

# An Evaluation of Remote Workers' Preferences for the Design of a Mobile App on Workspace Search

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Abstract. New ways of communication and the growth of mobile technologies allows a high degree of interaction between people, places, and even things, making it possible to work anywhere, anytime. This has led to the creation of new working models, where an increased number of independent workers fight the blurred line between working and personal life. The rise of the coworking spaces and their popularity came to fight that line and, also, help remote workers dealing with loneliness, promoting a collaborative and dynamic working environment. However, little is found in the literature about the specific preferences of the users of these types of spaces. This paper aims to identify and evaluate remote workers' preferences of working spaces characteristics, in the capital area of Portugal, to design a real time system that can help user's efficiency when looking for a space to work in. The paper presents the results of the study and the Heuristic Evaluation (Nielsen's 10 Heuristics) of the proposed system. Results show that working from home or in a Coworking spaces are the most common options among remote workers and their main motivations to work in those spaces were looking for a space that brings them comfort, allows an affordable accommodation and social interaction with other workers. WIFI quality, location and a quiet environment are the most important characteristics when choosing a specific working space. The results of the proposed system' evaluation showed that 6 usability problems were found, and 2 out of 10 heuristics were violated. However, the overall SUS score evaluation showed a score of 91 points, considered as "acceptable". These results can guide designers designing or developing working spaces related applications, or even owners creating those spaces.

Keywords: Remote work  $\cdot$  Working spaces  $\cdot$  Think aloud  $\cdot$  User testing  $\cdot$  User preferences

## **1** Introduction

The evolution in new ways of communication have led to changes in society. The advances of the internet have provided people with information from different places with fewer barriers. Today, people, goods, and information are moving quickly and easily to all parts of the globe [1]. The tendency is the daily use of communication devices,

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such as smartphones and mobile internet, along with the growing need for information while on the go. The continued advancement of digital technology and the rise of the gig economy led to the growth of new working models [2], increasing need for flexibility [3], increasing number of self-employed workers [4], and increasing use for public spaces as workplaces [5]. All these, along with the growth in the use of new technologies, decreased and changed the need for office space [5]. These changes blurred the distinction between where a person lives (i.e., first place or home), where a person works (i.e., second place or office), and where a person spends time in between (i.e., third place). Oldenburg [6] defined this third place as a "generic designation for a great variety of public places that host the regular, voluntary, informal, and happily anticipated gatherings of individuals" and listed public places like cafés, coffee shops, community centers, general stores, and bars as exemplary third places [6]. However, as mentioned, different changes blurred this distinction, as nowadays, cafés and coffee shops are synonymous with workspaces, as flexible workers often choose to work at such third places that are neither their homes nor offices [7].

Independent consultants, short-term contractors, and freelancers creating portfolios of work in lieu of full-time jobs, are transforming the way we work, by disconnecting work from the office [8]. According to Eurostat, 5,4% of employees, in the European Union (EU), aged between 15-64, are working from home. Additionally, 9% work remotely somedays [9]. In Portugal, the number of Portuguese citizens working remotely have grown between 2015 and 2019. Recent numbers have pointed to approximately 6,5% of Portuguese population working remotely, standing out from countries like Italy (3,6%), Spain (4,8%) and Germany (5,2%) [9]. With new working models and the increased number of independent workers, it is possible to witness the rise of new types of workplaces (emerging as third places) to work in the digital age. Those, known as coworking spaces or shared office environments, for independent professionals, have been increasing rapidly [10], and gain popularity over the past years [11-13]. In 2020, a study published by Coworking Resources [14], titled "Global Coworking Growth Study 2020", registered approximately 2 million people working in over 20 million co-working spaces worldwide, crossing over 40 million by 2040. Portugal has been distinguished as one of the 20 largest markets by number of coworking spaces and the corresponding share over all spaces worldwide (280 spaces), followed by Hong Kong (255 spaces) and Vietnam (251 spaces). Coworking spaces can be considered as the optimum third places to work as they combine the best of both first and second places (i.e., working at home and traditional office) by offering "control, autonomy, and scheduling flexibility of remote work combined with optional access to the structure and community of an office if and when the worker wants it" [8]. Their popularity can result from the increasingly looking for a workspace, by self-employees and other remote workers, outside their home, due to feelings of loneliness, when working from home, and the need for a better balance between their work and personal life [11, 15], increasing their efficiency and performance [16].

There are some studies focusing on specific subjects of coworking, such as, their knowledge dynamics contribution of coworking to the creativity of the city [13], economic growth and sustaining productivity and innovation [12, 17], and promoting entrepreneurship by coworking spaces [18]. However, not much can be found in the

literature about remote workers preferences for working spaces characteristics. Currently, a large number of existing mobile applications are focused on providing users with information about existent working spaces [19], and allowing them to make reservations [20, 21]; though, most of the existing systems have not been developed or adapted in Portugal and do not provide users with real time information related to occupation, noise levels, or internet speed. Also, the existing solutions only show outdated information about spaces which does not reflect the current situation in the country. Therefore, the aim of this paper is to identify and evaluate remote worker's preferences of working spaces characteristics in the capital area of Portugal, to design a real time system that can improve user's efficiency when looking for a space to work in. For this study, remote workers were defined as employees who work in a physically separate location as their teammates. This paper presents the user evaluation stage from an on-going project aiming to develop a mobile application for workspace search. The ongoing project will propose a system design that explores working spaces' characteristics and features, aiming for comfort of remote workers when looking for a space. The system is based on real-time sensors (occupation, noise levels, and internet speed) that monitor the activities in the space and send the information to the mobile application.

## 2 Methods

The study was divided into three stages: (i) Pre-study, (ii) Pilot Study, and (iii) Main Study.

- (i) Pre-study. A survey was carried out, which was tested in the form of an online questionnaire, through Google Forms. Data was collected between April and October 2020. Inclusion criteria were working remotely/telecommuting or desire to work remotely for a day. The questionnaire remained open until the 100 answers were reached. The questions concerned remote workers' daily life choices, frustrations, preferences and challenges when looking for a working space. The results of this stage were used to build the low-fidelity prototype for the pilot study.
- (ii) Pilot study. In the pilot study, a low-fidelity prototype was tested with the help of the Think Aloud protocol. Think-aloud protocol method refers to a type of research data used in empirical research processes. Data gathered is known as "thinking aloud", meaning that participants in the test are asked to verbalize their thoughts, while performing a task [22]. This stage was performed to ensure that the proposed method was viable. Figure 1 shows three of the main screens of the low-fidelity prototype, used for the pilot study.
- (iii) *Main study*. The same prototype had been further developed, and an internal moderated Think Aloud test was conducted. Additionally, participants were given tasks to perform.



Fig. 1. Low fidelity prototype interface.

#### 2.1 Pre-study

**Sample.** Table 1 shows the user characteristics of the sample. As can be seen, the sample consists of a close number of male (53%) and female (47%) co-workers. Deskmag [23], an online magazine about co-working worldwide, showed that female members in coworking spaces have been rising steadily, compared to early years, so, it is possible to note that the number of females working remotely is rising. The age of the remote workers is in the Y generation (30–45 years) (M = 32,7, SD = 6,99). Most respondents

	Total (N=100)	EW (N=43)	SE (N=16)	F (N=33)	S (N=5)	OFW (N=3)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Gender						
Female	47(47)	20(47)	5(31)	17(52)	2(40)	3(100)
Male	53(53)	23(53)	11(69)	16(48)	3(60)	0(0)
Age						
18-29	35(35)	17(40)	4(25)	6(18)	5(100)	3(100)
30-45	62(62)	24(56)	12(75)	26(79)	0(0)	0(0)
>45	3(3)	2(4)	0(0)	1(3)	0(0)	0(0)
Nacionality						
Portuguese	87(87)	39(90)	13(81)	30(91)	5(100)	0(0)
European	4(4)	2(5)	1(6)	0(0)	0(0)	1(33)
American	6(6)	2(5)	2(13)	2(6)	0(0)	1(33)
African	3(3)	0(0)	0(0)	1(3)	0(0)	1(33)
Education						
High school graduate	12(12)	6(14)	4(25)	1(3)	0(0)	0(0)
Bachelor's degree	56(56)	25(58)	5(31)	18(55)	5(100)	3(100)
Posgraduate degree	11(11)	3(7)	3(19)	5(15)	0(0)	0(0)
Master's degree	19(19)	8(19)	2(13)	9(27)	0(0)	0(0)
Doctorate degree	3(3)	1(2)	2(12)	0(0)	0(0)	0(0)

 Table 1. Participants' demographic data.

EW = Employed for Wages; SE = Self-Employed; F = Freelancer; S = Student; OFW = Out of work.

are highly educated (89%), which means they have completed at least a higher vocational education. It is possible to divide the respondents into 5 different categories: Employers (43%), Self-Employers (16%), Freelancers (33%), Students (5%) and Out of work (3%).

**Procedure.** The questionnaire was published mostly on social media boards, related to digital nomadism and remote work, and in communities. To increase the response rate, the questionnaire was also sent individually. Participants were invited to fill in a 5–10-min online questionnaire with a total of 25 questions. The questionnaire was divided into 5 different sections: demographic data (age, gender, nationality, education and occupation), company's stance on remote work (in order to filter who can work/works remotely), individual's preferences on working spaces, struggles and frustrations when looking for working spaces and opinions related to mobile applications and its information.

**Results and Discussion.** Users preferences were measured with open- and multiplechoice questions. Respondents were asked about socio-demographic characteristics including gender, age, nationality, and education level. Furthermore, they were asked about work-related characteristics, such as their company stance on remote work.

Participants were also asked about the primarily and second most common location where they work from. The choice options were Coffee shop and cafes, Coworking spaces, Home, Libraries, Park or Other (Table 2).

	Total (N = 80)	EW (N = 30)	SE (N = 16)	F (N = 32)	S (N = 2)
	n (%)	n (%)	n (%)	n (%)	n (%)
What location do you primarily work from? (N = 80)					
Coffee shop and cafes	4(5)	1(3)	1(27)	2(13)	0(0)
Coworking spaces	5(6)	1(3)	3(0)	1(8)	0(0)
Home	67(85)	26(87)	11(63)	29(73)	1(50)
Libraries	1(1)	0(0)	0(0)	0(0)	1(50)
Park	1(1)	0(0)	1(0)	0(0)	0(0)
Other (somewhere with a 4g internet)	1(1)	0(0)	0(0)	0(0)	0(0)
Other (Personal office / Shared office)	1(1)	2(7)	0(0)	0(0)	0(0)
What is the second most common location that you work from? (N = 80)					
Coffee shop and cafes	21(26)	7(23)	6(38)	8(25)	0(0)
Coworking spaces	23(28)	7(23)	5(31)	11(34)	0(0)
Home	15(20)	6(20)	2(12)	6(19)	1(50)
Libraries	12(15)	4(13)	3(19)	4(13)	1(50)
Park	7(9)	5(17)	0(0)	2(6)	0(0)
Other (somewhere with a 4g internet)	1(1)	0(0)	0(0)	1(3)	0(0)
Other (Personal office/ Shared office)	1(1)	1(4)	0(0)	0(0)	0(0)

 Table 2. Participants' preferences when choosing a location to work.

EW = Employed for Wages; SE = Self-Employed; F = Freelancer; S = Student; OFW = Out of work.

Next, respondents were asked about their main motives to choose the mentioned places to work in. Figure 2 shows the eleven motives mentioned by respondents. Most participants mentioned "Comfort" (24%) as their main motive. This can be associated with the previous questions about the primarily and second most common location where they work from, in which people mentioned "Home" as their preferred location. "Affordable/Free accommodation" (13%) and "Social interaction with co-workers" (13%) were found to be the most important second motive. Respondents were also asked what

working spaces attributes they considered the most important. Figure 3 shows the most rated attributes for the participants. Respondents attach more importance to "WIFI quality" (25,1%), "Location" (22%) and "Silence" (17,5%). The least important workspaces amenities/attributes are "Supporting Equipment" (13,5), "Price" (11,2%) "Plenty of space" (5,8%) and "Environment" (4,5%).

Furthermore, respondents were asked about their biggest struggles when working remotely. As Fig. 4 shows, most participants mentioned "Distractions/Interruptions" (38%) as the most common struggle. The second most common struggle is "Feelings of loneliness/Lack of interaction with others" (28%), followed by "Other" (13%) which includes "Knowing when to stop working" and "Family duties".



Fig. 2. Remote workers main Motives (M) when choosing places to work.



Fig. 3. Most rated working spaces Attributes (A) by remote workers.

#### 2.2 Pilot Study

**Sample.** Five participants, between 18 and 27 years of age (M = 23.8, SD = 4.08) volunteered in this experiment. Inclusion criteria were working remotely/telecommuting



Struggles when working remotely (S)

Fig. 4. Struggles (S) that the majority of remote workers face when working remotely.

or desire to work remotely for a day. 1 participant was a student, 1 was a freelancer, and 3 participants were employed for wages. Five users were considered enough for the emergence of a consistent pattern [24].

**Procedure.** The sessions were scheduled individually and had a maximum duration of 15 min. Tests were conducted using a mobile device provided by the researcher. All the sessions were video recorded to be transcribed later for producing verbal data.

The procedure was done in 2 stages:

- (i) Briefing. The participants were informed about the general objectives of this study and signed an informed consent form to be recorded. A pre-questionnaire was applied to obtain participant's data regarding demographics, work experience, and experience/contact with mobile applications related to working spaces. Additionally, a cover story was given to the participants so that they could get familiar with the objective and purpose of the study. Cover Story: Imagine you are working remotely for a company. You have a home office; however, you get too distracted and there is too much noise so you cannot focus on your work. There are a few working spaces from your knowledge, but you do not want to waste your time going there and turning back if they do not meet your expectations. Luckily, you know a mobile app that can help. Having this scenario in mind, you are invited to operate with the mobile application and verbalize your feedback and critics and describe what you are looking and/or trying to do.
- (ii) *Think-aloud protocol*. The users performed think-aloud protocol to find usability problems they face within each interface of each given task.

**Results and Discussion.** Although the pilot study consisted in a small sample of participants, it was possible to find a consistent pattern related to interface, iconography, and terminology. The 5 participants were familiar with remote work and mentioned past experiences with mobile applications related to working spaces. Overall, the participants were able to navigate through the application without major problems and it was possible to notice that some interface options were already familiar (e.g., back buttons, filter options, search bar). Participants showed satisfaction and interest related to the real-time information showed on screen. Some of the iconography presented in the prototype raised some questions and the size was considered small (see Fig. 5). Only one out of the five participants were familiar with the term "amenities" used in the prototype. The researcher highlighted and described each usability problem while participants were interacting with the system. The problems found were sorted into 4 categories: labelling, visual consistency, terminology, and interaction (see Fig. 6) and, later, resolved in further development.



Fig. 5. Prototype iconography: lack of labeling, small iconography, and poor visual representation.

Usability problem	Caterogy
Selecting only one filter option at the beginning prevines user from moving further in the process	Interaction
Overall small touch targets	Interaction
Lack of iconography labelling	Labelling
Iconography too small	Visual consistency
Wrong use of iconography for representation of a map	Visual consistency
User's weren't familiar with the terminology "Amenities"	Terminology

Fig. 6. Usability problems categorized.

#### 2.3 Main Study

**Sample.** Ten remote workers, between 19 and 32 years of age (M = 25.7, SD = 4.79), participate voluntarily in this study. 3 participants were between the ages of 18 to 24 years of age and the 7 remaining participants were aged between 25–34 years. 1 participant was a student, 1 was a freelancer and 8 participants were employed for wages.

**Procedure.** The same procedure was applied as in the Pilot Study. Due to different circumstances, related with the COVID-19 pandemic, the main study was performed as online remote sessions through the application Zoom, where participants shared their computer screen while performing the given tasks. The tasks are as following:

- (i) "You need to work in a quiet space and also make video calls. Find a coworking space with individual desks and meeting rooms" (Fig. 7).
- (ii) "You don't take public or private transportation but walk to the workplace. Choose a place that is closest to you" (Fig. 8).

- (iii) "You want to use your car to go to the workplace due to the rain and also you need individual desks to spread your paperwork. Find a coworking space with individual desks and free parking lots" (Fig. 9).
- (iv) "Locate the perfect place to work. See the location of the place called "Outside Lisbon" (Fig. 10).
- (v) "You want to work in a cafe today while eating and drinking along the day. Find the most popular cafe to work" (Fig. 11).

Additionally, after each session, users evaluated the prototype according to the System Usability Scale (SUS) to quantify the users experience on product satisfaction. The SUS, developed by John Brooke in 1996 [25], is a 10 items questionnaire using a 5-point Likert scale numbered from 5 (as "Strongly agree") to 1 (as "Strongly disagree") and, if any item gets no answer, it should be assigned as a 3 (the center of the rating scale) [25].



**Fig. 7.** Flow task I. A higher resolution version of the figure is available at: https://edirlei.com/papers/HCI2021/FlowTask\_Ljpg

**Results and Discussion.** A task analysis was performed to identify usability problems. During the evaluation, usability problems were described, categorized, and analyzed according to Nielsen's heuristics [26].

*Analysis and Heuristic Evaluation.* In total, 6 usability problems were found and 2 out of 10 heuristics were violated. The heuristics violated were "Visibility of the system" (H1) and "Match between system and the real world" (H2). The missing heurists had no violations identified. The problems were sorted into 3 categories: visual consistency, terminology and interaction. The usability problems found in the task analysis are reported in Table 3. At the screen related to the user preferences, the visual of the header was



**Fig. 8.** Flow task II. A higher resolution version of the figure is available at: https://edirlei.com/papers/HCI2021/FlowTask\_II.jpg



**Fig. 9.** Flow task III. A higher resolution version of the figure is available at: https://edirlei.com/papers/HCI2021/FlowTask\_III.jpg



**Fig. 10.** Flow task IV. A higher resolution version of the figure is available at: https://edirlei.com/papers/HCI2021/FlowTask\_IV.jpg



**Fig. 11.** Flow task V. A higher resolution version of the figure is available at: https://edirlei.com/papers/HCI2021/FlowTask\_V.jpg

considered affordable, even though it is not. This problem can confuse and frustrate the user. Another problem, related to visual consistency, was identified in the homepage screen where the menu buttons were considered disabled due to their color and contrast. At the filters screen, the terminology "sockets" was not recognized, leading to the problem of missing representation icons in this screen. Having icons representing the labels can help users recognize terms faster [26]. The last 2 problems were identified in the working space screen. The wrong use of the term "full" when the place was not at its full capacity confused the user. Another problem found was the lack of comparison between everyday sounds and the decibel scale that was presented to the user. Being the user unfamiliar with the decibel scale, it is important that he understands the meaning of the scale without having to look up for a possible comparison outside the application [26].

Place of occurrence	Problem category	Problem description	Heuristics violated
Screen 6 User preferences	Visual consistency	Header visual looks like it is affordable	H1
Screen 22 Popular spaces (homepage)	Visual consistency	Buttons (filters, map of spaces) look disabled	H1
Screen 30 Filters	Visual consistency	Missing representation icons	H2
Screen 30 Filters	Terminology	Term is not recognized: "Abundance of sockets"	H2
Screen 36 Working space	Terminology	Wrong use of word "full" when place is not at full capacity	H1
Screen 36 Working space	Interaction	No comparison between everyday sounds and decibel scale (dB)	H2

Table 3. Common usability problems identified.

Note. "Visibility of the system" (H1), "Match between system and the real world" (H2)

*SUS Results.* After receiving the SUS results, to calculate each item's score contribution the range would scale from 0 to 4 [25]. All participants (P) scored over 80 points. 4 participants scored over 90 points while 2 scored the maximum of 100 points. 4 participants had lower scores between 80 and 87.5 (Fig. 12). Although, on the final SUS score the total average score was 91. According to Bangor et al. [27], the score 91 can be considered as "acceptable" on acceptability ranges, which represents an A score, as it is shown on Fig. 13.



Fig. 13. SUS acceptability range by Bangor et al. [27].

## **3** Conclusion and Future Work

This paper presents the user evaluation stage from an on-going project aiming to develop a mobile application for workspace search. The ongoing project proposes a system design that explores working spaces' characteristics and features, aiming for comfort of remote workers when looking for a space. The objective of the paper is to report findings of a think aloud protocol method and a heuristic evaluation that identified potentially usability problems which could be faced by the users while interacting with the system. This study offered insights into the preferences for working spaces' characteristics that remote workers display when choosing where to work, which can be used when designing or developing a related mobile application or even a coworking space. The results showed that the majority of remote worker's chose to work at home as their first option, however, when working outside their home, remote workers' go for coworking spaces and cafes. The main motives of most remote workers when choosing a workplace outside their home are comfort, affordable accommodation, and the opportunity for social interactions with other remote workers. Remote workers' preferred workspaces amenities/attributes are the WIFI quality, the space location, and a silent environment. Through the usability tests the researcher identified potential usability problems that could impact users' overall experience. The SUS study revealed a score of 91 that can be considered as "acceptable" on acceptability ranges, representing an A. This study showed that applying a Think Aloud methodology can provide relevance and knowledge to improve a system's usability and experience. As a future work, the design review of the system and the implementation of real time sensors will be prioritized, followed by individual usability tests in order to obtain more feedback. The same methodology will be applied to the same target users. Therefore, it is interesting for future research to analyze which (other) preferred aspect of working spaces can be applied into this system.

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