

THE USE OF SMARTPHONES IN PUBLIC SPACES IN THE SMART CITIES ERA

Bianca Chaves-Custodio

Architect, Urban and Architectural Management and Valuation PhD student

disetectura@gmail.com

+34 615941139

Pilar Garcia Almirall

Architect, PhD. Hired professor

pilar.garcia-almirall@upc.edu

+34 93 401 63 96

Centre of Land Policy and Valuations (CPSV)

Department of Architectural Technology (TA)

Technical University of Catalonia (UPC)

Av. Diagonal 649, 4^a planta.

08028 - Barcelona, Spain

cpsv.info@upc.edu

+34 93 401 63 96

Key words: Smart cities, smartphones, public space, ubiquitous.

Abstract

Nowadays the possibility of being ubiquitous connected generates new patterns in the relation between people and the built environment. In a time when cities around the globe claim to be smart, it is crucial to be conscious and highlight the value of its inhabitant's collective wisdom. Technology can improve efficiency in many aspects but cities cannot be understood without its people. We are reorganizing our lives around mass mobile communications. Given that the research scope needs to be updated. Some studies on the use of mobiles in urban spaces have been done, however they have rarely been used to describe this phenomena at a street level, understanding how users interact with public spaces (or not), while online. The research sought to investigate how the widespread use of smartphones frames people's behavior and interaction with public spaces and create new forms of urban dynamics in the Smart Cities era. In this context, we compared the different social groups (tourists, temporary and permanent residents) that inhabit the city. Taking El Born area in the city of Barcelona as case study we have analyzed the use of public spaces and how mobile technology affects the way people relate to the city while online.

Adopting traditional methods of field observation and combining them with surveys we have extended and improved existing methodologies, generating a singular comprehensive dataset,

consisting of more than 5000 observations. The analysis of all collected data provided insightful outcomes both at street level and from the users' point of view. The results evince that behavioral patterns on the use of technology in public spaces are tightly linked to the social group each person belongs to and to the relation each one has to a place.

Although online information about places is getting progressively more accurate, there is still a valuable intangible layer of knowledge held by locals that can not be replaced by any map, recommendation system or app. Despite the infinite possibilities of being online, mediated perception do not replace the intangible value of face-to-face relations.

Introduction

Researchers in the fields of urban planning and physiology have historically investigated about perception and how people experience, perceive and navigate the urban landscape. With the widespread use of mobile smartphones, tablets, and portable computers, cities are progressively turning into the primordial locations for interacting with computing systems (F. Bentley et al, 2012). The possibility of being constantly "connected" is affecting and changing the way people interact and relate with the environment, and finally altering the city itself, reshaping the built environment. Cities around the world are being instrumented with digital devices and infrastructure (such as sensors, cameras, ...) that generate loads of data and enable real-time analysis of city life. The merging of digital and physical spaces conducts to innovative socio-spatial practices. This has a huge impact on urban phenomena and on the dynamics of inhabiting, meeting, traveling, displacement, work, provisioning, leisure and people's behaviour. Those changes affect not only cities dwellers but the way individuals experience places anywhere. Residents and non-residents have a complete different perception of the city as well as different needs. Moreover, the digital footprints left by users is allowing to study how people move in a city (Girardin, 2008), with an amount of data that was impossible to gather in the past. And here is where cross-disciplinarity becomes very important.

With the present wide use of the term "Smart City", cities around the world claim to be *Smart* even without defining its meaning. Beyond the idea of a high-tech city, based only in IT infrastructures, and having technology, sensors and automate systems as a solution to any kind of problem, the real smart city should be based on using networked infrastructures in order to generate social, cultural, economic and environmental development (Hollands, 2008). According to Anhony M. Townsend (Townsend, A. M., 2013), we are witnessing the birth of a new civic movement, as the smartphone becomes a platform for reinventing cities from the bottom up. We are reorganizing our lives around mass mobile communications. Given that the research scope needs to be updated. In this research, we have analysed the use of public spaces in El Born in Barcelona and how mobile technology affects the way people perceive and relate to the city.

Methodology

As a case study *El Born* area in the city of Barcelona was chosen given that its urban fabric offers a rich combination of uses and users. This area is part of the *Sant Pere, Santa Caterina i*

la Ribera neighbourhood, included in the old town district *Ciutat Vella*. This is a lively area that combines a variety of uses and users, where an intense touristic activity and a genuine “*vida de barrio*” (local life) takes place. Its streets are mainly pedestrian and its urban fabric is full of small squares which are permanence and interaction places generating an intense use of public spaces.

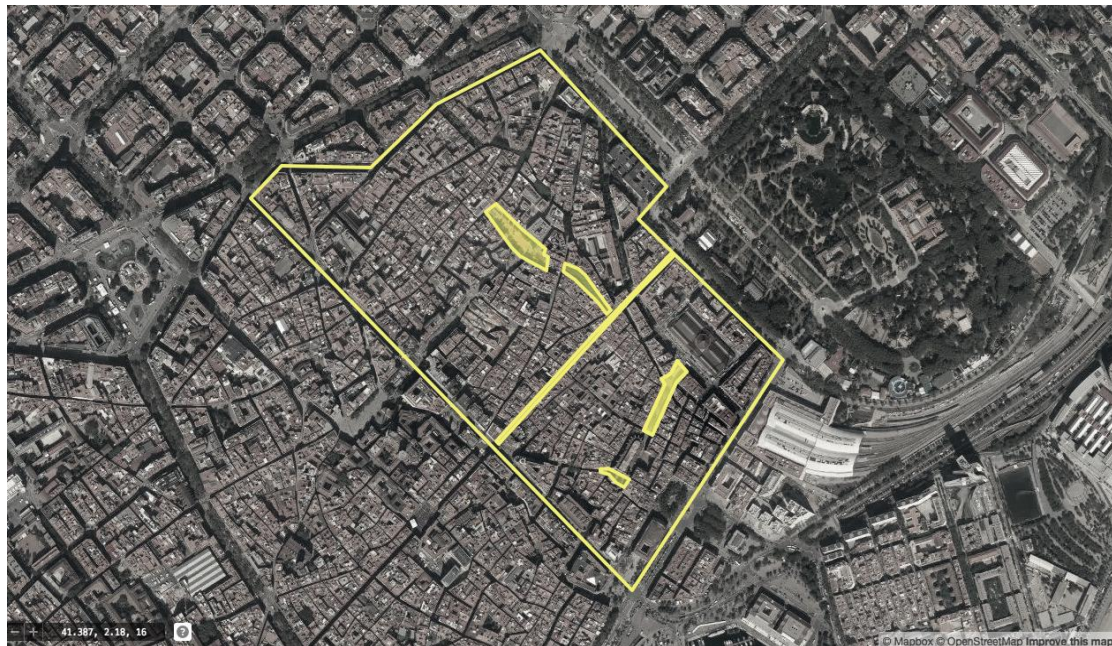
Due to the various aspects that this research seeks to cover, a combination of different methodologies was used, addressing qualitative and quantitative aspects, combining different data-gathering methods. A brief summary of the methodology can be depicted as follows:

- Defining observation Spots - Identification of relevant spots for field research
- Field Observation - Street level direct observation
- Short Survey - ¿where are you?
- Residents Questionnaire - Neighbours face-to-face and online questionnaire

Defining Observation Spots

Firstly we had to identify relevant spots in the neighbourhood where we could implement the field research. We sought to identify places with different character such as: a place important for the local life; a place important for neighbour’s everyday interaction; a circulation axis in the area; a place with high touristic interest and a city landmark in the neighbourhood. In order to reflect the neighbours perception about El Born and its character, a brief online survey was carried out, where we asked people who live in the area to identify those spots. Based on dwellers’ opinion, we defined five case study spots in El Born: (a) Allada Vermell, (b) Forat de la Vergonya, (c) Carrer de la Princesa, (d) Passeig del Born, (e) Santa Maria del Mar.

Figure 1. Case study spots



Source: Own elaboration using Mapbox

Field Observation Methodology







Street level direct observation was performed applying traditional methods of observing, recording, photographing and counting, in order to gather information on the use of public spaces and social dynamics focusing on the use of mobile devices.




Due to the rich aspects of El Born neighbourhood life and activities, we considered necessary to perform the field observation in different times of day and in diverse week days. The main aim was to map, quantify and qualify mobile phones activities, comparing the patterns between spots and hour of the day. Observation is a fundamental and highly important method in all qualitative inquiries.



The research was developed based in two methodologies (Gehl, 2013 and García Almirall, 2012). From those methodologies we have learned how to systematize the research in order to collect similar information for each observation what makes possible to compare results and take conclusions from the collected data. After studying carefully the methodology we have created a graphical tool, a record form (Figure 2) including all the activities related to mobile phones and maps that we wanted to observe; characteristics about who is performing the action and general information about time, weather and place. This record intends to simplify the task of writing down the collected information.









Figure 2. Field research records template

field research

 _____  °C    

 _/ _/ _  : _  : _

	solo	couples / groups
 holding a map		
 looking a map		
 holding a mobile		
 looking at a mobile / texting		
 talking on mobile		
 taking a picture		
 taking a 'selfie'		
 for mobile related actions		

Source: Own elaboration

We have performed different observations in the five case study spots, at different day times and week days, summing up 75 observations moments. We have recorded the number of passers-by; the amount and kind of mobile phone related activity (talking, texting, holding, taking pictures or selfie); the amount and kind of map related activity (holding, looking at); the characteristics of the ones performing the activities (male, female, child); if they were alone or in groups and in this case which kind of group (solo, couple, mixed group, female group, male group, children group or family) they belonged to. The outcome of the Observation is a dataset of 5290 entries, corresponding to each observed person.

Short Survey - ¿Where are you? Methodology

As the third phase of the field research, a short survey has been done. The answers were collected in person with a smartphone connected to internet, filling up an online form, resulting in a more efficient data collection. This part of the field research aimed to answer one of the most substantial questions of this work: why are so many people staring at their mobile phones? It doesn't matter what they are doing (going up stairs, talking, driving, crossing the street, in a bar, in a park, with friends...) they keep staring at the mobile.

A sample on the use of mobile phones in the five case study spots was done by approaching people staring at a mobile phone and asking what they were doing at their smartphone at that exact moment (Figure 3). For the purpose of having a direct comparable dataset and a relevant number of responses we have collected 100 responses, 20 in each case study point. From the 103 inquired people, only 3 didn't want to answer, mainly because of language issues.

Figure 3. Performing the Short Survey



Source: Own elaboration

The short survey was composed by the main question ¿Where are you? Followed by some questions regarding the respondent' origin and place of residence (El Born, Barcelona or

Other), for how long they have lived in El Born or in Barcelona or, in case of a tourist for how long they stayed in the city. We have categorized the respondents according to the time of stay (Tourists; Temporary residents; Extended Temporary; Residents and Since Always “*toda la vida*”).

Residents Questionnaire Methodology

Lately, a questionnaire to El Born residents was performed. It was addressed to people who live (or work) or has lived in the area in the last 3 years. We considered that before this period the use of smartphones was not as widespread as it is today, or that at least less people would have permanent internet connection. We also got responses from people living in the area for a short period of time (1 to 6 months) in order to compare the way they make use of technology for improving their knowledge of the area and how they relate to it.

The questionnaire intended to gather qualitative and quantitative data in order to better understand how dwellers interact with the area and how the use of smartphones is changing this relation. It also expected to determine how much residents rely on online information about the neighbourhood and the way they normally make use of mobile phones, internet, online maps and apps.

The online questionnaire was active for 21 days (from 25 May 2015 to 15 June 2015). In parallel we did the face-to-face questionnaires with neighbours. Finally we have done 12 face-to-face questionnaires and collected 48 online questionnaires, summing up 60 answers.

Analytical Techniques

The goal of data analysis is to describe, interpret and explain the collected data so that it may respond to issues raised in the study. In this research the data gathered during the different phases of the Field Research (Field Observation, Short Survey and Questionnaire) was analysed using statistic tests. The main analytical techniques applied were: frequency, which reveal how the data is distributed with respect to the values considered in the variable; dynamic and cross tables. Frequencies can be used to reveal important aspects in the relation between users and the built environment with no need of being combined with other statistical tests, (LAY, M. C. D.; REIS, A. T. L., 2005). All the statistical tests were carried out using statistic software (such as Excel, SPSS and its open-source version PSPP).

Analysis and Results

This study seeks to contribute to identify and understand how new mobile technologies influence and affect the relation between people and the built environment taking as a case study El Born area in the city of Barcelona.

Field Observation Results

In total we have observed 5290 persons (entries). Given that our main goal was to understand and recognize patters of activities related to the use o mobile phones and maps in public spaces, we created a subset of our data keeping only the entries were the value of the variable “action” was different from “no mobile related action”. In total this subset had 707 entries

(13.3%). From now on we will call it *activity subset*. The main (complete) dataset with 5290 entries is defined as *whole dataset*. We have performed additional analysis of the *activity subset* separately.

Table 1. Datasets labels

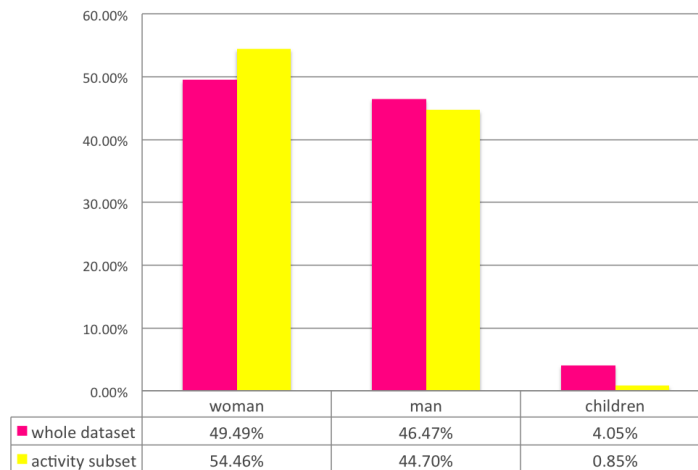
dataset label	dataset description	entries
inactivity subset	It contains entries that had not perform actions	4583
activity subset	It contains only entries where some activity was performed	707
whole dataset	Main complete dataset, including all the entries	5290

Source: Own elaboration

Who & How many? From all the observed persons, the *whole dataset* (5290 entries), 49.5% (2618) were women, 46.5% (2458) man and 4.0% (214) children. 30.28% of all entries were alone while 69.72% were in groups.

Seeking to explain the main characteristics of those people more engaged in the use of mobile phones, we have contrasted the percentage of woman, man and children from the whole dataset with the activity subset. Figure 4 suggests that the women are the ones more likely to be using the mobile phone in public spaces.

Figure 4. Percentage of woman, men and children - whole dataset vs activity subset



Source: Own elaboration

Following the same idea, we have compared the percentage of people from each kind of group from the whole dataset with the action subset Figure 5. Here the percentage of observed people alone (solo) was 30.3% (in the whole dataset) and 50.6% if we take in consideration only the subset. The difference is even more pronounced if we look at families: 6.8% (whole dataset) and 2.8% (action subset). That divergence indicates that someone is more likely to perform a mobile related activity while alone (solo), than when in groups or in family.

Figure 5. Kinds of group - whole dataset vs activity subset



Source: Own elaboration

When? Analysing the data we can identify some patterns. The rate of entries distributed in the different day time when looking to the *whole dataset* (15.16% morning; 40.68% midday and 44.16% evening) is very similar to results of frequencies analysis when we look only to the *activity subset* (14.99% morning; 45.26% midday and 39.75% evening).

Where? Something similar occurs to the distribution of occurrences among the five places as shown in Table 2

Table 2 Whole dataset vs activity subset - frequencies by place

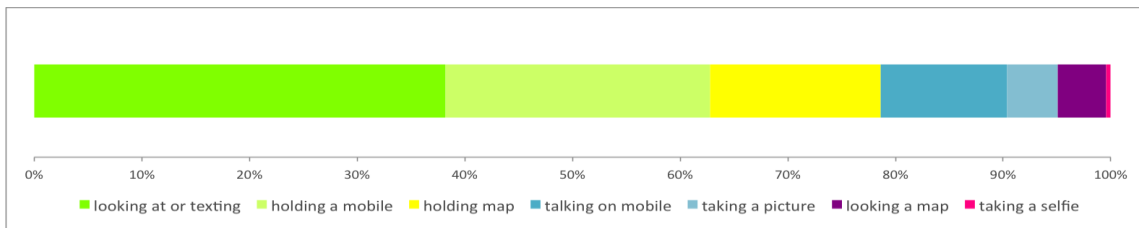
Whole Dataset - Table: place			Activity Subset - Table: place		
Value	Frequency	Percent %	Value	Frequency	Percent %
Allada_Vermell	577	10.91	Allada_Vermell	82	11.6
Carrer_Princesa	1296	24.5	Carrer_Princesa	170	24.05
Forat_Vergonya	430	8.13	Forat_Vergonya	65	9.19
Passeig_Born	1249	23.61	Passeig_Born	180	25.46
Sta_Maria_Mar	1738	32.85	Sta_Maria_Mar	210	29.7
Total	5290	100	Total	707	100

Source: Own elaboration

What? In what regards to mobile phone or map related activities, 13.3% (707 out of 5290) of all the observed people were performing some of the possible activities (holding map, looking a map, holding a mobile, looking at or texting, talking on mobile, taking a picture, taking a selfie).

If considering only the activity subset, the most frequent performed activity is *looking at the mobile* or *texting* (38.19%), followed by *holding a mobile* (24.61%). The most unusual activity observed is *taking a selfie* representing only 0.42% of all the activities (Figure 6). This percentage decreases to 0.06% when looking at the whole dataset.

Figure 6. Activity subset - activities percentage



Source: Own elaboration

Performing a crosstab with the variables place and action kind data from the activity subset, gave us the base to come out with several results Table 3.

Table 3. Activity subset - crosstab - place*action kind

Table: action_kind * place [count, row %, column %, total %]						
action_kind	place					Total
	Allada_Vermell	Carrer_Princesa	Forat_Vergonya	Passeig_Born	Sta_Maria_Mar	
map_holding	10 8.93% 12.20% 1.41%	30 26.79% 17.65% 4.24%	3 2.68% 4.62% 0.42%	22 19.64% 12.22% 3.11%	47 41.96% 22.38% 6.65%	112 100.00% 15.84% 15.84%
map_looking	1 3.13% 1.22% 0.14%	7 21.88% 4.12% 0.99%	8 25.00% 12.31% 1.13%	5 15.63% 2.78% 0.71%	11 34.38% 5.24% 1.56%	32 100.00% 4.53% 4.53%
mobile_holding	31 17.82% 37.80% 4.38%	50 28.74% 29.41% 7.07%	14 8.05% 21.54% 1.98%	44 25.29% 24.44% 6.22%	35 20.11% 16.67% 4.95%	174 100.00% 24.61% 24.61%
mobile_looking_texting	26 9.63% 31.71% 3.68%	64 23.70% 37.65% 9.05%	26 9.63% 40.00% 3.68%	70 25.93% 38.89% 9.90%	84 31.11% 40.00% 11.88%	270 100.00% 38.19% 38.19%
mobile_taking_picture	4 12.12% 4.88% 0.57%	1 3.03% 0.59% 0.14%	6 18.18% 9.23% 0.85%	7 21.21% 3.89% 0.99%	15 45.45% 7.14% 2.12%	33 100.00% 4.67% 4.67%
mobile_taking_selfie	0 0.00% 0.00% 0.00%	0 0.00% 0.00% 0.00%	0 0.00% 0.00% 0.00%	2 66.67% 1.11% 0.28%	1 33.33% 0.48% 0.14%	3 100.00% 0.42% 0.42%
mobile_talking	10 12.05% 12.20% 1.41%	18 21.69% 10.59% 2.55%	8 9.64% 12.31% 1.13%	30 36.14% 16.67% 4.24%	17 20.48% 8.10% 2.40%	83 100.00% 11.74% 11.74%
Total	82 11.60% 100.00% 11.60%	170 24.05% 100.00% 24.05%	65 9.19% 100.00% 9.19%	180 25.46% 100.00% 25.46%	210 29.70% 100.00% 29.70%	707 100.00% 100.00% 100.00%

Source: Own elaboration

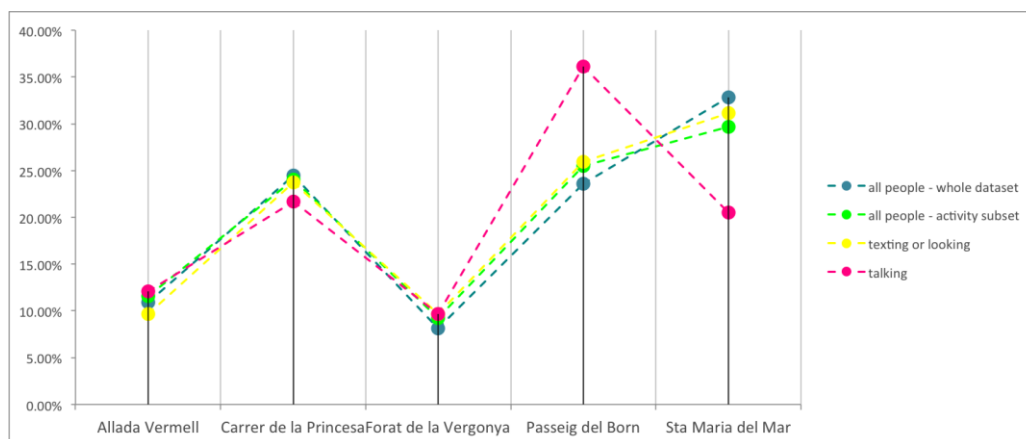
Looking first at activities related with maps, some expected results could be observed. The most touristic place, Santa Maria del Mar, had the higher score of people holding a map 41.96% of all the people *holding a map*, followed by Carrer de la Princesa, with 26.79%. A different pattern is observed when considering the action *looking a map*. This action is still prevalent in Santa Maria del Mar, with 34.38%, but it rises from 2.68% (*holding a map*) to 25.00% (*looking a map*) in Forat de la Vergonya. A possible explanation is that Forat, not being a touristic place, leads people to feel more “lost” and so having the need to look at a map to find their way. In relation to Carrer de la Princesa we assume that the high scores - 26.79% (*holding a map*) and 21.88% (*looking a map*) –, apart from its morphology and circulation axis character, are due to its proximity to Picasso Museum, and the total lack of “clues” about where it is. This outcome

confirms the on site experience, given that in some observation days we had to answer the question - *Where is Picasso Museum?* – four times even before starting to record.

Turning to mobile related activities, we can note that *holding a mobile* was more frequently observed in Carrer de la Princesa (28.74%), it may refer to its physical attributes, been like a connection corridor, without welcoming areas to stay; so people do not feel comfortable to do other actions.

Texting or looking at the mobile was the most observed action, with 38.19% of all entries from the activity subset. Its distribution in percentage in the five places is quite similar to the distribution of people by places (see Figure 7), what suggests that it is a very common activity that is performed disassociated to the place character. A diverse behaviour can be observed in the distribution of frequencies of *talking on mobile*. Although it follows the same pattern in Allada Vermell, Carrer de la Princesa and Forat e la Vergonya, Figure 7 shows that the frequency increases in Passeig del Born and decreases in Santa Maria del Mar. A possible reason is the impressive and monumental character of the church, that might keep people's attention, instead of talking on the phone!

Figure 7. Frequencies of "texting or looking at a mobile" and "talking" action from the activity subset compared to frequencies of people in different places



Source: Own elaboration

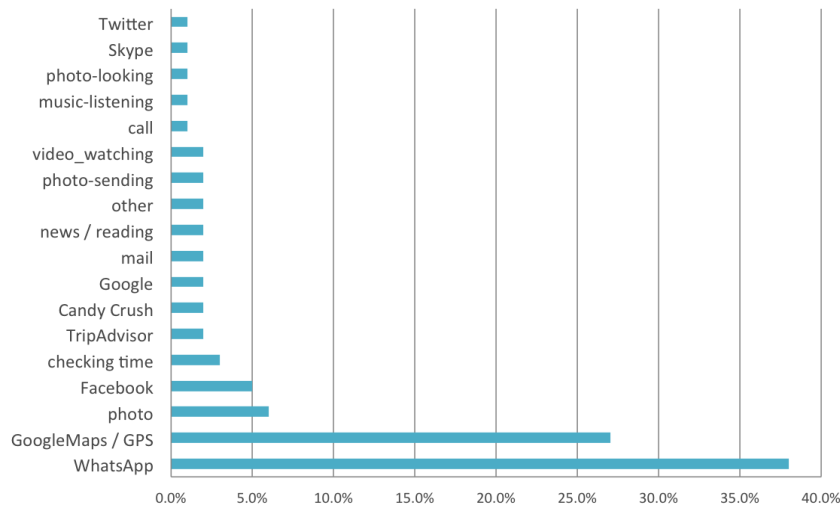
Short Survey Results

The aim of this research phase is to determine if the people using the mobile while walking on the street are in "another world" or if they are somehow relating to the city and their surroundings through mobile phones as well as identify patterns of behaviour, understanding if there is some relation among the use they do of their smart phones, places and time.

In total we have inquired 100 persons, 20 per place, being 46% women and 54% man. 27% of the respondents live in El Born, 36% in other neighbourhoods of Barcelona and 37% in other city or country.

As a starting point, a frequency analysis was done and the outcome is reflected in Figure 8.

Figure 8. ¿Where are you? - different answers in %



Source: Own elaboration

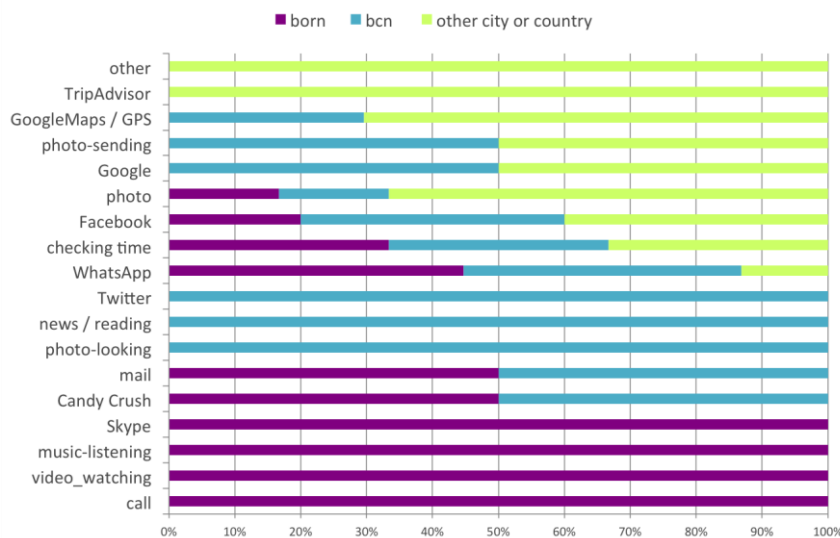
From all the answers, we can clearly see that the two more frequent answers are *using Whatsapp* (38.0%) and *using GoogleMaps/GPS* (27%).

The analysis of answers related to *activities* and the respondents' place of residence can be seen in

Figure 9. As expected, no people from the neighbourhood were looking for directions (Google maps or GPS) neither for TripAdvisor tips (

Figure 9).

Figure 9. Activities by place of residence



Source: Own elaboration

A very insightful result was to discover that people living for a longer time in El Born were found doing the most diverse kinds of unexpected activities, such as watching movies, playing, listening to music or talking by Skype on the street. One raised reason for this behaviour is that they might feel as comfortable in the area as they feel at home, so they extend their home activities to the neighbourhood public space. Another possible reason could be due to the very compact and high density (20.482 hab/Km², according to the Inhabitants Municipal Census, Statistics Department of Barcelona City Council) characteristics of the area (Sant Pere, Santa Caterina i la Ribera), and the probable reduced size of residences, so that they find the need of having more space outside. Although we consider that this kind of behavior relates more to the relation each person has to the area, this phenomenon was more frequently observed in less touristic places such as Forat de la Vergonya and Allada Vermell.

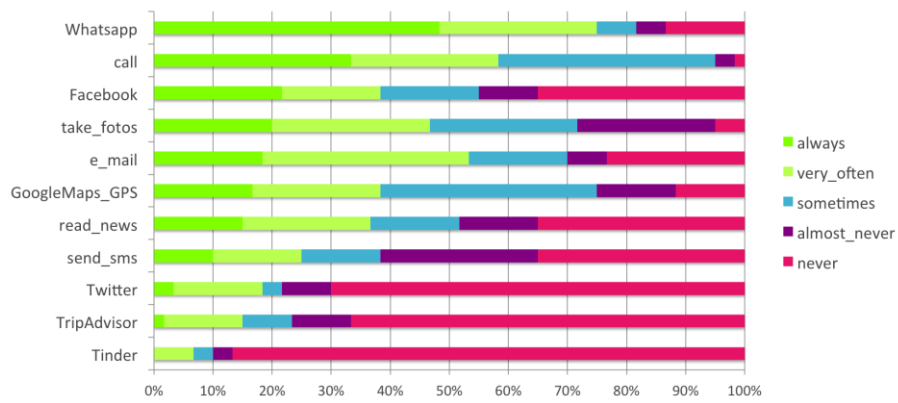
Residents Questionnaire Results

Looking first at “how connected” are the residents of El Born, the great majority of the respondents (81.7%) have (always) internet connection in their smartphones. When asked about using internet connexion in public spaces, more than 50% of the respondents would use it regularly (26.67% always and 26.67% very often). With regard to the way dwellers usually look for a service or a restaurant in El Born, the majority would still prefer to ask to a friend or neighbour rather than relying on internet. This preference is more accentuated in the case of *looking for a restaurant* (45% ask friends vs 28% internet). One possible reason for this difference may be that, since it involves personal taste, people would rely more on friends’ opinions than in internet recommendations. Although nowadays there are many very well developed recommendation and reviews apps where you can see people opinions and reviews about places, and even the profile of reviewers, you can never be sure if you share the same taste or preferences with them.

In what concerns to the use of Google Maps or GPS, when asked about how they find their way in El Born, the great majority (66.7%) of residents answered that they already know it so they do not need help. The second more popular answer was *using GoogleMaps or GPS* (15%). No one (0.00%) use a paper map.

With regard to the use residents do of their mobile while in the street or in public spaces, the questionnaire revealed that the main use is *Whatsapp* (48.33%).

Figure 10. Questionnaire - Use of mobile on the street



Source: Own elaboration

Figure 10 provides synthesized information about the possible uses respondents may do of their mobile phones while on the street and how often they would do so.

Conclusions

This research explored, from the point of view of users, how they make use of mobile phones in public spaces and how they relate and interact with places. In addition we have identified how new technologies is altering this relation and compared different social groups (tourists, temporary and residents) that inhabit the city.

Adopting traditional methods of observation and combining it with surveys, questionnaires and maps we have extended and improved existing methodologies to meet our own goal. We generated a valuable dataset including more than 5000 entries about the way people use mobile phones in public spaces.

Here, we summarize the main conclusions of this thesis:

- The patterns of mobile phones use do vary according to the character of the public space where users are, but mainly due to the relation users have with each place.
- The use of mobile phone patterns is different among diverse groups of users (residents, temporary and tourists).
- Individuals tend to make different uses of their mobile phone if they are alone or with someone else.
- People tend to use internet recommendations but they still prefer and trust better, whenever possible, in information from friends or colleagues.
- People living for a longer time in a place would rely more on self-knowledge about the area or in friends' tips than on internet recommendations when looking for a restaurant or service in this area.
- The most widely used app in public spaces (concerning the case study) is Whatsapp, followed by GoogleMaps or GPS.
- One of the most insightful conclusions was that the way people use smartphones in public spaces is more strongly related to the affinity and relation each person has with this place than to the place itself. Performed actions tend to correspond to people's perception of places, as well as how they feel about it. Someone would act completely different when feeling comfortable, related or connected to a place than when feeling strange, lost or insecure.

This research confirms that even though people thoroughly use and trust internet information, whenever it comes to recommendations, if possible, people would still rely more on friends' or colleagues' opinion rather than on internet. Despite the very refined recommendation systems existing, that allows us to see other people's opinion and reviews about places, experiences and things, and also reviewers profiles, one can never be sure to share same taste or opinion with them.

Summarizing this conclusion, internet does not replace direct contact; instead it adds a new source of information, adding *layers* of the *virtual city* to the physical one. Although this information is getting progressively more accurate, there is still a valuable intangible layer of knowledge about places held by locals that can not be replaced by any map, recommendation system or app. Our cultural references also influence the way we experience a place and

settling roots enables us to have unique experiences and assign special significance to places. Despite all the infinite possibilities that being online can mean, there is still nothing comparable to really being in a place, experiencing it, feeling it and getting to know it and have face-to-face relations with people. Hardly the value of being somewhere sharing experiences with real people could be ever replaced by mediated perception.

Limitations & Future Work

In this research we have created a comprehensive dataset, allowing us to have a deep understanding of how the use of new mobile technologies affects the relation between people and public spaces. Notwithstanding, when interpreting the results, we should take into account that they reflect the specific reality of the case study site and it might be biased towards people from a specific age range.

The methodology, however, has a broader value and could be applied to other contexts in forthcoming researches. For future work we would like to reply this research in other locations, sampling more diverse people in terms of age and nationality, as well as to explore the dataset performing comparisons among the different locations.

Acknowledgments

First of all I would like to thank my advisor, Dra. Pilar García Almirall for her support and guidance in this research. I also want to thank Rolando Biere for being so helpful as well as to all the teachers from Centre for Land Valuation Policy (CPSV). I would like to thank AGAUR for the conceded grant.

References

- Bentley, F; Cramer, H; Hamilton, W; and Basapur, S.** *Drawing the city: differing perceptions of the urban environment.* In Proceedings of ACM Conference on Human Factors in Computing Systems (CHI), Texas, US, 2012.
- García Almirall, P., Gutiérrez Valdivia, B.A., and Ciocoletto, A.,** 2012, *Hábitat para la convivencia. Herramientas de análisis y evaluación urbana* - Available at: <http://www.cpsv.upc.es/HabitatConvivencia/index.htm> (last accessed - June 2015)
- Girardin, F., Calabrese, F., Dal Fiore, F., Ratti, C., and Blat, J.** *Digital footprinting: Uncovering tourists with user-generated content.* IEEE Pervasive Computing, 2008 7(4):36–43.
- Hollands, R. G.,** 2008. *Will the real smart city please stand up?*, City: analysis of urban trends, culture, theory, policy, action, 12:3, 303-320
- Lay, M. C.; Reis, A. T.,** 2005. *Análise quantitativa na área de estudos ambiente-comportamento.* Ambiente Construído, v. 5, n. 2, p. 21-36.
- Gehl, J. and Svarre, B.,** 2013, *How to study public life.* Washington, DC : Island Press. ISBN 1610915259.
- Townsend, A. M.** *Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia.* W. W. Norton & Co., New York, 2013. (10-11)