

Smartphone and Mobile Territories - Technical Knowledge Transformed into an Object Producing New Territorial Layers: An Experience in the City of Strasbourg

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1 ABSTRACT

The “smartphone” is one of the individualized technical objects of the 21st century. This object is like a tool for socio-spatial reading of the territories thanks to the Internet of Things. The integration of geolocalised information with the Internet of Things opens the way to apprehend actual heritage of the cities in different ways.

The relationship between digital and physical mobility in mapping physical territories in a sensitive way has been investigated only in a few studies and there is controversy about its predictors. Therefore we aimed to investigate the relationships between the invisible and non-visible elements of territories and users with their networks. We hypothesized that the circulations of 10 participants during 7 days in Strasbourg would enable us to trace a sample of images of the collective memory of the city relevant to its architecture and urbanity.

The study is done by sending screenshots of the applications in use in the public space for at least three times in a day during a period of 1 week in the city of Strasbourg. The participants recorded also their daily journeys during this week via applications "Open GPS Tracker" or "Open GPX Tracker" (two open source applications). At the end of each day, they sent us both screenshots and open tracker gpx files of their journey and a total of 70 journeys were analysed. Afterwards the paths of the participants with their digital activities have been correlated by superimposing cartographically physical places frequented and digital activities carried out on each journey. By digital activities we considered all activities related to the use of smartphones, these activities may be related to the internet or not but they are categorically achievable through smartphones (messaging, communications applications, entertainment, etc.).

We observed that the flow elements, such as public transport, constituted a good physical place where the diversity of digital activities was increased. Furthermore we saw that the nature of the subject's presence in the public space (rest, passage, movement via the different systems of transport, etc.) was associated with his/her digital movements. Moreover, some physical locations were more appropriate for digital activities than the others interestingly.

Our work with a modest sample offered clues of the emergence of these new layers by the use of technological devices. Global computer knowledge is transformed into a mobile technical object and shared worldwide via smartphones. These objects are not just mere results of global knowledge, but they also produce socio-territorial knowledge by revealing the relations between the invisible or non-visible elements of territories and users. In other words, the people's digital and physical mobility with new individualized objects forms new layers of territories that we name Mobile Territories. We found and illustrated with many attractive examples, for the first time, that the nature of the digital activities of the participants is shaped according to their physical location and own speed. And vice-versa, the physical location appeared to be augmented according to digital activities. By establishing connections between the digital activities and physical location, we understood that the both are moving in accordance with their relationships.

Possible readings of the morphological and social characteristics of cities via layers of Mobile Territories, the consequences and the effects of these invisible layers would be remarkable for planners and architects.

Keywords: digital activities, Strasbourg, mobile territories, new territorial layers, smartphone

2 INTRODUCTION

The Smartphones entered into our lives as an object producing urban layers. At the base of its evolution, it is undeniable that the term Big Data has had a great importance. The Big Data is like the petroleum oil of the 21st century. The smartphone is a product which follows the interdisciplinary logic of the term and is a phenomenon that we call Big Data, at the same time (Diebold, 2012).

Pronounced by Weiss and Indurkha (1998) in computer science and by Diebold (2000) in statistics/econometrics, this phenomenon of Big Data accompanies the evolution of the use of the smartphones and enriches it. The unpublished research note by Douglas Laney highlighted that we can rethink the concepts of the Big Data (volume, velocity and variety) through the smartphones (Laney, 2001). The smartphone is one of the individualized technical objects and builds a new urban relationship (Picon, 2014). It regulates the data of the hidden city information, creates computer data and gives meaning to all these while linking the lives of the individuals with the technical systems. But the digital activities of mobile territories created by the smartphones are not fully discovered.

Our goal was to explore some of these links created by the smartphones using the cartography of the city of Strasbourg and the principles of the Big Data phenomenon built the baseline of our research.

3 RELATED WORK/ STATE OF RESEARCH

The smartphone has been mainly worked as an individualized technical object that connects individuals like a social condition (Hatuka, 2014) via an environment of a digital technology. It has always been at the meeting point of the physical and digital environment while being integrated in both of them. However, these two environments are two worlds which are not the parts of the same system. Therefore they are not totally compatible with each other. The smartphone was determined by the human choice that has tried to achieve the best possible compromise between two worlds (Simondon, 1958, 2012; Mizuko, 2004; Beauce, 2012). The associated environment of smartphones was considered as a set of human relations traversing mostly two social environments (the physical and the digital environments).

Muziko introduced physical territories as an object to work with associated smartphone environments for the first time. She highlighted the need to have common ground where everyone can get out from their protected areas and communicate with each other. According to her, the relationship between the public and the private sector is still in the center of many stratification and classification systems. It is not sufficiently evaluated but the smartphones enabled this relationship in some way (Muziko 2004). The relationships established by smartphones between the public and the private sector have overlapping economic, social, cultural and political dimensions and a clearly visible physical manifestation, perhaps more than any other form of the structures of the city.

Besides, Hatuka continued to work on the public-private relations created by smartphones as a social condition and took up the Muziko's ideas without being linked to the formal dimension of structure of the city. She suggests that the smartphone is building a mostly portable territory. Its mobility depends on the physical mobility of the people who own this object (Hatuka 2014).

But the smartphone is not only portable/mobile but it builds the mobile territories while being at the same time one of the parts of these territories. It is not only a social but also an urban physical condition that has many consequences for the economic, social, political and cultural dimensions of the urban territories. These territories produced by smartphones are physical, real and belong to the real world as well as to the digital world. They travel from the concrete to the abstract world and then return to the concrete world to finish their journey. These journeys are framed by smartphones which are the technical objects being in a continual state of transformation (Simondon 2012) and directly affecting the architecture and urban practices of our territories.

The trajectories of the mobile territories can be detected through digital traces (Beauce 2012 and 2014). There are many studies investigating digital traces in a way related to the mapping of physical territories. Among these researches, we can mention the studies interested in the rhythms of the cities, and the emotions, the various multiple representations (thanks to the augmented reality), the modelings as well as the limits and the different spatial consequences of the models of these rhythms. The smartphone, as an individualized technological object, has always been used in these studies but it was not always at the center of the work as a part of the Internet of Things.

In regard to the city's rhythms, the work of Miranda et al. , in the Tandon School of Engineering's Center for Data Science, mainly proposed an analogy between the recurrent processes in a city and the heart rate of a human body. Their Project Urban Pulse studied the human activity through empirical measurements related to the daily lives of citizens in the Rockefeller Center (NYC) and Alcatraz Island (SF) by using the phone

calls and letters. In this study, the digital traces of the citizens were a part of the measures established by the researchers. (Miranda et al., 2017).

The exploitation of digital traces was also used to work cartographically the emotions of the citizens in face of the rhythms of cities. The citizens were considered as sensors in various studies (Martino et al., 2010; Resch 2013; Zeile et al. 2016). Resch emphasized the model of innovative concept (called People as Sensors by him) in which measurements were taken by using the technical objects combined with individual measures such as subjective sensations, current perceptions or personal observations of citizens (Resch 2013). The smartphone was actually an instrument capable of creating new forms of collaboration and participation. Thus it may allow experiencing each individual as a node in a network of sensors (Martino et al. 2010). Moreover, the place of augmented reality must also be emphasized in graphic representations of the rhythms of the cities. Some authors gave a general overview of augmented reality techniques while showing the possible use cases in the fields of architecture and urbanism (Zeile and Bronchart 2014).

The Senseable City laboratory of The Massachusetts Institute of Technology (MIT) focused on modeling city beats by the uses of mobile phones that interacted with the urbanity and architecture. The cartographic modelings of the rhythms via the digital traces have been experimented. The experiences of "Mobile Landscape Graz in Real Time (Ratti et al., 2006)" and "Tweet Bursts: Quantifying mass excitement in social media (Ratti et al., 2014)" can be mentioned among different researches that have studied physical territories in connection with mobile phones. In both experiments, the goals were to understand the technologically oriented urban dynamics of the daily life and to open new ways to understand the contemporary city using mapping. On the other hand the experience of Mobile Landscape Graz in Real Time showed that even if the phone activities were put in connection with the city the distribution of different digital activities on the city is unclear. In the Tweet Bursts study, the aim was to understand people's reaction to a single event - which occurs in a specific place - being a part of a specific digital activity: the use of the Twitter. The limits of the cartographic modeling were reached in connection with the spatio-temporal patterns of the mobile phones (Ratti, Claudel, 2015, Kondor et al., 2017). The different consequences of these modelings were also explored in different disciplines such as medicine (Vanky et al., 2017) and computer science (Constantino et al., 2017). Eric Fischer modeled for the first time, the project "280 Million Tweets" revealing geographic usage of mobile phones using different operating systems (e.g. android, ios...), where he collected the tweets (by Twitter) during one week. Then he showed cartographically the data that he got from 130 cities of the world (Fischer 2010).

The works cited above let us realize that the cartographic modeling of the different digital activities is still not completely studied. That's why we focused on the digital activities of mobile territories created by the smartphones in order to understand the modeling system of urban rhythms limited in the urban open spaces. Our purpose was to give an integrated image of mobile territories by geolocating and analyzing one or more digital traces.

4 STUDY SET-UP

The interactions between the virtual places and the territorial places sheltering traditional infrastructures are not well investigated. Therefore we focused on the relationships of the invisible elements (urban layers) of the virtual places and the non-visible elements (urban layers) of both the virtual and territorial places. Our aim was to understand the characteristics of these relationships and the urbanity produced by the emergence of mobile territories. The main questions that we wanted to answer is how the interaction of these territories with multiple characters could cause changes in the architecture of public spaces and the urban practices, and how virtual spaces could compete with the traditional infrastructures?

For the purpose of investigating the questions above, we were interested in matching the digital activities and the physical territory, and in having access to these systems. Our methodology was based on the research of their interactions with the smartphones by following the spatial logic of the Simondon's philosophy (Simondon, 2012). The points of interaction of the activities of the smartphones with the city of Strasbourg have constituted the trunk of the research.

4.1 Methods

4.1.1 The cartographic analysis

To begin our cartographic work, we have scanned the experiences of representations of the previous data generated by the smartphones (Ratti et al. 2006, 2017; Yoshimura et al. 2014). Thereafter, we referred to the project "280 Million Tweets" (Eric Fischer 2010); we drew a time "t" of the possible location of the mobile territories created by the smartphones in the city of Strasbourg (Fig.1). We also showed the different operating systems (Android and iOS) used in the physical limits of the city (Fig.1a). We linked one of the flow elements of the territory to the new territories created by the smartphones (Fig 1b). In other words, we assembled the Strasbourg's public transport system with the new urban layer of the mobile territories.



Fig. 1: Mobile territories and flow elements in the city of Strasbourg*.

*Mobile territories are based on the computer data retrieved from Eric Fischer's project and represented at the time $t = \sum_{i=1}^7 a_i$, for a = day of the week.

The digital traces of smartphones are formally represented in the Figure 1. It gives us an idea of the configuration of the trajectories of the mobile territories on the physical territory of Strasbourg. This configuration seems to be consistent with the network of public transport in Strasbourg. This map giving a first view of the city of Strasbourg, is in accordance with the phenomenon of spatial transduction reported by Simondon (Simondon 2012). The digital activities of the smartphones and physical displacements on the territory come into resonance following this transduction which is representable by the invention of the cartographic dimension. The visibility in urbanism of Söderström (Söderström 2000) and the comprehension of the space via the images described by Lussault (Lussault 2003) inspired also our study design.

4.1.2 The collection and the interpretation of the data

A total of 10 citizens of Strasbourg agreed to participate in our study. Each participant recorded his/her daily journey via the Open GPX Tracker (Ios) or Open GPS Tracker (Android) applications executed by their smartphones, for a period of 7 days. This application did not only record the location (Von Landesberger et

al., 2016) but also the speed of the participants and the duration of the journeys. While using the Open GPX / GPS Tracker application, participants took the screenshots of the other current applications at least three times a day when they were in a public area of the city of Strasbourg. The examples of screenshots are given in Figure 2.

The temporal data of the GPX/GPS Tracker application of an exemplary day were superimposed with the precise moment of taking the screenshots. These overlays provided us the places where the screenshots were taken. We explored cartographically the spatial transduction phenomenon specific to mobile territories: the digital activities and the courses of the participants, considering some recent studies (Wu et al. 2016, Sleipness et al. 2016). The mobile territories were assessable by using the superposition of these spaces. The reading of the data was done by the open source program "QGIS 2.18"(2004-2016 QGIS Development Team/General Public License).

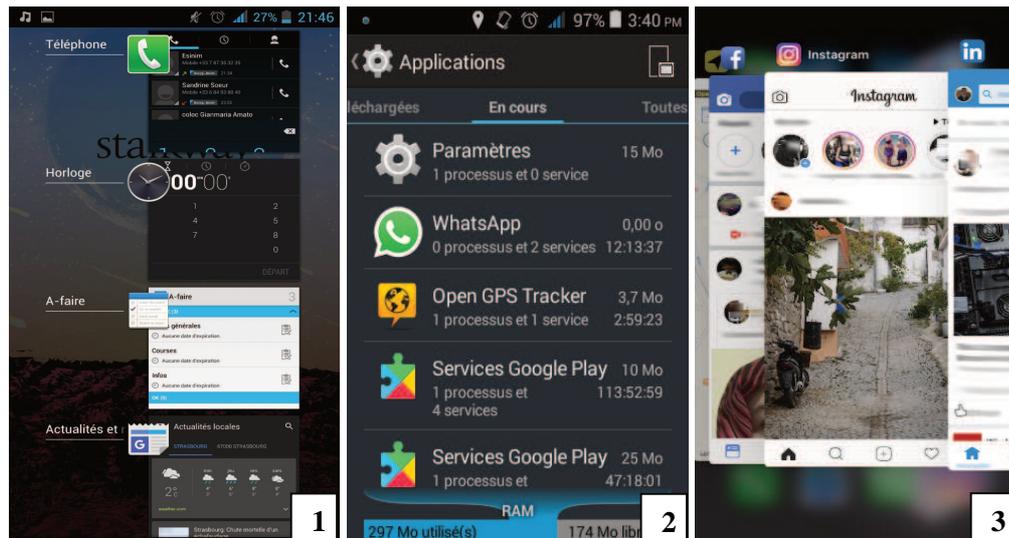


Fig. 2: The examples of screenshots: The first and the second belong to the smartphones having an Android operating system (less used than the third one); the third one from both operating systems (Android and IOS) is one of the mostly taken screenshots.

4.2 Findings

In this article we present the data of four representative journeys made by the 4 different participants. We want to reveal the results of a small scale (the scale of one journey per participant), then the results of the scale of Strasbourg. The journeys 2 and 3 (Fig.4, Fig. 5) of these four journeys were realized within the island ellipse of the city of Strasbourg. The first (Fig. 3) has touched the limits of the ellipse bounded by the Rhin. The fourth, the last journey which is chosen for this paper (Fig 6) has crossed remarkably the limits of the ellipse of the island.

4.2.1 The four representative journeys and Mobile Territories

In each journey, we found logic for the weekdays and also for the weekend. We saw that the week days were similar to each other for every participant which may be related to going to the work or to the school. It is undeniable that weekend days were more interesting. We realized a high flexibility in the journey of the participants during weekend; this flexibility nourished our work in order to better understand the logic of mobile territories within the limits of Strasbourg's physical territory.

The first journey (Fig.3) is a student's one and was recorded during a week day. During the whole journey the participant moved by walking. His/her journey begun from his/her home to the library in the square of République. Digital data were communicated via a smartphone with an Android operating system. The screenshots were taken in the inside of the home, in the inside and the outside of the National University Library and finally in the square of Marché Gayot (Table 1). An application for the communication (The Whatsapp), for the navigation and research on the Internet (the Chrome), for the leisure and the work (the Youtube) and for e-mailing (the Gmail) built the main body of the various digital activities of this journey.

The second journey (Fig.4) was at the limits of the island ellipse of Strasbourg. It was made during a weekend day. We have understood that the participant took the tram (A or D) to go from his home to the place of the old synagogue and then he walked in the street Noyer. The screenshots have been taken from

the outside of the home, on Street of Noyer and at Kléber Square by a smartphone with the Ios operating system. An application for the navigation and research on the Internet (The Chrome), for leisure (the Google Play Music) built the main body of the various digital activities of this journey.



Fig. 3- Fig. 4: The cartography of the journey 1 and 2. The physical paths are correlated with the digital activities in the city of Strasbourg.

The third journey (Fig. 5) is one of to young active people. He/she stayed in the inside of the island ellipse of Strasbourg during the days of the week (he/she was working). This exemplary journey was realized during a day of the week. The displacements of the whole journey were entirely made by bike. The screenshots were taken in a public space near to the home and near the Kléber Square This square was next to the work of the

participant. We have understood, from the data in the Gpx file obtained through the Open Gpx Tracker application (Ios Operation System), that the screenshots were made at the breaks when the participant was immobile. An application for the leisure (The Instagram), for communication (the Whatsapp), for the leisure and work (the Youtube), for the research and navigation on the Internet (the Chrome) and for the leisure with actualities (the Google News app) built the main body of the various digital activities of this journey.

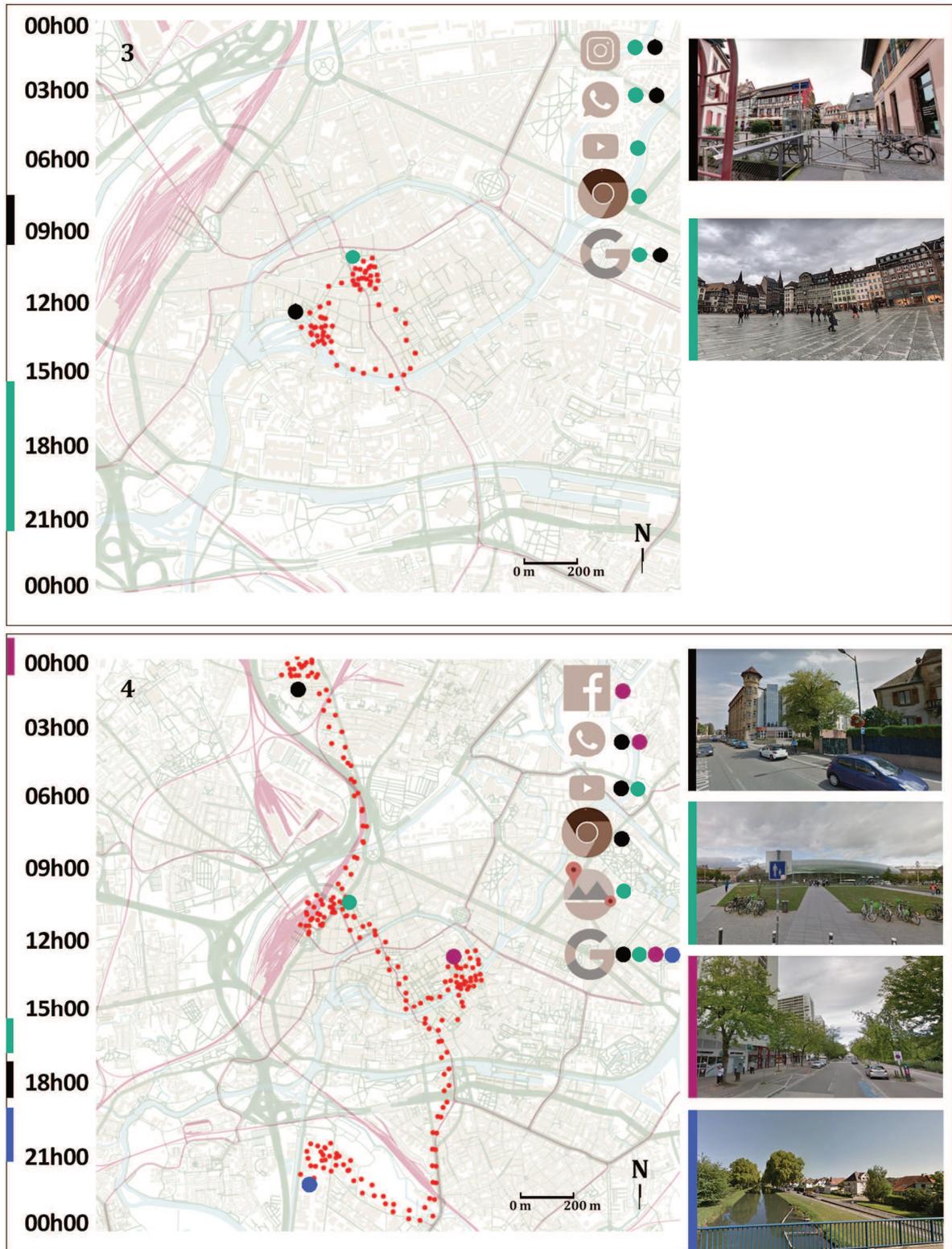


Fig. 5- Fig 6: The cartography of the journey 3 and 4. The physical paths are correlated with the digital activities in the city of Strasbourg.

The fourth journey (Fig. 6 is one of a young active person's. He/she passed through the ellipse island of Strasbourg during the days of the week. Digital data was communicated via a smartphone having an Ios

operating system. The journey of the day was made by the tram (A or D) from the Esplanade District to the Central Station and from the Central Station with the bus line 71 to the Bischheim District. After a break in the Bischheim the participant went to the Meinau by taking the same bus line and then the tram (A or D). This day was one of the most marked days by travel. The screenshots showed that there was a significant diversity in the digital activities. An application for the leisure and the communication (The Facebook), for the communication (the Whatsapp), for the leisure and the work (the Youtube), for the research (Le Chrome) and for the leisure and navigation (Le Google Navigation app) built the main body of the various digital activities of this journey.

Number of Journey	Date	Distance (km)	Duration (h:s:ss)	Average (km/h)	Frequented places	Period of time
#1	25/07/2017 (UTC+02:00)	2.0	21:04:18	0.1	District of “Haras” ⁽¹⁾ , “République” Square ⁽²⁾ , “Marché Gayot” Square ⁽³⁾	00:00:00-13:34:13 ⁽¹⁾ 14:09:02-17:36:30 ⁽²⁾ 17:42:05-19:03:26 ⁽³⁾ 19:22:16-21:04:18 ⁽¹⁾
#2	28/10/2017 (UTC+02:00)	1.5	19:22:53	0.2	“Corbeau”Square ⁽¹⁾ , Street of “Noyer” ⁽²⁾ , “Kléber” Square ⁽³⁾ , City center ⁽⁴⁾	00:00:00-15:13:29 ⁽¹⁾ 15:29:14-16:34:42 ⁽²⁾ 16:40:22-18:08:02 ⁽³⁾ 18:16:19-19:22:53 ⁽⁴⁾
#3	02/11/2017 (UTC+02:00)	1.2	22:45:59	1.0	District of “Petite France” ⁽¹⁾ , “Kléber” Square ⁽²⁾	00:00:00-08:55:10 ⁽¹⁾ 09:03:00-21:10:23 ⁽²⁾ 21:32:28-22:45:59 ⁽¹⁾
#4	13/10/2017 (UTC+02:00)	20.1	21:43:44	0.9	Esplanade ⁽¹⁾ , Neudorf ⁽²⁾ , Esplanade ⁽³⁾ , Station area(Gare de Strasbourg) ⁽⁴⁾ , “Halles” Square ⁽⁵⁾ , Bischheim ⁽⁶⁾ , Meinau ⁽⁷⁾	00:00:00-00:24:05 ⁽¹⁾ 00:29:44-12:36:48 ⁽²⁾ 12:50:17-13:43:00 ⁽³⁾ 13:52:03-15:17:39 ⁽²⁾ 15:23:15-15:37:15 ⁽³⁾ 15:59:05-16:03:04 ⁽⁴⁾ 16:14:07-16:20:04 ⁽⁵⁾ 16:36:11-18:11:09 ⁽⁶⁾ 19:03:26-21:43:44 ⁽⁷⁾

Table 1: The details of the 4 journeys chosen for the paper. These data are retrieved from the GPX files sent by the participants at the end of each day.

By looking at these 4 examples of journey, we can estimate the spirit of the remaining journeys (66 journeys). And also we can identify two states conditioning the nature of mobile territories, created by smartphones.

The first state is the state of action. It is possible to be part of the physical networks of the territories via a walking journey. In this state we can interact directly with the existing physical territorial system. The second state is the state of inertia. It is directly linked to the possibility of being part of these territorial physical networks by using public transport, cycling or driving a car. In this second state the citizens follow the system established by the authorities of the city. The interaction with the city is conditioned by the presence of the physical limits.

During the state of action (a walk for example), our participants became a part of the networks of the city. Because they converted themselves into a network inside the city of Strasbourg. We saw a perfect match of the themes between the destinations of the physical places and the nature of the digital activity. The example of the first journey, seen in the Figure 3, was correlated with the logic of the state of action, where the participant browsed the internet to do specific research inside of the National Library. Furthermore in the second journey (Fig.4), we discovered that the physical activity of shopping from one of the famous stores of France was accompanied by the research of the products of this store on the smartphone, interestingly.. These findings showed us the correspondence of the nature of the physical place and the digital activity.

The pause of any action in the urban or landscape public space is also one of the elements of the state of action. The third and fourth journeys (fig.6) are the examples of this fact. The pause in the open public space means the leisure, the communication and relaxation for both of the digital activities and physical displacement.

During the state of inertia, the participants were in a network system. In other words they were inside the flow elements of the city of Strasbourg and their displacements were experienced as a pause in the Inside of

these elements. Thus it was possible to see the digital activities of the recreation and the communication in the public transport. The fourth journey constitutes a good example where the participant was interacting with a leisure application during his/her tram trip from the Esplanade District to the Central Station. We also noted that cycling (second journey) and driving, being among the flow elements, were not very conducive to a possible interaction with digital activities; in the other words, for the birth of mobile territories.

4.2.2 The general appearance of the Mobile Territories and New Territorial Layers in the city of Strasbourg

In this study, we observed that the city's filled places (closed spaces), empty places with amenity qualities (open public spaces) and the interior spaces of the flow elements (public transport) were strategic locations for the birth of the mobile territories in the city of Strasbourg (Fig.7).



Fig. 7: The cartography of the directional layers of the Mobile Territories based on our results in the city of Strasbourg.

Finally we combined the cartography of the directional layers of the Mobile Territories and the physical places of the city of Strasbourg (Fig 7). These physical places hosted a wide variety of digital activities and by this way new layers of mobile territories were added to the existing urban layers (Fig.7). Moreover, the nature of the physical movements of citizens on the territory of Strasbourg might shape the directional layer of the mobile territories and create ephemeral intermediate layers related to the different temporalities of the digital activities.

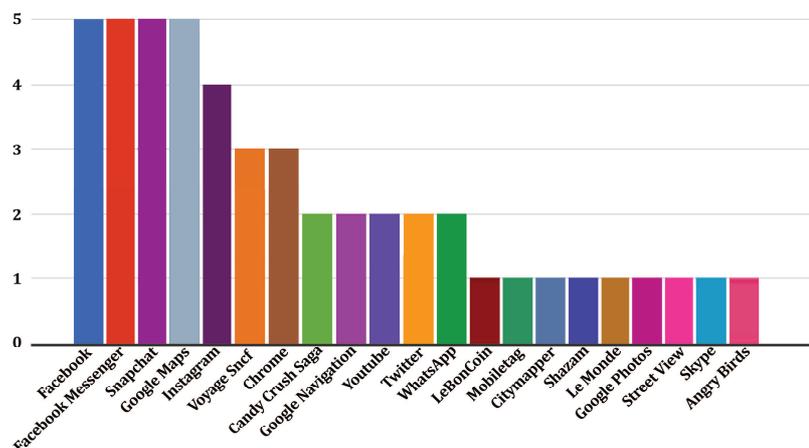


Fig. 8: The distribution of the applications used in the city of Strasbourg according to the participants. (The name of applications is given on the x axis and y axis represents the number of participants. The applications are divided into 3 subgroups according the frequency of use as A, B and C)

Furthermore we drew the map of the mobile territories using the series of ephemeral digital activities obtained through our findings of 70 journeys. In order to understand the intermediate layers of the mobile territories, we asked also our participants which applications they thought they used in common spaces. These interview based reports gave us a distribution of the applications shown in the Figure 8. But according to the digital findings of this study, the mostly used applications in the physical public territory were those in the group B, instead of group A (Fig 8).

4.3 Problems and Questions

In this study, the participants being mostly students or young workers composed a more or less homogeneous group. Their common leisure was being interested in digital technologies. However the total of 70 journeys provided us a variety of digital data. According to our findings, we can say the possibility of the occurrence of a certain digital activity in a certain place, which was not previously noted to our knowledge. One of the week points of this study was that we could not assess all of the digital activities of the participants to respect their private life. Thus our findings were restricted to the willingness of the subjects.

Our experience gives also rise to many questions. One of the most important questions is: How we may adapt our experience to the study of different cities in the long term? Making our experience transferable to other cities may elucidate the relationships between mobile territories and architectures of these cities. Our study is like a pioneering first step in understanding how virtual technologies can compete with traditional infrastructures. The public spaces where there is a high probability of interaction between digital activities and traditional infrastructures were identified in this study. Moreover, the Smartphone, as an individualized technical object is an "integrative" object for different territories, the spatial, social cultural and economic practices of the citizens. This may permit us to identify various operations of the cities and encourage us to think about the malfunctions of them.

We think that his study may be a start point for an understanding of the interactions of physical and digital territories, which allows to trace point by point the physical paths and gives us the possibility of occurrence and the features of the digital activities. Tracing all of the physical geolocations of a single digital activity may be investigated by the future studies.

5 CONCLUSION

The Mobile territories are a part of the big data phenomenon. They are composed and decoded frame by frame. In this study, we reached to a "sensible" cartography of the mobile territories after evaluating 70 journeys in the city of Strasbourg. This cartography was formed by the digital data of the citizens of that city according to the filled spaces, empty spaces and networks of the city's system. Our findings showed the first public places with possible interaction between the virtual spaces and traditional infrastructures of the city of Strasbourg.

In our research based on the reading of a physical path, we geolocated one specific image of a specific digital activity (communication, research, etc.) at one location of the physical territory. We had a point of interaction of the physical territory with a specific digital activity at a specific time. At this point each digital activity seemed to create a new urban layer invisible to the naked eye on the physical territory.

The technological knowledge becomes increasingly a means of change in the relationships between the people leading to social innovation; the use of the smartphones is an example. A permanent connective intelligence that represents a valuation of the forms of mobile territories will certainly lead to a territorial innovation, accompanied by changes in the relationships between people. It certainly deserves to be explored in the future experiences.

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