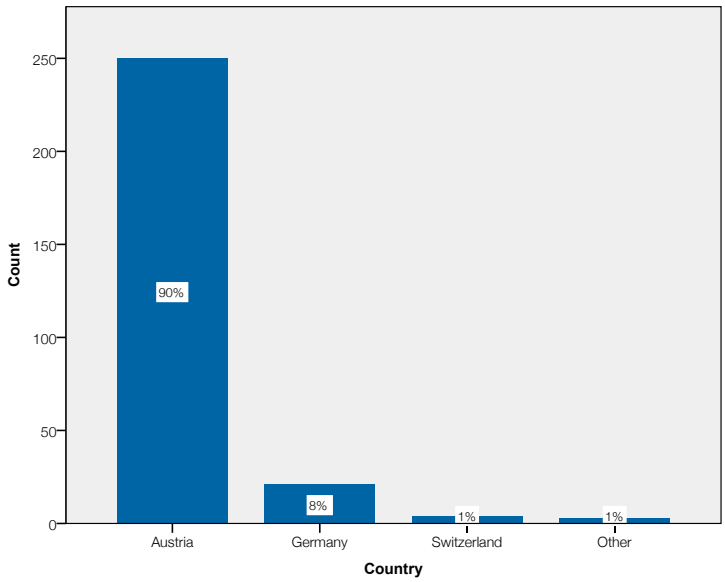


Figure 19: Countries of residence of smartphone owners (Question: AG02, n = 278).

Figure 19 shows the country distribution, which remains virtually identical to the distribution for all participants. Figure 20 again provides age and gender of the smartphone-owning respondents.

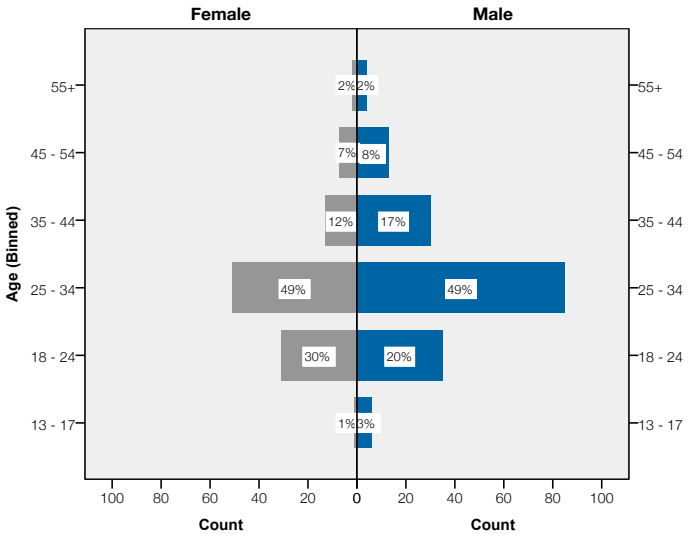


Figure 20: Smartphone owners by age class and gender (Questions: SD05/SD06, n = 278).

The graph shows that the bias in favour of male users has slightly worsened. To assess the quality of the results, let us compare them with the representative *Our Mobile Planet* study of smartphone users, conducted by *Google* in Q1/2012, yielding an age and gender distribution displayed by Figure 21:

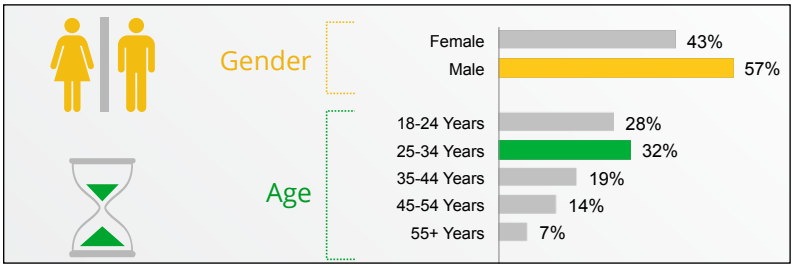


Figure 21: Age and gender demographics from the "Our Mobile Planet" study (n = 1,000). Taken from Google (2012)

Similar to the *Facebook* user statistics, the most prominent age class is 25 to 34 years. Also, male users are overrepresented here. Interestingly, there are no statistics on users younger than 18. Both studies' demographics diverge with increasing age: while 7% of the users interviewed by *Google* are older than 55, the fraction in this survey amounts to a mere 2%.

Figure 22 and Figure 23 show the respective education and occupation statistics.

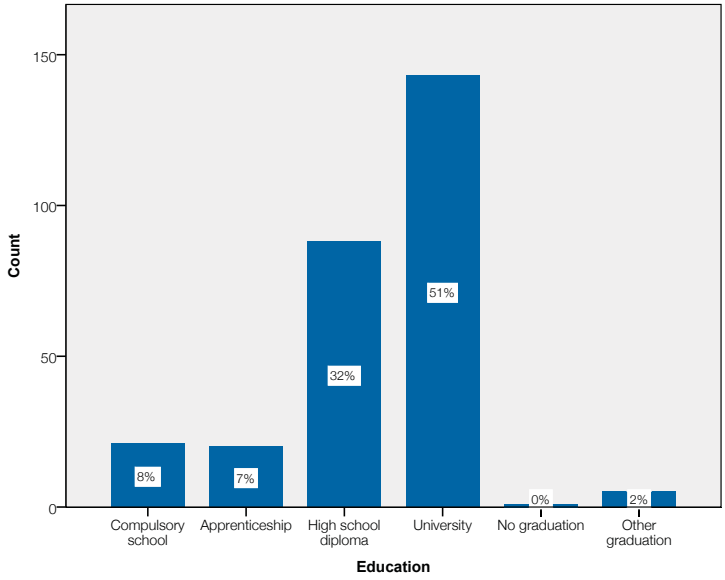


Figure 22: Education of all smartphone owners (Question: SD08, n = 278).

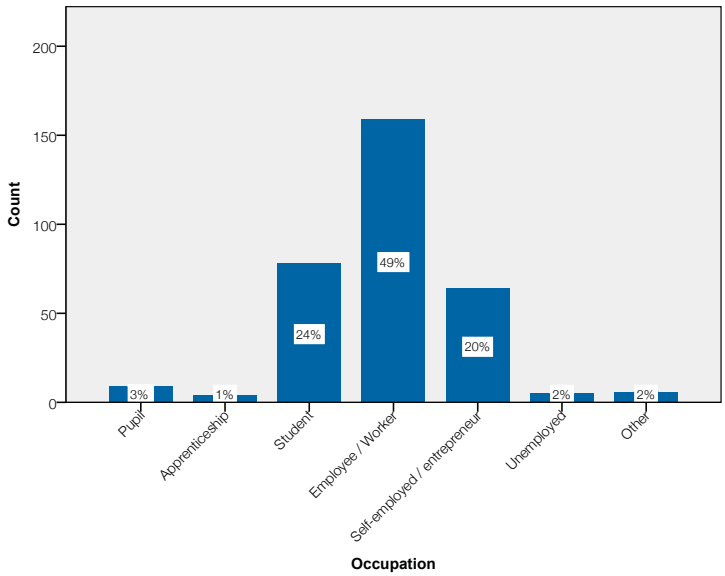


Figure 23: Occupation of all smartphone owners (Question: SD10, n = 278, multiple choice).

While the prevalence of users with a University degree seems not to reflect reality, *Google's* survey resembles the education distribution to some point, as shown in Figure 24. However, users with a university degree are considerably overrepresented here, and interestingly, also users who only finished compulsory school.

Concerning occupation, *Google's* results (cf. Figure 24) are not comparable due to the different nature of classification, but at least yield the same result for the first rank, namely, employees.

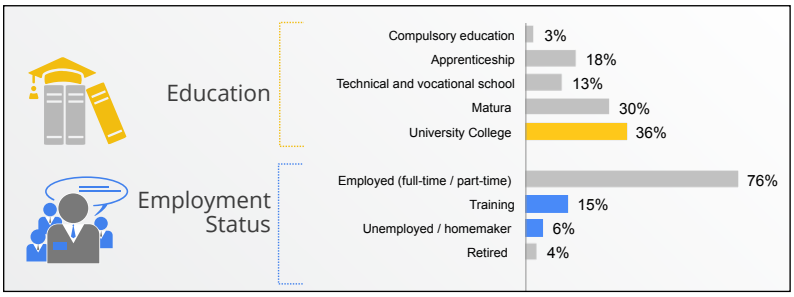


Figure 24: Education and occupation demographics from the "Our Mobile Planet" study (n = 1,000). Taken from Google (2012).

5.3.5. Operating System

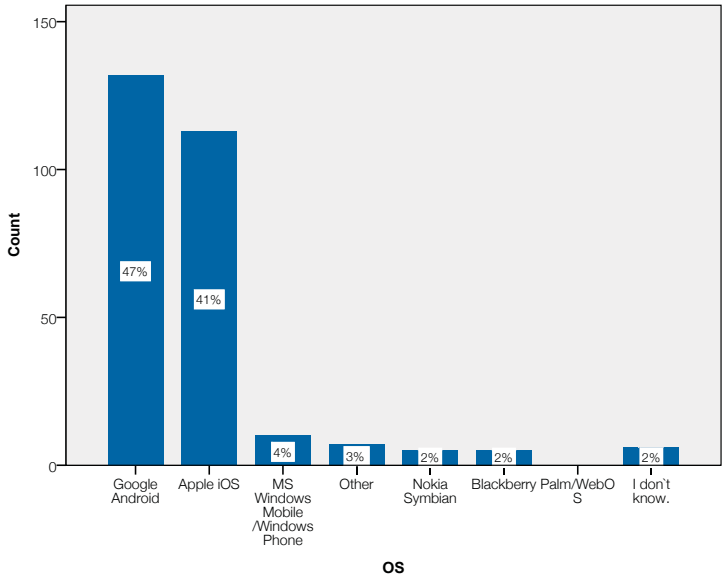


Figure 25: Operating system of the smartphone owner's primary smartphone (Question: SM01, n = 278). The sheer dominance of Android and iOS, as well as the low shares of other platforms, is not surprising, given recent popular market statistics.

The distribution of operating systems, depicted by Figure 25, was already anticipated: the absolute market lead of *Android*, followed by *iOS*, leaves the market shares of other vendors far behind. Remarkably, the gap between *iOS* and *Android* is not that big here. While worldwide market statistics, e.g. IDC (2013a), confirm that *Android* and *iOS* together cover more than 90% of the global market, they indicate that *Android* is outgrowing *iOS* steadily. The IDC statistics mentioned show a worldwide *Android* market share of 70%, versus an *iOS* share of just 21%, as seen in Table 37.

Android	iOS	BlackBerry	Windows Phone/Mobile	Linux	Other
70.1%	21.0%	3.2%	2.6%	1.7%	1.3%

Table 37: Worldwide smartphone OS market shares measured through shipped devices, Q4/2012, by the IDC Worldwide Mobile Phone Tracker. Taken from IDC (2013a).

Due to the lack of comparable statistics for the Austrian region, it remains unclear if there is a bias in favour of *iOS* in this work, or if the market share of *iOS* devices is higher in Austria. Figure 26 depicts the distribution of platforms by gender:

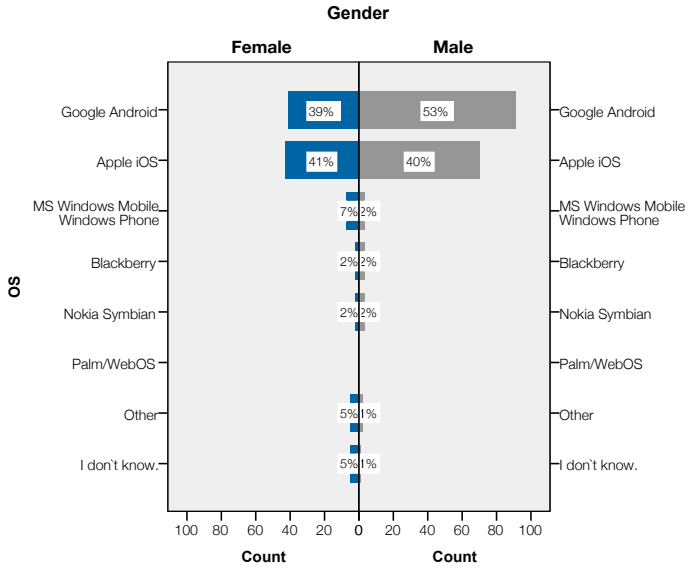


Figure 26: Operating system by gender. (Question: SM01, n = 278). Slightly more female participants indicated to own an iPhone, while a more distinct majority of male participants chose Android-based devices.

There is a noticeable difference between *iOS* and *Android* shares based upon gender: for male users, *Android* is clearly ranked first, while female users slightly prefer *iOS*. The results for the other operating systems are inconclusive due to the small sample size and the comparably high fraction of “other” and “I don’t know” answers.

5.3.6. Smartphone Use

The usage intensities of various fundamental smartphone features, measured on a five-level scale ranging from “never” to “very frequently (daily)”, are provided by Figure 27 and Figure 28.

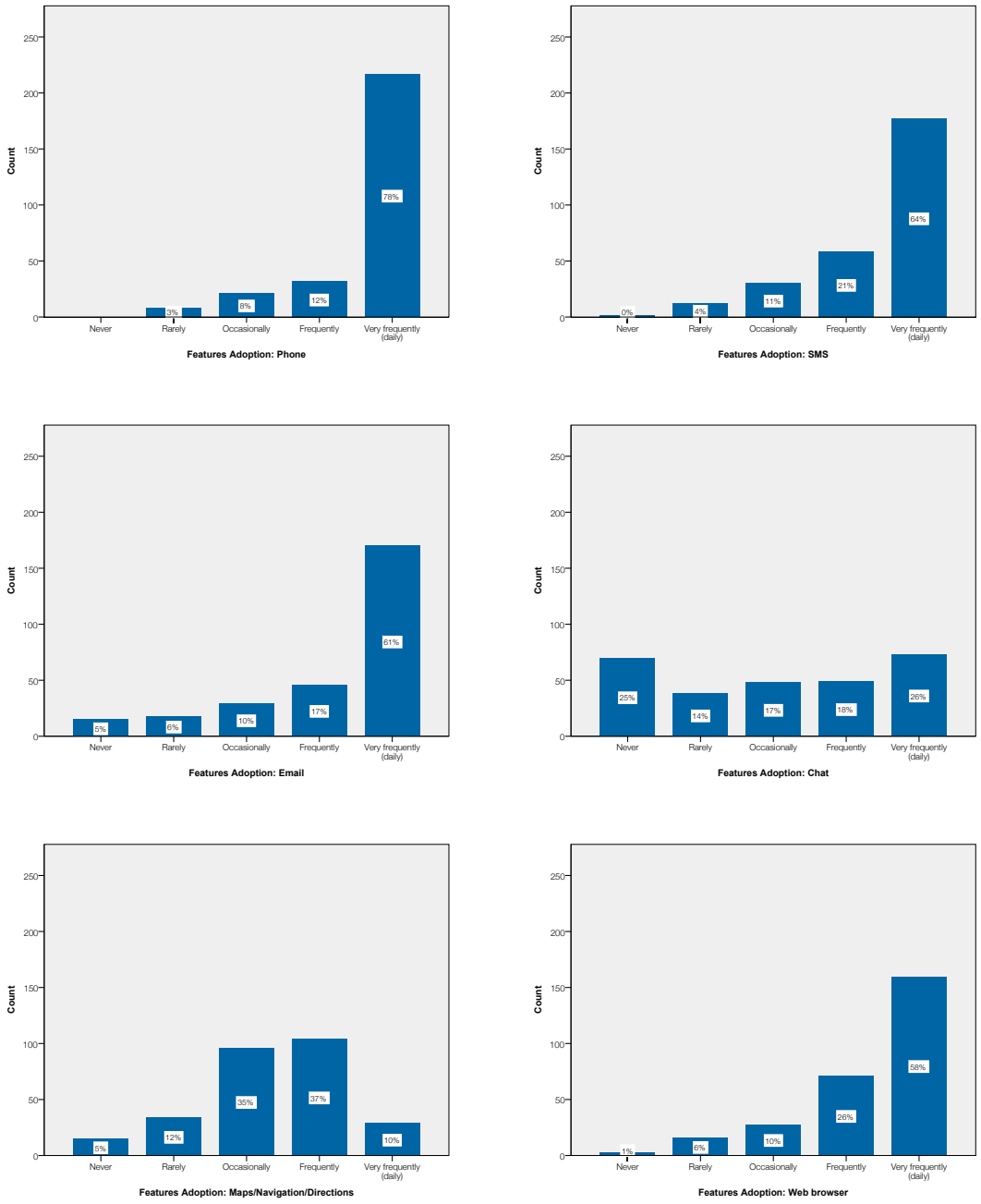


Figure 27: Features adoption by the smartphone users (Question: SM02, n = 278, part 1 of 2). As expected, phone, SMS, e-mail, and Web browser are the features used most intensively.

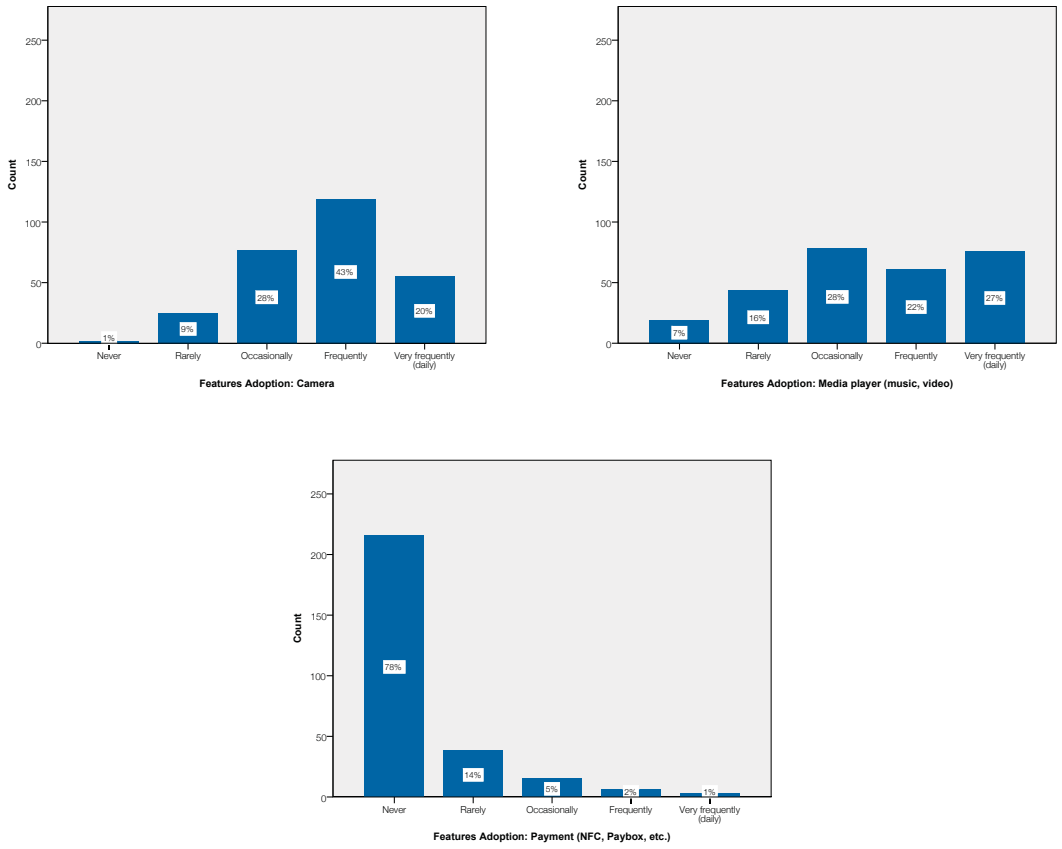


Figure 28: Adoption of the smartphone's camera, media player, and payment features (Question: SM02, n = 278, part 2 of 2).

Question SM02 just served to assess the plausibility of the results. Most of the results are expected and do not bear any novel findings. A majority of the 278 smartphone users responded to use phone, SMS, Web browser, and e-mail facilities daily. As expected, there are also users who indicated to use their smartphone for traditional telephony more seldom: 11% selected "occasionally" and "rarely". This is even more visible with SMS, that gets steadily substituted by global instant messaging apps, such as *WhatsApp*.

An interesting point is, that the use of media player facilities is not that intensive as one might think. Only a quarter of the users indicated to use the media player daily.

On the negative end, the adoption of mobile payments through NFC or payment services such as

Paybox[1] is very low. However, 14% of the users responded to perform mobile payments rarely. I suppose this is due to established SMS-based services, such as m-parking[2] or public transport ticketing.

5.3.7. Smartphone Buying Interval

The results from the smartphone buying interval question indicate that most users prefer to buy a new smartphone every one to two years (33.1%), less often than every two years (30.2%), or only as soon as their current phone gets broken or unusable (29.5%). Only a minority buys a new phone once a year (5.4%), or even more often (1.8%). The responses, broken down by gender and operating system, are depicted by Figure 29 and Figure 30.

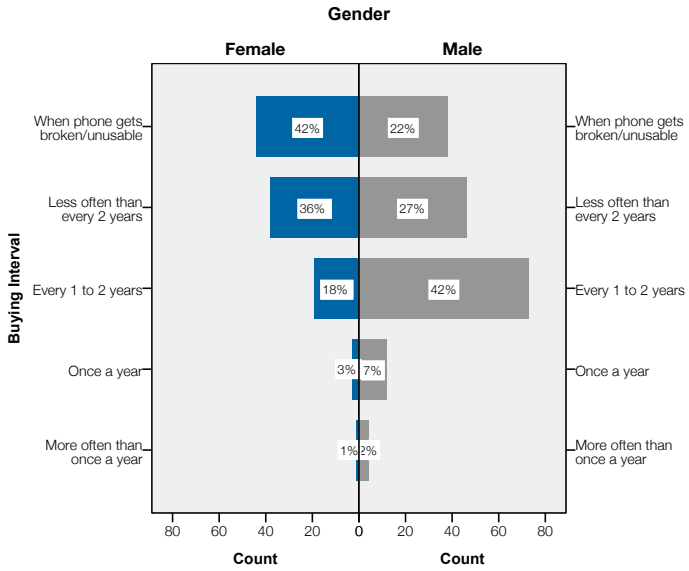


Figure 29: Smartphone buying interval by gender, (Question: SM04, n = 278).

[1] An Austrian mobile payment solutions vendor.

[2] Paying for parking permits through SMS or dedicated apps.

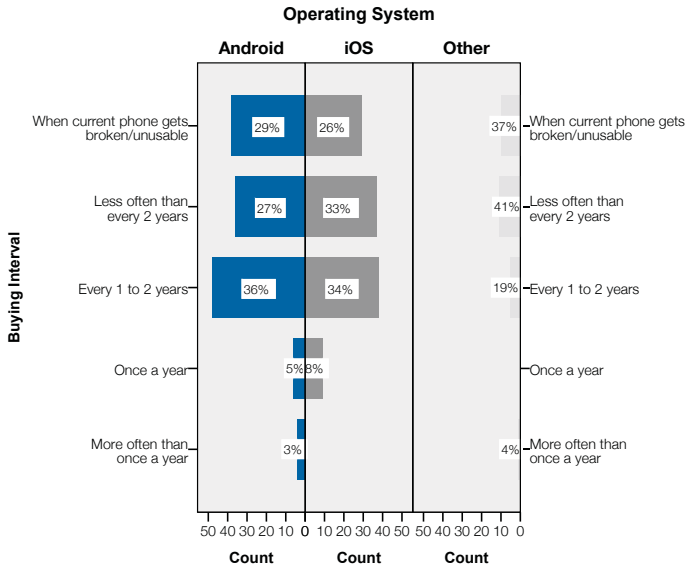


Figure 30: Buying interval by operating system (Question: SM04, n = 272).

While the differences in the operating system dimension are not that obvious, there seems to be a higher correlation concerning gender: female respondents buy smartphones more seldom, while most of the male smartphone owners prefer to buy their smartphone every one to two years (42 %). This is backed by the Spearman rank correlation coefficient for gender and buying interval, which amounts to -0.289, at a two-tailed significance of 0.000[1] (cf. Table 52 in Appendix F).

Please note, that in Figure 30, and in all of the following graphs that split up the results by operating system, answers are binned into three disjoint classes: *Android*, *iOS*, and "Other". The six "I don't know" answers from the operating system question SM01 are discarded there, leading to slightly lower populations for these graphs.[2]

5.3.8. Third-Party Apps Use and Installation Frequency

The following questions deal with the active use and installation of apps by the smartphone users. Approximately 95% of all respondents indicated that they are using third-party[3] apps, which leads to a population of n = 265 for the app-related questions following. The distribution is shown in Figure 31.

[1] Thus being significant at the 0.01 level.

[2] E.g. n = 272 for smartphone users, and n = 261 for app users.

[3] "Third-party" is a bit of a misnomer in this context, referring to apps that are not pre-installed on the user's smartphone. I have not found a more suitable single term to express this.

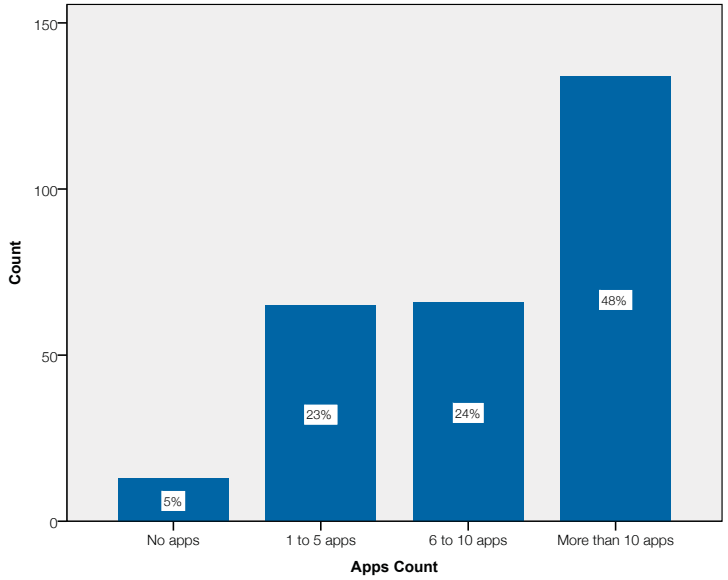


Figure 31: Amount of third-party apps that the respondents use (Question: NV05, n = 278).

A remarkable amount of smartphone owners answered to use more than 10 apps, while just 13 out of the 278 users selected the "no apps" answer option (5%). This can be backed by other studies, such as the *Our Mobile Planet* survey, that measured 25 apps installed on average for Austrian smartphone users[1], with 10 apps used within the last 30 days (*Google* 2012, p. 17).

Figure 32 and Figure 33 depict differences and similarities in the gender and operating system dimensions, providing additional insights.

[1] Private smartphone users who have at least one app installed, and are using the Internet; n = 954.

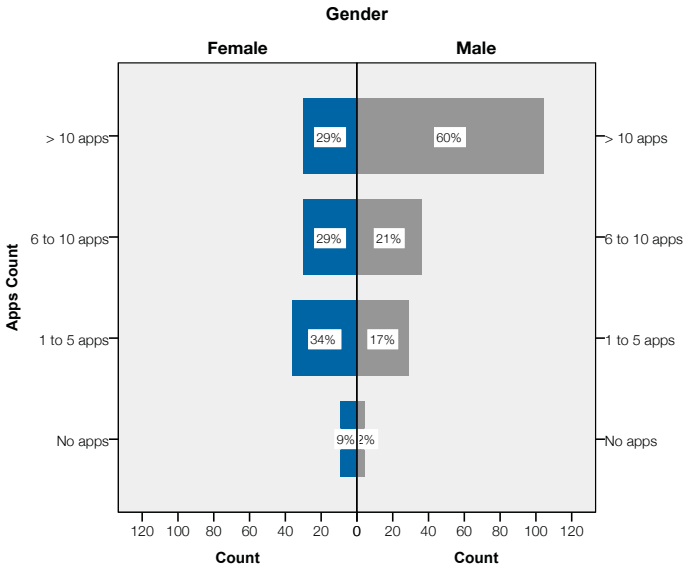


Figure 32: Third-party apps count versus gender (Question: NV05, n = 278).

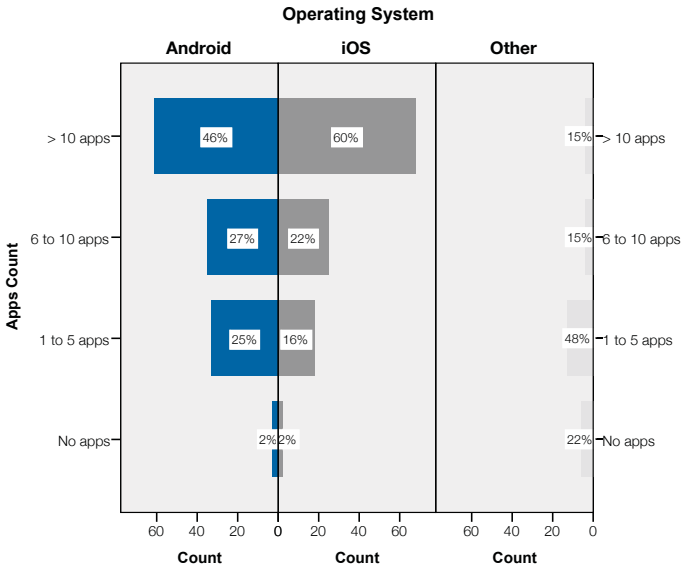


Figure 33: Third-party apps count vs. operating system (Question: NV05, n = 272).

The most obvious observation is, that 60% of all male users indicated to actively use more than 10 apps, while this is true for only 29% of all female participants. Noteworthy, the distribution of app users was almost uniform on the side of the female participants, despite the lack of an upper limit of the “> 10 apps“ class, where the centre of gravity of the male distribution is located. The Spearman rank correlation between apps count and gender is 0.323, significant at a 0.01 level.

In terms of operating systems, *iOS* has the lead over *Android* in this 10-plus apps class, backing the prevalent opinion that *Apple*'s ecosystem is more active. However, such snap judgements must be avoided here, as the apps count is roughly estimated by the survey participants, subject to an error of unknown severeness.

Of the few users who answered that they do not use third-party apps, the chosen reasons are displayed by Figure 34, which is not representative, due to the very low sample size.

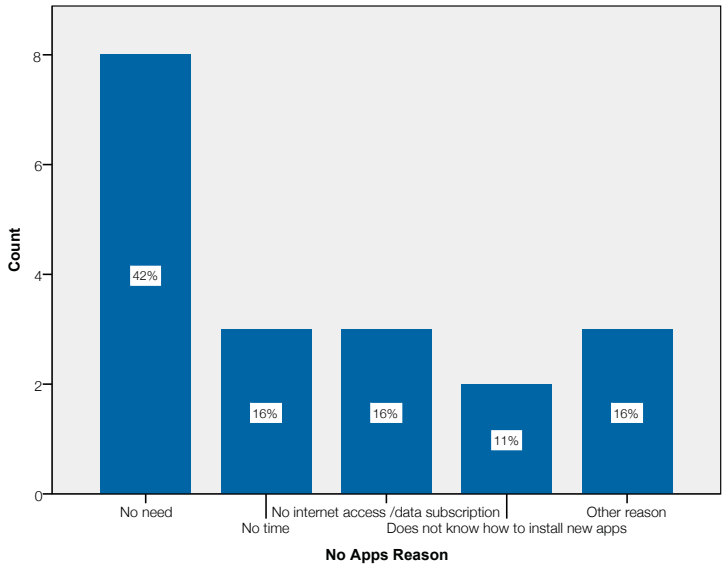


Figure 34: Reasons for not using third-party apps (Question: NV06, n = 13, multiple choice). Just 13 out of the 278 participants indicated not to use apps, so the figures displayed here are subject to a low precision.

The reason selected by most users, was a lack of need, followed by the lack of an Internet subscription, and a lack of time. Only two users answered that they do not know how to install new apps.

For developers, a probably more suitable measure to assess the intensity of the user's app engagement, is the frequency of new app installations, of which the results are shown in Figure 35.

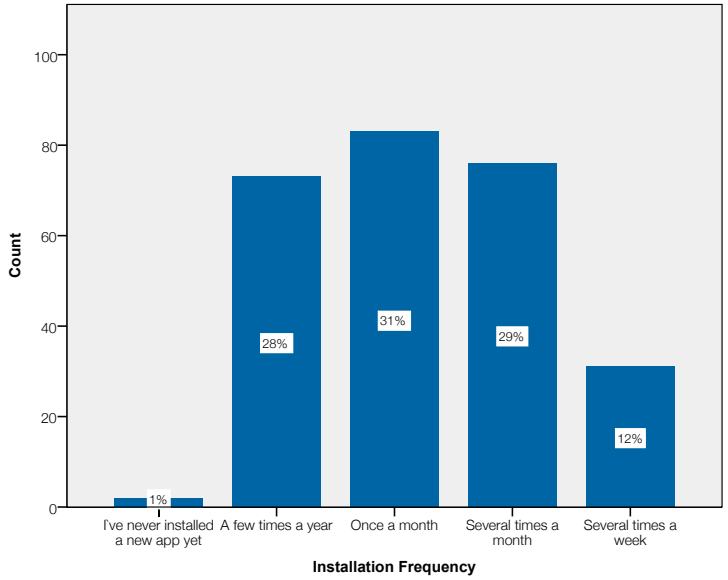


Figure 35: App installation frequency (Question: NV02, n = 265) for the subset of users who indicated that they use third-party apps (at question NV05).

The results show that most of the 265 app users install a new app once a month on average, while an almost equal fraction (29%) of them installs apps several times a month, and another one only a few times per year (28%).

The "I've never installed a new app" item was provided to verify the validity of the results – as this question was only posed to the subset of users who previously indicated that they use third-party apps, theoretically no-one should have chosen this answer option here. However, two users (1%) indicated that they have not installed a new app yet, which poses a contradiction to their choice at the third-party apps count question (NV05). Aside from a misunderstanding of the questions, this difference can occur in the rare case that someone uses one or more third-party apps that he or she has not installed by him- or herself.

As with the previous analysis, the breakdown of the results by gender and operating system are provided in Figure 36 and Figure 37.

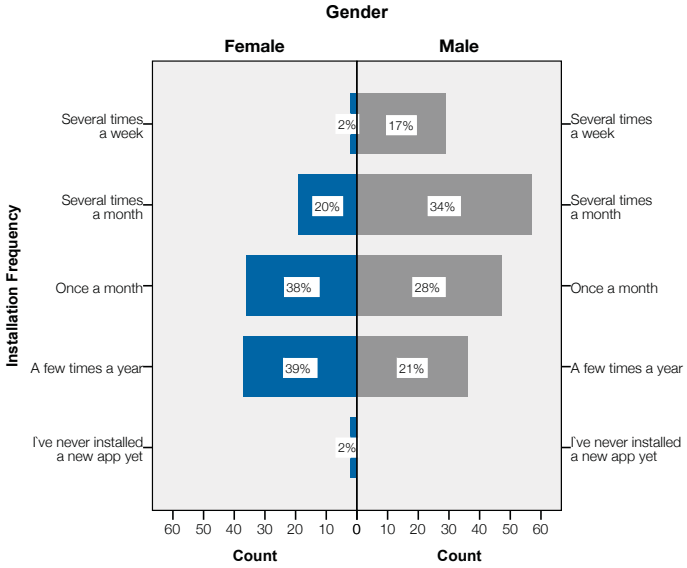


Figure 36: App installation frequency by gender (Question: NV02, n = 265).

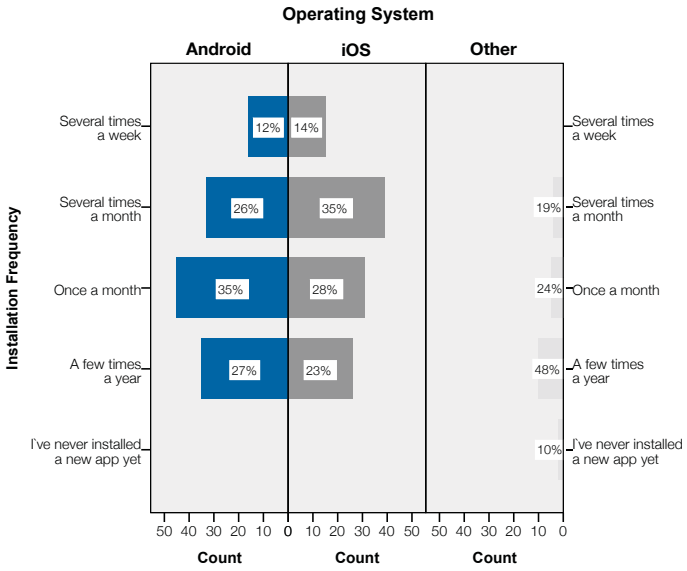


Figure 37: App installation frequency by operating system (Question: NV02, n = 261).

The results resemble the findings of the apps count question (NV05): the centre of gravity of the male distribution is located towards higher installation frequencies, while the opposite is true for female users. Again, there is a significant linear rank correlation between gender and installation frequency, with Spearman's Rho being 0.307, at a 0.01 significance. While most *Android* users responded with the "once a month" option, *iOS* users show slightly shorter installation intervals, with the mode of the distribution located at the "several times a month" option. The correlation between installation frequency and operating system is not significant however.

5.3.9. Apps Payment

Payment is one of the most crucial aspects for a startup considering the development of a mobile app. Questions arise, such as “how willing are users to pay for apps?”, “how many users paid to buy an app, and how many paid for something within an app?”, as well as “what are the main barriers and resentments concerning payment?”. Question NV03 addresses exactly this subject. The overall results concerning the payment acceptance are presented in Figure 38, and, as in the previous questions, broken down by gender, OS, and age in Figure 39, Figure 40, and Figure 41 respectively.

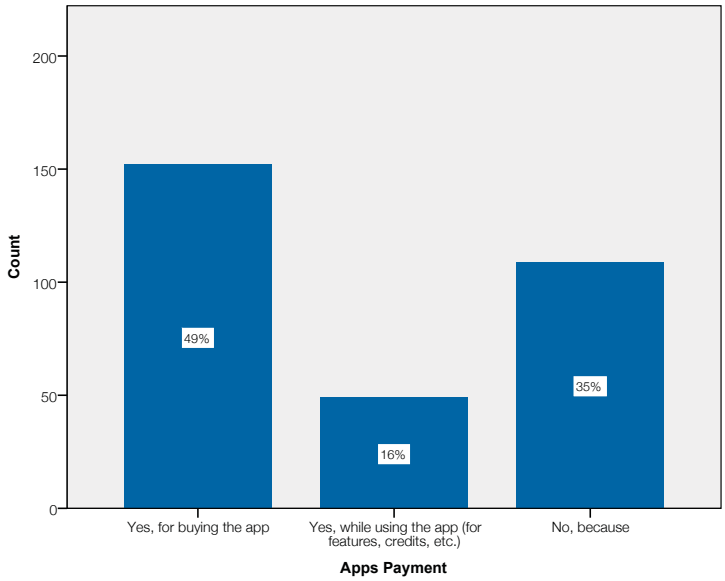


Figure 38: Apps payment acceptance (Question: NV03, n = 265, $n_{checked}$ = 310). The sum of absolute counts, $n_{checked}$, is higher than 265, due to the multiple-choice question type.

In question NV03, users could select both of the “yes” options if applicable, while the “no” option was exclusive. Thus the percentages displayed in the graph are referring to the sum of checked items, and not to the population of 265 app users. The results in Figure 38 show, that 152 users already paid for an app (57.4% of 265), and 49 already made an in-app purchasement (18.5%). 109 users (41.1%) indicated that they have not yet made any form of payment for or within an app.

This is interesting considering the need to monetise apps, as the fraction of 57.4% of all users can be regarded as a quite high overall acceptance of app purchasements. However, the figures do not tell much about the frequency of payments, and the average revenue per user (ARPU). Regarding app payment, *Google*’s *Our Mobile Planet* survey lists 10 paid apps on average for private smartphone users in Austria (*Google* 2012, p. 17).

Let us now have a look on the segmentation of payment adopters by gender, OS, and age.

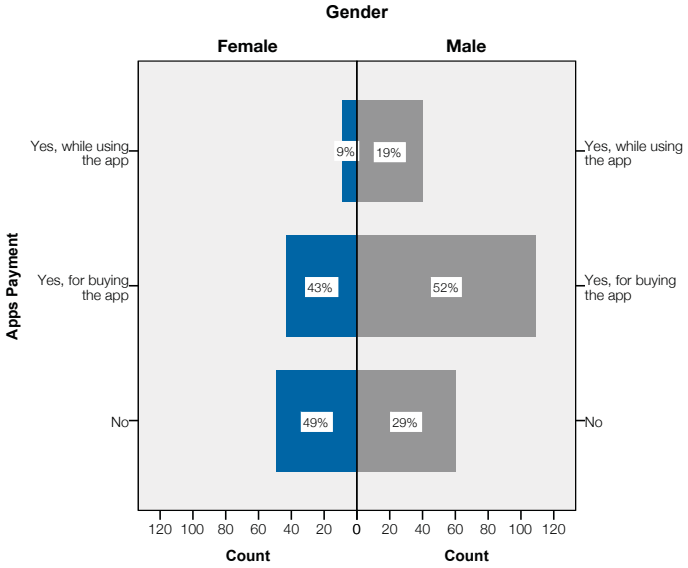


Figure 39: Apps payment acceptance by gender (Question: NV03, n = 265).

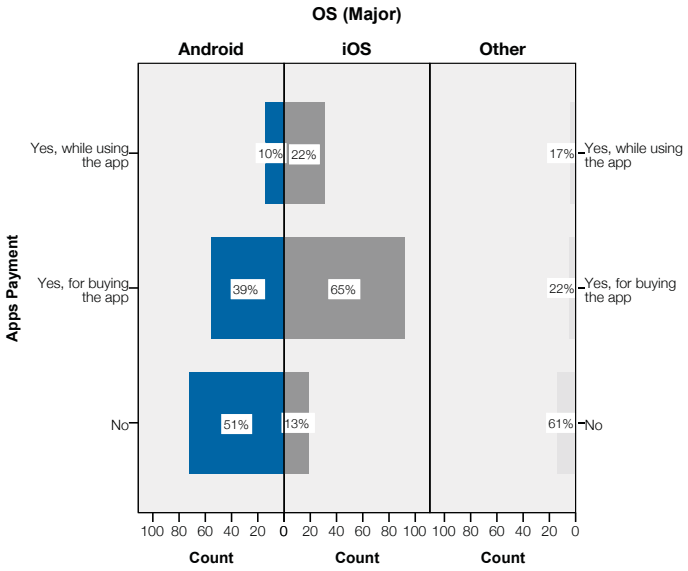


Figure 40: Apps payment acceptance by operating system (Question: NV03, n = 261).

Figure 39 and Figure 40 suggest, that app monetisation is main driven by male (52% yes vs. 29% no) and *iOS* users (65% yes vs. 13% no). This is particularly interesting concerning the operating system by gender distribution from Figure 26, which showed that *Android* is more prevalent in the male population. Calculating the conditional probabilities of these results through a cross-tabulation, one finds that the chance that a user has already purchased an app, is 85.7% for male *iOS* users, 78.0% for female *iOS* users, 50.6% for male *Android* users, and 25.0% for female *Android* users, as shown in Table 38.

		Gender											
		Female				Male				Total			
		Apps Payment: Yes, for buying the app				Apps Payment: Yes, for buying the app				Apps Payment: Yes, for buying the app			
		Not checked		Checked		Not checked		Checked		Not checked		Checked	
		Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %
OS (Major)	Android	30	75,0%	10	25,0%	44	49,4%	45	50,6%	74	57,4%	55	42,6%
	iOS	9	22,0%	32	78,0%	10	14,3%	60	85,7%	19	17,1%	92	82,9%
	Other	11	91,7%	1	8,3%	5	55,6%	4	44,4%	16	76,2%	5	23,8%
	Total	**50**	**53,8%**	**43**	**46,2%**	**59**	**35,1%**	**109**	**64,9%**	**109**	**41,8%**	**152**	**58,2%**

Table 38: Frequencies for the payment by gender and operating system (Question: NV03, n = 261). Columns show checked vs. unchecked app purchasement options.

The Spearman rank correlation between gender and purchasing is 0.192 (one-time) and 0.177 (in-app), significant at a 0.01 level. Between operating system and purchasing, there is a linear correlation of 0.223 (one-time) and 0.179 (in-app), both at a 0.01 significance level.

Finally, the chart relating the payment acceptance to the two age classes is shown in Figure 41.

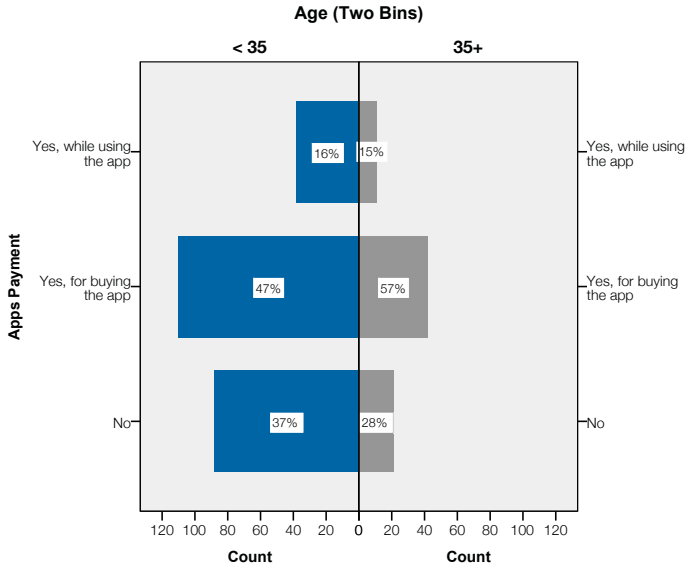


Figure 41: Apps payment acceptance by age classes (Question: NV03, n = 265): people under 35 vs. people over 35. Bars depict absolute counts, age classes are not stratified ($n_{<35}$ = 202, n_{35+} = 63).

On a first glance, there does not seem to be a significant effect related to the age class, except for a slightly stronger relative app purchasing adoption by people of age 35 and older (57%). The Spearman correlation yields a value of 0.158 between age and app purchasing, significant at a 0.05 level. As the topic of monetisation is of utmost importance to app developers, Figure 42, Figure 43, and Figure 44 plot the payment behaviour against gender, and more detailed age classes. These charts show the absolute "target market sizes" of several age/gender classes related to the whole sample. Due to the absolute counts in each class, and the unstratified sample, the relative adoption rates cannot be directly compared within each of the diagrams.

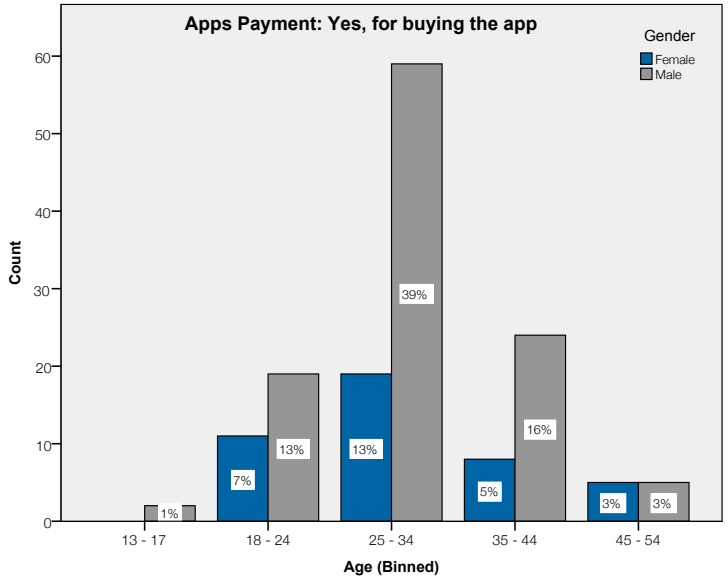


Figure 42: Apps buying acceptance by age class and gender (Question: NV03, n = 265, $n_{checked}$ = 152), representing the actual "target market sizes", if the unstratified sample was taken as representative for the entire population. The percentages displayed are fractions of $n_{checked}$.

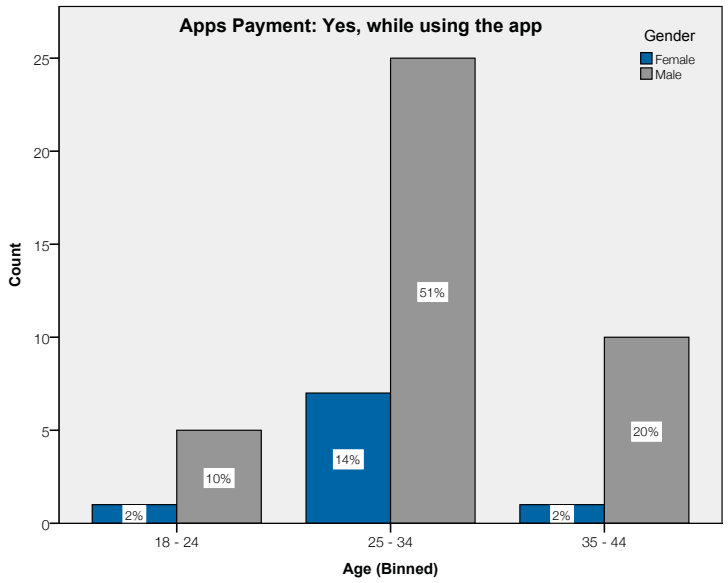


Figure 43: In-app purchasement or payment acceptance by age and gender (Question: NV03, n = 265, $n_{checked}$ = 49), representing the actual "target market sizes", if the unstratified sample was taken as representative for the entire population. The percentages displayed are fractions of $n_{checked}$.

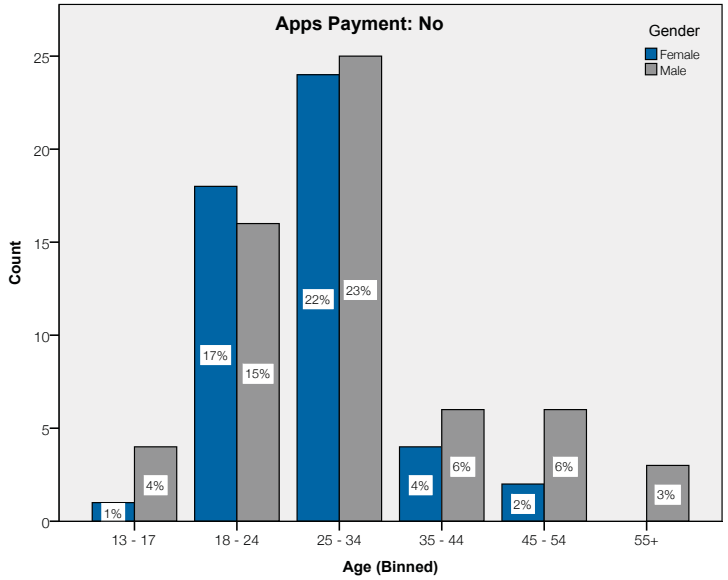


Figure 44: Respondents without any payments history by age and gender (Question: NV03, n = 265, $n_{checked}$ = 109). The percentages displayed are fractions of $n_{checked}$.

5.3.10. Development Aspects: App Features, Stability, and Update Interval

The following section deals with important decisions that almost every app developer faces, that is, if the app shall be as feature-driven as possible, or rather be focused on a specific customer pain. Furthermore, we try to measure, if the user prefers apps with experimental features at the sacrifice of stability, and if a short update release cycle with minor updates is preferred over occasional, large updates.

As already outlined, a problem with these questions is, that they are trying to deduct the user's intention and behaviour from asking about his attitude. While striving to measure concrete past actions, providing "hard" evidence, rather than mere attitudes or intents, I have not found a way to formulate these questions in a "have you ever...?"-kind of phrase.

An additional drawback of the resulting style of question is, that it requires more reflection on the part of the users, making the questions harder to answer. Nevertheless I was particularly interested, if any clear tendencies could be made out in the results, or if the results turn out to be completely random. Keeping the low discriminatory power of the questions in mind, and taking them just as a rough sketch of the users' sentiment, might be insightful though.

Let's begin with the aspect of generalisation vs. specialisation, with the corresponding results shown in Figure 45.

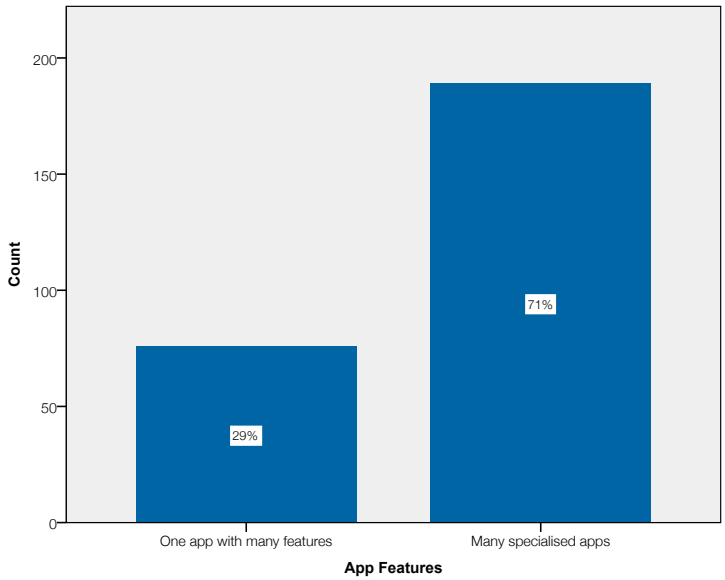


Figure 45: Preferences concerning app features vs. specialisation (Question: NV04, n = 265).

Interestingly, a clear majority of users voted for the “many specialised apps” option (71%). This makes sense from various points of view, and probably also has a counterpart in business model theory, where a clearly focused value proposition is judged to be the way to go. Due to the nature of apps, especially their design paradigms centering around an easy-to-use, reduced feature set, a fast context switch between apps, and operating system facilities for integrating different apps’ components[1], a user can efficiently use various highly specialised apps together, in order to get a job done.

Feature-laden apps might provide more versatility, but on the hand they might also be associated with cluttered interfaces and low ease of use.

Another feature-related decision is whether to release experimental, not thoroughly tested “beta” features into the wild, constantly providing users with more opportunities, or to focus on stability. Question DE04 addressed this problem, leading to the results depicted in Figure 46.

[1] E.g. the so-called “intents” on *Android*, which enable an app to offer services to other apps.

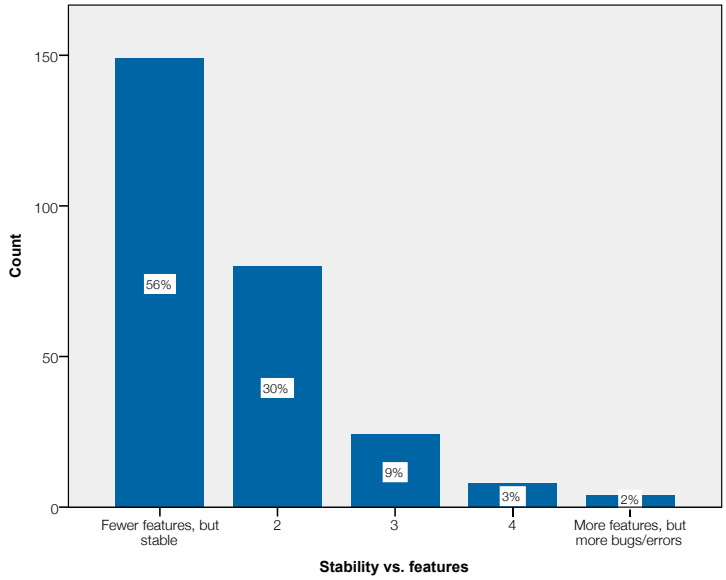


Figure 46: User's attitude concerning experimental features (Question: DE04_01, n = 265). Semantic differential with five levels. Most participants indicated to rather sacrifice features for improved stability.

The question was not dichotomous, but relied upon a five-level semantic differential scale between the two poles. The results show a clear tendency of users to favour stable apps with fewer features. This might be explained by "bugs" being a negatively connoted word, outweighing the "fewer" phrase of the opposite option. Another very likely reason is, that users have ever-growing demands on app quality and reliability, which is also driven by the extreme competitive pressure on the app markets – apps that are not working smoothly, can usually be substituted by perfectly stable offerings from other developers.

The next aspect to be dealt with is the update frequency: should an app developer release updates frequently, or more seldom? This has implications on the amount of changes introduced by each update. Figure 47 shows the results to this question.

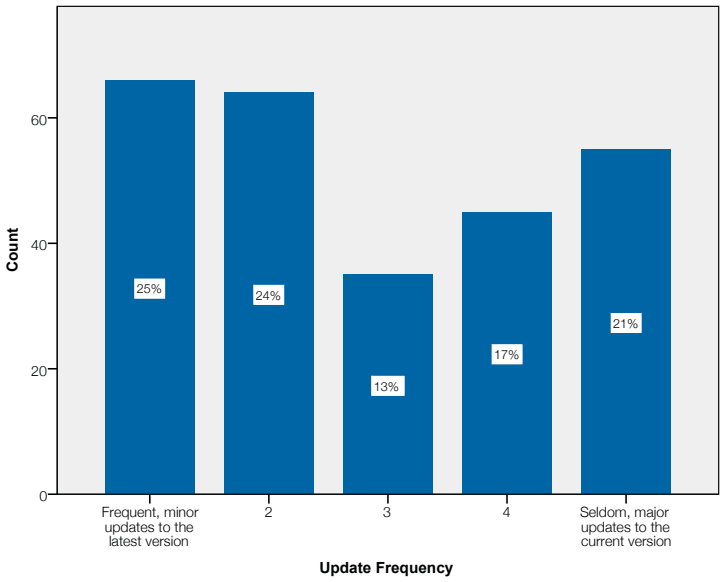


Figure 47: Update interval preferences (Question: DE04_02, n = 265). Semantic differential with five levels.

Users seem to slightly prefer frequent, minor updates. However, this question seems to be polarising. An interesting correlation arises when breaking down the answers by gender, as seen in Figure 48.

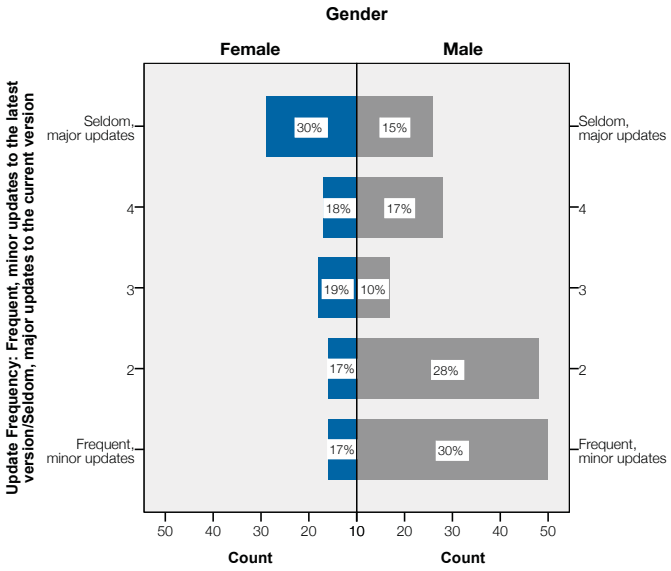


Figure 48: Update interval preferences by gender (Question: DE04_02, n = 265).

Here, a pattern emerges: female users clearly voted for the seldom updates option, while male participants were favouring frequent updates. Consequently, the Spearman correlation amounts to -0.221, at a 0.01 significance level. The reasons for this correlation can only be guessed at:

probably, this points into the direction of a more “pragmatic” approach by females, while male participants are more engaged in keeping software up to date. Another reason might be the conscious percipience of the update process itself.

Last but not least, I also checked for different answering distributions between the two age groups, as shown in Figure 49.

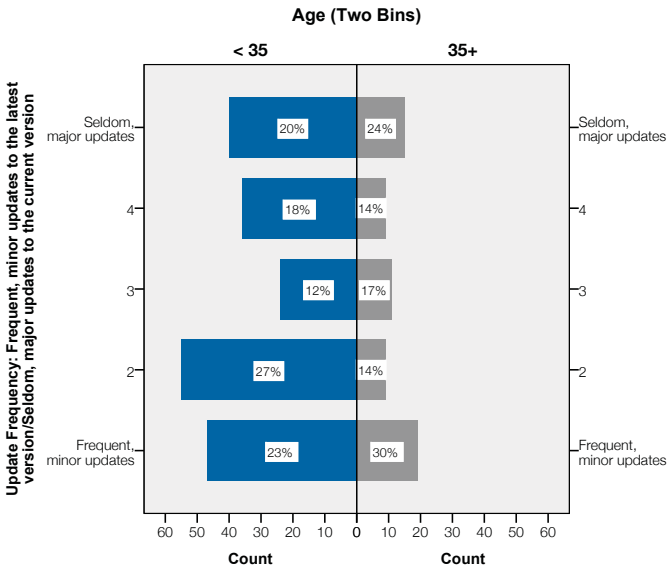


Figure 49: Update interval preferences by age class (Question: DE04_02, n = 265).

Here, the below-35 age group resembles the distribution of the overall group, with a slight preference for frequent updates, especially considering the ranks of the answers. The distribution for the older participants is slightly more balanced, with the first and second rank located at both extremes.

5.3.11. Installation Barriers and App Discovery

One important metric that cannot be found in the statistics from app stores, are potential users who are *not* downloading apps, as well as negative factors that make the user rethink the installation of an app of interest. Figure 50 shows the five-level Likert scale ratings of factors that the users consider detrimental to their intention to install an app.

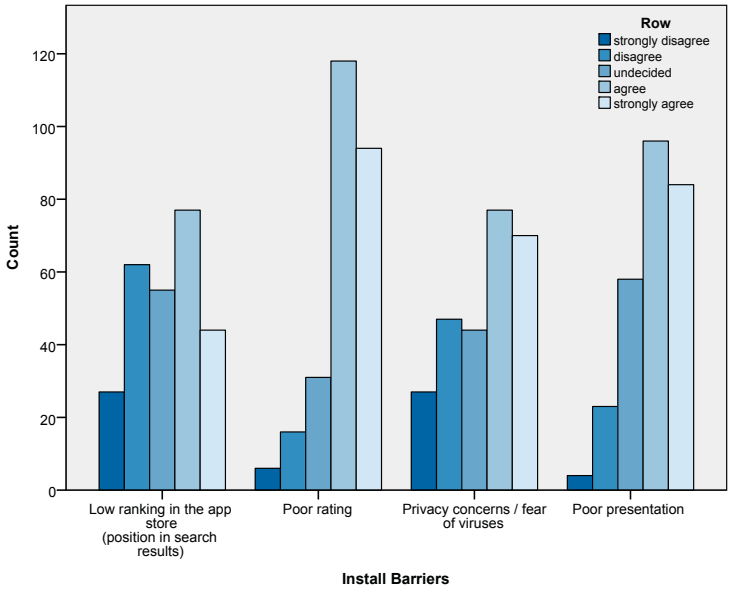


Figure 50: Four potential barriers that keep users from installing an app (Question: DE02, n = 265). Likert scale with five levels of agreement: left = strongly disagree, right = strongly agree.

Poor ratings and poor overall presentation of an app are the reasons judged to have the most undesired effects on app adoption – needless to say, that it is not unexpected, that ratings are considered as most important (80% agree or strongly agree). Privacy and security concerns are a big issue too (55% agree or strongly agree), while a low search ranking is relevant to more than a third of the users (39% agree or strongly agree).

The next question to be discussed are the channels, that are most relevant for users to find new apps. The results are depicted by Figure 51.

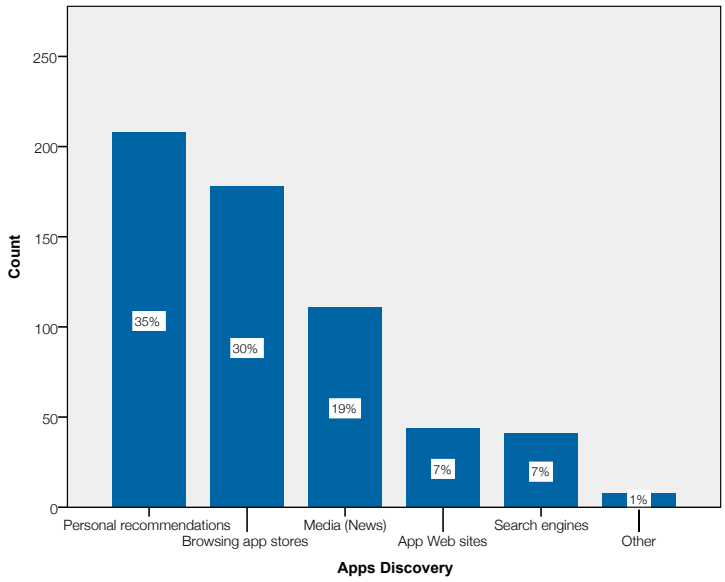


Figure 51: Means of app discovery (Question: SE01, n = 265, multiple choice), showing friends and colleagues as the most prominent way to find new apps.

Personal recommendation by friends and colleagues were selected most often, with browsing through app stores mentioned the second most times. This is interesting, as it puts media, such as newspapers, blogs and e-zines onto the third place, and represents a significantly greater share than the search engines option response.

Other quantitative research on recommendation behaviour and word-of-mouth marketing (WOM), such as Ahmet et al. (2011), found out that most respondents mentioned face-to-face recommendations as the primary means for recommending apps to other people.

5.3.12. Security and Privacy Aspects

A fundamental and more than ever debated topic is the user-perceived importance of security and privacy. Using questions SC02_01 and SC02_02, the users' opinion on these aspects will be explored along various dimensions. Figure 52 shows the overall response concerning security resentments on a Likert scale with five levels of agreement.

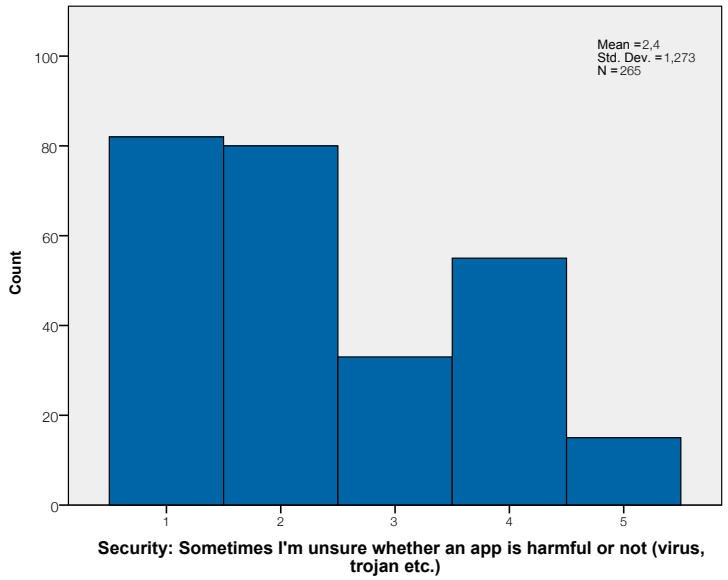


Figure 52: Security concerns (Question: SC02_01, n = 265). Likert scale of agreement to the statement "sometimes I am unsure whether an app is harmful or not": 1 = strongly disagree, 5 = strongly agree. Most participants responded that they are not occasionally unsure concerning the installation of malware.

Security in this regard does not refer to potential vulnerabilities of a legitimate app, but the risk to install adversary software, such as trojans or viruses. The results suggest that most users feel pretty safe about these issues: only 5.7% strongly agree, 20.8% agree, 30.2% disagree, 30.9% totally disagree, and the mean value (2.4) rests slightly towards disagreement concerning occasional insecurities. Figure 53 breaks down these results by gender.

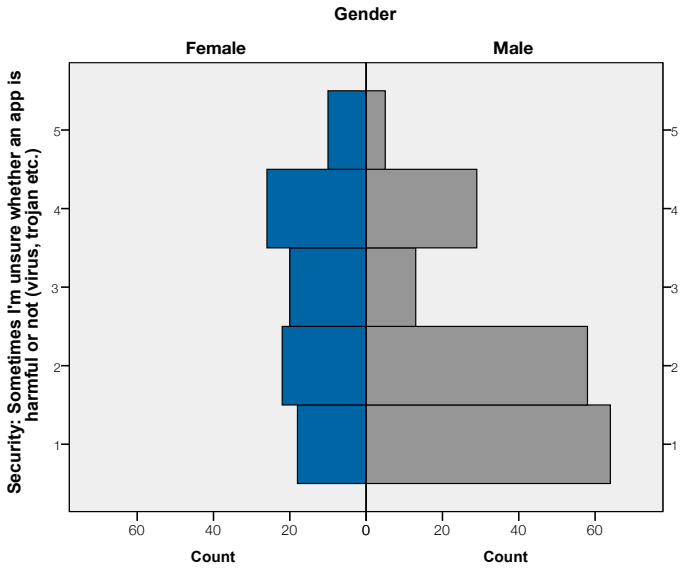


Figure 53: Security concerns by gender (Question: SC02_01, n = 265). Bars depict absolute counts of the unstratified sample. Male respondents seem to be more confident concerning security hazards in the course of apps installation.

Here it can be seen, that the perceived safety is particularly stronger in the male sample, while the mean and variance in the female sample is higher, with the mode at the “agree” level. Given the variety of possible threats, especially for heavy app users that do not stick to apps from widely-known app vendors, the confidence of male users could be viewed more as an illusion of safety. The Spearman correlation between the security attitude and gender is -0.280, at a 0.01 significance level. Figure 54 provides a breakdown of the security concerns by age class.

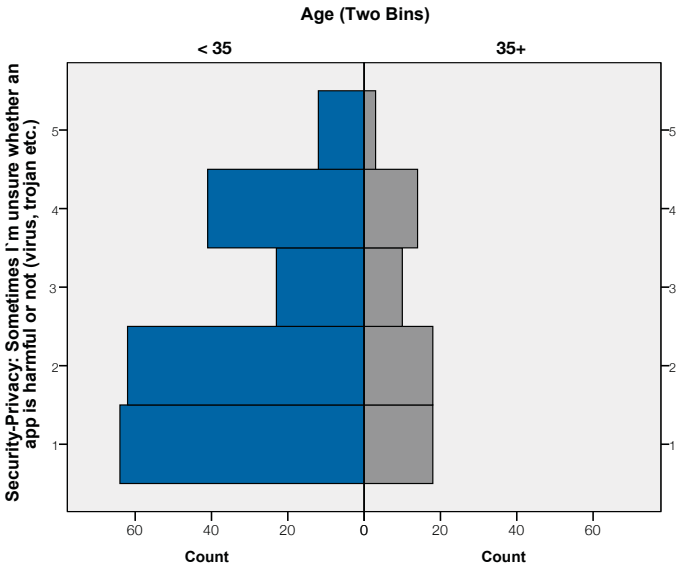


Figure 54: Security concerns by age class (Question: SC02_01, n = 265).

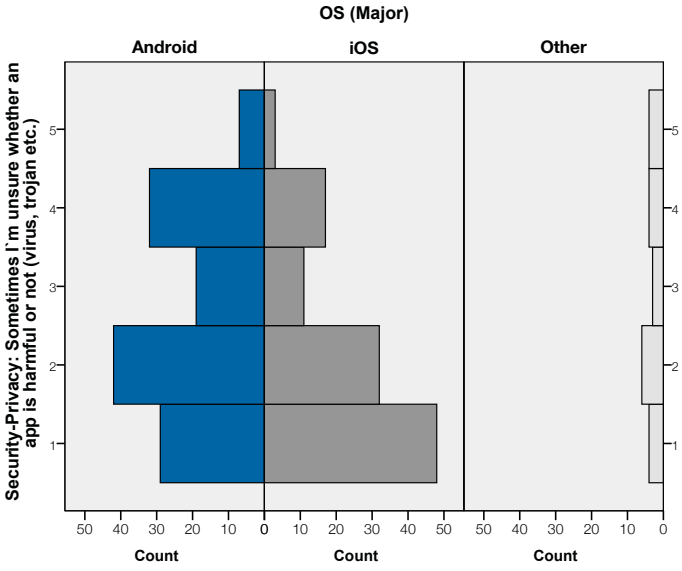


Figure 55: Security concerns by operating system (Question: SC02_01, n = 265). Not unexpected, Apple users indicated to be slightly more on the confident side concerning potential malware.

There are no significant differences between both age classes, except the different sample sizes. I have checked the 95% confidence intervals of the mean values through *SPSS*, which yielded a full overlapping of both intervals. The sample mean for the below-35 age class is 2.38, and 2.46 for users above 35. Consequently, there is no significant correlation between these attributes.

Another dimension to explore are both of the leading app ecosystems: one would expect, that *iOS* users are less wary concerning security, as *Apple* performs a mandatory code audit on every app before its release. If this expectation can be supported by the data, is visible in Figure 55.

Obviously, on the side of the *iOS* operating system, the "strongly disagree" item is ranked first. The mean values are 2.58 for *Android*, and 2.05 for *iOS*, and both distributions are different on a 0.000 significance (p-value).[1] This backs the previous assumptions on differences between those platforms. However, the Spearman correlation is just -0.123 at a 0.05 significance level.

Let us now move on to privacy aspects: in contrast to the previous question, where users have indicated confidence or discomfort concerning the legitimacy of apps, the following question deals with user trust in the rightful handling of personal data, regardless if an app is offered by a major, well reputed developer, or a small, unknown one. Figure 56 shows the overall confidence in app privacy, again on a five-level Likert scale measuring the users' agreement with the question statement.

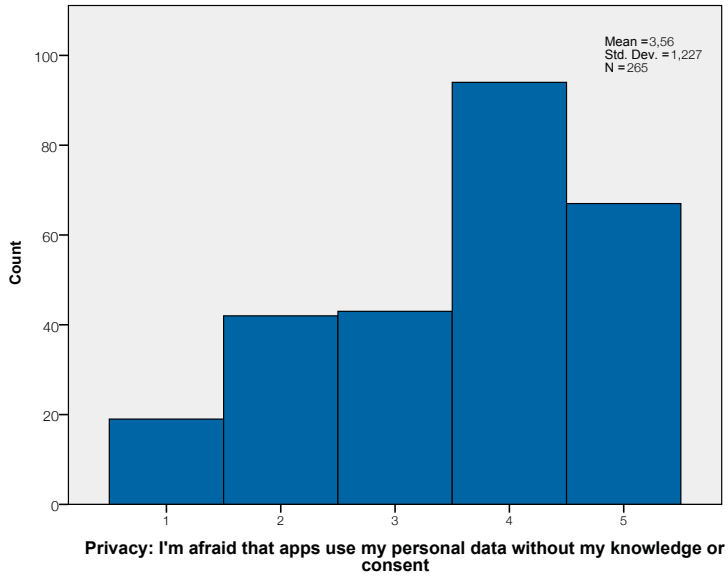


Figure 56: Privacy concerns (Question: SC02_02, n = 265). Likert scale of agreement to the statement "I am afraid that apps use my personal data without my knowledge or consent": 1 = strongly disagree, 5 = strongly agree. The majority of users showed to have concerns regarding the application's use of personal data, and trustworthiness.

This result shows that the study population's awareness of apps privacy hazards is considerably higher, than the awareness of malware. Most users (35.5%) agreed that they are generally – not just sometimes – afraid, that apps use their personal data in a questionable fashion. Additional 25.3% strongly agreed to this.

The sample breakdown by gender is depicted in Figure 57.

[1] Obtained through an automatic independent-samples Mann-Whitney U test in SPSS, with $\alpha = 0.05$.

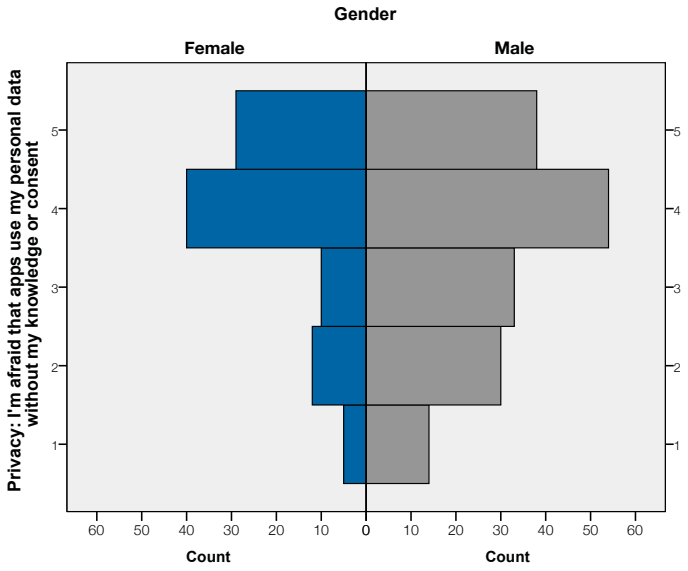


Figure 57: Privacy concerns by gender (Question: SC02_02, n = 265).

While the distribution is basically different between both genders, the centre of gravity is located within the agreement area for both of them. The mean value for the female population is 3.79, and 3.43 for the male. The Mann-Whitney U indicates a difference in the distributions with a 0.017 significance (α = 0,05). The Spearman correlation is -0.147 at a 0.05 significance.

The grouping by age shows a slightly different picture, provided by Figure 58.

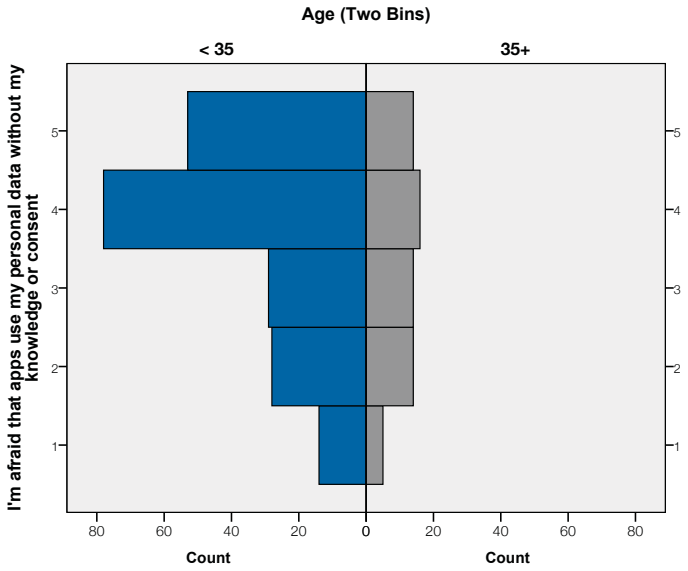


Figure 58: Privacy concerns by age (Question: SC02_02, n = 265). The results suggest that younger participants are more concerned about privacy than older ones.

Here, there is an obvious accumulation of “agree” and “strongly agree” answers in the below-35 age class. The distribution of the older population is more uniform. This is quite contrary to popular belief, thus marking an interesting point for further investigation on the results’ significance: both mean values are located near to each other (3.63 for the younger, 3.32 for the older sample). The Mann-Whitney U test yields a p-value of 0.07, suggesting that the hypothesis, that both groups are equally distributed, cannot be rejected under a significance level of $\alpha = 0.05$.[1] Accordingly, the correlation between age and privacy resentments is not significant either.

Concluding the privacy aspects, let us have a brief look at the privacy concerns by operating system, given by Figure 59.

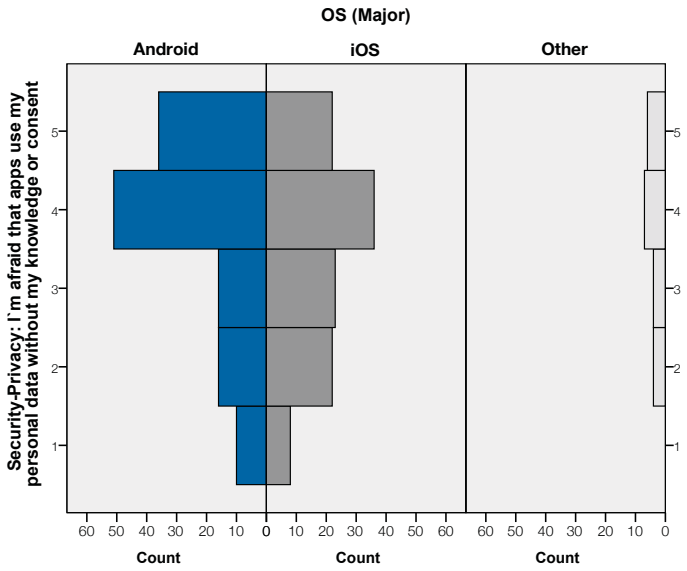


Figure 59: Privacy concerns by operating system (Question: SC02_02, n = 265).

The difference between operating systems does not look all too big: the resentments seem to be slightly higher on the *Android* platform than on *iOS*. The Mann-Whitney U test indicates a 0.039 p-value under a significance of $\alpha = 0.05$, implying that there is a (somewhat significant) difference between both distributions. This is what someone expects, due to the known screening of apps by *Apple* before a release into the *App Store*, and a probably higher trustworthiness of this closed ecosystem. However, the linear correlation between those attributes is not significant.

Due to the importance of the topic, the survey contained four different security- and privacy-related questions. As three of them were five-level Likert scales, and measured a somewhat similar construct, I calculated the Cronbach’s Alpha (Cronbach 1951) to check upon the internal validity of those items. Table 53 in appendix F shows the resulting alpha value, which is slightly higher than 0.7 for the three items, indicating that the internal consistency of the latent security and privacy construct is acceptable.

[1] Not implying that the null hypothesis is actually true, and the samples equally distributed.

5.3.13. Relevance of Terms and Conditions

Another aspect to be considered by app developers are legal documents, such as the terms and conditions, and the privacy policy. How much effort should be put into these documents? Are they even quickly flipped through by users, or ignored altogether? Question SC04 addresses this problem, asking users if, and how thoroughly they read those artefacts, as well as the list of required access privileges, which relates to the question of privacy. Figure 60 shows the responses to this question.

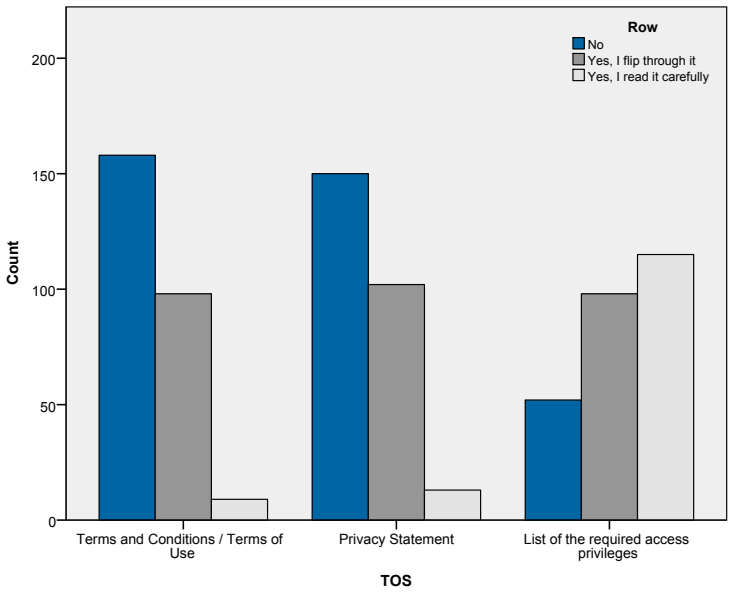


Figure 60: Relevance of the terms of service, privacy statement, and access privileges list from the users' point of view (Question: SC04, n = 265).

The results are not surprising: most users answered that they do not read the terms and conditions (59.6%), and the privacy statement (56.6%). Some of them indicated to at least flip through the terms and conditions (37.0%), with a similar fraction speed-reading the privacy statement (38.5%). Only the remaining few percent indicated to read those documents more thoroughly. Concerning the list of access privileges required by the application, the situation was opposite: a considerable amount of people pay attention to this list (43.4%), while some quickly browse through it (37.0%), and a fifth (19.6%) does not pay attention to it at all.

It has to be noted, that the list of access privileges is particularly relevant for *Android*, where it is presented to users in the course of an app installation. On *iOS*, users can grant permissions on a more granular level, thus answers from *iOS* users concerning such a list are basically questionable. A considerable amount of *iOS* users indicated to pay attention to this list, with 44 users reading it carefully, and 37 just flipping through it. This can possibly be explained through *iOS* users interpreting the "list" in the question as the app permissions dialogues.

5.3.14. Ranking of App Aspects

With question DE03, users were asked to rank eight different app aspects upon their relative importance. This forms an ordinal scale for every aspect, with the count of its assignments to each of the eight ranks, depicted as a histogram in Figure 61 and Figure 62.

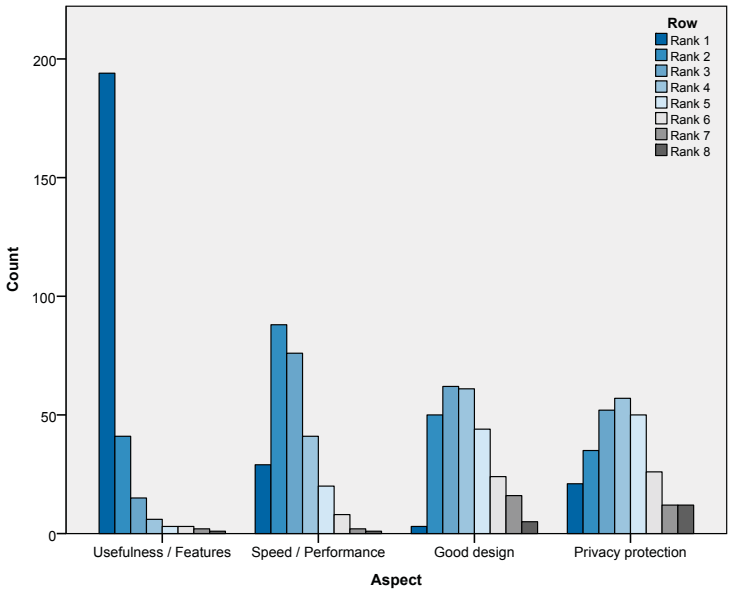


Figure 61: Ranking of app aspects upon their importance (Question: DE03, n = 265, part 1 of 2), sorted by their means from left to right. Eight ranks: 1 = most important, 8 = least important. Without a doubt, the usefulness of an app was judged to be most vital (mean = 1.51).

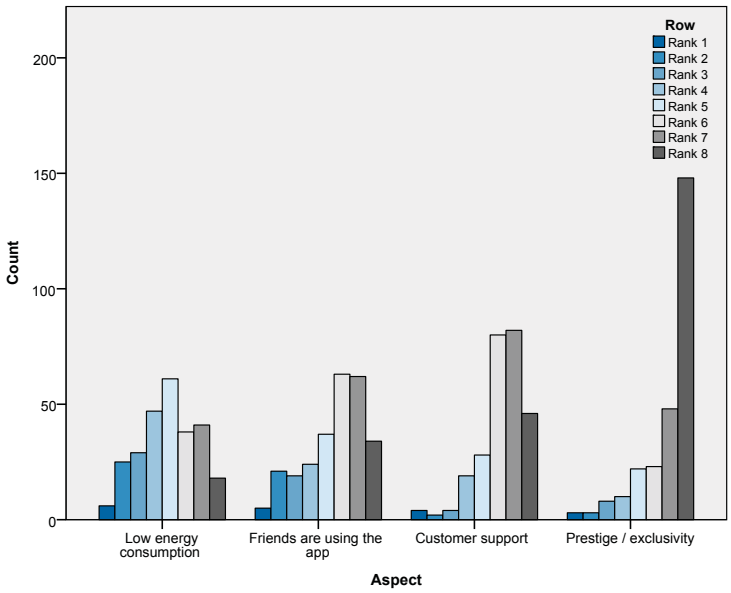


Figure 62: Ranking of app aspects (Question: DE03, n = 265, part 2 of 2), sorted by their means from left to right.

While in hindsight, it could be regarded almost as a no-brainer, that the usefulness of an app was assigned to the top ranks, the weighting of the other aspects is something that could not be anticipated that easily. The distributions of ranks that formed for each aspect, are distinct enough to extract the order of overall importance visually. The usefulness and features of an app were clearly judged to be most important, with rank 1 assigned 194 times (mean rank: 1.51), while speed and performance follows with most (88) assignments to rank 2 (mean: 2.89), design follows with 62 assignments on the third rank (mean: 3.96), privacy protection on rank 4 (mean: 4.00), low energy consumption on rank 5 (mean: 4.89), friends using the app on rank 6 (mean: 5.54), customer support on rank 7 (mean: 6.26), and prestige on the last rank (mean: 6.95).

The first thing that comes to mind is, that privacy protection is valued as the fourth most important aspect, before low energy consumption or customer support. The latter was placed on the last rank before the “prestige” aspect, which was chosen to be least important.

However, these results need to be interpreted with caution. For example, the reason that users rank support relatively low, is maybe because in many cases they can easily solve problems of an app by substituting it with another similar one, which is relevant for app developers, but a little problem for users. Furthermore, assigning a rank to the aspect of prestige is problematic, because it is a somewhat intrinsic value for an app user, that he or she might not even be aware of. Energy consumption of an app is difficult to assess, despite the power consumption diagnostic tools provided by operating systems. Furthermore, if an app consumes resources while running in the background, another app might be blamed for depleting the battery.

5.3.15. *Involvement: Reviewing and Feedback*

As we have found at the installation barriers question (DE02), the user ratings of an app are a key factor for a user's decision to install an app or not. Question IN01 accommodates for this fact, trying to assess the fraction of users who have already reviewed or rated an app. This could also be seen as an indicator for the general involvement of users concerning apps – do they care enough to rate and review, or do they remain "passive"? Figure 63 has the results to this question.

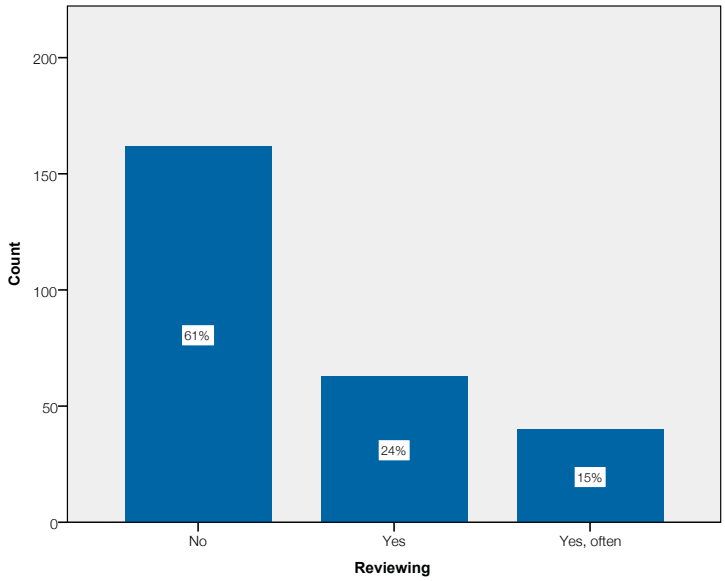


Figure 63: Reviewing experience (Question: IN01, n = 265). The majority of users never reviewed or rated an app.

It can be seen that almost two thirds of all survey participants have not reviewed or rated an app yet. A quarter of them has already done so, while 15% reviewed apps more often. These are not bad figures concerning the hassle to review or rate an app on a small mobile device. To further enhance the understanding of the users' motivation for reviewing, question IN02 dealt with the review reasons, as shown in Figure 64.

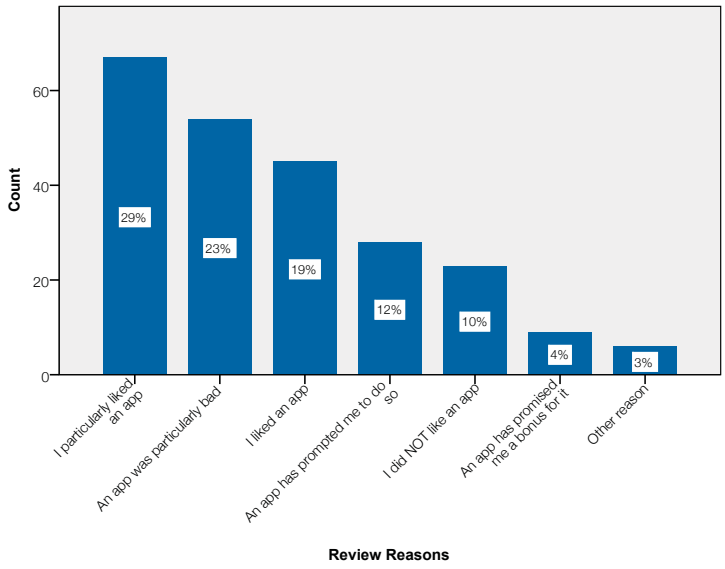


Figure 64: Reasons for reviewing (Question: IN02, n = 104, $n_{checked}$ = 231, multiple choice). Contrary to popular belief, more users reviewed because they liked an app, than users considering an app to be bad, or disliking an app.

Looking at the top reasons for reviewing, one might think about the old marketing proverb, that dissatisfied customers tell others about their negative experience more often than satisfied customers. This seems to be a little different for the sample population of this study: most users actually responded that they have already reviewed an app because they particularly liked it (29% of $n_{checked}$), with users who found an app to be particularly bad following on the second rank (23%). Again, the mere "liking" reason follows with 19% of all choices, while disliking was voted for only in 10% of the cases. 12% of the reviewing cases were due to the app asking for it, and 4% because the app promised a bonus for this.

The reviewing behaviour is quite different concerning gender: while 50% of all males indicated they have reviewed an app at least once, only 20% of all females did so. This is reflected by the Spearman correlation of 0.283, at a 0.05 significance level. Figure 65 depicts the breakdown of review reasons by gender.

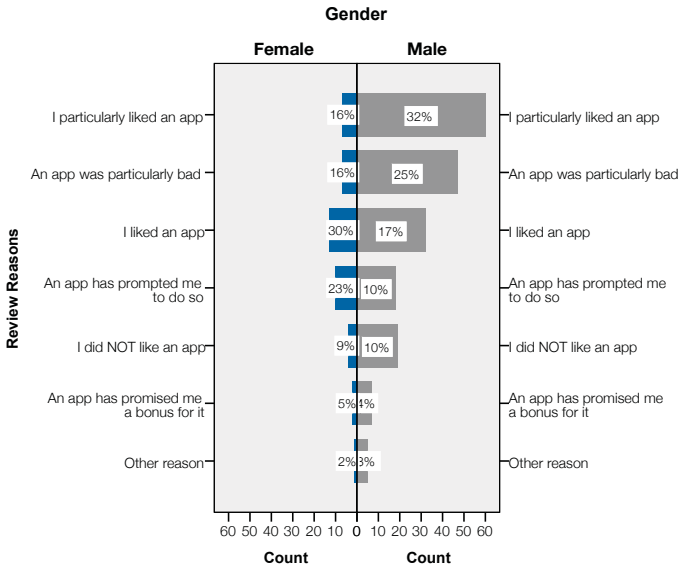


Figure 65: Review reasons by gender (Question: IN02, n = 104).

Here it becomes obvious that due to the over-representation of males in the sample, the overall population behaviour resembles the male reviewing behaviour. On the other hand, most females answered that they reviewed because they liked an app (30%), and, remarkably, 23% indicated that a reason was the app prompting them to do so.

For reference, the review reasons by age class are provided in Figure 66, which does not indicate any significant difference in the distributions.

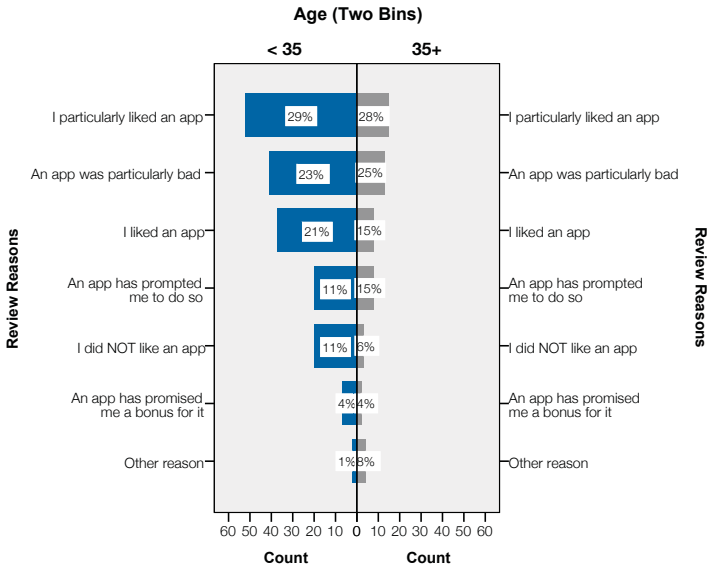


Figure 66: Review reasons by age class (Question: IN02, n = 104).

A different aspect of user involvement, particularly feedback behaviour, is the user contacting an app developer concerning problems, possible improvements, feature suggestions, and so forth.

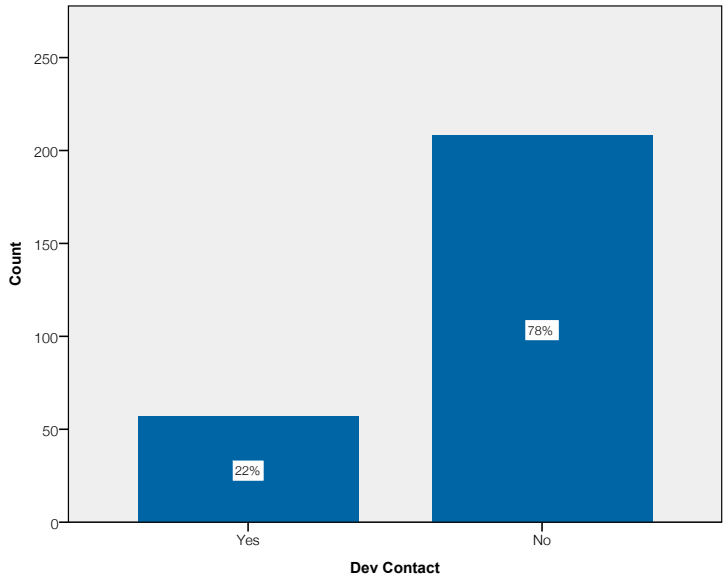


Figure 67: Involvement through contact with an app developer (Question: IN03, n = 265), for feedback and/or app improvement.

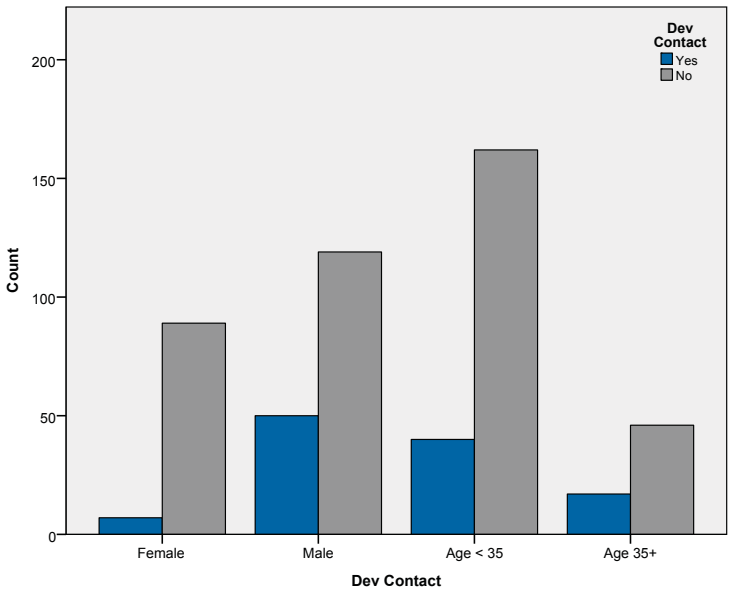


Figure 68: Developer contact by age and gender (Question: IN03, n = 265).

According to Figure 67, a fifth of all users already got in touch with an app's developer for various reasons, while the majority of users (78%) has not yet done so. Almost as expected, this is a slightly lower figure than the fraction of users who review apps. Concluding the user involvement aspects, Figure 68 summarizes the developer contacting behaviour by gender and age classes.

5.3.16. Social Networking and Community Aspects

The final section of the discussion of the results' descriptives deals with one of nowadays key aspects: social networking and community behaviour. Almost every app developer faces the question, if and how they shall connect their app to existing social networks, to allow for content sharing, better personalisation of the app, and to minimise user registration efforts through so-called "social login" facilities.

Let us commence the discussion of these aspects with an overview on the social networking engagement of users: Figure 69 shows, what social networks the survey participants actively use.

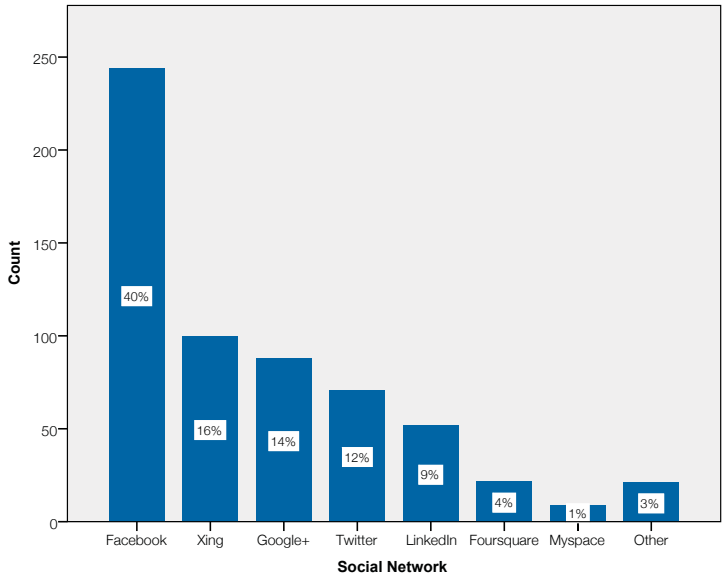


Figure 69: Active social network use (Question: SO01, n = 265, $n_{checked}$ = 607, multiple choice). Percentages relate networks to each other (giving the percent of $n_{checked}$).

While the prevalence of *Facebook* is unsurprising, the business network *Xing* surpassing *Google+* is particularly interesting here, backing *Xing's* considerable market share in German-speaking countries (Xing AG 2012). Social media statistics sites, such as the *Social Media Radar Austria* (Digital Affairs 2013), state that out of the Austrian population of 8.47 Million people, approx. three Million users are registered with *Facebook*, which amounts to roughly 35%. *Twitter* on the other hand, has only approx. 100,000 registered users in Austria, which is only 1.2% of the overall population. The huge difference to the *Facebook* share of 92%[1], and *Twitter* share of 27% in this study implies, that the survey's results are strongly biased towards more social media-affine people. *GPlusData* (Mediabistro 2013) even lists only approx. 33,300 *Google+* users for Austria, which equals measly 0.4% of Austria's population, in contrast to the 33% observed here.[2]

[1] Of n = 265, the app user population.

[2] Given, that the results and market statistics are right, this would imply, that the survey caught 0.27% of the entire *Google+* population in Austria.

Let us now have a brief look on the segmentation of the social network users by age and gender, provided by Figure 70.

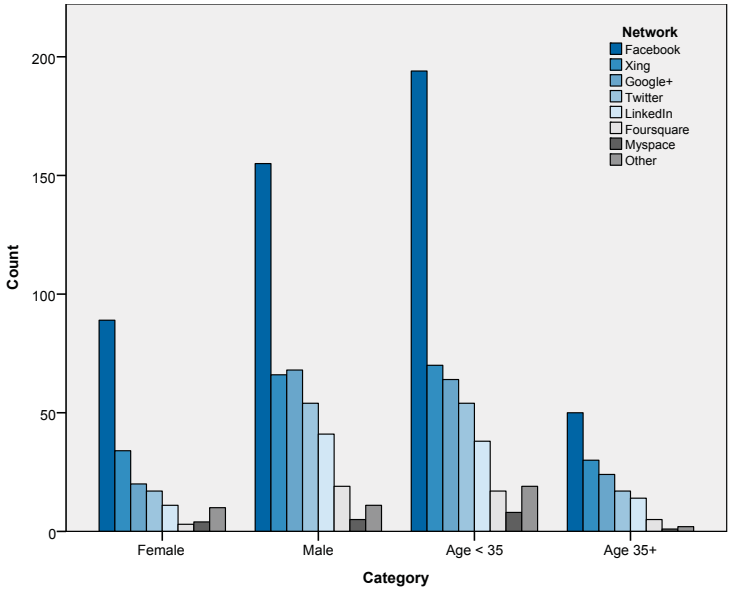


Figure 70: Social networks by gender and age (Question: SO01, n = 265).

The graph shows, that other networks such as *Xing*, *Google+*, and *LinkedIn* are more prevalent in the male users' category. Furthermore, the dominance of *Facebook* is strongly diminished within the older segment of the sample.

Having established the social media demographics, we can now dive more into the details of the users' social network preferences and behaviour.

The next question deals with an aspect vital to applications and platforms relying upon network effects: what is the fraction of users that are. as early adopters, out there searching for the new, in contrast to people who join a platform only as soon as most of their existing friends are aboard? While this is very difficult to measure, question SO02 approaches this in a naive way: its asks users to answer based upon their gut feeling, if they rather prefer networks that most of their friends are on, or if it is more appealing for them to discover new people. Figure 71 shows the results.

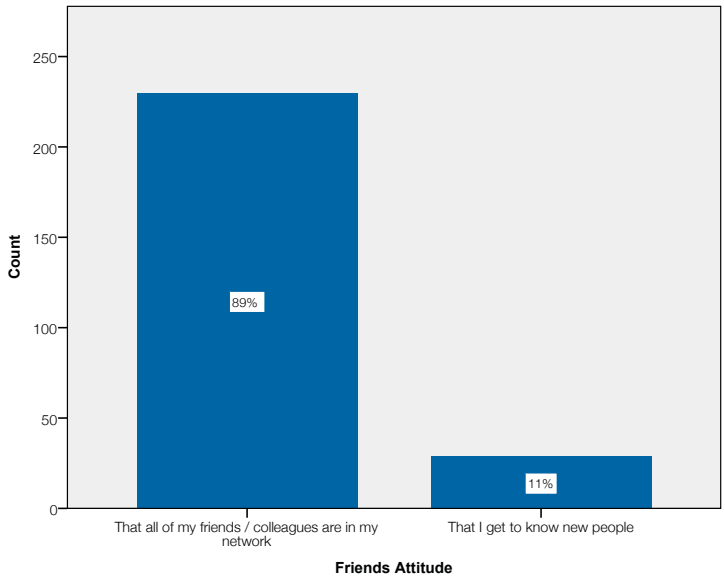


Figure 71: Social networking adoption concerning contacts (Question: SO02, n = 259): making new friends and acquaintances, vs. maintaining the existing "real-world" network. This question was only displayed to participants who indicated to use at least one social network.

Most people answered, that they prefer their existing contacts over uncharted social network territory. Only 11% indicated, that getting to know new people is more interesting for them. This is one of the underlying drivers making new social networks and multi-sided platforms so hard to get started: without a critical mass of users, their utility is low for anyone considering to join. Apps thus need to focus on acquiring those 11% of innovators and early adopters, who grow the network organically, until the network effect kicks in, and the early majority follows.

Given the assumption holds, that the outcome of question SO02 correlates with early adopterism[1], we have now identified the fraction of potential early adopters in our sample. Figure 66 shows the breakdown of the latter, by age and gender.

[1] Which, to be accomplished with high certainty, would require lots of further dedicated social research.

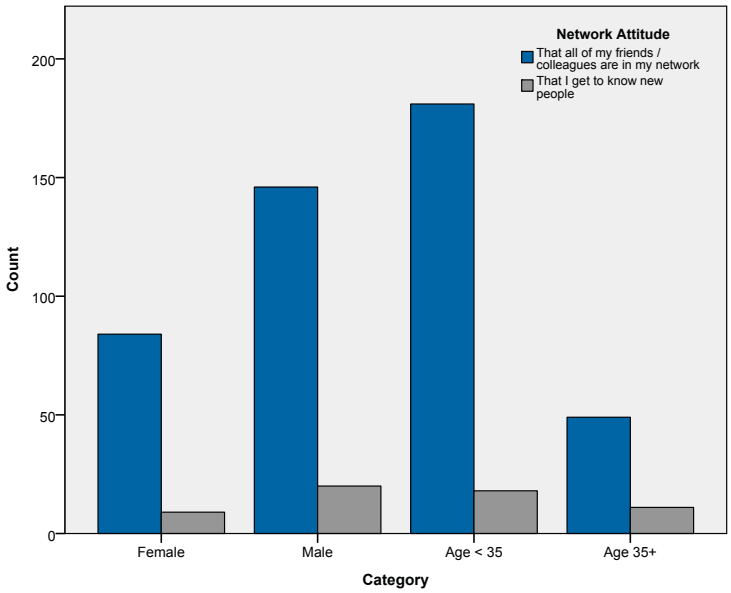


Figure 72: Social network motivation by gender and age (Question: SO02, n = 259).

There is no big difference between the male and female samples: 90% of all females prefer that all of their friends or colleagues are in the network, which is true for 88% of all males. Concerning the age breakdown, 91% of people below 35 prefer their existing friends, while 82% of all people above 35 answered this way. Accordingly, there are no significant linear rank correlations (except for the OS, with a 0.122 coefficient at a significance of 0.051).

The next question related to social networking, SO03, asks users directly if they prefer an app to be linked to *Facebook* to facilitate content sharing, or if they rather prefer a completely *Facebook*-independent app. Figure 73 shows the results.

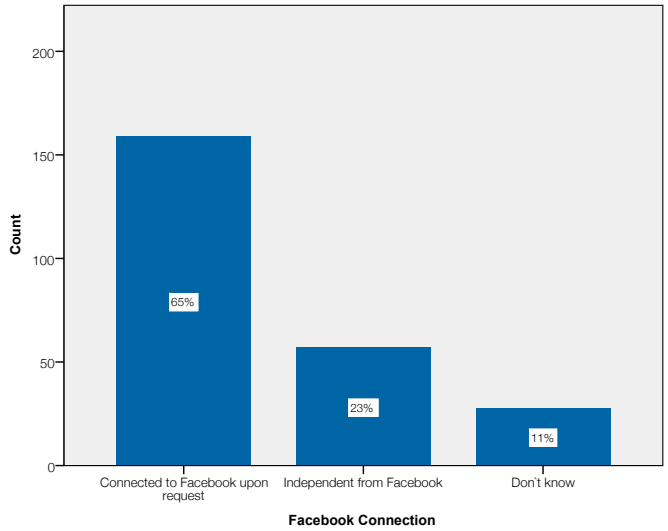


Figure 73: Facebook connection preferences (Question: SO03, n = 244). This question was only presented to Facebook users.

Most of the users (65%) prefer to be able to connect an app to *Facebook* upon request, and a considerable portion (23%) answered the opposite. This is interesting, as it indicates a strong refusal of *Facebook* even by some *Facebook* users: the "connected to *Facebook* option" was defined as "upon request", meaning that the user can choose if he or she actually makes use of these facilities. Nevertheless a quarter of all *Facebook* users answered that a *Facebook* connection option is undesired by them. The breakdown by gender and age is shown in Figure 74.

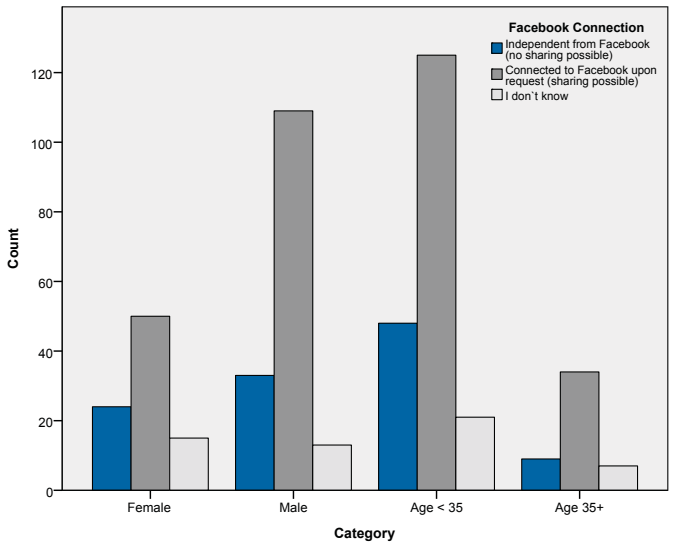


Figure 74: Facebook connection by gender and age (Question: SO03, n = 244).

Again, there do not seem to be any obvious differences between the various user segments. 27% of all female users answered, that they want an app to be independent from *Facebook*, as did 21% of all males, 25% of all people below 35, and 18% of all people above 35.

Finally, the last question to be discussed, asked users on their opinion concerning apps that require a *Facebook* account for various reasons, thereby not working without logging into the app through *Facebook*. I was very curious how this might turn out, as apps with a *Facebook* account requirement usually receive a lot of negative reviews and ratings. Since people that refuse to install an app that enforces a *Facebook* login, won't pop up in any statistics, it is difficult to assess the severity of this factor. Figure 75 provides an overview of the question's results.

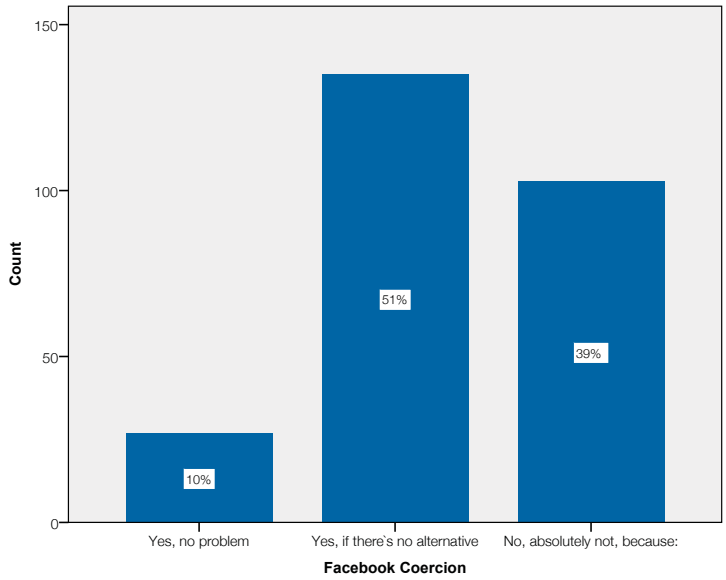


Figure 75: Attitude concerning apps that require a Facebook login (Question: SO04, n = 265).

While I anticipated that there will be users who have a severe discomfort concerning apps requiring a social login, I would not have assumed that the fraction of them would be that high: only 10% answered, that they do not have any problems or concerns regarding a *Facebook* login requirement, while half of the users (51%) indicated, that they would use such an app only grudgingly. 39% responded that they would completely reject an app that requires logging in through *Facebook*. This is a remarkable amount, and bad news for any app that relies upon a *Facebook*-based social login.

In Figure 76, the results are broken down by age and gender again.

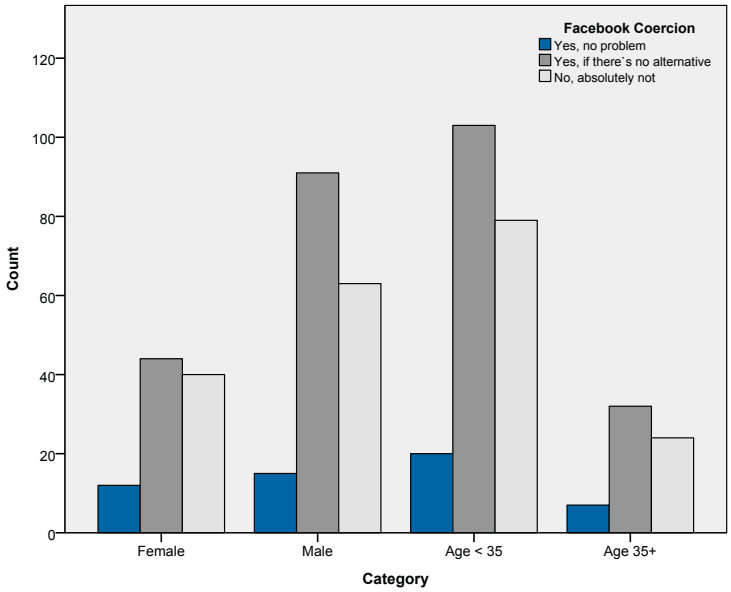


Figure 76: Facebook coercion by gender and age (Question: SO04, n = 265).

The fraction of females completely rejecting a *Facebook* login is 42%. Of the males, 37% voted this way, 39% of all aged below 35, and 38% of all above 35. The highest fraction was the one stating that they accept an app with a *Facebook* login, but unwillingly, only "if there is no alternative". These are 46% of the females, 54% of the males, 51% of all aged below 35, and 51% of all above 35. Given the population of all app users (n = 265), there were 244 users (92%) who use *Facebook*, this means that the findings above apply to most of the *Facebook* users themselves.

However, one thing needs to be beared in mind: the survey asks users on their opinion, if they would use an app with a compulsory *Facebook* login. The fraction of people who state to reject this, does not precisely reflect reality, as people could give up this principle, depending on specific cases. The responses to this question should be taken as a mere user sentiment, caused by an underlying factor that is detrimental to apps with a mandatory *Facebook* interconnection.

We conclude the discussion of this question by looking at the "no" answer option, that provided the possibility for users to enter a reason why they chose it. The full list of the over 100 original answers is provided by Listing 2 in appendix E. This feedback shows a very negative sentiment concerning *Facebook*. Most users stated that they want to keep *Facebook* out of third-party apps, because they fear that their data is used in an uncontrollable fashion. Among the particular reasons are:

- They do not want apps to propagate usage details into their *Facebook* timeline, because they find this "activity spam" annoying.
- They have serious concerns regarding the trustworthiness of *Facebook* in terms of privacy and anonymity.
- They generally disapprove any requirements to use such accounts without their freewill.

» They do not want to link their real name to the use of the app.

» They do not understand the implications of a link between an app and *Facebook*, especially, what data the app can gather from *Facebook* and vice-versa.

These findings are something that can be backed by the experience of platforms such as *Spotify*, that initially required a *Facebook* login, but dropped this policy for obvious reasons. A bit of a contradiction here is, that many of the users who strongly voted against a mandatory *Facebook* login, entered the *Facebook* app as one of their favourite apps in question NV01. This can either mean that they underestimate the privacy hazards of the *Facebook* app, or that they use the app albeit their negative feelings, but want to keep *Facebook* out of other apps as far as possible.

5.3.17. Summary

Before testing the research hypotheses, let us quickly recap the results so far. First, the survey attracted over 300 participants, of which 91% own a smartphone, and 86% use at least one third-party app. Particularly, almost half of the respondents indicated to actively use more than ten apps. The demographics of the participants are typical for online surveys of this kind, and reflect social media-affine people, with a bias towards male users in the 25 to 34 age class.

Concerning the operating system, 47% of all smartphone users indicated to use *Android*, with *iOS* following closely at 41%. The other operating systems' shares are far behind, as expected. Interestingly, *iOS* is overrepresented here, compared to the worldwide market statistics from *IDC*. It remains as a question, if there is a bias towards *iOS* in this survey, or if *iOS* has a higher market share in Austria, in contrast to other markets. Furthermore, *Android* was the operating system of choice for most male users, while females slightly tended towards *iOS*.

The results on the adoption of the phones' features did not reveal any novelties: voice telephony is used most often, followed by SMS and email, while payment through NFC, or mobile payment services, is on the opposite end of the scale.

Most users indicated to buy their phones every one to two years at most. Here, considerable differences between genders could be observed: a clear majority of male users answered to buy their phones every one to two years, while most females answered to buy a new phone less often, or only when their old phone breaks or gets unusable.

Regarding the app use behaviour, we will put our findings into relation to the app lifecycle described in section 2.3. Figure 77 shows the mobile app lifecycle enriched with key results from the survey.

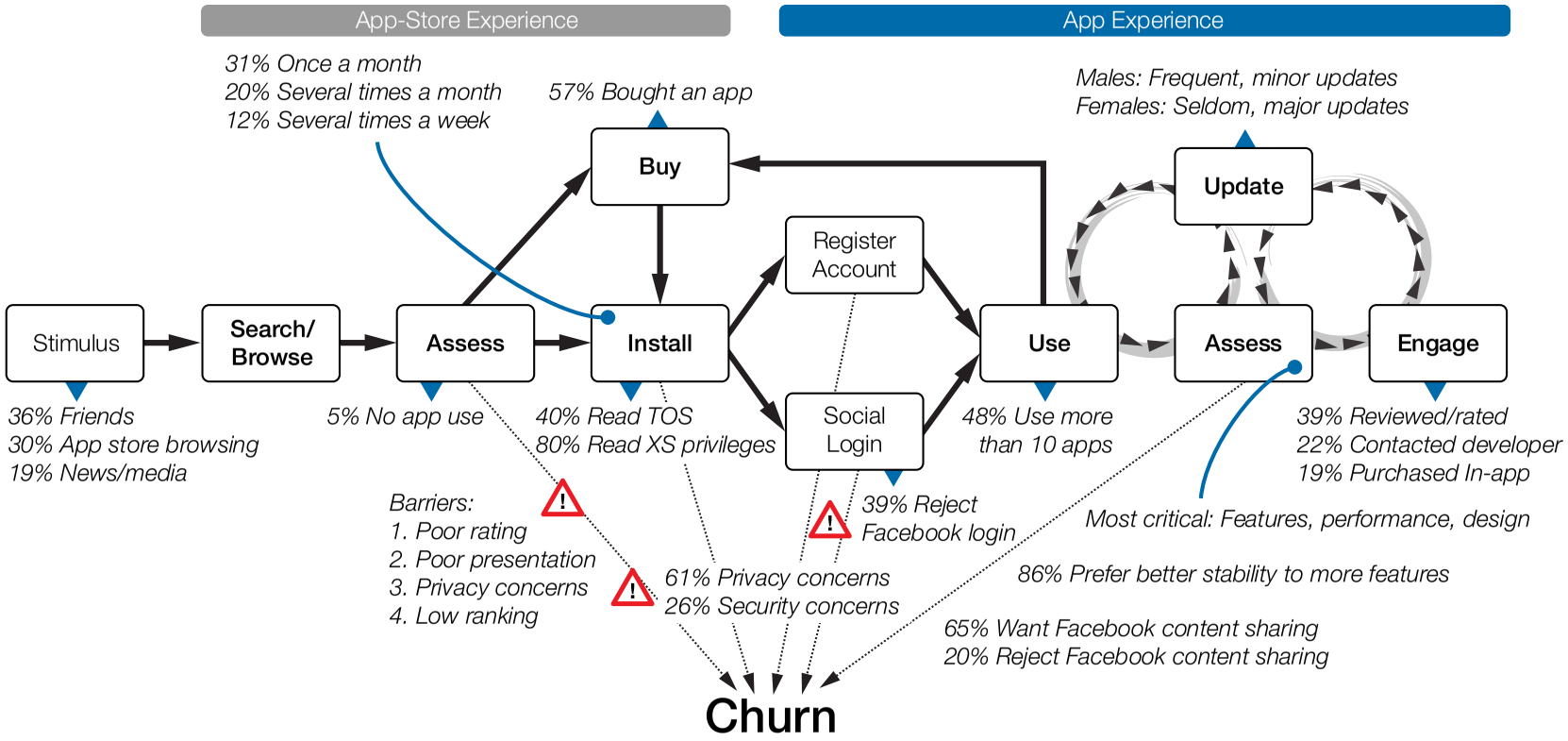


Figure 77: The mobile app use lifecycle, enriched with key results of the survey. The lifecycle, in combination with the concrete data acquired from the market, can now be regarded as a big picture of Austrian app user engagement. The warning signs mark considerable hazards to the customer retention. Figures are percentages of the respective smartphone owner and app user populations: $n_{smartphone\ owners} = 278$, $n_{app\ users} = 265$.

Concerning app monetisation, 57% of all app users have already bought an app, and 19% already made an in-app purchasement. On the other hand, 35% indicated that they have not yet paid for an app. The app purchasement figure is higher than I expected personally, given the potential barriers to payment already discussed. However, the high incidence of app purchasement is backed by the statistics on the ever-growing worldwide app market. An interesting finding from the payment questions is, that male *iOS* users represent the group with the highest fraction of payment experience: 85.7% indicated to have already bought an app, followed by 78.0% of the female *iOS* users. On the other hand, only 25% of all female *Android* users paid for an app. These observations are supported by the lead of *iOS* in terms of app store turnover.

An important part of the survey were aspects related to the app design and development process. We learned, that a clear majority of users, 71%, indicated to prefer specialised apps over apps that aim to provide as many features as possible. This could also be backed by the responses to the next question, asking if users prefer stable apps with fewer features over apps with more features, but also more bugs: here, 86% voted for better stability at the sacrifice of features. Another issue relevant for developers are the users' preferences concerning the update frequency. The results did not seem conclusive on the first sight, but splitting them up by gender revealed, that most male users prefer frequent, small app updates, while female users prefer seldom, major updates.

The survey also aimed to explore the users' main reasons for reconsidering to install an app: poor ratings had the most detrimental effect on app adoption, followed by a bad presentation of the app within the store. On the opposite side, the channels that are most relevant for the users to find new apps, were determined to be personal recommendations, and the browsing through app stores.

Another goal of this study was to check the security and privacy resentments that users might have regarding apps. Particularly, the topic of privacy has received much attention lately, and there seem to be some misconceptions on the relationship between privacy, age, gender, and the intention to use apps. In this survey, we could observe, that for 61% of all app users, privacy is a concern, and that they are generally afraid, that apps use their data in an unauthorised fashion. Here, female users answered to be more insecure than males, while the users' age did not have a significant effect on the question's outcome. As conjectured, also a difference between *Android* and *iOS* users exists here, the latter showing more faith in their applications' handling of personal data. The common notion, that younger users are less aware of privacy risks, is not evident in the data; in fact, the younger respondents indicated more often, that they are insecure in terms of privacy. However, the difference between both age groups turned out not to be significant.

On the other hand, security concerns were not an issue for most app users, as only 26% stated to be unsure about malware occasionally. The difference between male and female users was considerable here, with male users showing more – probably illusory – confidence in terms of security hazards. Another particular finding was, that younger users, and *iOS* users answered that they had less fear of malware.

Furthermore, results from the ranking of eight different app rating criteria were presented. Most users judged an app's features, speed, and design to be most important, while prestige and

customer support were judged to be the least important aspects.

Regarding the users' app involvement, a variety of results were discussed, such as the reviewing and feedback behaviour: 39% of all app users already reviewed or rated an app at least once, with the most popular reason being, that they liked an app. Moreover, 22% of all app users already got in touch with an app's developers to provide feedback.

Finally, the social networking behaviour of users revealed some interesting facts. The prevalence of *Facebook* among the survey population was not surprising, as well as the fact, that most users stated to engage in a social network mainly to interact with their existing friends and colleagues, rather than for getting to know new people. However, the questions on the *Facebook* connection to other apps showed, that a almost a quarter of all users prefers apps to be independent from *Facebook* in terms of content sharing, and that 39% categorically reject apps that require a *Facebook* login. This was particularly unexpected, given that 92% of the survey's participants answered to be active *Facebook* users.

Many of the results were explored across the gender, age, and operating system dimensions, and it was surprising, that many significant differences found in the answers could not be related to the OS, but to the gender of the participants. As already mentioned, the operating system choice itself, but also the app use intensity, phone purchasing interval, desired app update interval, security concerns, and a small effect concerning privacy resentments, turned out to correlate with the users' gender.

5.4. Hypotheses

Finally we shall check, if the research hypotheses postulated in section 3.3 can be backed by the results presented, or if they need to be rejected. For the significance tests, a significance level of $\alpha = 0.05$ is defined.

A quick outline of the results is provided by Table 39:

Hypothesis	Description	Support
H1	There is a considerable gap between smartphone owners, and users who are actively downloading and using mobile apps.	Not supported
H2	The majority of users is not aware of privacy hazards that arise with apps.	Not supported
H3	There is a positive correlation between the privacy concerns of users and their age, meaning that younger users are less aware regarding privacy hazards.	Not supported
H4	Users of the *iOS* ecosystem (*Apple iPhone*, iPad) are generally less aware concerning privacy, compared to *Android* users.	Supported
H5	A significantly greater fraction of *iPhone* users is actively downloading apps, compared to the *Android* platform.	Not supported
H6	*iPhone* users are generally more willing to pay for apps than *Android* users.	Supported

Table 39: Overview on the results of hypotheses testing, at a significance level of $\alpha = 0.05$. Please mind not to confuse the hypotheses' numbering with the symbols for the null hypothesis, H_0, and alternative hypothesis, H_1.

H1: Gap Between Smartphone Owners and App Users

Hypothesis H1 states, that "there is a considerable gap between smartphone owners, and users who are actively downloading and using mobile apps". What remains to be defined, is the "considerable" gap – I assume a gap of at least 10% of all smartphone owners as "considerable" here. Using this expected probability, the following null and alternative hypotheses can be formulated to facilitate a one-sample binomial test:

» H_0: The "no apps" category occurs with a probability of 10%.[1]

» H_1: The "no apps" category occurs with a probability of less than 10%.[2]

The binomial test was performed using *SPSS*, yielding a significant p-value as shown in Table 40.

App Use (NV05)	N	Observed Probability	Test Probability	One-tailed Significance (p)
No app use	13	0.047	0.1	0.00092
Using apps	265	0.953	-	-
Total	**278**	**1.000**	**-**	**-**

Table 40: Overview of the values observed for the apps count question NV05, and the resulting significance from the non-parametric one-sample binomial test. The value < 0.01 indicates a significant difference from the hypothesised distribution, meaning that the null hypothesis needs to be rejected.

In this study, out of the entire population of 278 smartphone owners, only 13 (5%) indicated that they do not use any third-party apps. This is lower than expected; presumably because the survey did not reach less technology-affine populations sufficiently, especially smartphone owners aged above 45.

The test outcome indicates to reject the null hypothesis due to a significant p-value[3] of 0.001 (which is smaller than α). Concluding, there is no considerable gap of 10% or more non-app-users in the population observed.

[1] Implying that the "one to five apps", "six to 10 apps", and "more than 10 apps" categories combined occur with a hypothesised probability of 90%.

[2] Because the alternative hypothesis states, that the proportion of records in the "no apps" category is less than the hypothesised probability, this is a one-sided (one-tailed) test (Bortz 2010, p. 102).

[3] The p-value indicates the probability that the observed values reflect the real hypothesised distribution, based on the assumption that the underlying null hypothesis is true (Bortz 2010, p. 107). A significant p-value implies that the null hypothesis cannot be retained, and also corresponds to the error probability of rejecting a true null hypothesis.

H2: General Unawareness of Privacy Hazards

Hypothesis H2 postulates, that "the majority of users is not aware of privacy hazards that arise with apps". Consequently, the null and alternative hypotheses are:

- H_0: The majority (≥ 50%) of users is not aware of privacy hazards that arise with apps.
- H_1: The majority (≥ 50%) of users is aware of privacy hazards that arise with apps.

Question item SC02_02 measured the users' privacy resentments on a five-level Likert scale. As already described, the survey participants were asked to indicate their level of agreement to the statement "I am afraid that apps use my personal data without my knowledge or consent". Table 41 shows the answers.

SC02_02 Level	Agreement	Classification	Answer Count	Percent	Cumulative Percent
1	**Strongly disagree**	Unawareness	19	7.2	7.2
2	**Disagree**	Unawareness	42	15.8	23
3	**Undecided**	Unawareness	43	16.2	39.2
4	**Agree**	Awareness	94	35.5	74.7
5	**Strongly agree**	Awareness	67	25.3	100.0
Total	-	-	**265**	**100.0**	-

Table 41: Overview of answers to the privacy resentments question SC02_02, indicating the level of agreement to the statement "I am afraid that apps use my personal data without my knowledge or consent". For testing hypothesis H2, the answers were classified into two categories: privacy awareness, and unawareness. The histogram of the distribution is depicted in Figure 56.

To analyse the results, we hereby define that "unawareness of privacy" manifests itself in a choice between level one and three on the answer scale (strongly disagree, disagree, neutral response). The unawareness of privacy answer was chosen by only 39.2% of all users. The majority, being 60.8% of the population, indicated to be afraid, that apps use their personal data without their knowledge or consent. Thus, hypothesis H2 is rejected.

H3: Correlation Between Age and Privacy Concerns

Hypothesis H3 states, that "there is a positive correlation between the privacy concerns of users and their age, meaning that younger users are less aware regarding privacy hazards". Consequently, we explore the relationship between privacy concerns and the users' age through a Mann-Whitney U test based upon the following null and alternative hypotheses:

- H_0: The distribution of privacy concerns (SC02_02) is the same across categories of age (SD06).
- H_1: The distribution of privacy concerns (SC02_02) is not the same across categories of age (SD06).

In this test, the categories of age consist of the two age groups, < 35 and 35+, derived from item SD06. The frequencies of those two categories, their rank sums, and the U test statistic is provided by Table 42 and Table 43 respectively:

Age (Two Bins)		Strongly Disagree	Disagree	Un-decided	Agree	Strongly Agree	Total
< 35	Count	14	28	29	78	53	**202**
	% within age	6.9%	13.9%	14.4%	38.6%	26.2%	**100.0%**
35+	Count	5	14	14	16	14	**63**
	% within age	7.9%	22.2%	22.2%	25.4%	22.2%	**100.0%**
Total	**Count**	**19**	**42**	**43**	**94**	**67**	**265**
	% within age	**7.2%**	**15.8%**	**16.2%**	**35.5%**	**25.3%**	**100.0%**

Table 42: Absolute and relative frequencies of the answers to the privacy concerns item SC02_02, grouped by the two age categories derived from item SD06.

Age (Two Bins)	N	Mean Rank	Sum of Ranks
< 35	202	137.59	27,794.00
35+	63	118.27	7,451.00
Total	**265**	**-**	**-**
Item / Grouping Item	**Mann-Whitney U**	**Z**	**Significance (two-tailed)**
SC02_02 / SD06 (two bins)	5,435.000	-1.811	0.070
Correlation (Pearson)	**Significance (two-tailed)**	**Correlation (Spearman)**	**Significance (two-tailed)**
-0.106	0.086	-0.111	0.072

Table 43: Rank sums and the Mann-Whitney U test statistic for the privacy concerns item SC02_02, grouped by the two age categories derived from the age item SD06, to test hypothesis H3. Furthermore, the Pearson and Spearman correlation coefficients and their two-tailed significance is shown.

As already discussed in section 4.2.5, the “agree” and “strongly” agree answers indicating high privacy concerns were – in contrast to the hypothesis – particularly found within the younger part of the population. Shown in Table 43, the Mann-Whitney U test yields a p-value of 0.07, suggesting that an equal distribution of both age classes cannot be rejected.

Furthermore, the Pearson correlation between the (numeric) age and privacy sentiment is negative (-0.106), at a two-tailed significance of 0.086. Due to the nature of the scales, the Spearman rank correlation is similar (-0.111, at a 0.072 significance).[1] In other words, the correlation coefficient is not significantly different from zero. This is remarkable, as a significant correlation would not prove a causal relationship though, but, as already discussed, a positive or negative correlation is *necessary* for causation. Applying these findings to our hypothesis H3, we need to reject it.

[1] A table of all correlations is provided in appendix F, Table 52.

H4: Differences in Privacy Awareness Between iOS and Android Users

Hypothesis H4 presumes, that "users of the *iOS* ecosystem (*Apple iPhone*) are generally less aware concerning privacy, compared to *Android* users". The null and alternative hypotheses are therefor as follows:

- H_0: The distribution of privacy awareness (SC02_02) is the same across categories of OS (SM01).
- H_1: The distribution of privacy awareness (SC02_02) is not the same across categories of OS (SM01).

Again, Table 44 and Table 45 depict the frequencies, sums of ranks, and the test statistic for the privacy item SC02_02, exploring the relationship between the *iOS* and *Android* platforms.

OS (Major)		Strongly Disagree	Disagree	Un-decided	Agree	Strongly Agree	Total
Android	Count	10	16	16	51	36	**129**
	% within OS	7.8%	12.4%	12.4%	39.5%	27.9%	**100.0%**
iOS	Count	8	22	23	36	22	**111**
	% within OS	7.2%	19.8%	20.7%	32.4%	19.8%	**100.0%**
Other	Count	0	4	4	7	6	**21**
	% within OS	0.0%	19.0%	19.0%	33.3%	28.6%	**100.0%**
Total	**Count**	**18**	**42**	**43**	**94**	**64**	**261**
	% within OS	**6.9%**	**16.1%**	**16.5%**	**36.0%**	**24.5%**	**100.0%**

Table 44: Absolute and relative frequencies of the answers to the privacy concerns item SC02_02, grouped by the two major OS categories, iOS and Android, plus the small share of the other platforms. Four users responded with "I don't know" at the OS question, representing the difference between the total of 261 users shown in the table, and the sum of 265 survey participants who use apps.

OS (Major)	N	Mean Rank	Sum of Ranks
Android	129	128.79	16,614.00
iOS	111	110.86	12,306.00
Total	240	-	-
Item / Grouping Item	**Mann-Whitney U**	**Z**	**Significance (two-tailed)**
SC02_02 / SM01	6,090.000	-2.069	0.039

Table 45: Rank sums and the test statistic for the privacy concerns item SC02_02, grouped by the two major OS categories, iOS and Android, to test hypothesis H4.

While a naive look at the histogram in Figure 59 does not reveal totally different distributions for both operating systems, Table 44 shows higher privacy concerns for the *Android* group. Performing a Mann-Whitney U test yields a significant (0.039) difference between both ecosystems at a 0.05 significance level, with a U value of 6,090. The null hypothesis is rejected, and the mean of the *iOS* group is lower, towards unawareness, thus we need to retain hypothesis H4.

H5: Apps Adoption Differences Between App Ecosystems

Hypothesis H5 surmises, that "a significantly greater fraction of *iPhone* users is actively downloading apps, compared to the *Android* platform". Again, we formulate hypotheses H_0 and H_1:

- H_0: The distribution of installation frequency (NV02) is the same across categories of OS (SM01).
- H_1: The distribution of installation frequency (NV02) is not the same across categories of OS (SM01).

Judging the results from question NV02 visually through Figure 37, we have already found that *iOS* users tend to slightly shorter app installation intervals, compared to *Android* users. To investigate this further, a U-test is employed, comparing the installation frequencies of both operating systems. The results are shown in Table 46 and Table 47:

OS (Major)		Never	Few Times / a	Once / M	Several times / M	Several times / w	Total
Android	Count	0	35	45	33	16	**129**
	% within OS	0.0%	27.1%	34.9%	25.6%	12.4%	**100.0%**
iOS	Count	0	26	31	39	15	**111**
	% within OS	0.0%	23.4%	27.9%	35.1%	13.5%	**100.0%**
Other	Count	2	10	5	4	0	**21**
	% within OS	9.5%	47.6%	23.8%	19.0%	0.0%	**100.0%**
Total	Count	**2**	**71**	**81**	**76**	**31**	**261**
	% within OS	**0.8%**	**27.2%**	**31.0%**	**29.1%**	**11.9%**	**100.0%**

Table 46: Absolute and relative frequencies of the answers to the installation frequency item NV02, grouped by the two major OS categories, iOS and Android, plus the small share of the other platforms.

OS (Major)	N	Mean Rank	Sum of Ranks
Android	129	115.41	14,888.00
iOS	111	126.41	14,032.00
Total	**240**	**-**	**-**
Item / Grouping Item	**Mann-Whitney U**	**Z**	**Significance (two-tailed)**
NV02 / SM01	6,503.000	-1.274	0.202

Table 47: Rank sums and the Mann-Whitney U test statistic for the installation frequency item NV02, grouped by the two major OS categories, to test hypothesis H5.

The test yields a U value of 6,503, and a p-value of 0.202, exceeding the significance level of 0.05. Furthermore, the Spearman correlation coefficient for both items (-0.039, at a 0.530 significance), again provided by Table 52 in the appendix, is not significantly different from zero. Thus, the null hypothesis, that both distributions are the same, needs to be retained, which implies, that hypothesis H5 is not supported.

H6: Differences in Willingness to Pay Between App Ecosystems

Finally, hypothesis H6 suspects, that "*iPhone* users are generally more willing to pay for apps than *Android* users". We therefore compare the two *Android* and *iOS* populations regarding the apps payment question NV03, applying the U test to the following hypotheses:

- H_0: The distribution of apps payment (NV03) is the same across categories of OS (SM01).
- H_1: The distribution of apps payment (NV03) is not the same across categories of OS (SM01).

"Apps payment" refers to the three different items of question NV03: app buying through one-time charges (NV03_01), in-app purchasement (NV03_02), and non-purchasement (NV03_02). Finally, Table 48 and Table 49 provide the distribution and test statistics of these items.

OS (Major)		App Buying	In-App Purchasing	Non-Purchasing	Total
Android	**Count**	55	14	72	-
	% within OS	42.6%	10.9%	55.8%	-
iOS	**Count**	92	31	19	-
	% within OS	82.9%	27.9%	17.1%	-
Other	**Count**	5	4	14	-
	% within OS	23.8%	19.0%	66.7%	-
Total	**Count**	**152**	**49**	**105**	-
	% within OS	**58.2%**	**18.8%**	**40.2%**	-

Table 48: Absolute and relative frequencies of the answers to the three apps payment items NV03_01/02/03, grouped by the two major OS categories, iOS and Android, plus the small share of the other platforms.

In Table 48 above, the row totals are not shown, as the buying and in-app-purchasing items were not exclusive. Thus, the sum of checked items is higher than the count of participants. Percentages indicate the fraction of "yes" answers within each category, e.g., app buying was selected by 152 (58.2%) out of 261 app-using participants who specified an OS. While 55 (42.6%) out of 129 *Android* users indicated to have already bought an app, 92 (82.9%) out of the 111 *iOS* users did so. Thus, one expects that the U test will show a significant difference between the OS categories.

Item	OS (Major)	N	Mean Rank	Sum of Ranks
App buying	Android	129	98.16	12,663.00
	iOS	111	146.46	16,257.00
	Total	240	-	-
In-app purchasement	Android	129	111.02	14,322.00
	iOS	111	131.51	14,598.00
	Total	240	-	-
Non-purchasement	Android	129	141.98	18,315.00
	iOS	111	95.54	10,605.00
	Total	240	-	-

Item	Item / Grouping	Mann-Whitney U	Z	Significance
App buying	NV03_01 / SM01	4,278.000	-6.368	0.000
In-app purchasement	NV03_02 / SM01	5,937.000	-3.372	0.001
Non-purchasement	NV03_03 / SM01	4,389.000	-6.148	0.000

Table 49: Rank sums and the Mann-Whitney U test statistic for the three app purchasing items NV03, grouped by the two major OSs, to test hypothesis H6.

Indeed, the U test shows significant differences for all of the three answer items, that is, a U value of 4,278 with a 0.000 significance for the app buying, a U value of 5,937 with a 0.001 significance for in-app purchasements, and a U value of 4,389 with a significance of 0.000 for the "no payment history" item. Thus, the differences of the means in the test statistic are significant at a 0.01 level, with *iOS* having the higher means concerning payment, and lower means concerning non-payment. This is can be reproduced graphically as in Figure 40, which shows the considerably higher monetising potential of *iOS*. Thus, the null hypotheses need to be rejected, and hypothesis H6 can be retained.

6 | Evaluation of Methods

After having checked the significance of the results, I will now briefly reflect on the methods used so far. As discussed, the core part of this work consisted of the conceptualisation, implementation, and execution of an online survey. Methods from descriptive and inferential statistics, and confirmatory analysis were employed, such as robust non-parametric null-hypothesis significance testing.

The online survey was, apart from minor problems, a convenient way to extract primary data from the market, as it scales quite well – more interviews are only an effort in terms of the recruiting of further participants. However, it is the recruiting that causes most problems: as discussed, and also visible in the results, it is a formidable challenge to create a representative sample by relying solely on online communications, especially, if a survey is not limited to any particular audience. In this survey, basically the overall population of Austrian smartphone owners was addressed. Looking at the resulting demographics, and the users' answers, it is obvious that there was a strong bias towards early adopters, and technology-affine people.

To counter that bias, I considered to perform a post-stratification on the non-random sample, employing the weighting feature of *SPSS*. But this would have only created an illusion of representativeness, as a stratification is not that easy to perform – one not only needs to account for the demographics, but also for the online use behaviour, and stratify e.g. based on the use of social networks, as well as probably unknown coefficients, which are relevant here. Remember, that almost 92% of all participants indicated to use *Facebook*, which is in stark contrast to reality, where this should be only approx. 35%. Weighting cases based upon demographics alone would not have solved the bias towards *Facebook* users. Steinmetz et al. (2009) evaluated the application of weighting to adjust the bias of non-random samples, but concluded, that, as "none of the applied weights coherently adjusts all coefficients of the web surveys in the appropriate direction it seems to be wiser to use the unweighted web data" (Steinmetz et al. 2009, p. 38).

Thus I decided to leave the data as it is. Another issue with online surveys are incomplete interviews – people can drop out of the process at any time. The completion rate of 85% was more than acceptable in the case of this survey, and the drop-off stats per page did not yield any significant problems. As expected, most people who left, did so on the first pages of the survey.

Concerning the motivation to participate, the survey relied completely upon the goodwill of users, which again introduces bias, as some user segments won't fill out a survey if they do not get compensated for their effort. Many commercial surveys try to remedy this problem by offering participants incentives – for example, the chance to win an *iPad* is very popular nowadays. I did not want to go this way, due to two reasons. First, the seriousness of the survey could be negatively affected, as users could suspect then, that the survey is solely intended to collect their contact details; and second, rewards could attract users who enter completely random data, just to receive their compensation. The latter can be filtered out to some extent, but anyway, the likelihood to receive invalid data increases.

Finally, a considerable pitfall of an online survey is accessibility, not only concerning impaired users, but particularly also smartphone users, who are primarily addressed by this survey, but cannot conveniently fill it out due to design constraints.

As mentioned, I closely monitored the statistics while the survey was running, and employed additional controls to check where the participants are coming from, and how long it takes them to complete an interview. Figure 78 shows users by referral categories that I assigned to each instrument or channel of promotion. It can be seen, that the promotion via *Facebook* yielded the most interviews, followed by participants that were recruited by my contacts. Another big source of participants were topically related *Facebook* pages of organisations. Other channels, such as Web or online ads only added a minor share of users. This *Facebook*-focus is one of the reasons, that users engaging in social media are over-represented in the survey.

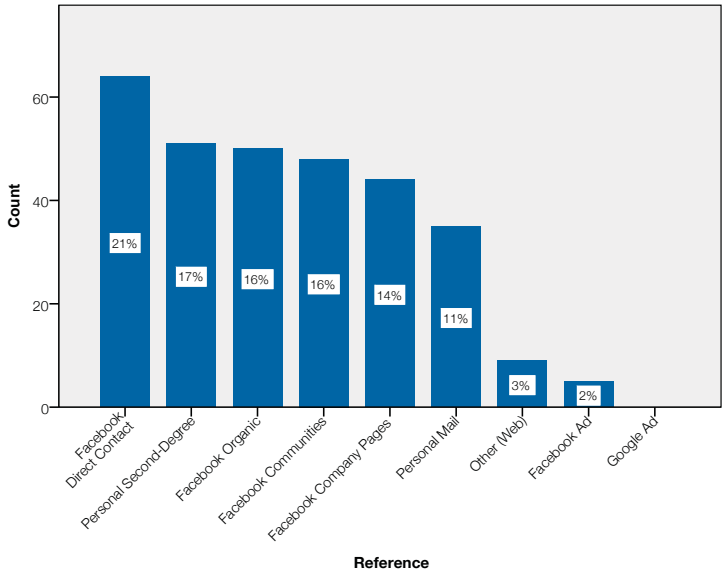


Figure 78: Survey participants by referrer (n = 306). Organic spreading via Facebook proved to be most successful, advertising via Google yielded not a single response.

Another meta-aspect related to the online survey are the times that users spent on the individual pages. Figure 79 shows the details, by gender and age class, while Figure 80 depicts the mean time users needed for filling out the entire survey.

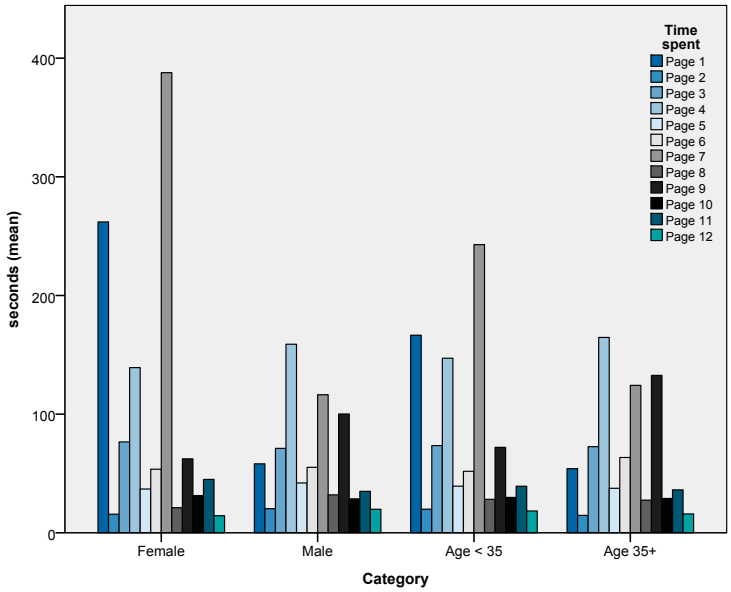


Figure 79: Mean time in seconds spent on survey pages, by age and gender (n = 306).

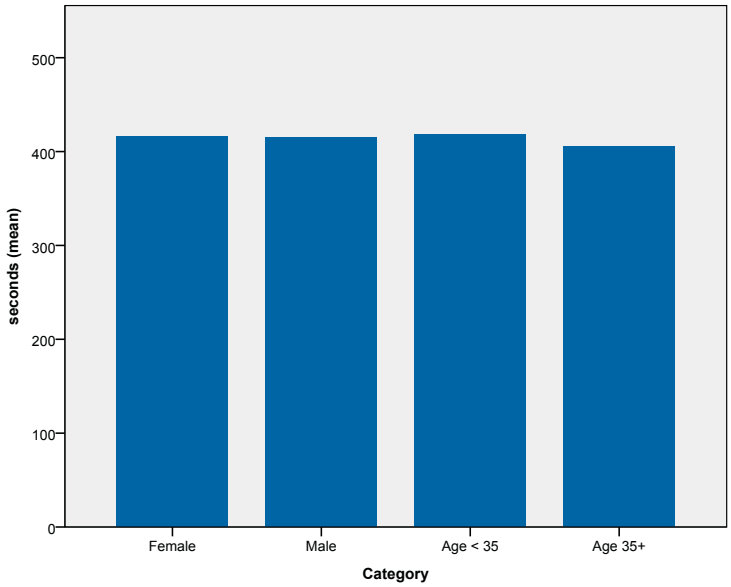


Figure 80: Mean time spent for completing the entire survey, by age and gender (n = 306, without outliers). There are virtually no differences along those dimensions.

The mean overall survey completion times are almost perfectly equal for the different user segments, which is surprising, given the fact, that younger people are said to be much more technologically literate in general. In this survey, there should have been an effect of this, as some of the questions used technical terms that I could not substitute with easier concepts.

6.4.1. Paid Online Advertising

Another interesting and somewhat novel aspect of this work, is its use of online advertising to recruit interviewees. Due to the wide reach of *Google* and *Facebook*, covering almost the entire online population, these could be ideal tools to aid quantitative market research. Particular advantages of them are, that:

- they can almost instantly reach hundreds of thousands of people.
- success is payed per clicks, not per impression (the display of the ad).
- the success of an online advertising campaign can be monitored almost in real-time.
- a campaign can be started, paused, or ended at any time, with almost instant feedback.[1]
- due to conversion tracking, the costs for each completed interview can be closely monitored.

Initially I was convinced that online ads would yield considerable return at virtually no cost, since one can run the survey promotion using keywords that are not associated with highly competitive offerings, thus requiring lower average CPCs. However, it turned out that the average click prices were still quite high, and moreover, the conversion rate was almost nonexisting. Table 50 shows stats on the *Google* and *Facebook* campaigns.

Item	Total	Facebook	Google
Ads impressions	~ 81,500	72,319	9,186
Ads clicks	114	83	31
Ads conversions	5	5	0
Ads costs	€ 34.00	~ € 29.80	€ 4.17
CTRs	0.14%	0.12%	0.34%
Cost per conversion	€ 6.80	€ 5.96	-

Table 50: Advertising statistics for the campaigns on Google and Facebook. Despite the considerable amount of impressions, and still acceptable CTR on Google, the amount of conversions was terrifyingly low. The conversion goal was defined to be a complete survey response (interview).

While the keyword tool of *Google* Adwords predicted hundreds of thousands impressions for various keywords at a given CPC, the ad was delivered only approx. 9,186 times in total within two weeks. The CTR at *Google* was not really bad, considering that the ad was not in displayed in a top position for the low CPC specified.[2] However, it was ruinous, that not a single one of the 31 clicks lead to a completed interview. *Facebook* on the other hand, displayed the ad nearly eight times as often, at a lower CTR rate, eventually yielding 83 clicks. However, only five surveys were filled out by users coming from the *Facebook* ad. Dividing the overall campaign costs by those five conversions, results in an unacceptable price of almost € 7 for each interview.

[1] However, it took *Facebook* a few days to approve the content of the ads, *Google* only needed a few hours for this.

[2] The average online advertising CTR is approx. 2%, dependent on the topic, and an ad's display position.

The reason for this might be, that an online survey cannot be targeted well by using keywords: terms such as “smartphones” do not work, as users who search for smartphones are looking for the phones, and not for a survey about them. Furthermore, users do not have any incentive to participate in a survey, if they are not offered anything in return.

On a side note, an interesting fact is, that the keyword with the highest reach and CTR (approx. 0.66%) on *Google Adwords* was “facebook”.

6.4.2. Hypotheses Testing Validity and Test Power

The research hypotheses postulated were tested using methods from confirmatory analysis, particularly, NHST. Significance testing is widely debated in scientific research. They bear several fallacies one can tap into by deriving wrong conclusions from retained or rejected hypotheses, and some argue that significance is something that can be found almost anywhere, as long as samples are sufficiently large (Albers et al. 2009, p. 211).

Furthermore, one has to keep an eye on the two types of error possible in significance testing:

» Alpha error, meaning to reject the null hypothesis H_0 in favour of the alternative hypothesis H_1, while in reality, the opposite is true. The alpha error probability corresponds to the level of significance chosen (e.g. 5%).

» Beta error, meaning to retain H_0, while H_1 is true in reality. The probability of this error is subject to the significance level, effect size, and sample size. The so-called *power* of the test can be derived by calculating the complementary probability of the beta error, that is, $1 - \beta$.

A rejected null hypothesis does not automatically imply that the alternative hypothesis is true, and vice-versa. The null hypothesis could have been rejected due to an error, the alpha error, that corresponds to the significance level chosen. I have formulated the conclusions in this thesis in a manner avoiding to sound like they have to be taken for granted. The results have to be taken as indicators, that are subject to a given probability. This probability is high, as long as the underlying test design is valid. Further discussion concerning the fallacies of NHST, and test power can be found in Albers et al. (2009).

7 | Conclusion

7.1. Summary

The Austrian mobile app ecosystem is flourishing – mobile app startups are developing sophisticated services, driven by the vast possibilities that nowadays smartphones provide. In this work, target market-related aspects that are vital to those innovative ventures, were discussed. Furthermore, I derived a set of questions, that every new mobile app developer will face sooner or later – questions concerning the use of smartphones and their features, as well as the users' app buying preferences, app involvement, and finally, social networking attitude.

Consequently, those questions were converted into an online survey, targeted at Austrian smartphone owners. The survey was promoted mainly via online advertising and social media, the former not yielding a satisfactory return. All in all, the survey succeeded to attract more than 300 participants of all ages from 13 to 55+, however, male users aged from 25 to 34 are overrepresented in the observed sample. Of all participants of the survey, a higher than expected fraction of 265 users answered to actively use apps, which enabled us to gain further insights on the users' preferences and needs.

While some facts extracted from the data have not revealed any novelties, such as the utilisation patterns of the built-in smartphone features, the prevalence of *Android*, and the already assumed differences between the *iOS* and *Android* platforms, some results were not anticipated. Remarkably, the high fraction of users who already paid for an app, the lack of significant differences in privacy concerns between groups of different age, and the very negative sentiment concerning *Facebook*, even by its own users, are surprising.

The key findings from the quantitative survey have been integrated into the mobile app lifecycle proposed in section 2.3, yielding a big picture of app adoption and use behaviour of Austrian smartphone users, depicted by Figure 77 in section 5.3.17. Here, particularly at the *assess*, *install*, and *social login* steps of the lifecycle, potential hazards to app adoption become apparent, that app developers need to take into account.

Furthermore, the main research questions of this work were formulated as hypotheses, to be confirmed through significance testing, at the common significance level of at least 0.05 (95%). Here, we saw the higher monetisation potential of *iOS*, manifest in the majority of users with an app payment history. Moreover, we saw that *iOS* users feel slightly more safe concerning privacy and security, presumably due to the nature of the closed platform. The hypothesis on a general unawareness of app users concerning privacy, could – fortunately – be rejected. While most users answered not to have serious concerns regarding malware, the opposite was the case in terms of privacy violations by legitimate apps. Other hypotheses, such as the existence of a significant gap between smartphone owners, and active app users, could neither be confirmed, nor rejected, mainly due to the sample's obvious bias towards active app users. This remains as an interesting question for future representative studies on this topic.

Through the exploration of the data, using visual means, rank correlation coefficients, and robust two-sample tests, we noticed significant differences between male and female participants, such as opposite preferences concerning the update interval of apps, as well as differences in the app installation frequency and smartphone buying interval.

Summarising all the findings of this study, a variety of recommendations for app developers can be derived:

» When monetising, aim for male *iOS* users, aged from 25 to 34,[1] as they were by far the biggest group of users with an app purchasing history in the sample of this study.

» In terms of features, create clearly-focused apps for specific use cases rather than general, feature-laden offerings. While generalisation is best practice at the software level, the users of this survey indicated to prefer specialised apps. This finding is consistent with the imperative to focus, that is commonly advocated by entrepreneurs, and business literature.

» Concerning update release cycles, prefer frequent small updates over seldom large ones.

» Ensure the privacy of your users, and tell them that you do. Privacy is an issue for your users, regardless of their age. It could not be observed, that younger users care less for privacy.

» If possible, implement user-to-user recommendations mechanisms, and make it as easy as possible for users to recruit their friends. Keep in mind, that personal recommendations, and WOM (Word-of-Mouth) advertising proved to be the primary source for users to find new apps.

» Ratings and reviews are one of the most important things to take care of. Most users mentioned negative ratings and reviews in app stores making them reconsider to install an app.

» Thoroughly rethink your decision, if you plan to release an app that requires a *Facebook* login. This not only locks out users categorically rejecting *Facebook*, but also causes a lot of negative reviews, which are a very serious problem, as discussed in the previous point.

» Concerning the integration of *Facebook* for content sharing between your platform and *Facebook*'s *Social Graph*, this is appreciated by most users, as long as you leave the decision up to them, whether to connect to *Facebook* or not.

» While most users answered, that they rather enjoy social networks where their existing friends and contacts are on, there are good news for new social networks and communities trying to bootstrap from zero: at least 11% of the survey participants answered, that they prefer to get to know new, interesting people. If you get these 11% aboard, the early majority of users will more likely be attracted, through persuasion from these innovators.

» Strive for perfect app stability. Most users preferred a stable app with fewer features, over an app with a bunch of more features, but also more bugs. This also means, that if you as a startup cannot afford a dedicated testing team yet, you should build your MVP, and at least test it on a limited friendly user base, before releasing it into the whole wide world.

[1] Of course, this does not apply, if your app's value proposition is targeted at a user segment with totally different demographics.

» Watch out for the changes in this dynamic market – the results of this survey will differ considerably, if it is repeated after a short while. The adoption rate of smartphones ramps up, and so will the adoption rates of mobile payments, and other services that occupy niches as of this writing.

Some of these conclusions are already backed by best practices found in literature, and by findings from other quantitative research. However, some of them might be erroneous due to bias in the underlying data. As discussed in the evaluation, great care needs to be taken about the fallacies of significance testing, which depends on sample sizes, effect sizes and the test power. The outcome of a significance test is always subject to certain probabilities. Concerning the results of this study, they describe effects, rather than underlying factors.

7.2. Future Work

This study explored various aspects regarding the app use behaviour of Austrian smartphone owners, which is closely related to the field of research of user acceptance theory, as outlined in section 2.4. In contrast to the efforts of building models like the TAM, this survey aimed to provide a big picture, encompassing further topics related to the diffusion of apps in general, with a focus on describing behaviour, and not explaining the users' attitude or intention to use a specific app. Moreover, also the users' behaviour in terms of app *engagement*, exceeding pure utilitarian use, was investigated, such as reviewing, and feedback behaviour. Only a few items dealt with the users' attitude, such as the social network integration questions, and the user's preferences regarding the app update interval, value proposition (generalisation vs. specialisation), and ranking of app aspects.

As the survey's main effort lies in the description of effects observed within the Austrian market, that are relevant to mobile app developers, the next step could be to derive a model that tries to explain these effects and, e.g., perform an exploratory factor analysis to spot further relationships between items, and their presumably underlying factors. If the wide range of attributes measured in this survey were used to build a model similar to the TAM or the UTAUT, more questions on the users' behavioural intention to use apps would have to be added, and furthermore, the internal validity and robustness of each individual construct would need to be warranted by a more comprehensive set of items and scales. Unfortunately, due to the survey's length constraints, the establishment of a fully-fledged, extended model on app user acceptance was not possible, and remains as an interesting challenge to cover within future, more comprehensive surveys. However, as discussed, models like the TAM have also been criticised to be of little practical use, and thereby, efforts continuing this work must consider, if the original goal to pragmatically aid app developers, might eventually be missed in favour of more fundamental research.

Last but not least, there are many other questions that would have been interesting to be answered. Particularly, given the high popularity of online communities and social apps, the following questions are interesting candidates for further exploration:

» What are success factors for app-based online communities? Are there any best-practices for the bootstrapping of such, that is, growing them from zero?

» What are the properties of the early adopters needed to grow a community, and how can those early adopters be reached via advertising?

» How can the findings from this survey be integrated into a diffusion model, that could be used to predict the success of new, innovative apps and communities?

Due to the increasing relevance of mobile apps, it would also be interesting to automate the sampling process for further research, and establish an Austrian smartphone users' panel, to account for the rapid changes in the market. This would also lead to more representative results.

Some app businesses are already pushing into a similar direction, such as *Qriously* (2013), who collect in-app sentiments directly from smartphone users. Concluding, I expect that research like this study will itself be app-based in the future.

Bibliography

Adjust.io (2013): *Adjust.io App Download Tracking Tool*. Website: http://www.adjust.io/ [Last accessed on 2013-04-18]

Adobe (2013): *PhoneGap Cross-Platform Mobile Apps Framework.* Website: http://phonegap.com/ [Last accessed on 2013-08-03]

Ahmet, Z., Väänänen-Vainio Mattila, K. (2011): *Face to Face Makes a Difference: Recommendation Practices of Users of Mobile Services*. In Proceedings of the 2nd International Workshop on Research in the Large. ACM, pp. 25—28

Albers, S., Klapper, D., Konradt, U., Walter, A., Wolf, J. (Ed.) (2009): *Methodik der empirischen Forschung*. 3. Ed. Gabler, Wiesbaden

Allfacebook.com (2013): *Facebook Nutzerzahlen Österreich*. Website: http://www.allfacebook.de/userdata/oesterreich [Last accessed on 2013-05-03]

Antoniadis, P., Le Grand, B. (2007): *Incentives for Resource Sharing in Self-Organized Communities: From Economics to Psychology*. Proceedings of the Second IEEE International Conference on Digital Information Management (ICDIM), Lyon, pp. 756—761

Appcelerator (2013): *Titanium Mobile Development Environment.* Website: http://www.appcelerator.com/platform/titanium-platform/ [Last accessed on 2013-08-03]

Beal, G. M., Bohlen, J. M. (1957): *The Diffusion Process*. Iowa State University.

Bernard, R. H. (2012): *Social Research Methods. Qualitative and Quantitative Approaches.* 2. Ed. Sage, Thousand Oaks

Bortz, J., Döring, N. (2006): *Forschungsmethoden und Evaluation für Human- und Sozialwissenschaftler*. 4. Ed. Springer, Heidelberg

Bortz, J., Schuster, C. (2010): *Statistik für Human- und Sozialwissenschaftler*. 7. Ed. Springer, Heidelberg

Brandtzaeg, P. B., Lüders, M., Skjetne, J .H. (2010): *Too Many Facebook "Friends"? Content Sharing and Sociability Versus the Need for Privacy in Social Network Sites*. International Journal of Human-Computer Interaction, 26:11-11, London, pp. 1006—1030

Brown, I., Zukowski, T. (2007): *Examining the Influence of Demographic Factors on Internet Users' Information Privacy Concerns*. Proceedings of the 2007 Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists on IT Research in Developing Countries. ACM, New York, pp. 197—204

Christensen, C. M. (2003): *The Innovator's Dilemma. The Revolutionary Book that Will Change the Way You Do Business*. Harper Collins, New York

Churchill, G. A. Jr., Brown, T. J. (2004): *Basic Marketing Research*. Thomson South-Western, Ohio

Cohen, J. (1992): *A Power Primer*. Psychological Bulletin, Vol. 112, No. 1, p. 155

Cronbach, L. J. (1951): *Coefficient Alpha and the Internal Structure of Tests*. Psychometrika, Vol. 16, No. 3, pp. 297—334

Cuadrado, F. (2012): *Mobile Application Stores: Success Factors, Existing Approaches, and Future Developments*. Communications Magazine, IEEE, Vol. 50, No. 11, pp. 160—167

Davis, F. D. (1985): *A Technology Acceptance Model for Empirically Testing New End User Information Systems - Theory and Results*. PhD thesis, Massachusetts Institute of Technology

Davis, F. D. (1991): *User Acceptance of Information Technology: System Characteristics, User Perceptions and Behavioral Impacts*. International Journal of Man-Machine Studies, Vol. 38, No. 3, Academic Press Ltd., London, pp. 475—487

Davis, F. D., Bagozzi, R. P., Warshaw, P. R. (1992): *Extrinsic and Intrinsic Motivation to Use Computers in the Workplace*. Journal of Applied Social Psychology, Vol. 22, No. 14, pp. 1111—1132

derStandard.at (2013): *Flohmarkt-App Shpock wird zum österreichischen eBay. Im deutschsprachigen Raum Nummer Zwei bei Downloads mobiler Kleinanzeigen-Portale.* Website: http://derstandard.at/1363710119703/Flohmarkt-App-Shpock-wird-zum-oesterreichischen-eBay?ref=article, 13 May 2013 [Last accessed on 2013-05-29]

d'Heureuse, N., Huici, F., Arumaithurai, M., Ahmed, M., Papagiannaki, K., Niccolini, S. (2012): *What's App?: A Wide-scale Measurement Study of Smart Phone Markets*. ACM SIGMOBILE Mobile Computing and Communications Review, Vol. 16, No. 2, pp. 16—27

Diekmann, A. (2003): *Empirische Sozialforschung. Grundlagen, Methoden, Anwendungen*. 10. Ed. Rowohlt, Hamburg

Digital Affairs (2013): *Social Media Radar Austria (Beta)*. Website: http://socialmediaradar.at/ [Last accessed on 2013-07-02]

Dillman, D. A. (2011): *Mail and Internet Surveys: The Tailored Design Method. 2007 Update with New Internet, Visual, and Mixed-mode Guide*. Wiley, New Jersey

Drmota, M., Gittenberger, B., Karigl, G., Panholzer, A. (2008): *Mathematik für Informatik*. 2. Ed. Heldermann, Lemgo

Eboli, G. B. (2012): *Mobile Development: The Choice Between Native and Web Applications*. N.p., n.p.

Fishbein, M., Ajzen, I. (1975): *Belief, Attitude, Intention and Behavior*. Addison-Wesley, Reading

Fishbein, M., Ajzen, I. (1980): *Understanding Attitudes and Predicting Social Behavior*. Prentice-Hall, Englewood Cliffs

Fling, B. (2009): *Mobile Design and Development*. O'Reilly, Sebastopol

FluidSurveys (2013): *FluidSurveys Online Survey Software*. Website: http://www.fluidsurveys.com/ [Last accessed on 2013-03-19]

Flurry Analytics (2013): *Flurry App Analytics Software*. Website: http://www.flurry.com/flurry-analytics.html [Last accessed on 2013-03-26]

Ghezzi, A., Balocco, R., Rangone, A. (2010): *How a New Distribution Paradigm Changes the Core Resources, Competences and Capabilities Endowment: The Case of Mobile Application Stores*. In Mobile Business and 2010 Ninth Global Mobility Roundtable (ICMB-GMR), 2010 Ninth International Conference. IEEE, Washington, pp. 33—42

Google (2012): *Our Mobile Planet: Austria. Understanding the Mobile Consumer*. PDF report: http://services.google.com/fh/files/blogs/our_mobile_planet_austria_en.pdf Website: http://www.thinkwithgoogle.com/mobileplanet/en/downloads/ [Last accessed on 2013-06-15]

Gordon, M. E. (2013): *The History of App Pricing, and Why Most Apps Are Free.* Flurry Blog. Website: http://blog.flurry.com/bid/99013/The-History-of-App-Pricing-AndWhy-Most-Apps-Are-Free [Last accessed on 2013-07-30]

Gretl (2013): *Gretl. Gnu Regression, Econometrics and Time-series Library*. Website: http://gretl.sourceforge.net/ [Last accessed on 2013-04-10]

Griffith, M. (2011): *The Lifecycle of a Mobile App, a User's Perspective*. Website: http://uxmatters.com/mt/archives/2011/10/the-lifecycle-of-a-mobile-app-a-users-perspective.php [Last accessed on 2013-07-20]

Hassenzahl, M. (2004): *The Thing and I: Understanding the Relationship Between User and Product*. In Blythe, M. A., Overbeeke, K., Monk, A.F. & Wright, P. C. (Eds.): *Funology: From Usability to Enjoyment*. Kluwer, Norwell, pp. 31—41

Hoffman, D. L., Novak, T. P. & Peralta, M. (1999): *Building Consumer Trust Online*. Communications of the ACM, Vol. 42, No. 4, New York, pp. 80—85

Howard, T. W. (2010): *Design to Thrive. Creating Social Networks and Online Communities that Last*. Elsevier, Burlington

IBM (2013): *IBM SPSS Statistics Software*. Website: http://www.ibm.com/software/analytics/spss/products/statistics/ [Last accessed on 2013-04-10]

IDC (2013a): *Android and iOS Combine for 91.1% of the Worldwide Smartphone OS Market in 4Q12 and 87.6% for the Year, According to IDC*. Press release, February 14, 2013. Website: http://www.idc.com/getdoc.jsp?containerId=prUS23946013 [Last Accessed on 2013-05-10]

IDC (2013b): *More Smartphones Were Shipped in Q1 2013 than Feature Phones, An Industry First According to IDC*. Press release, 25 April 2013. Website: http://www.idc.com/getdoc.jsp?containerId=prUS24085413 [Last Accessed on 2013-04-26]

Jain, R., Sonnen, D. (2011): *Social Life Networks*. IT Professional, Vol. 13, No. 5, IEEE Computer Society, Los Alamitos, pp. 8—11

Jakob, N., Schoen, H., Zerback, T. (Ed.) (2009): *Sozialforschung im Internet. Methodologie und Praxis der Online-Befragung*. GWV Fachverlage, Wiesbaden

Katz, M. L., Shapiro, C. (1985): *Network Externalities, Competition, and Compatibility*. The American Economic Review, Vol. 75, No. 3, pp. 424—440

Koekkoek, H. (2013): *Publication: How the Most Successful Apps Monetize their User Base.* Distimo Blog. Website: http://www.distimo.com/blog/2013_03_publication-how-the-most-successful-apps-monetize-their-user-base/ [Last accessed on 2013-07-30]

Kruskal, H., Wallis, W. A. (1952): *Use of Ranks in One-Criterion Analysis*. Journal of the American Statistical Association, Vol. 47, No. 260, Chicago, pp. 583—261

KwikSurveys (2013): *KwikSurveys Online Survey & Questionnaire Tool*. Website: http://www.kwiksurveys.com/ [Last accessed on 2013-03-19]

Langenbahn, C.-M. (2009): *Quantitative Methoden der Wirtschaftswissenschaften*. 2. revised Ed. Oldenbourg, München

Leiner, D. J. (2013): *SoSci Survey (Version 2.3.04). oFb - der Online-Fragebogen.* Website: https://www.soscisurvey.de/ [Last accessed on 2013-04-08]

Likert, R. (1932): *A Technique for the Measurement of Attitudes*. Archives of Psychology, Vol. 22, No. 140, New York, p. 155

LimeSurvey (2013): *LimeSurvey. The Free & Open Source Online Survey Software Tool*. Website: http://www.limesurvey.org/ [Last accessed on 2013-03-19]

Maghnati, F., Ling, K. C. (2013): *Exploring the Relationship between Experiential Value and Usage Attitude towards Mobile Apps among the Smartphone Users*. International Journal of Business and Management, Vol. 8, No. 4, p. 1

Malhotra, N., Kim, S., Agarwal, J. (2004): *Internet Users' Information Privacy Concerns (IUIPC): The Construct, the Scale and a Causal Model*. Information Systems Research, Vol. 15, No. 4, pp. 336—355

Mann, H. B., Whitney, D. R. (1947): *On a Test Whether One of Two Random Variables is Stochastically Larger than the Other*. Annals of Mathematical Statistics, Vol. 18, pp. 50—60

Mediabistro (2013): *GPlusData. The Comprehensive Resource for Google+ Trends and Statistics from Inside Network*. Website: http://www.gplusdata.com/world_map [Last Accessed 2013-07-02]

Meier, R. (2012): *Professional Android 4 Application Development*. Wiley, Indianapolis

Moore, G. A. (1999): *Crossing the Chasm. Marketing and Selling High-Tech Products to Mainstream Customers*. Revised Edition. Harper Collins, New York

MTV Networks (2011): *MTV Networks' Mobile Apps Study Reveals the Life Cycle of an App: From Discovered to Discarded*. PR Newswire Press Release. Website: http://www.prnewswire.com/news-releases/general-business-latest-news/mtv-networks-mobile-apps-study-reveals-the-life-cycle-of-an-app-from-discovered-to-discarded-123348433.html [Last accessed on 2013-05-20]

OAuth 2.0 (2013): *OAuth Community Site. An Open Protocol to Allow Secure Authorization in a Simple and Standard Method from Web, Mobile and Desktop Applications.* Website: http://oauth.net/2/ [Last accessed on 2013-07-20]

OpenRefine (2013): *OpenRefine. A Free, Open Source, Power Tool for Working with Messy Data*. Website: http://openrefine.org/ [Last accessed on 2013-09-10]

OpenSignalMaps (2012): *Android Fragmentation Visualized*. Website: http://opensignal.com/reports/fragmentation.php [Last accessed on 2013-07-02]

Osterwalder, A. & Pigneur, Y. (2010): *Business Model Generation. A Handbook for Visionaries, Game Changers, Successful Businesses*. Crown Business, New York

Qriously (2013): *Qriously Taps the Values of Opinions*. Website: http://www.qriously.com/ [Last accessed on 2013-07-10]

Raab-Steiner, E., Benesch, M. (2010): *Der Fragebogen. Von der Forschungsidee zur SPSS-Auswertung*. 2. revised Ed. Facultas, Wien

Ries, E. (2011): *The Lean Startup. How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*. Penguin, London

Rogers, E. M. (2010): *Diffusion of Innovations*. 4. Ed. The Free Press, New York

R Project (2013): *The R Project for Statistical Computing*. Website: http://www.r-project.org/ [Last accessed on 2013-04-10]

RTR (2008): *Mobile Penetration at 120%: More than 10 Million SIM Cards in Use.* Press release, 15 October 2008. Website: http://www.rtr.at/en/pr/PI15102008TK [Last accessed on 2012-06-08]

SoGoSurvey (2013): *SoGoSurvey. Create Online Surveys.* Website: http://www.sogosurvey.com/ [Last accessed on 2013-03-19]

StatCounter (2013): *GlobalStats*. Website: http://gs.statcounter.com/ [Last accessed on 2013-07-02]

Statistik Austria (2012): *Qualitätsrichtlinien*. Website: http://www.statistik.at/web_de/ueber_uns/aufgaben_und_grundsaetze/qualitaet/index.html, PDF: http://www.statistik.at/web_de/static/qualitaetsrichtlinien_054599.pdf [Last accessed on 2012-12-10]

Steinmetz, S., Tijdens, K., García, P. P. (2009): *Comparing Different Weighting Procedures for Volunteer Web Surveys*. AIAS Working Paper No. 76. Amsterdam Institute for Advanced Labour Studies

SurveyMonkey (2013): *SurveyMonkey Online Survey Software & Questionnaire Tool*. Website: http://www.surveymonkey.com/ [Last accessed on 2013-03-19]

Tarde, G. (1903): *The Laws of Imitation*. Henry Holt, New York

Techcrunch (2013): *Shpock Sees 120K Downloads, 60K Items Listed as Competitors Start their Photocopiers.* TechCrunch Article: http://techcrunch.com/2013/01/14/shpock-2/, 14 January 2013 [Last accessed on 2013-03-30]

Trochim, W. M. (2006): *The Research Methods Knowledge Base*. 2. Ed. Website: http://www.socialresearchmethods.net/kb/ [Last accessed on 2012-11-14]

Unity Technologies (2013): *Unity Mobile Game Development*. Website: http://unity3d.com/unity/multiplatform/mobile [Last accessed on 2013-08-03]

University of Waikato (2013): *Weka. Waikato Environment for Knowledge Analysis*. Website: http://www.cs.waikato.ac.nz/ml/weka/ [Last accessed on 2013-04-10]

Van der Heijden, H. (2004): *User Acceptance of Hedonic Information Systems*. MIS Quarterly, Vol. 28, No. 4, pp. 695—704

Venkatesh, V., Bala, H. (2008): *Technology Acceptance Model 3 and a Research Agenda on Interventions*. Decision Sciences Institute, N.p. PDF: http://vvenkatesh.com/Downloads/Papers/fulltext/pdf/Venkatesh_Bala_DS_2008.pdf [Last accessed on 2013-09-20]

Venkatesh, V., Davis, F. D. (2000): *A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies*. Management Science, Vol. 46, pp. 186—204

Venkatesh, V., Morris, M. G., Davis, G. B. & Davis, F. D. (2003): *User Acceptance of Information Technology: Toward a Unified View*. MIS Quarterly, Vol. 27, No. 3, pp. 425—478

Verkasalo, H., Lopez-Nicolas, C., Molina-Castillo, F. J., Bouwman, H. (2010): *Analysis of Users and Non-Users of Smartphone Applications*. Telematics and Informatics, Vol. 27, No. 3, pp. 242—255

Walliman, N. (2005): *Your Research Project: Designing and Planning Your Work*. 3. Ed. SAGE Publ., London

Wang, Y., Norcie, G., Cranor, L. F. (2011): *Who is Concerned about What? A Study of American, Chinese and Indian Users' Privacy Concerns on Social Network Sites. Short Paper*. Proceedings of the TRUST Conference, Springer, Heidelberg, pp. 146—153

Williams, K., Boyd, A., Densten, S., Chin, R., Diamond, D., Morgenthaler, C. (2009): *Social Networking Privacy Behaviors and Risks*. Seidenberg School of CSIS, Pace University, New York

Wilson, Fred (2006): *My Favourite Business Model*. A VC Blog. Website: http://www.avc.com/a_vc/2006/03/my_favorite_bus.html [Last accessed on 2013-07-25]

Xing AG (2012): *XING Passes 6-Million-Member Mark in German-Speaking Countries. Austria and Switzerland Both Reach More than 500,000 Members*. Press Release, 15 November 2012. Website: http://corporate.xing.com/no_cache/english/press/press-releases/ [Last accessed on 2013-08-02]

Yamakami, T. (2011): *A Three-Dimension Analysis of Driving Factors for Mobile Application Stores: Implications of Open Mobile Business Engineering*. 2011 Workshops of International Conference on Advanced Information Networking and Applications (WAINA), IEEE, pp. 885—889

Further Reading

Anderson, C. (2008): *The Longer Long Tail. How Endless Choice is Creating Unlimited Demand.* 1. expanded and updated Ed. Random House Business Books, London Apptrace (2013): *Apptrace Beta. App Economy Statistics.* Website: http://www.apptrace.com/ [Last accessed on 2013-04-18]

Becker, J. (2001): *Marketing-Konzeption. Grundlagen des ziel-strategischen und operativen Marketing-Managements.* 7. Ed. Vahlen, München

Campbell, D. T., Stanley, J. C. (1966): *Experimental and Quasi-Experimental Designs for Research*. Houghton Mifflin, Boston

Collins, J. (2001): *Good to Great. Why Some Companies Make the Leap and Others Don't*. Harper Collins, New York

Collins, J., Hansen, M. T. (2011): *Great By Choice. Uncertainty, Chaos, and Luck - Why Some Thrive Despite them All*. Harper Business, New York

Duan, W., Gu, B., Whinston, A.B. (2008): *Do Online Reviews Matter? An Empirical Investigation of Panel Data*. Decision Support Systems, Vol. 45, No. 4, pp. 1007—1016

Eurostat (2012): *Methodological Documents Glossary*. Item 4.2C, Working Group "Assessment of Quality in Statistics". PDF: http://epp.eurostat.ec.europa.eu/portal/page/portal/quality/documents/GLOSSARY_1.pdf [Last accessed on 2012-12-10]

Fayol, H. (1984): *General and Industrial Management*. Rev. Ed. IEEE Publications, New York

Fields, T. (2012): *Social Game Design. Monetization Methods and Mechanics*. Elsevier, Waltham/MA

Fife, E., Orjuela, J. (2012): *The Privacy Calculus: Mobile Apps and User Perceptions of Privacy and Security*. International Journal of Engineering Business Management, Vol. 4, No. 11

Gladwell, M. (2001): *The Tipping Point. How Little Things Can Make a Big Difference*. 1. Ed. Little, Brown and Company, Boston

Holm, K. (Ed.) (1975): *Die Befragung 2. Datenaufbereitung, Tabellenanalyse, Korrelationsmatrix*. UTB/Francke, München

Holm, K. (Ed.) (1976): *Die Befragung 3. Die Faktorenanalyse*. UTB/Francke, München

Holzer, A., Ondrus, J. (2011): *Mobile Application Market: A Developer's Perspective*. Telematics and Informatics, Vol. 28, No. 1, pp. 22—31

Kirk, G. A., Rouge, B. (2011): *There's an App for that, But is there a Market for that App? An Exploration of the App Market as an Avenue for Entrepreneurship*. Issues in Information Systems, Vol. 12, No. 1, pp. 313—117

Kranz, M., Murmann, L., Michahelles, F. (2013): *Research in the Large: Challenges for Large-Scale Mobile Application Research. A Case Study about NFC Adoption using Gamification via*

an App Store. International Journal of Mobile Human Computer Interaction (IJMHCI), Vol. 5, No. 1, pp. 45—61

Merz, M. (2002): *E-Commerce und E-Business. Marktmodelle, Anwendungen und Technologien.* 2. Ed. dpunkt, Heidelberg

Pew Internet (2013): *56% of American Adults are Now Smartphone Owners*. Website: http://pewinternet.org/Reports/2013/Smartphone-Ownership-2013/Findings.aspx [Last accessed on 2013-06-10]

Racherla, P., Furner, C., Babb, J. (2012): *Conceptualizing the Implications of Mobile App Usage and Stickiness. A Research Agenda*. Available at SSRN: http://ssrn.com/abstract=2187056

Renninger, K. A. (2002): *Building Virtual Communities. Learning and Change in Cyberspace*. Cambridge University Press, Cambridge

Roma, P., Perrone, G., Giardina, S., & Enea, C. A (n.d.): *Factors Influencing Prices in the Mobile Apps' Store Distribution Model: An Empirical Study.* N.p., n.p.

Shirky, C. (2009): *Here Comes Everybody. The Power of Organizing Without Organizations.* Penguin, New York

Subercaze, J., El Morr, C., Maret, P., Joly, A., Koivisto, M., Antoniadis, P., Ihara, M. (2009): *Towards Successful Virtual Communities*. Enterprise Information Systems. Springer, Berlin Heidelberg. pp. 677—688

Varian, H. R. (1997): *How to Build an Economic Model in Your Spare Time*. Essay for: Passion and Craft: Economists at Work (Ed. Szenberg, M.). University of Michigan Press, Ann Arbor

Wiersma, W. (n.d.): *Critical Mass in Collaborative Hypertext Environments*. N.p, n.p.

Xu, H., Gupta, S., Shi, P. (2009): *Balancing User Privacy Concerns in the Adoption of Location-Based Services: An Empirical Analysis across Pull-Based and Push-Based Applications*. University of North Carolina, Chapel Hill

Zerfaß, A., Welker, M. & Schmidt, J. (2008): *Kommunikation, Partizipation und Wirkungen im Social Web. Grundlagen und Methoden: Von der Gesellschaft zum Individuum*. Halem, Köln

Zhang, J., Mao, E. (2012): *What's Around Me?: Applying the Theory of Consumption Values to Understanding the Use of Location-Based Services (LBS) on Smart Phones*. International Journal of E-Business Research (IJEBR), Vol. 8, No. 3, pp. 33—49

Appendix

A. List of Acronyms

ANOVA ..... Analysis of Variance
API ..... Application Programming Interface
ARPD ..... Average Revenue per Download
ARPU ..... Average Revenue per User
CDN ..... Content Distribution Network, also: Content Delivery Network
CEO ..... Chief Executive Officer
CFO ..... Chief Financial Officer
CMV ..... Common Method Variance
CPC ..... Cost per Click
CTR ..... Click-through Rate
DACH ..... Region: Germany, Austria, Switzerland
DSLR ..... Digital Single-Lens Reflex Camera
EOU ..... Ease of Use
GPS ..... Global Positioning System
GSM ..... Global System for Mobile Communications
IUIPC ..... Internet Users Information Privacy Concerns
LAN ..... Local Area Network
MAU ..... Monthly Active Users
MC ..... Multiple Choice
MNAR ..... Missing Not At Random
MNO ..... Mobile Network Operator
MVP ..... Minimum Viable Product (cf. Ries 2011)
NFC ..... Near-Field Communication
NHST ..... Null Hypothesis Significance Test
OS ..... Operating System
PE ..... Private Equity
PEOU ..... Perceived Ease of Use
PU ..... Perceived Usefulness
QM ..... Quality Management
SDK ..... Software Development Kit
SIM ..... Subscriber Identity Module
SLN ..... Social Life Network
SME ..... Small and medium enterprise
SMS ..... Short Message Service
SNS ..... Social Network Sites
TAM ..... Technology Acceptance Model
TRA ..... Theory of Reasoned Action
UI ..... User Interface
UTAUT ..... Unified Theory of Acceptance and Technology
UX ..... User Experience
UXD ..... User Experience Design
VC ..... Venture Capital; also: Virtual Community
WLAN ..... Wireless LAN
WOM ..... Word-of-Mouth

B. Tools Used

- Web survey: *SoSci Survey* version 2.3.04 (Leiner 2013)
- Data cleaning: *Open Refine* (*Google Refine*) Version 2.0
- Data exploration: *Weka - Waikato Environment for Knowledge Analysis* version 3.6.
- Statistics and charts: *IBM SPSS* Statistics version 21
- Operating system/environment: *Microsoft Windows 7 Professional* 64 bit SP 1
- Diagrams: *Adobe Illustrator CS5*
- Math equations typesetting & vector export: *formula sheet*, www.formulasheet.com

C. Survey Questions Proposal for the Expert Interviews

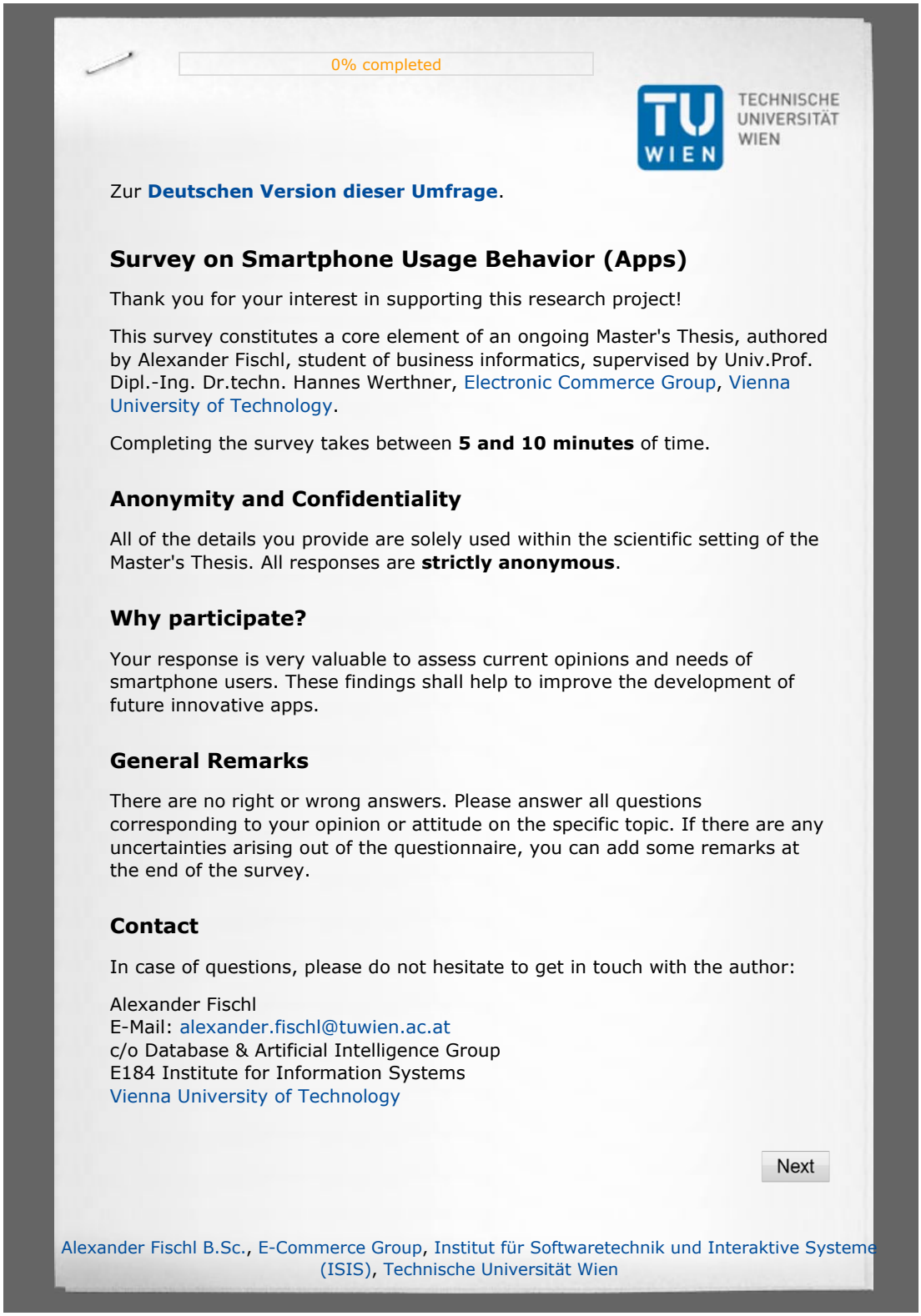
The following questions were initially supplied to the startups to ease discussion.

No.	Question
A. Basic Questions on the Use of Smartphones	
A-1	Do you own a smartphone? If not, are you going to buy one?
A-2	What smartphone operating system do you use? (*Android*/*iOS*/Windows/Blackberry/Symbian/etc.)
A-3	How often do you buy a new (smart)phone?
A-4	What features of your smartphone do you use, with which intensity? (Phone, SMS, mail, chat, navigation, web, apps, camera, music listening, video, payment)
A-5	Do you use third party apps on your smartphone? If yes, how many?
B. In-Depth Information on Apps Usage	
B-1	Do you use „built-in“ apps on your phone, such as games, music player, etc.?
B-2	If you use any of the above-mentioned apps, how often do you?
B-3	What are the three most important apps for your daily life?
B-4	How often do you download or try out new apps?
B-5	How do you find new apps? (Friends' recommendations, Internet, media, app markets/store search, etc.)
B-6	How do you download apps? (App Web sites, app markets/stores, other)
B-7	Have you ever paid for an app? (Purchased an app, or in-app purchasement)
B-8	Would you pay for an app that is useful? If yes, how much are you typically willing to pay for a useful app? (Choose both one-time and recurring fees)
C. User's Security & Privacy Attitude / Installation Barriers / Development-relevant Aspects / App Involvement	
C-1	Are you aware of privacy problems arising out of the use of your smartphone?
C-2	For *Android* users: Have you ever aborted the installation of an app because of privacy concerns (e.g. an app asking for too many permissions?)
C-3	Have you ever not installed an app because you feared it could be malicious? (Virus, trojan, etc.)

No.	Question
C-4	What are the main reasons for you *not* to install an app? (Bad user reviews, low ranking, excessive permissions, privacy concerns, bad description/screenshots/ name/presentation, costs, bad press, fear of malware, etc.)
C-5	Have you ever rated an app in the app store/market? If yes, why? (e.g. App asked for it, liked it, hated it)
C-6	Have you ever written an app review? If yes, why? (e.g. App asked for it, liked it, hated it)
C-7	Do you typically read an app's terms & conditions? The privacy policy? (No, briefly, thoroughly)
C-8	Rank the following app-related aspects upon their importance to you: responsiveness, design, usefulness/ features, prestige/exclusivity, friends are using it, privacy preservation/encryption, support?
C-9	Do you think it is better to use an app which provides a lot of features, or use many different apps for very specific purposes?
C-10	Would you prefer an app with 2 more features but possibly 2 more bugs?
C-11	Have you ever gotten in touch with the developer of an app concerning a problem or a feature improvement?
C-12	Would you appreciate the possibility for in-app feedback, such as a feedback page/tab?
C-13	What do you think is better concerning updates: frequent minor improvements, or occasional major improvements?
D. Presentation / Reputation / App Website	
D-1	How important is it to you, *who* created the app? E.g. have you ever looked up the creator of an app on *Google*?
D-2	How important is it for you, that there is a Web site for the app?
E. Information on Social Network / Online Communities Attitude	
E-1	Do you use a private social network (e.g. *Facebook*, studivz, etc. ?) If yes, which networks, if not, why?
E-2	In a private social network such as *Facebook*, do you use your real name?
E-3	Is it more important for you, that really every one of your friends is using the same social network, or that you discover new interesting people?
E-4	Do you find it more interesting, if a new network/community is integrated with *Facebook* (via your *Facebook* account), or do you rather prefer new, independent communities?
E-5	If you have a *Facebook* account, do you use it to log into other services? (E.g. Web sites, apps, or social communities)
E-6	Would you refrain from using an application, if it requires a *Facebook* login? If yes, why?
F. Standard Demographics	
F-1	Participants' demographics (age class, gender, education, area/location, income)
F-2	What other technologies and devices do you use? (desktop PC, notebook/netbook, tablet, ebook reader, game console, e-gov card/"Bürgerkarte")
F-3	Optional: Questions concerning mobile Internet connection/subscription type

Table 51: Initial version of the quantitative survey questions for discussion within the expert interviews.

D. Main Survey Version



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TECHNISCHE UNIVERSITÄT WIEN

Zur **Deutschen Version dieser Umfrage**.

Survey on Smartphone Usage Behavior (Apps)

Thank you for your interest in supporting this research project!

This survey constitutes a core element of an ongoing Master's Thesis, authored by Alexander Fischl, student of business informatics, supervised by Univ.Prof. Dipl.-Ing. Dr.techn. Hannes Werthner, Electronic Commerce Group, Vienna University of Technology.

Completing the survey takes between **5 and 10 minutes** of time.

Anonymity and Confidentiality

All of the details you provide are solely used within the scientific setting of the Master's Thesis. All responses are **strictly anonymous**.

Why participate?

Your response is very valuable to assess current opinions and needs of smartphone users. These findings shall help to improve the development of future innovative apps.

General Remarks

There are no right or wrong answers. Please answer all questions corresponding to your opinion or attitude on the specific topic. If there are any uncertainties arising out of the questionnaire, you can add some remarks at the end of the survey.

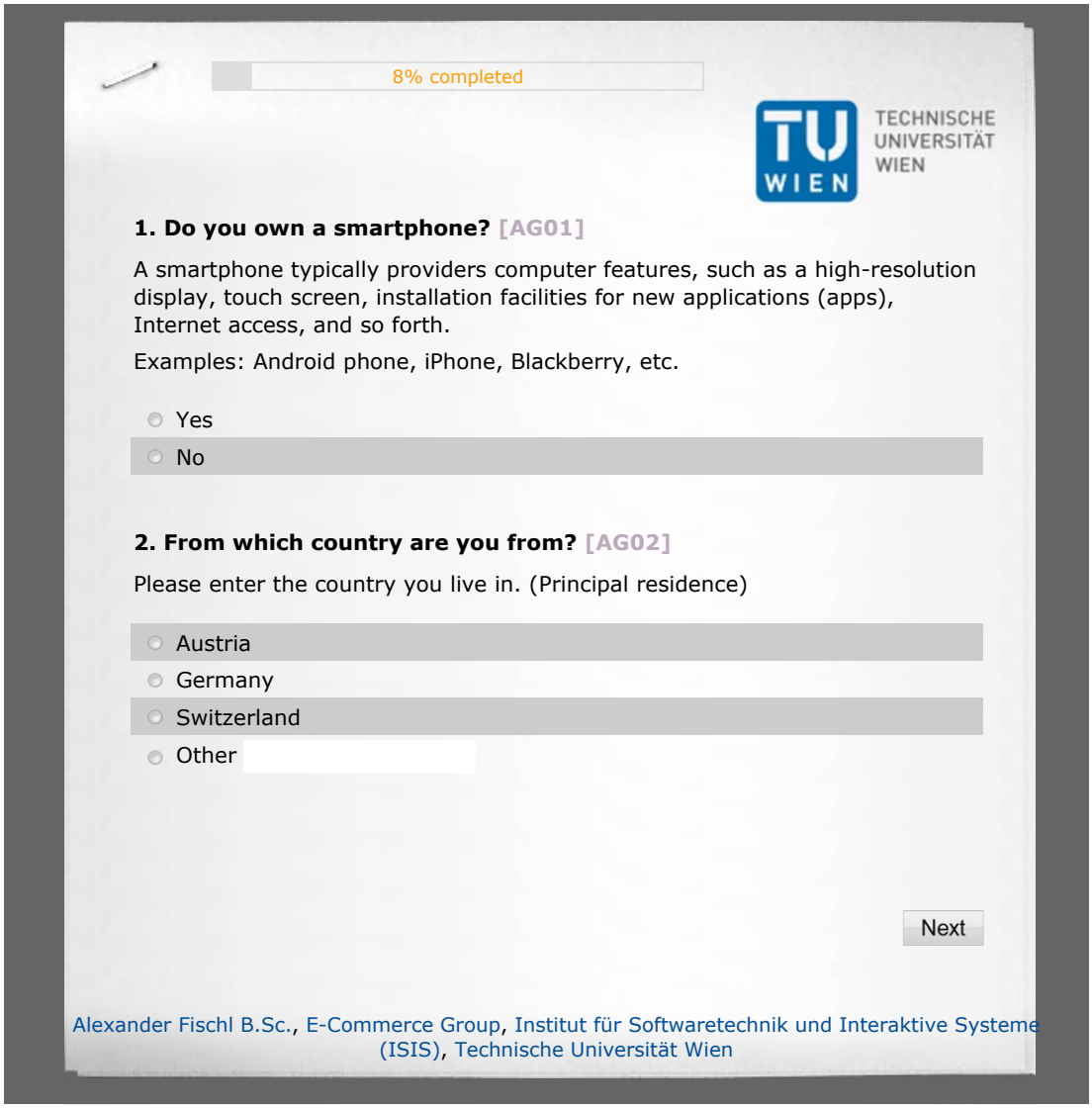
Contact

In case of questions, please do not hesitate to get in touch with the author:

Alexander Fischl
E-Mail: alexander.fischl@tuwien.ac.at
c/o Database & Artificial Intelligence Group
E184 Institute for Information Systems
Vienna University of Technology

Next

Alexander Fischl B.Sc., E-Commerce Group, Institut für Softwaretechnik und Interaktive Systeme (ISIS), Technische Universität Wien


8% completed
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1. Do you own a smartphone? [AG01]
A smartphone typically providers computer features, such as a high-resolution display, touch screen, installation facilities for new applications (apps), Internet access, and so forth.
Examples: Android phone, iPhone, Blackberry, etc.
Yes
No
2. From which country are you from? [AG02]
Please enter the country you live in. (Principal residence)
Austria
Germany
Switzerland
Other
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3. Which operating system is running on your smartphone? [SM01]

In case you use **multiple Smartphones** (e.g. for business and private use), please answer all questions in the following pertaining to the phone you primarily use.

- Google Android
- Apple iOS (iPhone)
- Microsoft Windows Mobile/Windows Phone
- Blackberry
- Nokia Symbian
- Palm/WebOS
- Other, please specify:
- I don't know.

4. Which functions of your smartphone do you use? [SM02]

If you are unaware of some function, or if your smartphone does not provide it, please select the "never" option.

	Never	Rarely	Occasionally	Frequently	Very frequently (daily)
Phone					
SMS					
Email					
Chat					
Maps/Navigation/Directions					
Web browser					
Camera					
Media player (music, video)					
Payment (NFC, Paybox, etc.)					

5. On average, how often do you buy a new smartphone? [SM04]

If your current smartphone is your first one, please just estimate how often you are going to buy a new smartphone in the future.

- More often than once a year
- Once a year
- Every 1 to 2 years
- Less often than every 2 years
- Only as soon as my current phone gets broken/unusable

6. Do you use third-party apps on your smartphone? [NV05]


Apps are new software applications you can install on your smartphone.
Third-party apps are e.g. games, tools, social networking apps, that you have installed by yourself, or that are not pre-installed by the manufacturer of your phone.
At the moment, I use...
No apps
1 to 5 apps
6 to 10 apps
More than 10 apps
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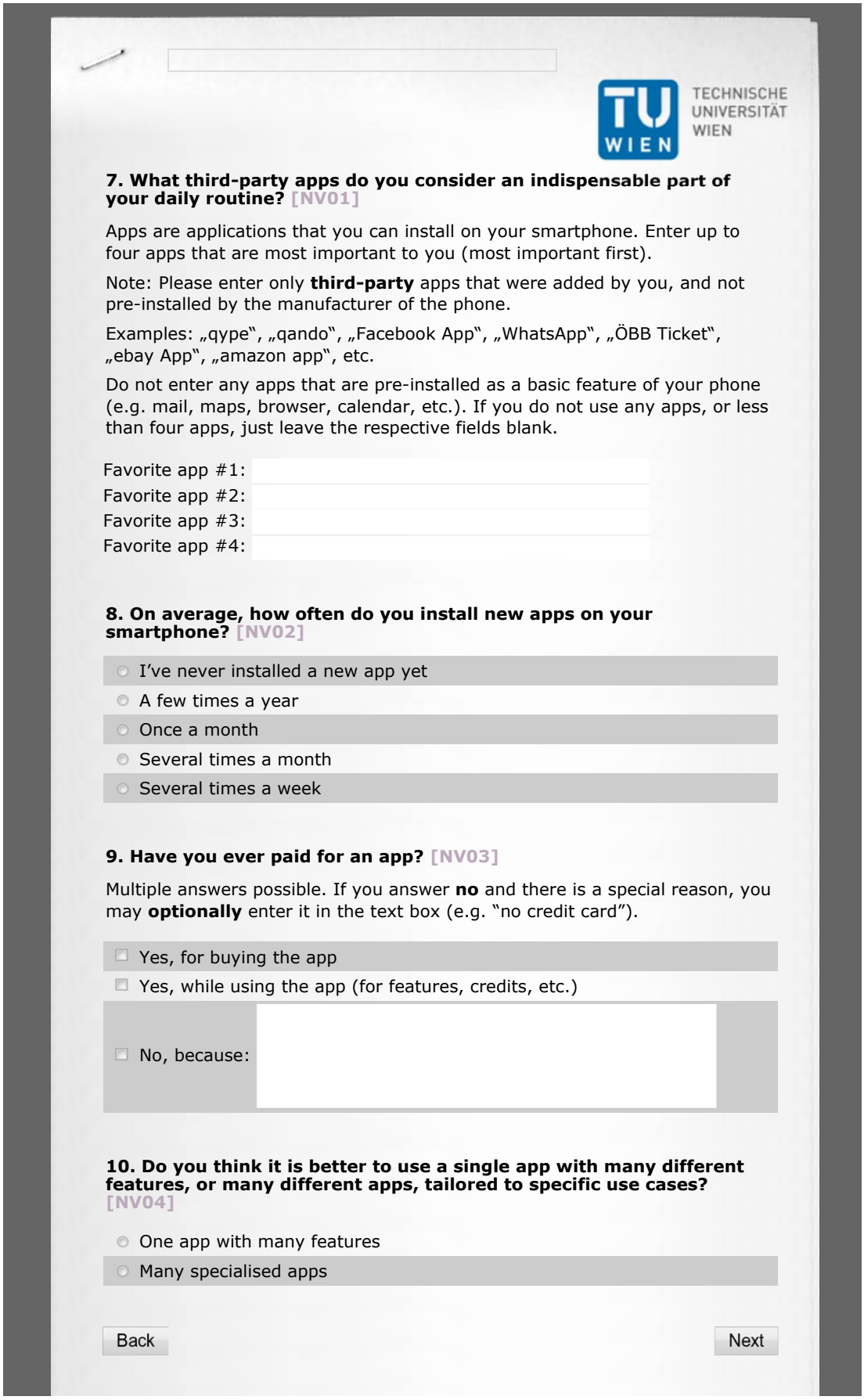

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7. What third-party apps do you consider an indispensable part of your daily routine? [NV01]

Apps are applications that you can install on your smartphone. Enter up to four apps that are most important to you (most important first).

Note: Please enter only **third-party** apps that were added by you, and not pre-installed by the manufacturer of the phone.

Examples: „qype", „qando", „Facebook App", „WhatsApp", „ÖBB Ticket", „ebay App", „amazon app", etc.

Do not enter any apps that are pre-installed as a basic feature of your phone (e.g. mail, maps, browser, calendar, etc.). If you do not use any apps, or less than four apps, just leave the respective fields blank.

Favorite app #1:
Favorite app #2:
Favorite app #3:
Favorite app #4:

8. On average, how often do you install new apps on your smartphone? [NV02]

- I've never installed a new app yet
- A few times a year
- Once a month
- Several times a month
- Several times a week

9. Have you ever paid for an app? [NV03]

Multiple answers possible. If you answer **no** and there is a special reason, you may **optionally** enter it in the text box (e.g. "no credit card").

- Yes, for buying the app
- Yes, while using the app (for features, credits, etc.)
- No, because:

10. Do you think it is better to use a single app with many different features, or many different apps, tailored to specific use cases? [NV04]

- One app with many features
- Many specialised apps

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42% completed

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11. How do you typically find new apps? [SE01]

Usually, I find new apps through (multiple answers possible):

- ☐ Personal recommendations (friends / relatives)
- ☐ Browsing app stores (Google Play / Android Market, App Store, etc.)
- ☐ App Web sites
- ☐ Media (newspapers, trade press, magazines)
- ☐ Search engines (Google)
- ☐ Other, namely:

12. How strongly do you feel about the following issues of apps concerning your security and privacy? [SC02]

	strongly disagree	disagree	undecided	agree	strongly agree
Sometimes I'm unsure whether an app is harmful or not (virus, trojan etc.)	○	○	○	○	○
I'm afraid that apps use my personal data without my knowledge or consent	○	○	○	○	○

13. In the course of an app installation, do you normally read the terms & conditions of use, and privacy policy? [SC04]

	No	Yes, I flip through it	Yes, I read it carefully
Terms and Conditions / Terms of Use	○	○	○
Privacy Statement	○	○	○
List of the required access privileges	○	○	○

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14. What does most likely keep you from installing an app you have found? [DE02]

Please rate the relevance of the issues below.

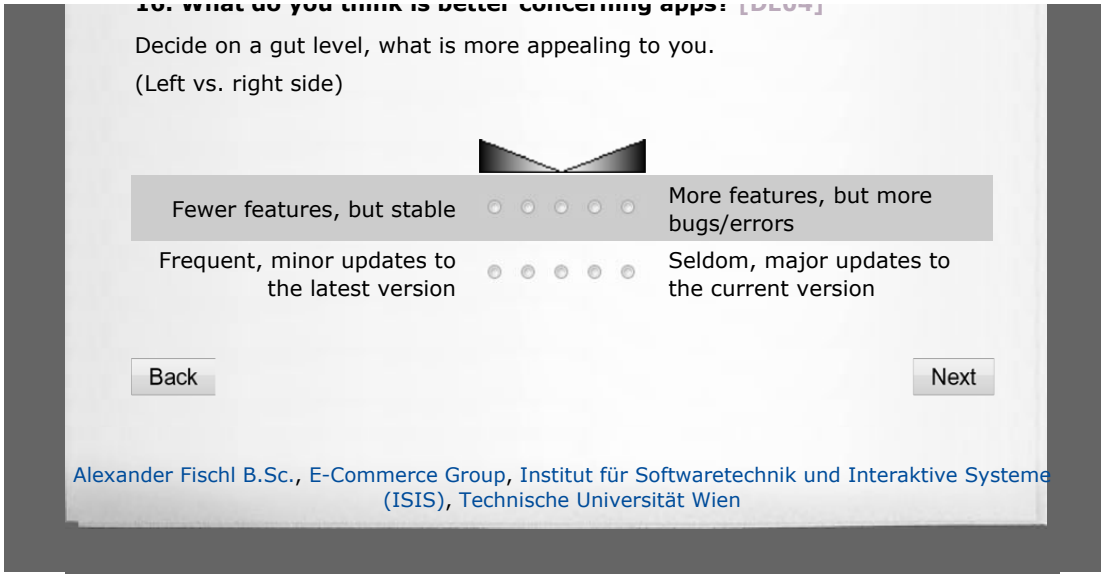
	strongly disagree	disagree	undecided	agree	strongly agree
Low ranking in the app store (position in search results)	○	○	○	○	○
Poor rating ("stars" / reviews)	○	○	○	○	○
Privacy concerns / fear of viruses	○	○	○	○	○
Poor presentation (bad description texts, icons, screenshots, etc.)	○	○	○	○	○

15. How important are the following aspects of an app to you? [DE03]

Please rank all aspects according to their importance.

To do this, drag the boxes from the left to the desired position on the right side (1 = most important, 8 = least important)

Customer support	1
Usefulness / Features	2
Low energy consumption	3
Friends are using the app	4
Speed / Performance	5
Prestige / exclusivity	6
Privacy protection	7
Good design	8


Decide on a gut level, what is more appealing to you.
(Left vs. right side)
Fewer features, but stable
More features, but more bugs/errors
Frequent, minor updates to the latest version
Seldom, major updates to the current version
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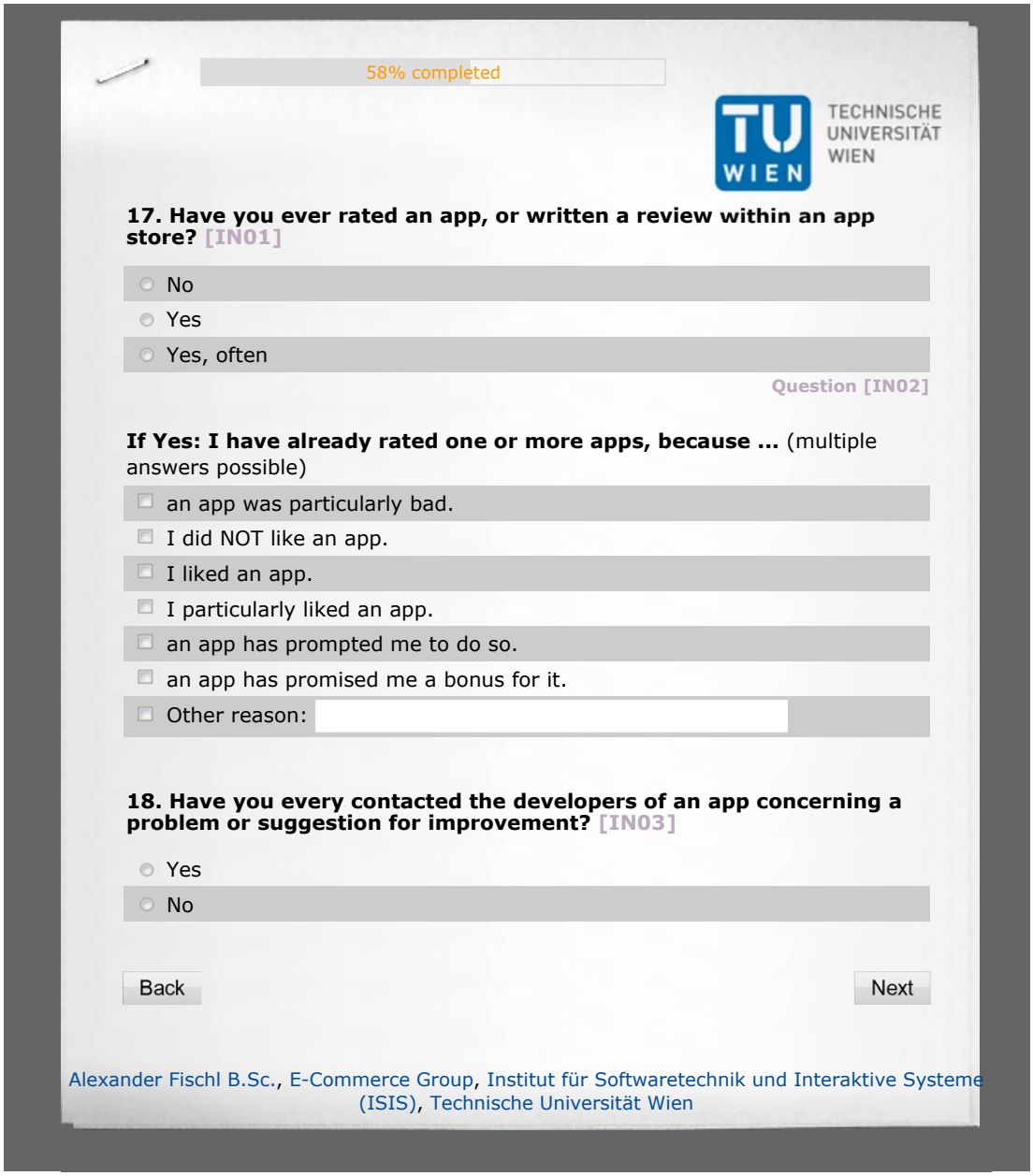
58% completed
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17. Have you ever rated an app, or written a review within an app store? [IN01]
No
Yes
Yes, often
Question [IN02]
If Yes: I have already rated one or more apps, because ... (multiple answers possible)
an app was particularly bad.
I did NOT like an app.
I liked an app.
I particularly liked an app.
an app has prompted me to do so.
an app has promised me a bonus for it.
Other reason:
18. Have you every contacted the developers of an app concerning a problem or suggestion for improvement? [IN03]
Yes
No
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67% completed
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19. Do you use a social network? [SO01]
If applicable, please select the networks that you have actively used lately (no unused accounts). Multiple selection is possible.
Facebook
Google+
Twitter
Myspace
LinkedIn
Xing
Foursquare
Other
Other
Other
20. Would you use an app that strictly requires a Facebook account? [SO04]
There are apps that require you logging in via a Facebook account, otherwise they cannot be used. Do you use such apps/would you use them?
Yes, no problem
Yes, if there's no alternative
No, absolutely not, because:
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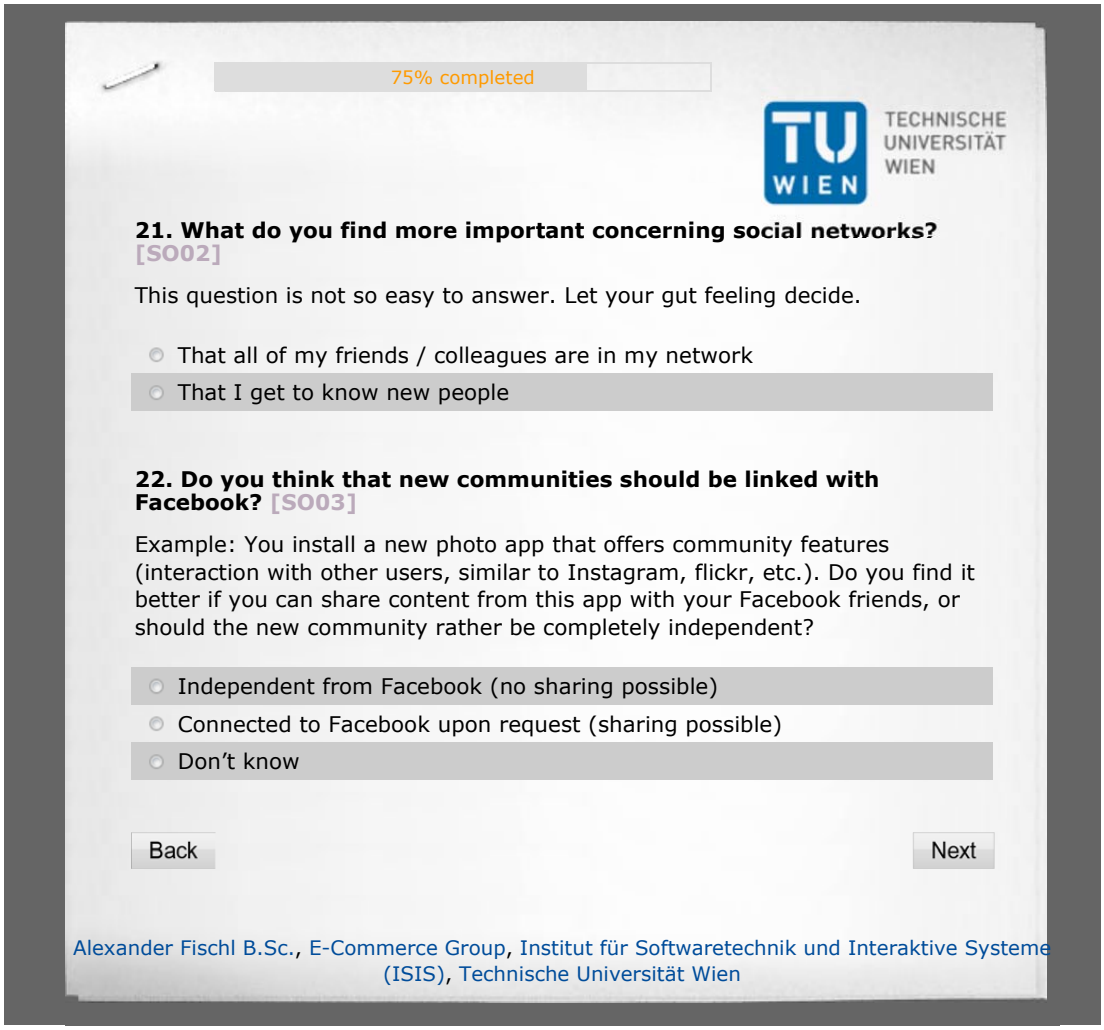
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21. What do you find more important concerning social networks? [SO02]
This question is not so easy to answer. Let your gut feeling decide.
That all of my friends / colleagues are in my network
That I get to know new people
22. Do you think that new communities should be linked with Facebook? [SO03]
Example: You install a new photo app that offers community features (interaction with other users, similar to Instagram, flickr, etc.). Do you find it better if you can share content from this app with your Facebook friends, or should the new community rather be completely independent?
Independent from Facebook (no sharing possible)
Connected to Facebook upon request (sharing possible)
Don't know
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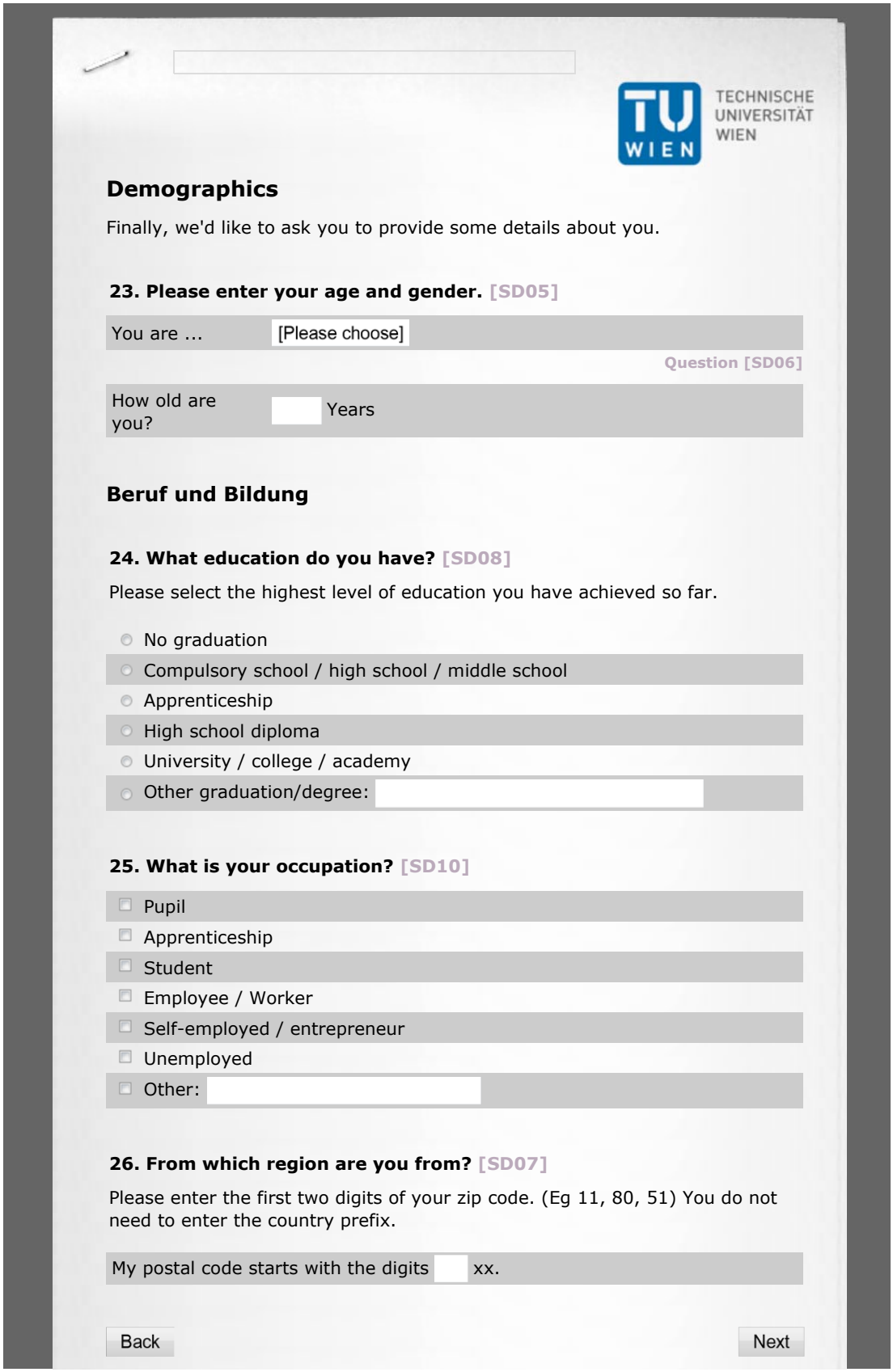

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Demographics

Finally, we'd like to ask you to provide some details about you.

23. Please enter your age and gender. [SD05]

You are ... [Please choose]

Question [SD06]

How old are you? Years

Beruf und Bildung

24. What education do you have? [SD08]

Please select the highest level of education you have achieved so far.

- No graduation
- Compulsory school / high school / middle school
- Apprenticeship
- High school diploma
- University / college / academy
- Other graduation/degree:

25. What is your occupation? [SD10]

- Pupil
- Apprenticeship
- Student
- Employee / Worker
- Self-employed / entrepreneur
- Unemployed
- Other:

26. From which region are you from? [SD07]

Please enter the first two digits of your zip code. (Eg 11, 80, 51) You do not need to enter the country prefix.

My postal code starts with the digits xx.

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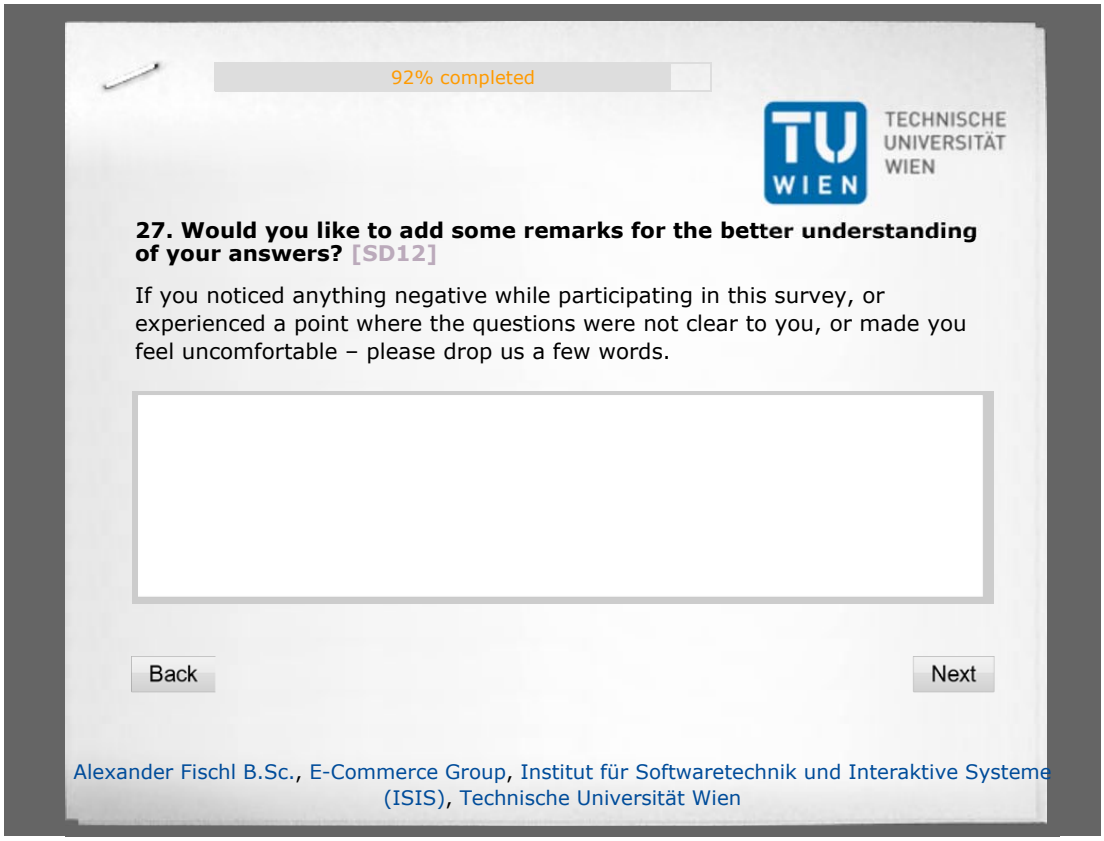
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27. Would you like to add some remarks for the better understanding of your answers? [SD12]
If you noticed anything negative while participating in this survey, or experienced a point where the questions were not clear to you, or made you feel uncomfortable – please drop us a few words.
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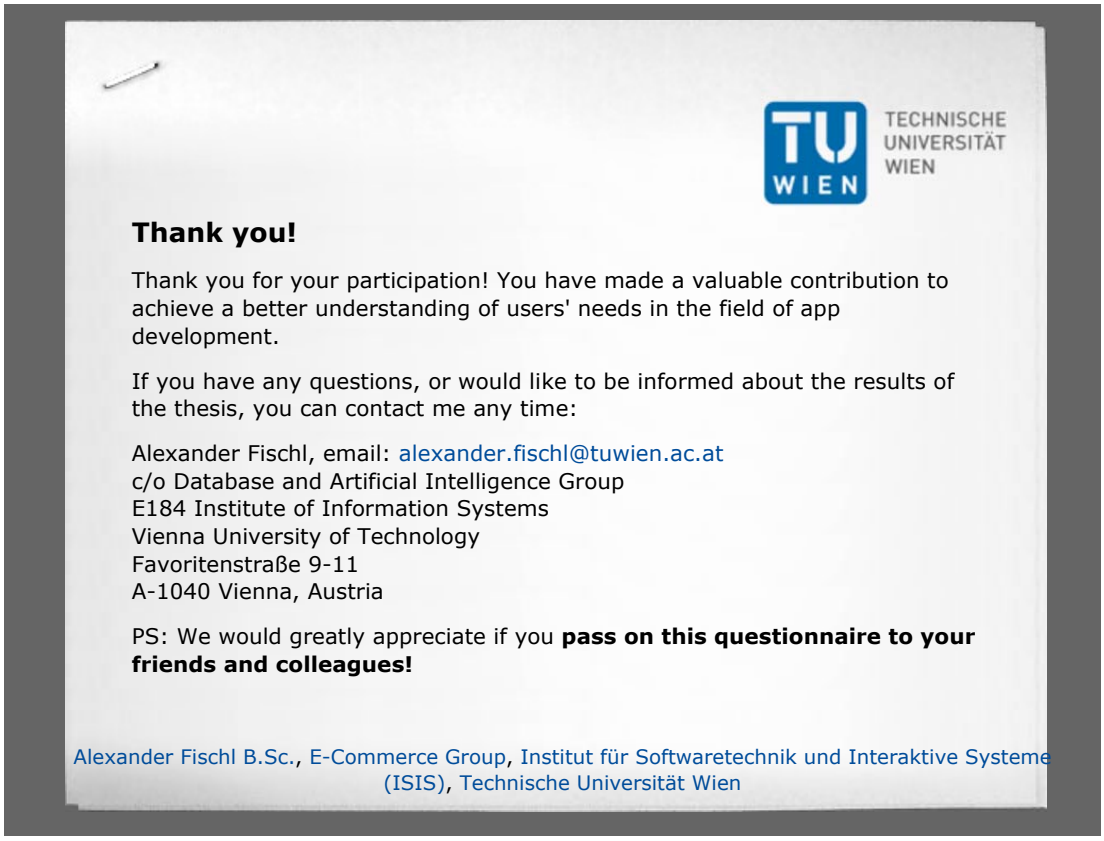
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Thank you!
Thank you for your participation! You have made a valuable contribution to achieve a better understanding of users' needs in the field of app development.
If you have any questions, or would like to be informed about the results of the thesis, you can contact me any time:
Alexander Fischl, email: alexander.fischl@tuwien.ac.at
c/o Database and Artificial Intelligence Group
E184 Institute of Information Systems
Vienna University of Technology
Favoritenstraße 9-11
A-1040 Vienna, Austria
PS: We would greatly appreciate if you pass on this questionnaire to your friends and colleagues!
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E. User Answers: Open Text Inputs

This section provides the actual feedback entered into the respective open text input fields of the survey. No alterations were made to these comments.

Question NV03: Reason for Not Having Paid Yet for an App

```
 1  Ich kein Geld für sowas ausgebe.
 2  risiko beim kauf. nicht so sehr interessiert.
 3  keine Kreditkarte
 4  weil ich die Apps die kosten höchstwarscheinlich doch nie nutzen werde.
 5  Kein Vertrauen in den Zahlungsverkehr
 6  keine Kreditkarte
 7  keine Kreditkarte; Vouchers sind anstrengend
 8  jene Apps, die ich brauche, (auch) kostenlos verfügbar sind.
 9  kreditkarte ist erforderlich und dann braucht mans doch nicht so dringen, dass es
    den aufwand wert wär. wenns z.b über die telefonrechnung od. so gehen würd, dann
    würd ich so 1euro apps mal gelegentlich ausprobieren. zugegebener maßen ;)
10  meine Bedürfnisse mit kostenlosen Apps abgedeckt werden können.
11  kein Interesse
12  ich keins dieser Apps wirklich benötige und sie mir deshalb auch nicht Wert sind
    dafür zu zahlen. Würde ich eine App jedoch wirklich gebrauchen (z.B. aus beruflichen
    Gründen), wäre ich auch bereit dafür zu zahlen.
13  ich apps dafür zu selten nutze.
14  meistens ein Gratisangebot vorhanden
15  die meisten apps auch kostenlos gibt.
16  viele brauchbare Apps auch kostenlos zur Verfügung gestellt werden.
17  Es gibt sehr gute Gratis-Apps.
18  Zu kostenpflichtigen Apps gibt es meist sehr gute kostenlose Alternativen, deren
    eventuell vorhandene Werbung meist auch nicht stört.
19  Es gibt zu viele Apps, die man gratis downloaden kann.
20  Bezahlmöglichkeiten in den Stores eingeschränkt Verwendung gecrackter Apps
21  Die Apps schon auf dem SM waren und nichts kosten
22  keine Notwendigkeit
23  noch keinen Zusatznutzen gesehen, der es Wert wäre
24  ich für Spiele, die nur zum Zeitvertreib dienen kein Geld ausgeben möchte.
25  Es bisher alle gratis gab, die ich gebraucht habe.
26  ich dafür niemals bezahlen würde.
27  Wäre nicht bereit dafür
28  nutze nur Gratis App
29  weil ich nur GratisApps benutze, bzw über Android ich nicht über Handyrechnung
    bezahlen kann.
30  Weil es genügend kostenlose Alternativen gibt
31  Weil ich keine Kreditkarte hab die dazu benötigt wird
32  Wichtigsten apps gibts auch gratis
33  ich noch über keine App gestolpert bin die etwas gekostet hätte.
34  keine Kreditkarte vorhanden.
35  Funktionsumfang der kostenlosen Apps reicht.
36  genug kostenlose apps vorhanden
37  keine Kreditkarte
38  keine Kreditkarte, genügend Gratis-Apps, schlechtes Smartphone (kaum Speicherplatz
    für mehr Apps, sehr langsam)
```

Listing 1: Text inputs for question NV03, option 03a

Question SO04: "Would You Use an App that Strictly Requires a Facebook Account?", Answer Option "No, because..."

1 Ich Angst habe, dass dieses App sämtliche fb-Daten von,mir einsieht und eventuell sogar für fremde Dinge oder Werbung nutzt.
2 Ich Facebook aus Privacy-Gründen wo möglich meide.
3 Ich Facebook selten, passiv und von in Bezug auf die privacy-settings sehr restriktiv nutze.
4 uninteressant
5 ist der grund für ich spotify nicht zu verwenden. ich mag den zwang nicht.
6 Kein Facebook-Account. Kein Interesse an Facebook! --> Stichwort: Datenschutz!!!
7 hat andere leute nicht zu interssieren
8 Keinen Facebook-Account
9 ich dann nur mein fake account verwenden würde
10 ich dem Login über Facebook generell kritisch gegenüber stehe (Datenschutzbedenken; Zwang, einen Facebook-Account zu haben, bzw. Ausschluss von Menschen ohne Facebook-Account ; erwartete Kurzlebigkeit von Facebook)
11 ich facebook nicht verwende
12 Kein Bock auf Vernetzung meiner Daten und komplexe Privatsphärenregelungen usw...
13 Weil ich Facebook nicht verwende.
14 Bedenken bezüglich der Privatsphäre & ich Facebook nicht noch mehr Marktmacht geben möchte
15 nicht alles mit Facebook verknüpft sein muss.
16 ich gerne selbst entscheiden würde, wer mein Facebook-Profil einsehen darf bzw. falls die App dann automatisch über meinen Login posten würde wäre mir das nicht recht.
17 ich Bedenken betreffend meiner Privatsphäre habe. Zudem nutze ich Facebook äußerst selten und nur im notwendigen Umfang.
18 Angst vor Zugriff auf Facebook-Daten
19 ich meine Daten nicht mit Facebook synchronisieren will. Es könnten Daten von meinem Smartphone unabsichtlich ungewollt veröffentlicht werden. Außerdem
20 Unzulässige Vermischung
21 Ich möchte nicht, dass Facebook und alle meine Bekannten wissen, dass ich die App verwende (Privatsphäre)
22 FB ist alleine schon schlimm genug...
23 ich keine apps verwende, die mit facebook in verbindung stehen und ich daher nicht verstehe, wofür eine app einen account benötigen könnte.
24 ich mich dadurch auf einer Website anmelden müsste, die ich nicht mag.
25 weil ich nicht unbedingt eine Facebook-Anbindung haben möchte
26 Datenschutz.
27 Unsicherheit bzgl. Daten-Nutzung
28 Angst um Datensicherheit
29 Auch Menschen ohne Facebook-Account sind Menschen
30 so wichtig kann keine app sein :)
31 Wenn ich FB nutze, dann weil ich FB nutzen will und nicht, weil ich die App nutzen will. Und umgekehrt.
32 Möchte nicht, dass die App in meinen Facebook Account Daten einträgt. Wenn dies garantiert nicht passiert und der Account nur zum Login verwendet wird, würde es mich weniger stören, da ich einen Account habe. Hätte ich keinen Account, würde ich deswegen keinen anlegen.
33 habe kein Facebook.
34 ich Kontoverknüpfungen in punkto Privatsphäre kritisch sehe.
35 warum Querverbindungen? Um Daten zu stehlen?
36 solche Apps im Newsfeed meiner Freunde nervig sein könnten.
37 ich die Verbindung damit nicht herstellen will.
38 Verweigere Registrierungspflicht über Facebook
39 nicht bei allen
40 weil ich nicht weiss was mit meinen daten passiert
41 weil ich nicht will dass eine app auf meine fb-daten zugreift ...
42 ich Facebook hasse
43 meines Erachtens die vielen Daten, die Facebook über mich gesammelt hat (bewusst oder unbewusst von Facbook erhobene), gehen der Firma, die die App gemacht haben nichts an und brauchen diese nicht zu wissen. Falls man doch nicht um den Facebook-Account herum komme, mache ich einfach einen Fake-Account auf

44 Kein FB account
45 Privatsphäre geht vor
46 Angst vor Zugriff der App auf persönliche Daten aus Facebook.
47 schwachsinnige Funktion
48 Ich lasse mir aus Prinzip keinen Account bei einem Bestimmten Anbieter aufzwingen
49 Ich möchte meine Daten (Freunde, Orte, Nachrichten, Gefällt mir Angaben usw usf) nicht weitergeben und nicht unabsichtlich erlauben, dass meine Nachrichten etc gelesen werden können. (Man liest ja oft, dass es Apps gibt die einzig und alleine dazu dienen private Daten aus FB-Accounts auszulesen, App = direkter und einfacher Zugriff)
50 ich apps keine Zugriff auch meine Facebookdaten geben will und schon gar nicht will, das apps in meinem namen posten können Falls sichergestellt ist, das nur der Login verwendet wird, würde ich es in manchen Fällen machen
51 Es gibt ganz einfach keinen Grund Benutzer dazu zu zwingen, einen FB-Account zu haben bzw. ihn mit einer App zu verknüpfen.
52 Es muss auch ohne gehen.
53 Grundsätzlich nicht - Facebook kennt meinen Realnamen, weil das im Facebook-Kontext Vorteile für mich bietet. Mir ist bisher keine App untergekommen, wo ich es wünschen würde oder es irgendeinen Vorteil für mich hätte, dass diese meinen Namen kennt und mich mit den Inhalten meines Facebookprofils verknüpfen kann
54 Facebook ist nicht vertrauenswürdig und es gibt für mich keinen Grund eine Verbindung zu sonstigen Aktivitäten herzustellen, die ich nicht explizit auf FB erwähnen möchte.
55 ich nicht will dass Programme auf meinen Facebook Account zugreifen (bzw. ich dazu gezwungen werde)
56 postet dann einträge in meinem namen
57 Weil ich facebooks Privatsphäreschutz nicht vertraue.
58 Damit sowohl auch Zwingend Internetverbindung erfordert wird, Zugriff auf persönliche Daten wie Namen & Alter möglich ist und meistens auch erweiterte Berechtigungen angefordert werden.
59 Ich halte meine Accounts gerne getrennt, will keinen Bezug zu anderen Services und nicht, dass zB Updates auf meiner Wall gepostet werden
60 eher nicht
61 das Erlauben von Zugriffen auf meine Facebook-Seite quasi zur Bedingung wird.
62 ich das nicht für nötig halte
63 kein Interesse an zwingenden Verknüpfungen
64 Apps sollten unabhängig von Facebook laufen.
65 weil 1. kein Facebook nutzer und ich keinem Nutzer-Zwang unterliegen möchte
66 Aus Angst, dass das nie wieder aus dem Netz verschwindet. Ich bin der Meinung, dass alles was mit Facebook zu tun hat, im Netz verbreitet wird und das möchte ich nicht.
67 ich keine sozialen Netzwerke nutze
68 ist mir nicht anonym genug
69 nicht gewünscht, zu öffentlich
70 Facebook account ungenutzt, wenig Interesse an sozialen Netzwerken.
71 ich nicht will, das div. Apps bzw. Anbieter unter meinem Facebook Namen Werbung oder ähnliches Posten bzw. Zugriff darauf hat.
72 -Kein gutes Gefühl bezüglich des Schutzes meiner Privatspähre -Lasse mich nicht dazu zwingen etwas zu tun
73 diese links sind mir unsympathisch
74 Facebook darf kein muss sein.
75 ich in dieser hinsicht um meine privatsphäre besorgt bin
76 ich nicht bei jeder App die Benachrichtigung auf FB ausstellen möchte und grundsätzlich kein Freund von der Verbindung von Services zu Facebook bin.
77 soweit kommts noch...
78 ich nicht auf Facebook bin.
79 die nsa darf lesen was sie will - aber facebook - nein. ist alles sehr undurchsichtig. man munkelt, wenn man eine fb app installiert, dürfen die entwickler die privatnachrichten lesen - um das jetzt genauer sagen zu können müsste man halt die agb lesen... aber wie ist es dann mit fb login für die app? will mir darüber keine gedanken machen müssen.
80 Ich Facebook verweigere
81 keine verbindung der nutzerdaten
82 Habe keinen Account
83 ich nicht FB-gezwungen sein will

```
 84  Habe da Bedenken was Datenschutz bzw. Privatsphäre-Schutz betrifft ... Verwende
     Facebook zwar, habe aber natürlich auch bei Facebook oft Bedenken bzw. Ist mir
     bewusst dass dort der Privatsphäre-Schutz auch schlecht ist!
 85  Ich will nicht gezwungen werden, etwas zu tun.
 86  Bedenken, bezüglich kontrollverlust über account
 87  facebook dann noch mehr über mich weiß
 88  Persönlichen Daten
 89  es immer andere Möglichkeiten gibt (zB Anmeldung per Email), was sicher langlebiger
     ist als FB
 90  nein
 91  ich die Appnutzung nicht an die Freigabe meines FB-Profils knüpfen will.
 92  keine Angabe
 93  geht keinem was an, wenn ich kindische spiele spiele :)
 94  was mach ich wenn mich facebook nicht mehr interessiert aber die app schon wenn
     beide möglichkeiten sind nutz ich die momentan von Facebook gebe aber zusätzlich
     die email an
 95  Warum soll ich mich von FB knebeln lassen.
 96  facebook muss nicht alles über mich wissen
 97  Keine Lust auf den Zwang
 98  nein
 99  Ich finde es unsinnig, dass ein Facebook Account ein Kriterium für eine App ist
100  keine verknuepfung der daten erwuenscht
101  ich nicht die Leute nicht mit belanglosen scores zuspammen will und auch net will
     das Facebook mehr weiß als ich will.
102  Datenschutz???
```

Listing 2: Text inputs for question SO04, option 01

Question SD12: General Survey Remarks and Comments[1]

```
 1  Bei der Berufsangabe fehlt ein Feld für "Arbeiter".[2]
 2  Es gibt unterschiedliche Soziale Netzwerke mit unterschiedlichem Charakter. Wenn
    der Freizeitcharakter wie z.B. bei Facebook im Vordergrund steht, dann bevorzuge
    ich es wenn viele meiner Freunde auch Mitgleider sind. Bei beruflich orientierten
    SNs ist das wiederum völlig egal.
 3  Leute die soziale Netzwerke nicht verwenden suchen wender freunde noch kontakte
    in sozialen netzwerken. die radio buttons bei der frage sind nötigung zu einer
    falschen antwort[3]
 4  Zu lange
 5  Ein Lob: Ich habe wirklich bereits an unzähligen Umfragen teilgenommen und selten
    sind die Fragen so klar gestellt, die Antwortmöglichkeiten so eindeutig.
 6  Wirklich sehr gute Umfrage!!! Die Fragen sind klug, das Design ansprechend und
    einfach zu bedienen. Herzlichen Glückwunsch. Hat sogar etwas Spass gemacht ;-)
 7  Bei Wechsel auf günstigeren Vertrag war das Handy dabei. Sonst hätte ich ein Palm
    Pre plus.
 8  iOS zeigt Zugriffsrechte nicht an sondern fragt bei erstmaliger Nutzung
 9  Ich würde mich sehr für die Ergebnisse der Studie interessieren. Ich hoffe sie
    werden öffentlich zugänglich gemacht!(Ich habe den Link zur Studie auf der austrian
    startup pinwall gefunden)
10  Die meisten Anwendungen die ich auf dem Smartphone nutze sind selbst entwickelt aber
```

[1] Some people were motivated by the introductory text to wish me luck completing this thesis. I have removed those responses for brevity here. Positive remarks were left in the list, as well as the almost completely absent negative comments.

[2] This comment came from the second survey response; thus I corrected the problem by extended the answering options here.

[3] I have immediately corrected this problem by making the social networking attitude question invisible for participants who indicated not to use social networks. The responses concerning social networking attitude from the previous participants who do not use social networks were discarded accordingly.

nicht über einen "App Store" veröffentlicht. Desweiteren achte ich bei Anwendungen bei Berechtigungen vor allem darauf in welcher Kombination sie gefordert werden (z.B. ist der Zugriff auf Telefonbuch / USB Speicher kein Problem sofern keine Internetverbindung oder das versenden von SMS angefordert wird). Bei Internet Permissions muss das Programm einen sehr guten Grund mitliefern wieso es diese benötigt (Werbung ist bis auf eine Ausnahme (Locus) kein Grund - genausowenig wie das Teilen von Inhalten auf Social Networks o.ä.)

11 "Soziales Netzwerk" ist ein zu breiter Begriff, um dabei eine klare Antwort auf die Frage (neue Leute kennenlernen vs. alle meine Freunde sind schon dort) zu geben. Kommt ganz auf den Kontext an: bei Facebook bin ich genau aus dem Grund, dass ich die Leute wirklich kenne, und es besteht kein Wunsch, darüber neue Leute kennenzulernen. (Friend Requests von Leuten die ich nicht persönlich kenne werden z.B. kategorisch abgelehnt.)Bei online-Foren aber (z.B.) ist genau das Gegenteil der Fall: da will man sich halt mit anderen Mitgliedern der selben Interessensgemeinschaft unterhalten, und es ist eigentlich nebensächlich, wenn dort auch Leute die ich wirklich kenne dabei sind.

12 mehr detailliertere Fragen zu app Nutzungsverhalten, gewünschten Features (im generellen von apps) und Hygiene Faktoren: "Was stört mich besonders an apps?" (in app werbung, registrierungspflicht,...) wären sicher sehr einsicht-liefernd

13 meine handynutzung hat sich in letzter zeit etwas verändert. verwende es derzeit fast nur zum telefonieren, smsn und für notizen (text, fotos). bevor ich ein ipad hatte habe ich vermehrt apps genutzt und auch gespielt. mein jetztiges smartphone is auch schon alt, langsam und buggy (cyanogenmod). mir ist es oft zu lästig auf einem so kleinem bildschirm mehr als das nötige zu machen.

14 10. Finden Sie es besser, eine einzelne App mit möglichst vielen Funktionen zu verwenden, oder viele unterschiedliche spezialisierte Apps je nach Anwendungsfall? Eine App mit vielen Funktionen Viele spezialisierte Apps kann man das allgemein ueberhaupt sagen?

15 Der Fragebogen ist sehr gut gemacht!

16 Gut gemacht.

17 letze Frage war nicht eindeutig ob der jetzige wohnort gemeint ist oder wo ich aufgewachsen bin.

18 hatte ein smartphone, nutze vorübergehend wieder ein - naja - nokia e irgendwas halt. userverhalten spiegelt mein verhalten mit fähigem gerät wieder;)

19 Top 4 Apps auswählen war echt nicht einfach. Nicht wegzudenken waren eher die Widgets, als die Apps an sich. Darum sind auch zwei Widgets, die ich eigentlich täglich nutze, in die Liste eingeflossen. Aber Trennung App/Widget für diese Umfrage wäre wahrscheinlich vielen zu kompliziert gewesen/hätte zu viel vorausgesetzt. Außerdem gibt es so was bei iOS ja auch gar nicht... Bez sozialer Netzwerke: Integration in Apps ist eine schreckliche Sache! Das Login Über (zB) Facebook macht den Einstieg oft einfacher, aber ein Ersatz sollte es nie sein!

20 Benutze CyangonMod mit OpenPDroid, somit kann ich die Rechte per App vergeben!

21 Negativ-formulierungen, denen man anhand einer Skala zustimmt sind etwas schwer zu entschluesseln.

22 sehr gut formulierte umfrage und fragen - da können sich manche umfrage-institute was abschauen ! gratulation dazu !

23 Nie wieder Smartphone,schon gar nicht Windows Betriebsystem, braucht Akku ohne Ende, Minstellungsmöglichkeiten minimal, Datentransfer zwischen PC und Handy nur im Multimediabereich möglich, Sicherung von Adressdaten unmöglich.

Listing 3: Text inputs for question SD12, option 01

F. Tables

Survey Variables Overview (Export from SoSci Survey)

CASE Fortlaufende Nummer der Versuchsperson
REF Referenz, falls solch eine im Link zum Fragebogen übergeben wurde
LASTPAGE Nummer der Seite im Fragebogens, die zuletzt bearbeitet und abgeschickt wurde
QUESTNNR Kennung des Fragebogens, der bearbeitet wurde
MODE Information, ob der Fragebogen im Pretest oder durch einen Projektmitarbeiter gestartet wurde
STARTED Zeitpunkt, zu dem der Teilnehmer den Fragebogen aufgerufen hat
FINISHED Information, ob der Fragebogen bis zur letzten Seite ausgefüllt wurde
TIME_001... Zeit, die ein Teilnehmer auf einer Fragebogen-Seite verbracht hat

Bitte beachten Sie, dass Sie die Fragebogen-internen Variablen nicht mit der Funktion value() auslesen können. Für Interview-Nummer und Referenz stehen aber die PHP-Funktionen
PHP-Funktion caseNumber() und PHP-Funktion reference() zur Verfügung.

Details über die zusätzlichen Variablen stehen in der Anleitung:
Zusätzliche Variablen in der Datenausgabe

Rubrik AG: Miscellaneous

[AG01] Selection
Own
"Do you own a smartphone?"

AG01 Own
1 = Yes
2 = No
-9 = Not answered

[AG02] Selection
Country
"From which country are you from?"

AG02 Country
1 = Austria
2 = Germany
3 = Switzerland
4 = Other
-9 = Not answered

AG02_04 Other
Free text

Rubrik SM: Smartphone

[SM01] Selection

OS
"Which operating system is running on your smartphone?"

SM01 OS

1 = Google Android
2 = Apple iOS (iPhone)
3 = Microsoft Windows Mobile/Windows Phone
4 = Blackberry
5 = Nokia Symbian
6 = Palm/WebOS
7 = Other, please specify:
8 = I don't know.
-9 = Not answered

SM01_07 Other, please specify

Free text

[SM02] Scale (fully labeled)
Features Adoption
"Which functions of your smartphone do you use?"

SM02_01 Phone
SM02_02 SMS
SM02_03 Email
SM02_04 Chat
SM02_05 Maps/Navigation/Directions
SM02_06 Web browser
SM02_07 Camera
SM02_08 Media player (music, video)
SM02_10 Payment (NFC, Paybox, etc.)

1 = Never
2 = Rarely
3 = Occasionally
4 = Frequently
5 = Very frequently (daily)
-9 = Not answered

[SM04] Selection
Buying Interval
"On average, how often do you buy a new smartphone?"

SM04 Buying Interval

1 = More often than once a year
2 = Once a year
3 = Every 1 to 2 years
4 = Less often than every 2 years
5 = Only as soon as my current phone gets broken/unusable
-9 = Not answered

Rubrik NV: Usage Behavior

[NV05] Selection
Apps Count
"Do you use third-party apps on your smartphone?"

NV05 Apps Count

1 = No apps
2 = 1 to 5 apps

3 = 6 to 10 apps
4 = More than 10 apps
-9 = Not answered

[NV01] Free Mentions
App Names
"What third-party apps do you consider an indispensable part of your daily routine?"

NV01 Number of mentions
Free input (integer)
NV01x01 Mention 1
NV01x02 Mention 2
NV01x03 Mention 3
NV01x04 Mention 4
Free text

[NV02] Selection
Install Freq
"On average, how often do you install new apps on your smartphone?"

NV02 Install Freq
1 = I've never installed a new app yet
2 = A few times a year
3 = Once a month
4 = Several times a month
5 = Several times a week
-9 = Not answered

[NV03] Multiple Choice
Apps Payment
"Have you ever paid for an app?"

NV03_01 Yes, for buying the app
NV03_02 Yes, while using the app (for features, credits, etc.)
NV03_03 No, because
1 = Not checked
2 = Checked
NV03_03a No, because (free text)
Free text

[NV04] Selection
App Features
"Do you think it is better to use a single app with many different features, or many different apps, tailored..."

NV04 App Features
1 = One app with many features
2 = Many specialised apps
-9 = Not answered

[NV06] Multiple Choice
No Apps Reason
"Is there a reason why you do not use third-party apps?"

NV06_01 I do not know how to install new apps
NV06_02 No internet access / data subscription
NV06_03 No time for that
NV06_04 No need for

NV06_05 Other reason

1 = Not checked
2 = Checked

NV06_05a Other reason (free text)

Free text

Rubrik SE: Searching

[SE01] Multiple Choice
Apps Discovery
"How do you typically find new apps?"

SE01_01 Personal recommendations (friends / relatives)
SE01_02 Browsing app stores (Google Play / Android Market, App Store, etc.)
SE01_03 App Web sites
SE01_04 Media (newspapers, trade press, magazines)
SE01_05 Search engines (Google)
SE01_06 Other, namely

1 = Not checked
2 = Checked

SE01_06a Other, namely (free text)

Free text

Rubrik SC: Security

[SC02] Scale (fully labeled)
Security-Privacy
"How strongly do you feel about the following issues of apps concerning your security and privacy?"

SC02_01 Sometimes I'm unsure whether an app is harmful or not (virus, trojan etc.)
SC02_02 I'm afraid that apps use my personal data without my knowledge or consent

1 = strongly disagree
2 = disagree
3 = undecided
4 = agree
5 = strongly agree
-9 = Not answered

[SC04] Scale (fully labeled)
TOC
"In the course of an app installation, do you normally read the terms & conditions of use, and privacy po..."

SC04_01 Terms and Conditions / Terms of Use
SC04_02 Privacy Statement
SC04_03 List of the required access privileges

1 = No
2 = Yes, I flip through it
3 = Yes, I read it carefully
-9 = Not answered

Rubrik DE: Development

[DE02] Scale (fully labeled)

Install Barriers
"What does most likely keep you from installing an app you have found?"

DE02_01 Low ranking in the app store (position in search results)
DE02_02 Poor rating ("stars" / reviews)
DE02_03 Privacy concerns / fear of viruses
DE02_04 Poor presentation (bad description texts, icons, screenshots, etc.)

1 = strongly disagree
2 = disagree
3 = undecided
4 = agree
5 = strongly agree
-9 = Not answered

[DE03] Ranking
Aspects Ranking
"How important are the following aspects of an app to you?"

DE03_01 Good design
DE03_02 Speed / Performance
DE03_03 Usefulness / Features
DE03_04 Prestige / exclusivity
DE03_05 Friends are using the app
DE03_06 Low energy consumption
DE03_07 Customer support
DE03_08 Privacy protection

1 = Rank 1
2 = Rank 2
3 = Rank 3
4 = Rank 4
5 = Rank 5
6 = Rank 6
7 = Rank 7
8 = Rank 8
-9 = Not ranked

[DE04] Polarity Profile
Update Frequency
"What do you think is better concerning apps?"

DE04_01 Fewer features, but stable/More features, but more bugs/errors

1 = Fewer features, but stable
5 = More features, but more bugs/errors
-9 = Not answered

DE04_02 Frequent, minor updates to the latest version/Seldom, major updates to the current version

1 = Frequent, minor updates to the latest version
5 = Seldom, major updates to the current version
-9 = Not answered

Rubrik IN: Involvement

[IN01] Selection
Reviewing
"Have you ever rated an app, or written a review within an app store?"

IN01 Reviewing

1 = No
2 = Yes
3 = Yes, often
-9 = Not answered

[IN02] Multiple Choice
Review Reasons
"If so, why have you done this?"

IN02_01 an app was particularly bad.
IN02_02 I did NOT like an app.
IN02_03 I liked an app.
IN02_04 I particularly liked an app.
IN02_05 an app has prompted me to do so.
IN02_06 an app has promised me a bonus for it.
IN02_07 Other reason

1 = Not checked
2 = Checked

IN02_07a Other reason (free text)

Free text

[IN03] Selection
Dev Contact
"Have you every contacted the developers of an app concerning a problem or suggestion for improvement?"

IN03 Dev Contact

1 = Yes
2 = No
-9 = Not answered

Rubrik SO: Social Community Aspects

[SO01] Multiple Choice
SN User
"Do you use a social network?"

SO01_01 Facebook
SO01_02 Google+
SO01_03 Twitter
SO01_05 Myspace
SO01_07 LinkedIn
SO01_06 Xing
SO01_12 Foursquare
SO01_09 Other
SO01_10 Other
SO01_11 Other

1 = Not checked
2 = Checked

SO01_09a Other (free text)
SO01_10a Other (free text)
SO01_11a Other (free text)

Free text

[SO02] Selection
Friends Attitude
"What do you find more important concerning social networks?"

SO02 Friends Attitude
1 = That all of my friends / colleagues are in my network
2 = That I get to know new people
-9 = Not answered

[SO03] Selection
Facebook Connection
"Do you think that new communities should be linked with Facebook?"

SO03 Facebook Connection
1 = Independent from Facebook (no sharing possible)
2 = Connected to Facebook upon request (sharing possible)
3 = Don't know
-9 = Not answered

[SO04] Selection
Facebook Coercion
"Would you use an app that strictly requires a Facebook account?"

SO04 Facebook Coercion
3 = Yes, no problem
2 = Yes, if there's no alternative
1 = No, absolutely not, because:
-9 = Not answered

SO04_01 No, absolutely not, because
Free text

Rubrik SD: Social Demographics

[SD05] Dropdown Selection
Gender
"Please enter your age and gender."

SD05 Gender
1 = Female
2 = Male
-9 = Not answered

[SD06] Text Input
Age
"Please enter your age."

SD06_01 How old are you? ... Years
Free input (integer)

[SD07] Cloze Text
ZIP
"From which region are you from?"

SD07_01 My postal code starts with the digits ... xx.
Free text

[SD08] Selection

Education

"What education do you have?"

SD08 Education

9 = No graduation
3 = Compulsory school / high school / middle school
5 = Apprenticeship
7 = High school diploma
8 = University / college / academy
10 = Other graduation/degree:
-9 = Not answered

SD08_10 Other graduation/degree

Free text

[SD10] Multiple Choice

Occupation

"What is your occupation?"

SD10_01 Pupil
SD10_02 Apprenticeship
SD10_03 Student
SD10_04 Employee / Worker
SD10_05 Self-employed / entrepreneur
SD10_06 Unemployed
SD10_07 Other

1 = Not checked
2 = Checked

SD10_07a Other (free text)

Free text

[SD11] Dropdown Selection

Income

"What is your approximate monthly income?"

SD11 Income

1 = less than 250 €
2 = € 250 to 500 €
3 = € 500 to € 1,000
4 = € 1,000 to € 1,500
5 = € 1500 to 2000 €
6 = € 2,000 to € 3,000
7 = € 3,000 to € 4,000
8 = € 4,000 to € 5,000
9 = € 5,000 and more
10 = I do not want to answer this
-9 = Not answered

[SD12] Text Input

Remarks

"Would you like to add some remarks for the better understanding of your answers?"

SD12_01 [01]

Free text

Spearman’s Rho Correlations

		Buying Interval	Apps Count	Installation Frequency	Security: Malware	Privacy	Apps Purchasing	In-App Purchasing	No Payment	Dev Contact	Reviewing	Facebook Connection	Facebook Coercion	Friends Attitude	Gender	OS (Major)	Age (Two Bins)	Age (Numeric)
Buying Interval	Correlation Coefficient	1,000	-,306**	-,319**	,136*	,145*	-,196**	-,221**	,189**	,212**	-,268**	-,059	-,105	,068	-,289**	,062	,120*	,111
	Sig. (2-tailed)	.	,000	,000	,027	,018	,001	,000	,002	,001	,000	,357	,088	,275	,000	,310	,045	,065
	N	278	278	265	265	265	265	265	265	265	265	244	265	259	278	272	278	278
Apps Count	Correlation Coefficient	-,306**	1,000	,538**	-,226**	-,081	,400**	,307**	-,391**	-,276**	,370**	-,006	,142*	,003	,323**	-,071	-,027	,010
	Sig. (2-tailed)	,000	.	,000	,000	,189	,000	,000	,000	,000	,000	,930	,021	,956	,000	,244	,654	,871
	N	278	278	265	265	265	265	265	265	265	265	244	265	259	278	272	278	278
Installation Frequency	Correlation Coefficient	-,319**	,538**	1,000	-,170**	-,147*	,260**	,283**	-,271**	-,227**	,380**	,055	,203**	,005	,307**	-,039	-,125*	-,169**
	Sig. (2-tailed)	,000	,000	.	,005	,017	,000	,000	,000	,000	,000	,392	,001	,937	,000	,530	,042	,006
	N	265	265	265	265	265	265	265	265	265	265	244	265	259	265	261	265	265
Security: Malware	Correlation Coefficient	,136*	-,226**	-,170**	1,000	,471**	-,206**	-,232**	,181**	,164**	-,182**	,014	-,160**	,006	-,280**	-,123*	,031	,001
	Sig. (2-tailed)	,027	,000	,005	.	,000	,001	,000	,003	,008	,003	,824	,009	,920	,000	,047	,614	,986
	N	265	265	265	265	265	265	265	265	265	265	244	265	259	265	261	265	265
Privacy	Correlation Coefficient	,145*	-,081	-,147*	,471**	1,000	-,112	-,233**	,104	,115	-,104	,028	-,201**	-,065	-,147*	-,093	-,111	-,111
	Sig. (2-tailed)	,018	,189	,017	,000	.	,069	,000	,093	,062	,092	,658	,001	,295	,016	,136	,070	,072
	N	265	265	265	265	265	265	265	265	265	265	244	265	259	265	261	265	265
Apps Purchasing	Correlation Coefficient	-,196**	,400**	,260**	-,206**	-,112	1,000	,332**	-,969**	-,266**	,222**	,022	,165**	,129*	,192**	,223**	,105	,158*
	Sig. (2-tailed)	,001	,000	,000	,001	,069	.	,000	,000	,000	,000	,732	,007	,038	,002	,000	,088	,010
	N	265	265	265	265	265	265	265	265	265	265	244	265	259	265	261	265	265
In-App Purchasing	Correlation Coefficient	-,221**	,307**	,283**	-,232**	-,233**	,332**	1,000	-,398**	-,318**	,342**	-,023	,181**	,016	,177**	,179**	-,015	,081
	Sig. (2-tailed)	,000	,000	,000	,000	,000	,000	.	,000	,000	,000	,716	,003	,797	,004	,004	,810	,191
	N	265	265	265	265	265	265	265	265	265	265	244	265	259	265	261	265	265
No Payment	Correlation Coefficient	,189**	-,391**	-,271**	,181**	,104	-,969**	-,398**	1,000	,288**	-,263**	-,026	-,191**	-,144*	-,152*	-,237**	-,089	-,153*
	Sig. (2-tailed)	,002	,000	,000	,003	,093	,000	,000	.	,000	,000	,684	,002	,021	,013	,000	,151	,013
	N	265	265	265	265	265	265	265	265	265	265	244	265	259	265	261	265	265
Dev Contact	Correlation Coefficient	,212**	-,276**	-,227**	,164**	,115	-,266**	-,318**	,288**	1,000	-,344**	,013	-,020	,041	-,261**	,013	-,074	-,067
	Sig. (2-tailed)	,001	,000	,000	,008	,062	,000	,000	,000	.	,000	,843	,741	,513	,000	,832	,227	,276
	N	265	265	265	265	265	265	265	265	265	265	244	265	259	265	261	265	265
Reviewing	Correlation Coefficient	-,268**	,370**	,380**	-,182**	-,104	,222**	,342**	-,263**	-,344**	1,000	,076	,142*	,065	,283**	-,021	-,018	,069
	Sig. (2-tailed)	,000	,000	,000	,003	,092	,000	,000	,000	,000	.	,237	,020	,295	,000	,733	,775	,265
	N	265	265	265	265	265	265	265	265	265	265	244	265	259	265	261	265	265
Facebook Connection	Correlation Coefficient	-,059	-,006	,055	,014	,028	,022	-,023	-,026	,013	,076	1,000	,238**	-,026	-,014	-,039	,070	,055
	Sig. (2-tailed)	,357	,930	,392	,824	,658	,732	,716	,684	,843	,237	.	,000	,689	,822	,552	,278	,394
	N	244	244	244	244	244	244	244	244	244	244	244	244	244	244	240	244	244
Facebook Coercion	Correlation Coefficient	-,105	,142*	,203**	-,160**	-,201**	,165**	,181**	-,191**	-,020	,142*	,238**	1,000	,128*	,016	,005	,014	-,021
	Sig. (2-tailed)	,088	,021	,001	,009	,001	,007	,003	,002	,741	,020	,000	.	,040	,796	,933	,826	,733
	N	265	265	265	265	265	265	265	265	265	265	244	265	259	265	261	265	265
Friends Attitude	Correlation Coefficient	,068	,003	,005	,006	-,065	,129*	,016	-,144*	,041	,065	-,026	,128*	1,000	,036	,122	,124*	,113
	Sig. (2-tailed)	,275	,956	,937	,920	,295	,038	,797	,021	,513	,295	,689	,040	.	,563	,051	,046	,069
	N	259	259	259	259	259	259	259	259	259	259	244	259	259	259	255	259	259
Gender	Correlation Coefficient	-,289**	,323**	,307**	-,280**	-,147*	,192**	,177**	-,152*	-,261**	,283**	-,014	,016	,036	1,000	-,145*	,095	,112*
	Sig. (2-tailed)	,000	,000	,000	,000	,016	,002	,004	,013	,000	,000	,822	,796	,563	.	,017	,098	,050
	N	278	278	265	265	265	265	265	265	265	265	244	265	259	306	272	306	306
OS (Major)	Correlation Coefficient	,062	-,071	-,039	-,123*	-,093	,223**	,179**	-,237**	,013	-,021	-,039	,005	,122	-,145*	1,000	,136*	,172**
	Sig. (2-tailed)	,310	,244	,530	,047	,136	,000	,004	,000	,832	,733	,552	,933	,051	,017	.	,024	,004
	N	272	272	261	261	261	261	261	261	261	261	240	261	255	272	272	272	272
Age (Two Bins)	Correlation Coefficient	,120*	-,027	-,125*	,031	-,111	,105	-,015	-,089	-,074	-,018	,070	,014	,124*	,095	,136*	1,000	,765**
	Sig. (2-tailed)	,045	,654	,042	,614	,070	,088	,810	,151	,227	,775	,278	,826	,046	,098	,024	.	,000
	N	278	278	265	265	265	265	265	265	265	265	244	265	259	306	272	306	306
Age (Numeric)	Correlation Coefficient	,111	,010	-,169**	,001	-,111	,158*	,081	-,153*	-,067	,069	,055	-,021	,113	,112*	,172**	,765**	1,000
	Sig. (2-tailed)	,065	,871	,006	,986	,072	,010	,191	,013	,276	,265	,394	,733	,069	,050	,004	,000	.
	N	278	278	265	265	265	265	265	265	265	265	244	265	259	306	272	306	306

Table 52: Spearman’s Rho for selected attributes, indicating the rank-based linear correlations. An asterisk (*) marks a correlation significant at the 0.05 level, two asterisks at the 0.01 level.

Cronbach's Alpha for the Security / Privacy Items

Scale: Security/Privacy

Case Processing Summary

		N	%
Cases	Valid	265	86,6
	Excluded[a]	41	13,4
	Total	306	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,725	3

Item Statistics

	Mean	Std. Deviation	N
Security-Privacy: Sometimes I`m unsure whether an app is harmful or not (virus, trojan etc.)	2,40	1,273	265
Security-Privacy: I`m afraid that apps use my personal data without my knowledge or consent	3,56	1,227	265
Install Barriers: Privacy concerns / fear of viruses	3,44	1,322	265

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Security-Privacy: Sometimes I`m unsure whether an app is harmful or not (virus, trojan etc.)	7,00	4,723	,558	,623
Security-Privacy: I`m afraid that apps use my personal data without my knowledge or consent	5,84	5,000	,533	,653
Install Barriers: Privacy concerns / fear of viruses	5,96	4,578	,549	,635

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
9,40	9,430	3,071	3

Table 53: Cronbach's Alpha for the security/privacy Likert-scale questions. The value of 0.725 indicates, that the internal consistency of the scale is within an acceptable range.