UNIVERSIDADE CATÓLICA PORTUGUESA

Personal data sharing acceptance for mobile application's users

Health Sector Analysis

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Católica Porto Business School
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Final Dissertation presented to Católica Porto Business School, Universidade Católica Portuguesa to obtain a master's degree in Management with specialization in Business Analytics

by

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Abstract

Mobile applications have become essential to people's daily lives, since nowadays they use mobile applications for many things other than just communicating. The use of mobile health applications has also increased. These apps have several benefits for both healthcare providers and patients. Companies that own mobile applications collect all types of personal information of their users. Geolocation is one of those data types. It is especially important for health mobile applications since it can help slow the spread of contagious diseases. When determining whether to disclose this kind of data, users must consider the benefits and risks of doing so.

This study's main goal is to discover which socio-demographic factors and perceived benefits and risks most strongly influence users' willingness to share their geolocation data with mobile applications. It was concluded that the users' generation, marital status, parenthood and employment status are the variables that impact the users' willingness to share geolocation data with mobile apps. Being able to use the service provided by an app and having their data used for other purposes are the most frequent benefit and risk experiences by the users, respectively. Yet, it was also shown that certain risks and benefits are viewed differently by users based on their generation and gender.

The following conclusions about other factors that influence the users' willingness to share geolocation data with apps were also drawn: users are more likely to share that data periodically rather than continuously; if the data processing procedures are transparent and if data anonymity is granted, that willingness increases; some characteristics of the company that owns an app influences that willingness; rewards like donations to charity, discounts and virtual reward points have little impact on the users' decision.

Keywords: Personal data sharing; Mobile applications; Health sector; Perceived risks and benefits; Geolocation.

Resumo

Nos dias de hoje, as pessoas usam aplicações para tudo. Inevitavelmente, a consequente utilização de aplicações do setor da saúde também tem vindo a aumentar. As aplicações do setor da saúde trazem vantagens para os prestadores de serviços de saúde e para os pacientes. As empresas detentoras das aplicações recolhem todo o tipo de informação pessoal dos utilizadores, nomeadamente a geolocalização. É especialmente importante para o setor da saúde, visto que pode ajudar na prevenção de doenças contagiosas. Partilhar este tipo de informação traz benefícios e riscos que têm de ser avaliados pelos utilizadores quando decidem se devem partilhá-lo com as aplicações.

O principal objetivo deste estudo é perceber quais os fatores sociodemográficos, riscos e benefícios que mais influenciam a disponibilidade dos utilizadores para partilhar dados pessoais de geolocalização com aplicações móveis, em particular, com aplicações do setor da saúde. Concluiu-se que a geração, o estado civil, a parentalidade e a situação profissional são os fatores que influenciam a decisão de partilhar dados pessoais de geolocalização com aplicações móveis. Poder utilizar o serviço prestado por uma *app* e ter os seus dados utilizados para outros fins são, respetivamente, o benefício e o risco mais referidos pelos utilizadores. Alguns benefícios e riscos são percecionados de forma diferente por utilizadores de géneros e gerações diferentes.

Relativamente a outros fatores que influenciam a disponibilidade dos utilizadores para partilhar dados de geolocalização aferiu-se que: estão mais disponíveis para partilhar esses dados esporadicamente do que continuamente; se o processamento de dados for transparente e o anonimato for garantido, essa disponibilidade aumenta; algumas características das empresas detentoras das *apps* influenciam essa decisão; recompensas como doações para a caridade, descontos e pontos de recompensa virtuais, não são relevantes para a sua decisão.

Palavras-chave: Partilha de dados pessoais; Aplicações móveis; Setor da saúde; Benefícios e Riscos; Geolocalização.

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1. Introduction

1.1. Problem Situation and Motivation

Today's world is more technologically advanced than ever. For billions of people worldwide, smartphones and mobile applications have become indispensable (Quermann & Degeling, 2020).

To provide their users with a more tailored experience and, consequently, increase their revenue and/or improve their brand's awareness, companies are using mobile applications to gather personal data shared by their users. However, those users are frequently unaware of the data being shared.

Over the years, numerous mobile applications have been created to improve health services. These have become essential to improve disease detection, offer patients disease management and treatment programs, and improve the health care systems.

The willingness to share personal data depends on the users' perceived costs and benefits (Wottrich et al., 2018). The term *perceived costs* refers to the possible costs entailed with customers' purchase decisions, which reflect a certain amount of future uncertainty (Zhou et al., 2020). Privacy issues are the most common perceived costs (Smith et al., 1996). Perceived benefits are perceptions about the favourable results associated with actions taken in response to a specific perceived risk (Farag Awad & Krishnan, 2006). They typically come in the form of monetary rewards or customization (Farag Awad & Krishnan, 2006).

This study's objective is to examine the socio-demographic characteristics and perceived risks and benefits that influence a user's decision to share geolocation data with mobile applications, focusing on health mobile applications.

1.2. Research Definition

This study's goal is to determine whether users are willing to share their personal information with mobile applications, focusing on geolocation data and the health sector, depending on the perceived costs and benefits of doing so as well as on socio-demographic characteristics.

Therefore, this study intends to answer the following question:

Which socio-demographic characteristics and perceived risks and benefits affect the users' willingness to share personal geolocation data with mobile applications and, in particular, with *mHealth* apps?

1.3. Methodology

An exploratory quantitative research methodology was used to develop this study. A questionnaire and in-depth interviews were the two selected methods to collect the data.

Ten respondents participated in in-depth interviews, which were essential for developing the questionnaire and selecting the most pertinent subjects for this study. These were a pilot study for the questionnaire.

The 271 respondents who completed the questionnaire were crucial in helping to generate more accurate and dependable replies to the suggested research questions.

The Statistical Package for the Social Sciences (SPSS), RStudio and Microsoft Excel were the chosen software to analyse the data gathered from the utilized methods.

1.4. Thesis Outline

The second chapter consists of the literature review. There are three subchapters in it. The first chapter, which is divided into two sub-subchapters, addresses the topic of technology. The first sub-subchapter covers the evolution of smartphones and mobile applications over time, and the second one focuses on the health sector. The second subchapter explores the concept of geolocation data, its key benefits and risks, and how it is being used in the health sector. The final subchapter, which is divided into two sub-subchapters, examines the personal data sharing. The first sub-subchapter focuses on the concept of personal data, while the second one emphasizes the main perceived benefits and risks that influence the users' behaviour and willingness to share geolocation data.

The third chapter includes everything concerning the methodologies used in this study. This chapter is divided into two subchapters. The first one describes the research methodology, data collection procedures and explains how the pilot study worked. The second subchapter presents the research design and data analysis. This section includes two sub-subchapters which outline the structure of the in-depth interviews and the questionnaire as well as how the data collected was analysed.

Chapter four includes three subchapters. The first and second subchapters, present the analysis of the results from the in-depth interviews and the questionnaire, respectively. The third subchapter consists of the analysis of the socio-demographic variables' impact on the users' willingness to share personal geolocation data.

The discussion, the conclusion, the limitations and the recommendation for future researchers are all included in the final chapter. The discussion highlights the key findings after analysing this study's results and compares them to those of past studies.

2. Literature Review

2.1. Technology

2.1.1. Smartphones and mobile applications evolution

With the evolution of technology, smartphones have become a necessary part of people's daily lives. On November 2, 1992, IBM introduced the Simon Personal Communicator, the first smartphone (Aamoth, 2014). A few years later, Steve Jobs announced the launch of Apple's iPhone and affirmed right away that only web-based apps could guarantee the device's viability as a product (Bell, 2011). The creation of the App Store in July 2008 helped the iPhone to levels of popularity never seen before and irrevocably changed the world of mobile phones and applications forever. By 2026, the market for mobile applications is expected to be worth more than $400 billion (Pramod & Supradip, 2019).

People started using mobile applications for other purposes besides essential communications (Jesdabodi & Maalej, 2015), such as managing health, online shopping and web browsing.

Mobile applications were also responsible for the changes in the interaction between companies and their clients. They are viewed as advertising and promotion tools that enable businesses to build customer loyalty, brand awareness and a solid reputation, which will, ultimately, lead to greater financial results (Kim et al., 2016) and to obtain a competitive edge (Zhou et al., 2020).

Apps promote the interaction between the company and the customer, increase market knowledge, and assist in segmentation, customization, and personalization (Rust & Espinoza, 2006). Data-driven companies are increasingly capturing and analysing the online and mobile activity of prospective customers (Kumar et al., 2018).

New business realities have emerged and are becoming more widely used as a result of the growth in the number of mobile applications and their users. The sharing economy, which is described as "*the peer-to-peer-based activity of obtaining, giving, or sharing access to goods and services, coordinated through community-based online services*", is one example of those new business realities (Hamari et al., 2016, p. 2047).

Mobile applications were essential for the spread of the "Internet of Things" (IoT). IoT consists of a collection of devices connected by smart sensors that let computers observe, categorize, and comprehend the world without the need for human intervention, because humans are not very good at gathering data about real-world things due to their limited time, attention and accuracy (Ashton, 2009). Information can be shared between users' mobile applications and the aforementioned devices through mobile apps.

Thus, it can be concluded that the advent of mobile phones and mobile applications was essential to facilitate the collaboration and communication between the customers and the companies (Rust & Espinoza, 2006) and to turn the marketing campaigns more customer-centric than product-centric.

2.1.2. Technology in the Health Sector

Following the development of technology over the past years, numerous devices and mobile apps have been developed to improve public health.

The use of medical datasets and data-driven research is gaining fast momentum and providing major opportunities for enhancing both health systems and individual care (Kostkova et al., 2016).

The Internet Medical Things (IoMT) is a branch of the IoT that is composed of, among others, clinical sensors, clinical frameworks, and computing frameworks. The IoMT helps in the diagnosing, treatment and maintenance of a patient's well-being and welfare (Judeehemanth et al., 2021). Healthcare service providers can

deal with chronic conditions in a better and faster way when they receive the patients' data in real time through IoT devices (Shin, 2017). They can also help reduce the number of contacts between patients and healthcare workers, resulting in a decrease in clinical costs and an increase in efficiency and adaptability (Abawajy & Hassan, 2017).

The connection between health mobile (*mHealth*) apps and wearable technology is revolutionizing healthcare and is especially beneficial to the elder generations (Malwade et al., 2018). *mHealth* apps offer potential strategies to boost older people's sense of autonomy, stop physical and cognitive deterioration, and offer aid with daily tasks (Dupuis & Tsotsos, 2018; Helbostad et al., 2017). Despite the increasing number of older adults using mobile apps daily (Rosales & Fernández-Ardèvol, 2019), they show a shortage of perceived self-efficacy when it comes to doing so (Rasche et al., 2018).

The Global Observatory for eHealth (GOe) defines *mHealth* as "*medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices*" (WHO Global Observatory for eHealth, 2011, p. 5). There were more than 350 000 health apps accessible from the various app stores in 2020, an increase of more than 90 000 apps from the year before (May, 2021). This number is anticipated to keep increasing.

There are three primary categories of health services offered by the *mHealth* apps: interventions to enhance disease detection, investigation, treatment, and monitoring; interventions to give disease management or treatment programs to patients; and interventions to enhance health care systems (Free et al., 2010).

Some researchers and global policy marketers argue that it is urgently necessary to recognize health data as a global public good with mechanisms to facilitate fast data sharing and data governance, as it would help them hasten the development of critical diagnostic essays (Schwalbe et al., 2020). Nevertheless,

this is still not consensual as there are still some concerns regarding this subject, mainly due to the risk of leakage and loss of privacy.

van Panhuis et al. (2014) summarized the major barriers to using public health data and emphasized six primary categories: technical, motivational, economic, political, legal, and ethical. Table 1 lists the barrier for each category:

Table 1: Major barriers with using public health data

Category	Barrier
Technical	Data not collected
	Data not preserved
	Data not found
	Language barrier
	Restrictive data format
	Technical solutions not available
	Lack of metadata and standards
Motivational	No incentives
	Opportunity cost
	Possible criticism
	Disagreement on data usage
Economic	Possible economic damage
	Lack of resources
Political	Lack of trust
	Restrictive policies
	Lack of guidelines
Legal	Ownership and copyright
	Protection of privacy
Ethical	Lack of proportionality
	Lack of reciprocity

Note. Adapted from *BMC Public Health (Vol.14, Issue 1)*, by van Panhuis et al., 2014

These risks are the main reasons why some health service providers are still sceptical about adopting mobile health devices, such as mobile applications, that require them to gather personal health data from their patients.

Not all patients are willing to share their personal health information with mobile applications either. This happens due to their perception of the risks and benefits of doing it and because of socio-demographic characteristics of the users. These topics will be the focus of this study, in order to answer the proposed research question, and will be explored in the following chapters.

2.2. Geolocation Data

The widespread usage of mobile phones in modern society makes it possible to collect loads of data in real-time, including geolocation data, which is helpful, for example, in clinical situations.

Most mobile applications nowadays make use of location-aware technologies, which gives them the ability to track users' locations in real-time and offer Location-Based Services (LBS). This tracking can be done through GPS or by requiring a location position system (Boutet & Cunche, 2021).

Since geolocation data can be linked to publicly accessible data sets with high spatial and temporal resolution and since it is less prone to recall bias than keeping a location diary, it is particularly helpful for boosting the validity of studies (Beukenhorst et al., 2017). However, the accuracy of geolocation is impacted by uncontrollable factors including the operating system of the phone (Ben-Zeev et al., 2015), app developer choices, and user-defined smartphone settings, hence the findings of a particular study may be in question (Beukenhorst et al., 2017).

In the health sector, the usage of geolocation data has become more significant. A growing range of wearable pocket-sized gadgets and location-tracking devices have been developed (Hardy et al., 2018). These wearable devices are connected

to *mHealth* applications which facilitate quicker and more straightforward communication between patients and healthcare providers.

Even if there are many cases of geolocation data being successfully used in *mHealth* applications – for instance, it was crucial for the containment of contagious diseases in the past – there are still some drawbacks and risks related to this type of data. These issues are mostly related to privacy concerns. The potential to pinpoint a user's work and home locations is the main issue with geolocation sharing with mobile apps and is the reason why some users are still wary of doing so (Krumm, 2009).

2.3. Personal Data Sharing

2.3.1. Concept

Most companies that own mobile applications view users' personal information as the currency of their businesses as it can be used for multiple commercial purposes. For instance, that information can be used to present the users with tailored advertisements. Occasionally, users are not aware of which data is being gathered by the mobile application, with who it is being shared and/or if it is being used for other purposes than the agreed ones. All these concerns influence their willingness to share their data.

In article 4 paragraph 1 of the General Data Protection Regulation (GDPR), the personal data regulation in the European Union, personal data is described as "*any information relating to an identified or identifiable natural person; an identifiable natural person can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person*". (European Parliament and Of The Council, 2016, p.5)

A study developed by Libert (2015) concluded that users are not aware of what type of information is gathered by mobile apps and what those apps do with the acquired data. However, due to the current laws, Android and iOS do not require the apps to notify the user that they are sharing the user's data with third parties (Zang et al., 2015). Most time, the users need to accept an app's permission request to be able to download the app and share their data without even noticing (King et al., 2011). Zang et al. (2015) also mentioned that the user's name, email address and location are the information that is transmitted the most to third parties.

2.3.2. Consumers' behaviour and willingness to share geolocation personal data

The decision to share geolocation personal data will depend on the users' behaviour and attitude towards risk, as different people value different things. When deciding on whether to share their geolocation data with mobile applications, individuals weigh the perceived benefits and costs of their actions (Wottrich et al., 2018). The analysis of whether different users will perceive the risks and benefits of sharing geolocation data with mobile applications, including *mHealth* ones, will be crucial to answer the proposed research question, as it will also allow us to understand which socio-demographic variables will impact that willingness the most.

The Privacy Calculus Theory is the most common method of explanation for this trade-off. The user assesses all the costs and benefits of providing their information to the apps and determines if doing so is worthwhile or not based on the app's perceived value. A higher perceived app value results in consumers being less strict about an app's privacy setting (Keith et al., 2013).

Even so, the reality is that more information is required to comprehend individuals' privacy decision-making processes than simply the cost-benefit trade-off, because costs and benefits are frequently changed, resulting in inaccurate trade-offs. Some authors argue that individuals occasionally may have access to information about the costs and benefits of sharing their information with a specific app but may not be able to fully understand them and, as a result, are unable to make a logical decision (Acquisti & Grossklags, 2005).

Thus, the users' behaviour regarding personal data sharing with the apps depends on individual and social dimensions (Reddy et al., 2018). The authors enumerate the following individual dimensions that might have an impact on the user's decisions: age, gender, education level, income level, health insurance, region, ethnicity, and language. Some of these individual dimensions will be tested in the questionnaire that will be analysed later in this paper. That questionnaire will be essential to conclude which individual dimensions impact the users' willingness to share geolocation data, answering the presented research question. In the case of health decisions, health awareness and e-health literacy are also important factors. In terms of the social component, users' behaviour is mainly influenced by source reliability and legal concerns (Wang et al., 2021).

3. Methodology

3.1. Research Methodology, Data Collection and Pilot Study

This research aims to identify which socio-demographic characteristics and perceived risks and benefits affect users' willingness to share their geolocation data with mobile apps, focusing on the health sector.

Given that this research will generalize the results from a sample group (the people who will take the questionnaire) to an entire group of people, a quantitative research methodology is the most appropriate.

Two different methods were combined: in-depth interviews and, a questionnaire that was first introduced by a pilot study.

An in-depth interview is designed to combine structure and flexibility. It is essentially a conversation between two people but the researcher has several important topics to cover and will base their interview on a topic guide with prepared open questions that allow the respondent to answer them freely (Legard et al., 2003). The in-depth interviews were essential to highlight the main demographic factors that influence a user's decision to share personal geolocation data with mobile applications and the main perceived benefits and risks of doing so. These worked as a pivot study for the questionnaire.

Online questionnaires are a valuable tool for conducting survey research because they give researchers access to unique groups or individuals that would be challenging to reach through other means; they allow the researchers to quickly reach large numbers of people; and they are an inexpensive electronic channel (Wright, 2006). In this study, the questionnaire was the main tool as its responses were essential to develop the necessary analysis to answer the proposed research question.

Before spreading the questionnaire, another pilot study was conducted to check if the questionnaire was prepared to be given to a broader sample of persons from multiple backgrounds. For this pilot study, convenience sampling was used to select a small number of respondents from a larger group of possible participants (Cooper & Schindler, 2014). The pilot study was useful to identify flaws in the initial version of the questionnaire and to make adjustments to the final one.

3.2. Research Design and Data Analysis

3.2.1. In-depth interviews

Information was collected from 10 interviewees from different age generations.

The interviews were divided into 5 parts. Their structure can be found in *Appendix I*.

The first part was composed of four questions, whose goal was to gather demographic information about the interviewees.

The second section was essential to determining whether it was worthwhile to interview the selected individuals. It was asked if the interviewees own a smartphone with access to the internet if they download mobile applications that required them to share personal geolocation data and, in particular, *mHealth* applications. The interviewees were also asked if the company that owns the app affects their decision on sharing personal geolocation data.

The third part consists of two questions regarding the benefits and risks associated with sharing geolocation data with mobile applications.

The final part questions the interviewees if their willingness to share personal geolocation data is influenced by the app sector and if they feel more comfortable doing so with *mHealth* apps.

3.2.2. Questionnaire

The questionnaire was carried out through an online survey, created on Microsoft Forms. The questionnaire was divided into three sections.

The first section gathers the personal and demographic data of the respondents. This section includes questions 1 to 9.

The second section includes general questions about the users' attitude towards sharing personal geolocation data with mobile apps.

The last section pinpoints factors that influence a person's willingness to share personal geolocation data with mobile apps.

The full structure of the questionnaire can be found in *Appendix II*.

A pilot study was carried out to evaluate the questionnaire's quality before its distribution. Ten respondents made up the sample for the pre-test, which was useful to highlight confusing questions while also demonstrating that most of the questions were comprehensible.

The questionnaire received a total of 271 replies, 3 of which were disregarded because they did not meet the requirement of having a smartphone with access to the internet. The criteria for stopping collecting replies was two weeks without new responses.

RStudio, Statistical Package for Social Sciences (SPSS) and Excel Pivot Table tools were used to analyse the answers to the questionnaire and draw conclusions about them.

4. Results

4.1. In-depth interviews results

The interviews were conducted to 10 people. As this study includes personal questions and sensitive information, people under the age of 18 were not considered.

Table 2: Demographic information of the interviewees

Interviewee	Gender	Age Group	Region
1	Male	55-64	Porto
2	Female	55-64	Porto
3	Male	45-54	Aveiro
4	Female	45-54	Braga
5	Male	35-44	Porto
6	Female	35-44	Aveiro
7	Male	25-34	Porto
8	Female	25-34	Porto
9	Male	18-24	Aveiro
10	Female	18-24	Braga

Table 2 presents the demographic information of the interviewees. Half of them were males, and the other half were females. The in-depth interviews were carried out to five of the seven age groups that will be considered in the questionnaire.

Regarding the region of residence: 5 interviewees were from Porto, 3 were from Aveiro and 2 were from Braga.

The second part started with a question that intends to understand if all the interviewees own a mobile phone with access to the internet. This question was followed by two other questions that asked whether the interviewees download mobile applications that require their personal geolocation data and, in particular, health mobile applications.

Table 3: Information regarding the mobile phone with access to the internet, mobile applications that require sharing personal geolocation data and health mobile applications that require sharing geolocation data usage

Statement	Answer	N
Mobile phone with access to the internet usage	Yes	10
Mobile applications that require sharing personal geolocation data	Yes	10
Health mobile applications that require sharing personal geolocation data	Yes	7

As presented in Table 3 all interviewees answered positively about owning a mobile phone with access to the internet and downloading apps that require sharing personal geolocation data. 70% of the interviewees download *mHealth* apps that require geolocation data sharing.

For instance, Interviewee 5 indicated that he uses Google Maps almost every day because his job requires him to drive often. According to interviewee 10, she uses WhatsApp to share her geolocation with her friends so they can find each other when they go out. Interviewee 10 mentioned that he shares his geolocation with *mHealth* applications to track his running progress and save the routes he takes.

Table 4: Variable "The company who owns an app affects your willingness to share personal geolocation data" answers

Statement	Answer	N
The company that owns an app affects your willingness to share personal geolocation data	Yes	9

90% of the interviewees said that their willingness to share personal geolocation data is affected by the company that owns the apps.

In the third part of the questionnaire, the interviewees were asked which benefits and risks they believe they have when sharing their geolocation data.

Table 5: "Perceived benefits" answers

Perceived Benefit	N
Being able to use the service provided by an app	7
Being able to get a faster and more effective experience with an app	2
Being able to get more customized services in an app	2

Starting with the benefits, 70% of the respondents mentioned being able to use the service provided by an app; 20% mentioned having a faster and more efficient experience with the apps; and 20% highlighted having a more personalized experience.

Table 6: "Perceived risks" answers

Perceived Risks	N
Having their data used for other purposes	7
Fraud	6
Having their data controlled by other companies	2
Having their data used by other companies	2

As for the risks, 70% mentioned having their data used for other purposes; 60% mentioned frauds; 20% mentioned having their data used by other companies; and 20% mentioned having their data controlled by the government.

Finally, the interviewees were questioned whether their willingness to share their geolocation data with an app is influenced by its sector.

Table 7: Variable "Willingness to share personal geolocation data is influenced by the app sector" and "More willing to share personal geolocation data with apps in the health sector" answers

Statement	N
Willingness to share personal geolocation data is influenced by the app sector	6
More willing to share personal geolocation data with apps in the health sector	5

6 interviewees answered affirmatively to that question. 5 of those interviewees said they were more comfortable sharing their geolocation data with *mHealth* apps.

4.2. Questionnaire results

The purpose of this chapter is to evaluate the questionnaire results. The survey yielded 271 responses, of which 268 were considered valid. Answers from interviewees who do not have a smartphone with the internet were not regarded as valid.

Table 8: Gender and age of questionnaire respondents

	Valid Percent (%)
Gender	
Female	64.93
Male	33.95
Prefer not to disclose	1.12
Total	100
Age Group	
18-24	56.34
25-34	15.30
35-44	13.43
45-54	10.07
55-64	3.74
65-74	0.75
>74	0.37
Total	100

Of the 268 respondents, the most part (64.93%) were females. As for the age groups, about 56.35% of the respondents fall under the 18-24 age range. There was only one respondent over the age of 74 years old.

Table 9: Level or degree of schooling completed by questionnaire respondents

	Valid Percent (%)
Level of schooling	
No schooling completed	0
Primary school	0.75
Lower secondary school	0.37
High school	20.52
Bachelor's degree	61.19
Master's degree	15.30
Doctorate degree	1.87
Total	100

Regarding the highest level of degree of education completed, 61.19% of the respondents had completed a bachelor's degree. No respondent had no schooling completed.

Table 10: Marital status and children information of questionnaire respondents

	Valid Percent (%)
Marital Status	
Single	72.76
Married	21.64
Divorced	3.73
Widowed	0.75
Civil union	1.12
Total	100
Children	
Yes	25.75
No	74.25
Total	100

In terms of the respondents' marital status, most of them are single. Only 25.75% are parents.

Table 11: Employment status and household net income of questionnaire respondents

	Valid Percent (%)
Employment status	
Full-time employed	48.51
Part-time employed	1.49
Housewife	0
Student	29.48
Student Worker	14.18
Retired	1.49
Unemployed	3.36
Unable to work	0.37
Self-employed	1.12
Total	100
Household net income	
Less than 750 euros	7.09
750 to 1000 euros	14.93
1001 to 1500 euros	20.90
1501 to 2000 euros	17.15
2001 to 2500 euros	13.81
2501 to 3000 euros	9.70
3001 euros or more	16.42
Total	100

Regarding the employment status, most respondents are employed full-time (48.51%) and students (29.48%).

As for the monthly household income (after taxes), the results are well distributed as can be seen in Table 11.

Table 12: Risk attitude of questionnaire respondents

	Valid Percent (%)
Risk attitude	
Very risk-averse	8.96
Willing to take modest risks but only after careful research and consideration	44.40
Willing to take modest risks after some thought	28.36
Willing to take substantial risks after careful research and consideration	12.68
Willing to take substantial risks after taking professional advice	2.24
Someone who embraces risk, perhaps without sufficient consideration	3.36
Total	100

To finalize the demographic questions, most respondents are willing to take modest risks but only after careful research and consideration.

Table 13 makes it possible to examine the frequency of answers to questions 10 and 11 of the questionnaire.

Table 13: Frequency of variables "Smartphone with access to the internet usage" and "Mobile Apps that require sharing geolocation data"

Smartphone with access to the internet usage	**Valid Percent (%)**
Yes	98.89
No	1.11
Total	100
Apps that required sharing geolocation data usage	
Yes	93.66
No	6.34
Total	100

Most respondents have a smartphone with access to the internet usage and download apps that require sharing geolocation data usage. If the respondents select "No" on any of these questions, the questionnaire ends.

As the following questions were only posed to users who share their geolocation with mobile applications, only 251 responses will be analysed.

Table 14: Frequency of variables "Download apps which require geolocation data continuously", "Download apps which require geolocation data periodically" and "Download mHealth apps that require geolocation data"

Download apps which require geolocation data continuously	**Valid Percent (%)**
Yes	69.72
No	30.28
Total	100
Download apps which require geolocation data periodically	
Yes	92.83
No	7.17
Total	100
Download *mHealth* apps that require geolocation data	
Yes	47.81
No	52.19
Total	100

69.72% of the respondents download apps that require them to share their personal geolocation data continuously, while 92.83% respondents download apps that only require them to do it periodically.

Only 47.81% of the respondents download *mHealth* apps that require them to share personal geolocation data.

Table 15: Frequency of variables "Transparency", "Anonymity", "Company Profile" and "Pandemic Impact"

More inclined to share personal geolocation data if the data processing procedures are transparent	**Valid Percent (%)**
Yes	70.12
No	29.88
Total	100
More inclined to share personal geolocation data if data anonymity was granted	
Yes	85.66
No	14.34
Total	100
The company that owns the app affect the decision on sharing personal geolocation data	
Yes	76.10
No	23.90
Total	100
The willingness to share personal geolocation data increased after the pandemic	
Yes	20.23
No	79.77
Total	100

The majority of the respondents are more inclined to share personal geolocation data if the data procedures are transparent and if data anonymity is granted. Only 20.23% affirmed that their willingness to share this type of data increased after the pandemic.

Table 16 displays the frequency of replies to the questions regarding the perceived benefits and risks that the users perceive when sharing their geolocation data with mobile applications.

Table 16: Frequency of variables "Perceived Benefits" and "Perceived Risks"

		Percentage
Perceived Benefits	Use the service provided by an app	53.29
	Faster and more effective experience	27.25
	Being able to get more customized services in an app	18.86
	Other – No problems with data sharing	0.60
	Total	100
		Percentage
Perceived Risks	Fraud	31.80
	Data used for other purposes	37.17
	Data controlled by other companies	21.26
	Data controlled by the government	9.00
	Other – Cyberattacks	0.77
	Total	100

It was concluded that the ability to use an app's service is the perceived benefit that the respondents value the most.

In terms of perceived risks, the results are more mixed; respondents are most concerned about their data being used for other purposes, followed by fraud and by other companies controlling their data.

Question 21 asks whether respondents agree or disagree with certain claims about several factors that might affect users' decisions to share their geolocation data with mobile applications.

To facilitate the analysis of the results, the responses were tallied on a scale of 1 to 5, where 1 represents a strong disagreement; 2 a disagreement; 3 a neutral opinion; 4 an agreement; and 5 a strong agreement.

Table 17 represents all the statements ranked from the most "relevant" factor to the least based on their mean.

Table 17: Rating of the willing to share personal geolocation data based on different factors

	Ranking	Mean (std. deviation)
I am more willing to share personal geolocation data if it allows me to get useful information.	1	3.74 (0.981)
My willingness to share personal geolocation data is influenced by the app sector.	2	3.52 (1.080)
I am more willing to share personal geolocation data with health apps.	3	3.43 (1.123)
I am more willing to share personal geolocation data if the services provided by the app are more personalized.	4	3.24 (1.176)
The company size affects my decision on sharing personal geolocation data.	5	3.15 (1.115)
I feel more comfortable sharing my geolocation data in apps that belong to big companies in comparison to apps that are created by startups.	6	3.10 (1.101)
I am more willing to share personal geolocation data if the app offers a donation to charity.	7	2.71 (0.859)
I am more willing to share personal geolocation data if the app offers me a discount.	8	2.67 (1.109)
I am more willing to share personal geolocation data if the app offers virtual reward points.	9	2.47 (1.105)

It can be concluded that users' willingness to share their geolocation data with a mobile application is influenced the most by their ability to get useful information.

Additionally, it can be inferred that the sector of the app has an impact on users' willingness to share geolocation data and that users are more likely to do it with *mHealth* apps. Personalization also seems to be a key component in the users' decisions.

The size of the company that owns a mobile app slightly affects the user's decision to share their geolocation data and users seem to be slightly more comfortable with sharing it with big companies than with startups. However, the mean of these factors is quite close to 3, which indicates that users have no strong opinions about them.

The three types of rewards mentioned in the questionnaire do not make users more willing to share their geolocation data with mobile apps.

4.3. Variables impact

Throughout this chapter, the impact of the main demographic variables on the users' willingness to download mobile apps, and in particular *mHealth* apps, that require them to share personal geolocation data will be analysed using Kruskal-Wallis H tests and Mann-Whitnney U tests. Kruskal-Wallis H tests are used for comparing three or more groups on a dependent variable that is measured on at least an ordinal level. Mann-Whitney U tests are used to determine whether the dependent variable differs between two independent groups. It evaluates if the dependent variable's distribution is the same across two groups (Mann & Whitney, 1947).

The analysis of the variables' impact is the most relevant one as it helps answering the proposed research question, since it allows us to understand which socio-demographic characteristics impact the most the users' willingness to share personal geolocation data.

The following tests' computed means were tallied on a scale from 0 to 1. In the statements about whether respondents download mobile applications and, in

particular, *mHealth* applications, a value of 0 indicated that they do not do it, while a value of 1 indicates the opposite. As for the statements regarding the perceived benefits and risks, 0 means the respondents did not tick that benefit/risk; while 1 means that they did.

All the tests conducted in this study assumed a significance level of 0.05 and a 95% interval of confidence.

4.3.1. Impact of gender

To determine whether users' willingness to share their geolocation data with mobile apps, and in particular *mHealth* apps, was impacted by their gender, multiple Kruskal-Wallis H tests were used. This test was also fundamental to evaluate how gender influences how users perceive benefits and risks.

Table 18: Gender impact on users' willingness to share personal geolocation data with mobile applications, including mHealth ones, and on the perceived benefits and risks

Statements	**Gender**		**p-value**
	Male	**Female**	
	Mean (std. deviation)	**Mean (std. deviation)**	
The distribution of "Download apps in which you need to share geolocation data" is the same across categories of Gender	0.936 (0.246)	0.920 (0.273)	0.292
The distribution of "Download *mHealth* apps in which you need to share geolocation data" is the same across categories of Gender	0.477 (0.502)	0.469 (0.501)	0.190
The distribution of "Being able to get a faster and more effective experience with an app" is the same across the categories of Gender	0.420 (0.496)	0.329 (0.471)	0.376

The distribution of "Being able to get more customized services in an app" is the same across the categories of Gender	0.333 (0.474)	0.199 (0.400)	**0.014**
The distribution of "Being able to use the service provided by an app" is the same across the categories of Gender	0.701 (0.460)	0.708 (0.456)	0.978
The distribution of "Fraud" is the same across the categories of Gender	0.609 (0.491)	0.634 (0.483)	0.443
The distribution of "Having your data used for other purposes" is the same across the categories of Gender	0.770 (0.423)	0.770 (0.422)	0.907
The distribution of "Having your data controlled by other companies" is the same across the categories of Gender	0.494 (0.503)	0.404 (0.492)	0.268
The distribution of "Having your data controlled by the government" is the same across the categories of Gender	0.261 (0.442)	0.137 (0.345)	**0.006**

By analysing Table 18, it is possible to conclude that the gender does not affect the users' willingness to share personal geolocation data with mobile applications, including *mHealth* apps.

As for the perceived benefits and risks, only the benefit of being able to get more customized services in an app and the risk of having their data controlled by the government is different across the categories of gender.

It is possible conclude that males value the most getting more customized services in app and are more worried with having their data controlled by the government.

4.3.2. Impact of generation

As the user generation is expressed in 7 different age gaps, where a number is associated with each one of them, a Kruskal-Wallis H test is the most adequate.

Table 19: Generation impact on users' willingness to share personal geolocation data with mobile applications, including mHealth ones, and on the perceived benefits and risks

Statements	**Generation**					**p-value**
	18-24	**25-34**	**35-44**	**45-54**	**55-64**	
	Mean (std. dev.)	**Mean (std. dev.)**	**Mean (std. dev.)**	**Mean (std. dev.)**	**Mean (std. dev.)**	
The distribution of "Download apps in which you need to share geolocation data" is the same across categories of Generation	0.993 (0.082)	0.950 (0.221)	0.886 (0.323)	0.885 (0.326)	0.800 (0.422)	**<0.001**
The distribution of "Download *mHealth* apps in which you need to share geolocation data" is the same across categories of Generation	0.510 (0.502)	0.395 (0.495)	0.516 (0.508)	0.391 (0.499)	0.375 (0.518)	0.512

The distribution of "Being able to get a faster and more effective experience with an app" is the same across the categories of Generation	0.416 (0.495)	0.474 (0.506)	0.226 (0.425)	0.130 (0.344)	0 (0)	**0.004**
The distribution of "Being able to get more customized services in an app" is the same across the categories of Generation	0.228 (0.421)	0.342 (0.481)	0.226 (0.425)	0.174 (0.388)	0.500 (0.535)	0.104
The distribution of "Being able to use the service provided by an app" is the same across the categories of Generation	0.718 (0.451)	0.605 (0.495)	0.710 (0.461)	0.826 (0.388)	0.625 (0.518)	0.562
The distribution of "Fraud" is the same across the categories of Generation	0.620 (0.487)	0.632 (0.489)	0.806 (0.402)	0.739 (0.449)	1 (0)	0.054
The distribution of "Having your data	0.781 (0.415)	0.789 (0.413)	0.613 (0.495)	0.913 (0.288)	0.625 (0.518)	**0.037**

used for other purposes" is the same across the categories of Generation						
The distribution of "Having your data controlled by other companies" is the same across the categories of Generation	0.424 (0.496)	0.552 (0.504)	0.290 (0.461)	0.511 (0.478)	0.750 (0.463)	0.135
The distribution of "Having your data controlled by the government" is the same across the categories of Generation	0.176 (0.382)	0.263 (0.446)	0.129 (0.341)	0.087 (0.288)	0.375 (0.518)	0.087

The first test performed had the goal to find out if the users' generation affects their willingness to share personal geolocation data with mobile applications. As the p-value is lower than 0.05, the null hypothesis is rejected so it can be concluded that the generation of a user affects their willingness to share personal geolocation data with mobile applications.

By analysing the means of each category of generation for this statement, it is possible to conclude that as the respondents get older, the less willing they are to share their geolocation data with mobile applications.

There are some differences between the generation groups when it comes to the perceived benefits and risks.

Starting with the benefits, only the benefit of getting a faster and more effective experience with an app is perceived differently across the generation groups. Young generations seem to value this benefit more than older ones. Interestingly, none of the respondents in the 55-64 generation ticked this benefit.

Regarding the perceived risks, the only one that is different across the multiple categories of generation is having their data used for other purposes.

The 65-74 generation group was not taken into consideration when analysing the means and standard deviations as all the respondents in this group do not share their personal geolocation with mobile applications and, therefore, they did not have access to the questions where the remaining statements present in Table 19 were asked. As for the >74 age group, there was only one respondent from this group and, therefore, their answers were not considered.

4.3.3. Impact of education

Table 20: Level of education impact on users' willingness to share personal geolocation data with mobile applications, including mHealth ones.

Statements	Education Level						p-value
	A	B	C	D	E	F	
	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	
The distribution of "Download apps in which you need to share geolocation data" is the same across categories of Level of Education	1 (0)	1 (0)	0.855 (0.356)	0.946 (0.227)	0.976 (0.156)	0.800 (0.447)	0.174
The distribution of "Download *mHealth* apps in which you need to share geolocation data" is the same across categories of Level of Education	0.500 (0.707)	1 (0)	0.478 (0.505)	0.452 (0.499)	0.600 (0.496)	0 (0)	0.413

Note. A= Primary school; B= Lower secondary school; C= High school; D= Bachelor's degree; E= Master's degree; F= Doctorate degree

The level of education of the users' does not impact their willingness to share personal geolocation data with mobile apps in general or *mHealth* apps as the p-value of both tests is higher than 0.05.

4.3.4. Impact of marital status and being a parent

Table 21: Marital Status impact on users' willingness to share personal geolocation data with mobile applications, including mHealth ones.

Statements	Marital Status					p-value
	A	**B**	**C**	**D**	**E**	
	Mean (std. dev.)	**Mean (std. dev.)**	**Mean (std. dev.)**	**Mean (std. dev.)**	**Mean (std. dev.)**	
The distribution of "Download apps in which you need to share geolocation data" is the same across categories of Marital Status	0.969 (0.173)	0.879 (0.329)	0.600 (0.516)	1 (0)	0.667 (0.577)	**<0.001**
The distribution of "Download *mHealth* apps in which you need to share geolocation data" is the same across categories of Marital Status	0497 (0.501)	0.392 (0.493)	0.667 (0.516)	1 (0)	0 (0)	0.126

Note. A= Single; B= Married; C= Divorced; D= Widowed; E= Civil Union

By performing the Kruskal-Wallis H test it was possible to conclude that marital status impacts the user's willingness to share personal geolocation data with mobile apps. Single people are the ones that are more willing to share geolocation with mobile apps. Both widows replied affirmatively to both questions. None of the respondents who are in civil unions share their geolocation data with *mHealth* apps.

To analyse the impact that being a parent has, Mann-Whitney U tests were performed.

Table 22: Being a parent impact on users' willingness to share personal geolocation data with mobile applications, including mHealth ones.

Statements	**Do you have children?**		**p-value**
	No	**Yes**	
	Mean (std. deviation)	**Mean (std. deviation)**	
The distribution of "Download apps in which you need to share geolocation data" is the same across categories of Being a parent	0.970 (0.171)	0.841 (0.369)	**<0.001**
The distribution of "Download *mHealth* apps in which you need to share geolocation data" is the same across categories of Being a parent	0.505 (0.501)	0.397 (0.493)	0.157

After performing these tests, the conclusion that having children has an impact on the users' willingness to share personal geolocation information with mobile apps in general can be reached, but not with *mHealth* apps.

4.3.5. Impact of the employment status

Table 23: Employment status impact on users' willingness to share personal geolocation data with mobile applications, including mHealth ones.

Statements	Employment Status							p-value
	A	B	C	D	E	F	G	
	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	
The distribution of "Download apps in which you need to share geolocation data" is the same across categories of Employment Status	0.907 (0.292)	1 (0)	0.975 (0.158)	1 (0)	0.500 (0.577)	1 (0)	0.667 (0.577)	**0.006**
The distribution of "Download *mHealth* apps in which you need to share geolocation data" is the same across categories of Employment Status	0.444 (0.499)	0.500 (0.577)	0.468 (0.502)	0.526 (0.506)	0.500 (0.707)	0.667 (0.500)	0.500 (0.707)	0.773

Note. A= Full-time employed; B= Part-time employed; C= Student; D= Student worker; E= Retired; F= Unemployed; G= Self-employed

The employment status impacts the users' willingness to share personal geolocation with mobile apps. Nevertheless, this impact was not verifiable in the case of *mHealth* apps.

The differences across categories of employment status in the case of the respondents' willingness to share personal geolocation data with mobile applications in general can be easily identified by looking at the differences in their means presented in Table 23.

As there was only one respondent who was unable to work, this option was not taken into account for the presented analysis.

4.3.6. Impact of income

Table 24: Monthly income (after taxes) impact on users' willingness to share personal geolocation data with mobile applications, including mHealth ones.

Statements	Monthly income (after taxes)							p-value
	A	**B**	**C**	**D**	**E**	**F**	**G**	
	Mean (std. dev.)	**Mean (std. dev.)**	**Mean (std. dev.)**	**Mean (std. dev.)**	**Mean (std. dev.)**	**Mean (std. dev.)**	**Mean (std. dev.)**	
The distribution of "Download apps in which you need to share geolocation data" is the same across categories of Monthly Income (after taxes)	0.941 (0.243)	0.950 (0.221)	0.946 (0.227)	1 (0)	0.865 (0.347)	0.885 (0.326)	0.977 (0.151)	0.068
The distribution of "Download *mHealth* apps in which you need to share geolocation data" is the same across categories of Monthly Income (after taxes)	0.563 (0.512)	0.447 (0.504)	0.585 (0.497)	0.413 (0.498)	0.469 (0.507)	0.435 (0.507)	0.432 (0.501)	0.650

Note. A= Less than 750 euros; B= 750 to 1000 euros; C= 1001 to 1500 euros; D= 1501 to 2000 euros; E= 2001 to 2500 euros; F= 2501 to 3000 euros; G= 3001 euros or more

After performing the Kruskal-Wallis H test, it cannot be stated that the user's monthly income affects the willingness to share personal geolocation data with mobile apps, including *mHealth* apps, as the p-value is higher than 0.05 and, thereby, the null hypothesis is retained.

4.3.7. Impact of attitude towards risk

Table 25: Users' attitude towards risk impact on users' willingness to share personal geolocation data with mobile applications, including mHealth ones.

Statements	Attitude towards risk						p-value
	A	B	C	D	E	F	
	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	Mean (std. dev.)	
The distribution of "Download apps in which you need to share geolocation data" is the same across categories of Attitude towards risk	0.917 (0.282)	0.933 (0.251)	0.961 (0.196)	0.912 (0.288)	1 (0)	0.889 (0.333)	0.847
The distribution of "Download *mHealth* apps in which you need to share geolocation data" is the same across categories of Attitude towards risk	0.364 (0.492)	0.505 (0.502)	0.411 (0.495)	0.581 (0.502)	0.500 (0.548)	0.625 (0.518)	0.444

Note. A= Very risk-averse; B= Willing to take modest risks but only after careful research and consideration; C= Willing to take modest risks after some thought; D= Willing to take substantial risks after careful research and consideration; E= Willing to take substantial risks after taking professional advice; F= Someone who embraces risk, perhaps without sufficient consideration

Contrary to what was expected, the attitude towards risk of the users does not influence their decision on downloading apps, including *mHealth* apps, in which they need to share geolocation data. However, by analysing the means presented in Table 25, it can be concluded that, in general, the respondents that are less risk averse seem to be more willing to download *mHealth* apps that require geolocation data sharing.

5. Discussion and Conclusion

5.1. Discussion

In this chapter, the main results obtained through the interviews and questionnaire will be analysed and compared to the ones of previously published studies. The focus of this analysis will be the questionnaire as the interviews were used as a starting point for the creation of the questionnaire.

There are many contradictory findings from earlier researchers about the impact of gender on the users' willingness to share personal geolocation data. Manierre (2015) affirms that, in general, females are more likely than males to use mobile devices to look up health information. In terms of their willingness to share personal geolocation data with mobile apps, some studies claim there are no significant variations between genders (Brandtzaeg et al., 2019; Olmsted-Hawala & Nichols, 2019). Our study concluded that gender does not affect the users' willingness to share personal geolocation data with mobile applications, including *mHealth* applications.

Gender has an impact on how the users will evaluate their cost-benefit trade-off to decide whether to share their geolocation data with a mobile app, according to Manierre (2015). For example, Fox et al. (2021) claim that females have lower app trust than males. Our study concluded, that being able to get more personalized services in an app is the only benefit that is perceived differently between the genders; males value this benefit the most. As for the risks, having the share controlled by the government is the only one that is perceived differently between the gender categories.

Age has an impact on the adoption of technology (Morris & Venkatesh, 2000) and, therefore, the generation of a user is an essential factor when it comes to

personal data sharing with mobile applications (Jai & King, 2016). A generation is a group of individuals who were born or lived at around the same time and who experiences similar significant social or historical life events (McCrindle & Wolfinger, 2010). Helou et al. (2021) defended that, generally, when the age of a user increases, the willingness to share personal health data tends to decrease. The results obtained through our study agree with what was stated by Jay & King (2016). As for the perceived benefits and risks, the only benefit and risk that are evaluated differently by the different generation groups are being able to get a faster and more effective experience with an app and having their data used for other purposes, respectively.

The education level of the users affects their usage patterns relative to mobile applications. Wang & Qi (2021) discovered that populations with a higher education level tend to use more mobile health applications. Velicia-Martin et al. (2021) concluded that those users choose whether to use an app or not based on its perceived usefulness and that the concern for a potential loss of privacy is not significant, indicating that the users choose health when given the option to choose between health and privacy. Despite this information, there were not many findings about how the willingness to share personal geolocation data is affected by a user's education level. Our study concluded that the education level of the users does not affect their willingness to share their geolocation app with mobile apps, including health mobile apps.

The impact of marital status and parenthood on the user's decision to share personal geolocation with mobile apps has not been explored by previous researchers. With our study, it was possible to conclude that both variables have an impact on the users' willingness to share personal geolocation data with mobile apps in general. However, there are no significant differences across the categories of both variables when it comes to *mHealth* apps.

The influence of the users' employment status on their decision to share personal geolocation data with mobile applications was not explored by previous researchers. Through our study, it can be concluded that employment status influences the decision of the users to share their geolocation data with mobile apps, but the opposite happens in the case of *mHealth* apps. Approximately, 76% of the respondents who do not download apps that require geolocation data sharing are full-time workers, 12% are students and 12% are retired.

The income of a user is positively correlated with the possession of smartphones and the usage of mobile applications (Post et al., 2015). According to Wang et al. (2016), users' willingness to share personal data is not influenced by their income level. Our study concluded the same as Wang et al. (2016).

Whether a user thinks an app is safe to use or download depends on their attitudes toward perceived risks (Joshi & Mishra, 2016). Based on our study, this does not seem to be verifiable in the case of the users' willingness to share personal geolocation data with mobile apps, including *mHealth* apps.

Our research was also essential to understand whether users' willingness to share their personal geolocation data changes depending on whether the apps ask them to do it continuously or periodically. 70% of the respondents download apps which require geolocation data sharing continuously, while 93% download apps which require geolocation data sharing periodically. Therefore, it can be concluded that users are more likely to share personal geolocation data periodically than continuously.

Transparency and anonymity are two subjects that users value a lot when it comes to sharing personal geolocation data with mobile apps.

Transparency is defined as an as close to real-time as possible exchange of information between a mobile application's company and the user. Some users are reluctant to share their personal information with the apps because of their lack of transparency (Liang et al., 2022). With our study, it is possible to affirm

that users are more inclined to share their personal geolocation data if the company collecting it made its data processing procedures transparent, as 70% of respondents confirmed.

When users share their data with mobile applications, there is always a chance that their privacy will be compromised. For instance, patient clinical records gathered from *mHealth* apps may be exploited for medical purposes (Sheikhalishahi et al., 2022). Approximately 86% of the respondents affirm that they are more inclined to share personal geolocation data with a mobile application if data anonymity is granted.

Characteristics related to the company that owns an app might be essential factors in a user's decision to share personal geolocation data with the app.

The level of trust is one of those factors. It consists in the degree to which a company's customers have faith in its ability to protect their personal information (Malhotra et al., 2004). Previous studies found a positive correlation between trust and the willingness to share personal data (Malhotra et al., 2004; Zimmer et al., 2010). Approximately, 76% of the respondents said that the company that owns the app affects the decision on sharing personal geolocation data and, approximately, 47% agree/strongly agree that the size of the said company also affects it (approximately, 30% disagree, and 23% is neutral). Approximately 39% feel more comfortable sharing that data with big companies than with start-ups (approximately, 28% disagree, and 33% are neutral).

According to Milne & Boza (1999), consumer perceptions of trust and concern levels differ by industry. Around 70% of the respondents agree/strongly agrees with this statement and 57% are more willing to share personal geolocation data with health apps.

Users' willingness to do something is sometimes influenced by the benefits associated with doing so. People are highly motivated by being able to help others and the chance to obtain direct benefits from a certain action (Evans &

Ferguson, 2014). However, our study concluded the opposite: only 24% of the respondents feel more willing to share personal geolocation data if the app offers a donation to charity; 29% if the app offers them a discount; and 20% if the app offers virtual rewards points.

Finally, approximately 49% of the respondents agree/strongly agree (25% are neutral and 26% disagree/strongly disagree) that their willingness to share personal geolocation data increases if the services provided by the apps are more personalized and 74% agree/strongly agree that they are more willing to share that type of information if that action allows them to get useful information (18% is neutral and 8% disagree/strongly disagree).

5.2. Conclusion

Smartphones and mobile applications are more present than ever in people's daily lives. Some apps, including health ones, require users to share personal data. Geolocation data is a very important type of data for the companies that own the apps and for the users. However, some users are still sceptical to share this type of information because of fraud and the possibility of having their data used for other purposes and by other companies and/or controlled by the government. The users' decision to share personal geolocation will be done by weighing its perceived benefits and risks.

The goal of our study is to understand which socio-demographic characteristics and perceived risks and benefits influence the most the users' willingness to share personal geolocation data with mobile applications, including *mHealth* apps. Gender, education level, income and attitude towards risk do not influence the users' willingness to share personal geolocation data with mobile applications (in general). On the contrary, generation, marital status, parenthood and employment status influence the users' decisions. Regarding the

users' willingness to share this type of information with health mobile applications, it can be concluded that: none of the chosen factors influences it.

The results were obtained from two different methods: in-depth interviews and a questionnaire.

The in-depth interviews were essential to understanding which topics were the most important to tackle during the questionnaire. The first conclusion taken after analysing the interviews was that all the interviewees download applications that require sharing geolocation data; however, 30% do not download *mHealth* applications that require them to share this type of information. It was also concluded that the company that owns an app affects the interviewees' decision to share geolocation data (90% of the interviewees). Being able to use the service provided by an app is the most mentioned perceived benefit while having their data used for other purposes and frauds are the most mentioned risks. Finally, most interviewees agreed that their willingness to share personal geolocation data is influenced by the app sector; and 50% are more willing to share it with *mHealth* apps.

Finally, the questionnaire was fundamental to analyse if the benefits and risks of sharing personal geolocation data with mobile applications are different according to the users' gender and generation. Being able to get more personalized services and having their data controlled by the government was the only perceived benefit and risk that were significantly different between the gender, respectively. Being able to get a faster and more effective experience with an app and having their data used for other purposes was the only perceived benefit and risk significantly different between the generation groups, respectively.

5.3. Limitations of the Research

The main limitation of this research is the concentration of the respondents' residence region, approximately, 87% of the respondents live in Aveiro, Porto or Braga. Due to the concentration on these three areas, this variable wasn't considered for this study.

There are also some limitations concerning the methods utilized for the development of the analysis of this study.

Starting with the in-depth interviews, their main limitation is that they are not generalizable, as they are conducted with a very small sample chosen by the interviewer, meaning that no random sampling methods are being utilized (Boyce & Neale, 2006).

Regarding the online questionnaire, as it was an anonymous questionnaire, it is impossible to test the reliability of the answers given by the respondents.

5.4. Recommendations

As for recommendations for future researchers, what would be suggested is to test how the willingness to share personal geolocation data with mobile applications is affected by region of residence. As mentioned in the limitations chapter, this topic was not explored by this study since most of the questionnaire respondents were from Aveiro, Braga and Porto.

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Appendix I – In-depth interview structure

First Part

1. With which gender do you identify?
2. What is your age?
3. What region of the country do you live in?
4. What is your employment status?

Second Part

5. Do you own a smartphone with access to the internet?
6. Do you download apps in which you share personal data, more specifically geolocation data?
7. Do you download apps belonging to the health sector (mHealth) in which you share your personal geolocation data?
8. Does the company that owns the app affect your decision on sharing personal geolocation data?

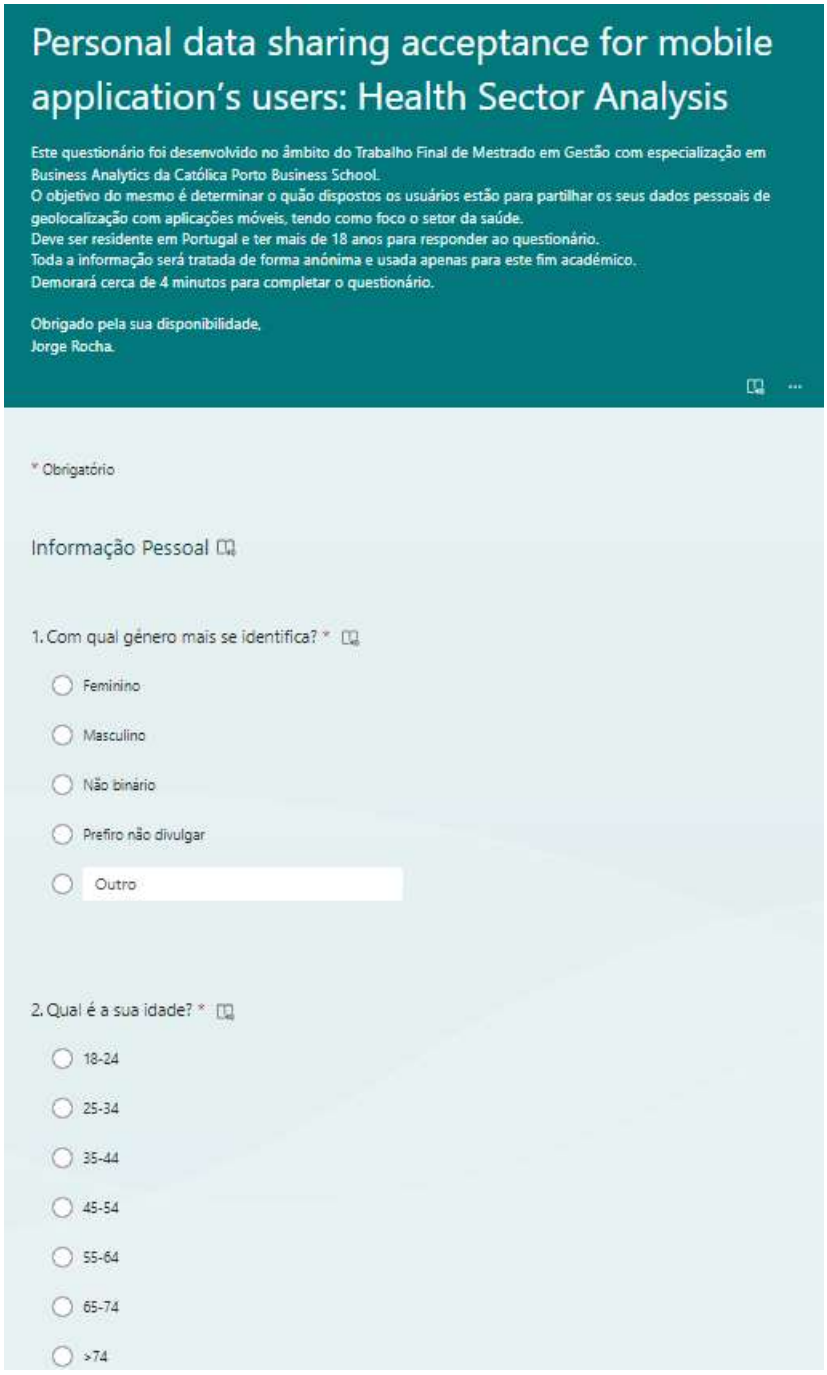
Third Part

9. What benefits do you believe you have by sharing personal geolocation data?
10. What risks do you perceive when you have to share personal geolocation data?

Fourth Part

11. Is your willingness to share personal geolocation data affected by the app sector?
12. Are you more willing to share personal geolocation data with health apps? If so, why?

Appendix II – Questionnaire structure



Personal data sharing acceptance for mobile application's users: Health Sector Analysis

Este questionário foi desenvolvido no âmbito do Trabalho Final de Mestrado em Gestão com especialização em Business Analytics da Católica Porto Business School.
O objetivo do mesmo é determinar o quão dispostos os usuários estão para partilhar os seus dados pessoais de geolocalização com aplicações móveis, tendo como foco o setor da saúde.
Deve ser residente em Portugal e ter mais de 18 anos para responder ao questionário.
Toda a informação será tratada de forma anónima e usada apenas para este fim académico.
Demorará cerca de 4 minutos para completar o questionário.

Obrigado pela sua disponibilidade,
Jorge Rocha.

* Obrigatório

Informação Pessoal

1. Com qual género mais se identifica? *

- Feminino
- Masculino
- Não binário
- Prefiro não divulgar
- Outro

2. Qual é a sua idade? *

- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65-74
- >74

3. Em qual região do país reside? *

- ◯ Aveiro
- ◯ Beja
- ◯ Braga
- ◯ Bragança
- ◯ Castelo Branco
- ◯ Coimbra
- ◯ Évora
- ◯ Faro
- ◯ Guarda
- ◯ Leiria
- ◯ Lisboa
- ◯ Portalegre
- ◯ Porto
- ◯ Santarém
- ◯ Setúbal
- ◯ Viana do Castelo
- ◯ Vila Real
- ◯ Viseu
- ◯ Região Autónoma dos Açores
- ◯ Região Autónoma da Madeira

4. Qual é o nível ou grau de escolaridade mais alto que concluiu? *

- ◯ Nenhum nível de ensino
- ◯ 1º ciclo do ensino básico
- ◯ 2º ciclo do ensino básico
- ◯ Ensino secundário
- ◯ Licenciatura
- ◯ Mestrado
- ◯ Doutoramento
- ◯ Outro

5. Qual é o seu estado civil? *

- ◯ Solteiro
- ◯ Casado
- ◯ Divorciado
- ◯ Viúvo
- ◯ Outro

6. Tem filhos? *

- ◯ Sim
- ◯ Não

7. Qual é a sua situação profissional? *

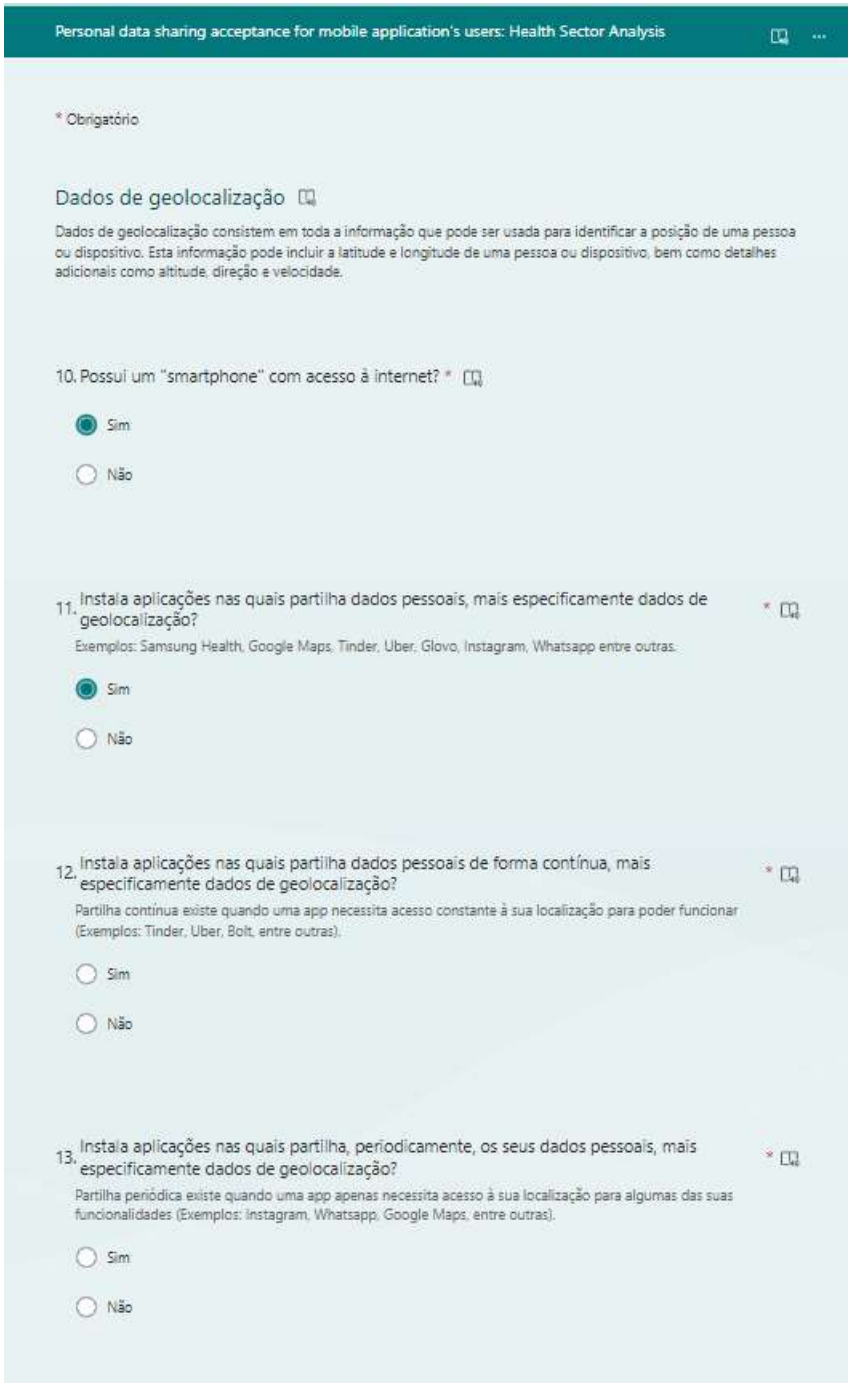
- ◯ Empregado a tempo inteiro
- ◯ Empregado a tempo parcial
- ◯ Dona de casa
- ◯ Estudante
- ◯ Estudante trabalhador
- ◯ Reformado
- ◯ Desempregado
- ◯ Inválido
- ◯ Outro

8. Qual é o rendimento líquido mensal do seu agregado familiar (após dedução de impostos)? *

- ◯ Menos de 750 euros
- ◯ 750 a 1000 euros
- ◯ 1001 a 1500 euros
- ◯ 1501 a 2000 euros
- ◯ 2001 a 2500 euros
- ◯ 2501 a 3000 euros
- ◯ 3001 euros ou mais

9. Como é que se descreveria em relação à sua atitude face ao risco? *

- ◯ Muito avesso/a ao risco
- ◯ Disponível para tomar riscos moderados, mas somente após pesquisa e consideração cuidadosas
- ◯ Disponível para tomar riscos moderados após algum pensamento
- ◯ Disponível para tomar bastantes riscos após pesquisa e consideração cuidadosas
- ◯ Disponível para tomar bastantes riscos após receber aconselhamento profissional
- ◯ Alguém que enfrenta riscos, talvez sem consideração suficiente


Personal data sharing acceptance for mobile application's users: Health Sector Analysis
* Obrigatório
Dados de geolocalização
Dados de geolocalização consistem em toda a informação que pode ser usada para identificar a posição de uma pessoa ou dispositivo. Esta informação pode incluir a latitude e longitude de uma pessoa ou dispositivo, bem como detalhes adicionais como altitude, direção e velocidade.
10. Possui um "smartphone" com acesso à internet? *
Sim
Não
11. Instala aplicações nas quais partilha dados pessoais, mais especificamente dados de geolocalização? *
Exemplos: Samsung Health, Google Maps, Tinder, Uber, Glovo, Instagram, Whatsapp entre outras.
Sim
Não
12. Instala aplicações nas quais partilha dados pessoais de forma contínua, mais especificamente dados de geolocalização? *
Partilha contínua existe quando uma app necessita acesso constante à sua localização para poder funcionar (Exemplos: Tinder, Uber, Bolt, entre outras).
Sim
Não
13. Instala aplicações nas quais partilha, periodicamente, os seus dados pessoais, mais especificamente dados de geolocalização? *
Partilha periódica existe quando uma app apenas necessita acesso à sua localização para algumas das suas funcionalidades (Exemplos: Instagram, Whatsapp, Google Maps, entre outras).
Sim
Não

14. Instala aplicações pertencentes ao setor da saúde (mHeatlh) nas quais partilha os seus dados pessoais de geolocalização? *

mHealth é definida como práticas médicas e de saúde pública apoiada por dispositivos móveis, como telemóveis (OMS, 2011) (Exemplos: Stay Away COVID, Samsung Health, Nike Run Club, entre outras).

- ◯ Sim
- ◯ Não

15. Estaria mais disposto/a a partilhar os seus dados pessoais de geolocalização se a empresa que os coleta tornasse os seus procedimentos de processamento de dados transparentes? *

- ◯ Sim
- ◯ Não

16. Se o anonimato de dados fosse garantido, estaria mais inclinado/a a partilhar os seus dados pessoais de geolocalização? *

- ◯ Sim
- ◯ Não

17. A empresa responsável por uma certa aplicação influencia a sua decisão de partilha de dados pessoais de geolocalização? *

- ◯ Sim
- ◯ Não

18. A pandemia COVID-19 tornou-o/a mais disponível para partilhar os seus dados pessoais de geolocalização? *

- ◯ Sim
- ◯ Não

Anterior | Seguinte

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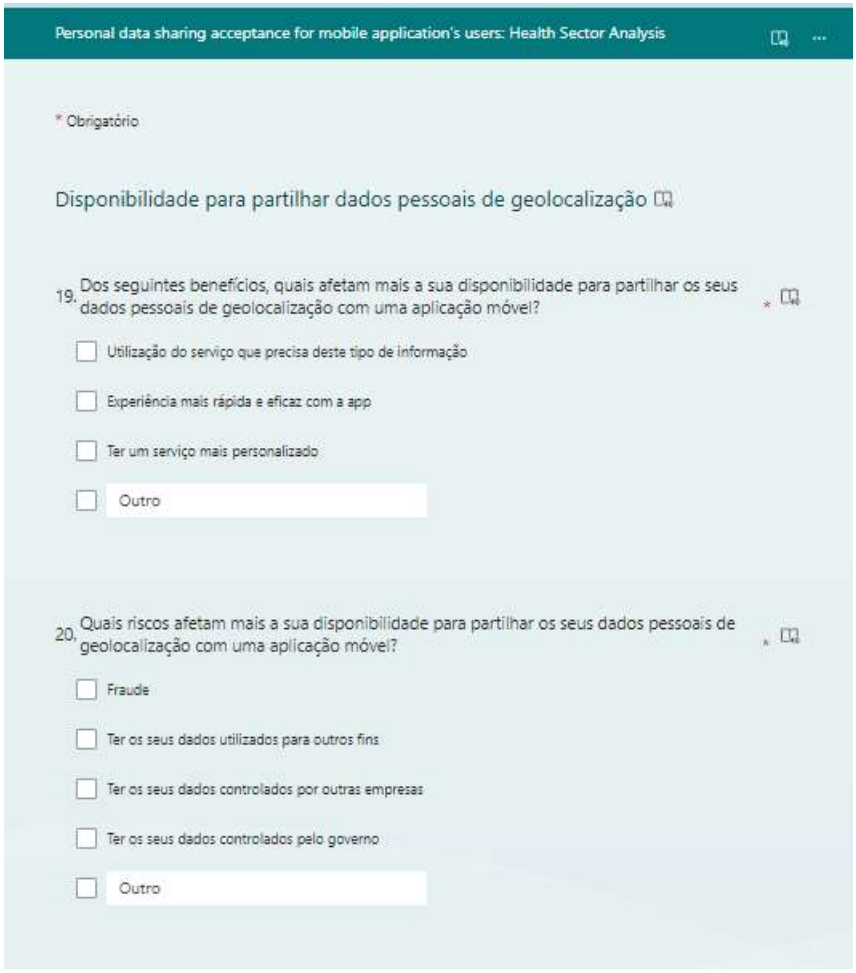
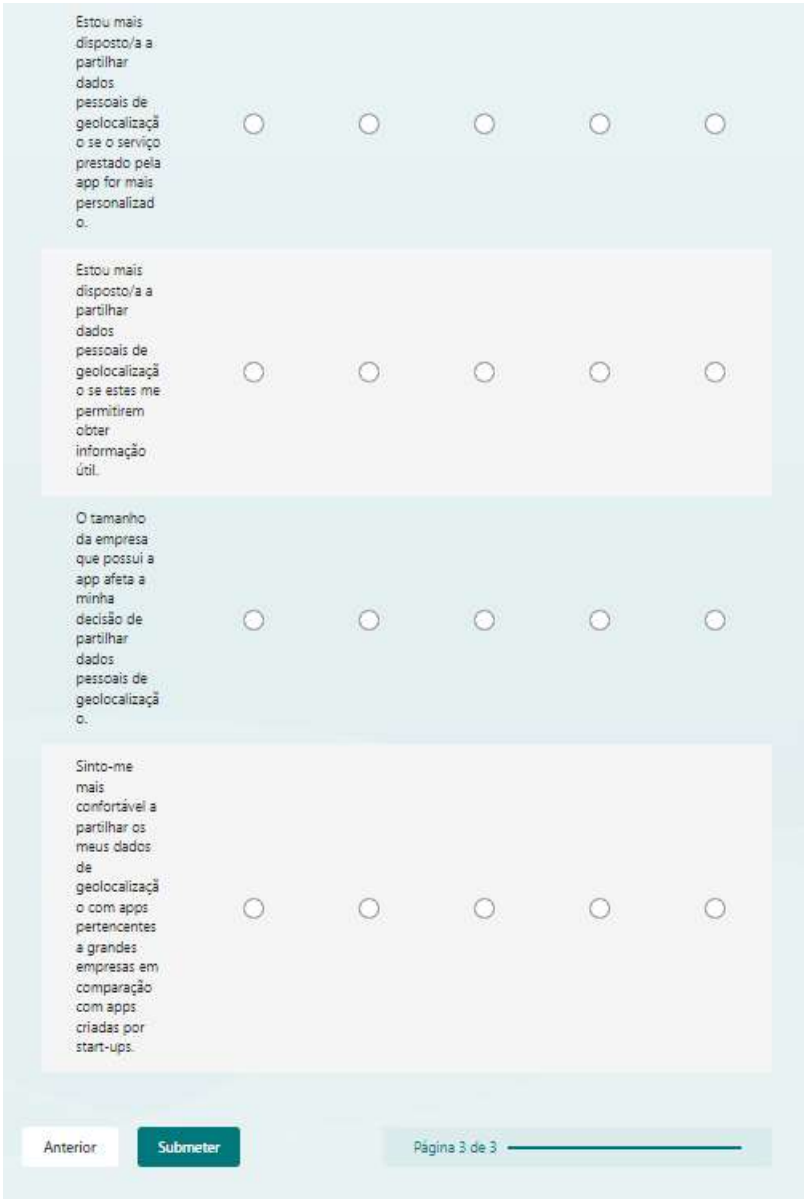

Personal data sharing acceptance for mobile application's users: Health Sector Analysis
* Obrigatório
Disponibilidade para partilhar dados pessoais de geolocalização
19. Dos seguintes benefícios, quais afetam mais a sua disponibilidade para partilhar os seus dados pessoais de geolocalização com uma aplicação móvel? *
Utilização do serviço que precisa deste tipo de informação
Experiência mais rápida e eficaz com a app
Ter um serviço mais personalizado
Outro
20. Quais riscos afetam mais a sua disponibilidade para partilhar os seus dados pessoais de geolocalização com uma aplicação móvel? *
Fraude
Ter os seus dados utilizados para outros fins
Ter os seus dados controlados por outras empresas
Ter os seus dados controlados pelo governo
Outro

21. Classifique as seguintes afirmações *

	Discordo Fortemente	Discordo	Neutro	Concordo	Concordo Fortemente
A minha disponibilidade para partilhar dados pessoais de geolocalização é influenciado pelo setor da app.	○	○	○	○	○
Estou mais disposto/a a partilhar dados pessoais de geolocalização em apps do setor da saúde.	○	○	○	○	○
Estou mais disposto/a a partilhar dados pessoais de geolocalização se a app fizer uma doação para a caridade.	○	○	○	○	○
Estou mais disposto/a a partilhar dados pessoais de geolocalização se a app me oferecer um desconto.	○	○	○	○	○
Estou mais disposto/a a partilhar dados pessoais de geolocalização se a app me oferecer pontos de recompensa virtuais.	○	○	○	○	○


Estou mais disposto/a a partilhar dados pessoais de geolocalização se o serviço prestado pela app for mais personalizado.
Estou mais disposto/a a partilhar dados pessoais de geolocalização se estes me permitirem obter informação útil.
O tamanho da empresa que possui a app afeta a minha decisão de partilhar dados pessoais de geolocalização.
Sinto-me mais confortável a partilhar os meus dados de geolocalização com apps pertencentes a grandes empresas em comparação com apps criadas por start-ups.
Anterior
Submeter
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