Geo-social networks and the understanding of the dynamics of the city: the case of Rio de Janeiro's boundaries of formal and informal neighborhoods

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1. Mapping as strategy

What use is a map?
This was the title of an exhibition at the British Museum in London, on the late 1980s. The idea was, through the display of different sort of maps, open up a discussion of the different roles played my maps across centuries. In fact, this question has been answered through different approaches and disciplines along time. Earlier in the 1970s, the French geographer Yves Lacoste argued that geography served, first and foremost, to wage war – stressing here one of the interests of the discipline, which is mapping the world and therefore bringing information that could be used to control people and territories. In other words, mapping is knowing.

It is already acknowledged that the act of knowing through mapping means the making of choices: spatial, temporal, physical and even emotional choices – among many others. The graphic recording of this information in a map brings new possibilities of reading and involvement with territories. As argued by Cosgrove (1999, p.1-2): "to map is in one way or another to take the measure of a world, and more than merely take it, to figure the measure so taken in such a way that it may be communicated between people, places or times".

Here lies the main objective of this paper: having digital information and geo-social networking systems as the main tools of mapping, to explore a social cartography of the city of Rio de Janeiro concerning the relations between boundaries of formal and informal neighbourhoods. These digital network systems have a spatiality that is yet to be further explored. This paper is thus an attempt to contribute to academic studies that look at digital information as a strategy to mapping and understanding urban territories.

2. Geosocial networking systems and the complex contemporary city

The dynamics of a contemporary city are shaped by very diverse and complex factors. Recently ubiquitous experiences towards the city have dramatically changed our concepts and perceptions of its territory. As earlier advocated by Castells (1996) the vertiginous popularization of new ways of communication has collaborated to sharpen urban life though new dynamics and flows. Serra (2010) later addressed the strengthened role of citizens as innovative actors in this environment, affording immediate impact in public spaces. New medias are somehow reinforcing the value of place instead of eliminating it.

In more recent years, new spatial means have been developed on social networks, some of which seem less tied to traditional perception of the surrounding environment. Widespread geo-social networking systems have been playing an important role in shaping a parallel digital space based on the real interactions between citizens and the urban landscape. These networks have opened up new possibilities of exploring the city combining the preciseness of mobile location estimation services with personalized content, full of cognitive and perceptive clues. It has since been producing a new geography characterized by decentralization and horizontality, and people are yearning to some extend to move beyond Cartesian representation.

Connected citizens, touchscreen swiping their latest smartphone while out experiencing the city is a growing tendency on mature and emerging societies. Levels of connectivity and dataflow have starkly increased in the past decade, while both citizens and government are

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bound to consider those platforms as a vessel for and a product of urbanity. Those networks also enrich the concept of social and collaborative creation, important for the local identity and community engagement. Recent mobilization through social networks, for example, transcends traditional hierarchies- as recently seen in Turkey and Brazil- and millions go to street demonstrations projecting social structure onto space.

Moreover, the physical dimension of cities has historically referred to people's access to resources, infrastructure and especially the interactions between them through the space. The new urban dynamics, driven by the connected citizens, is subsumed by timely encompassing narratives. Consequently, cities have since become increasingly hard to understand and map. This difficulty has been already noted by Cosgrove (1999, p.5): "Culturally, at every scale, connections between phenomena formerly considered distinct and relatively fixed, rooted in space (…) have been shown to be contingent and unstable (…). An implicit claim of mapping has conventionally been to represent spatial stability, at times to act as a tool to achieve it. In a world of radically unstable spaces and structures, it is unsurprising that the idea of mapping should require rethinking." From this perspective, cities digital counterparts can furnish it at some extension, adding a valuable contemporary case for urban analysis.

It its important to stress that the manner and degree to which is possible the interaction or isolation between citizens also shape the digital world and vice versa. Like digital segregation, spatial segregation is a persisting debate in most contemporary cities. Particularly in emerging economies, where a considerable percentage of urban population lives in precarious informal settlements, spatially segregated and socially excluded from the surrounding formal city, digital inclusion and digital visibility can become an important instrument to tackle inequality and improve quality of life.

Those informal urban spaces, once disconnected and set apart to the emerging digital sphere, do not operate in isolation. On the contrary, they complement and juxtapose with cities' formal circuits, forming a complex web of different morphological and typological patterns, added by cultural singularities, which cannot be disregarded whatsoever.

3. The case of Rio´s formal and informal neighborhoods

Roughly 20% of Rio de Janeiro's population live in slum areas (IBGE, 2010), despite the country´s considerable economic growth in the past decade and the fact that the city has been put into the spotlight again hosting mega-events such as 2007 Pan American Games, 2014 World Cup and 2016 Olympics.

Large redbrick favelas – as slums are often referred to in Brazil– sitting atop the city's steep and verdant hills, contrasting with adjoining best real estate and sharing together a thin strip between the tropical forest and the Atlantic Ocean, is a memorable portray of Rio's social exclusion´s reflection in the landscape. Those informal communities that have sprang up unplanned, have been historically regarded as eyesores, unworthy form of urban developments, blighted by poverty, low access to services and widely renowned as lawlessness no-go zones plagued by shoot-outs between rival drug gangs (Neate and Platt, 2006; Leite 2008).

Favelas in the south zone are commonly very compacted settlements wedged between tony beachfront areas like Copacabana and Ipanema, and are historically the cheap workforce for the nearby formal city. The borderline between them has been always clearly defined by the topography. Once ending a road and beginning stairways, there starts a favela. Favelas in the north and west zones are commonly located in sparse hills, fringes of previous industrial sites and wetlands, more fragmented settled.
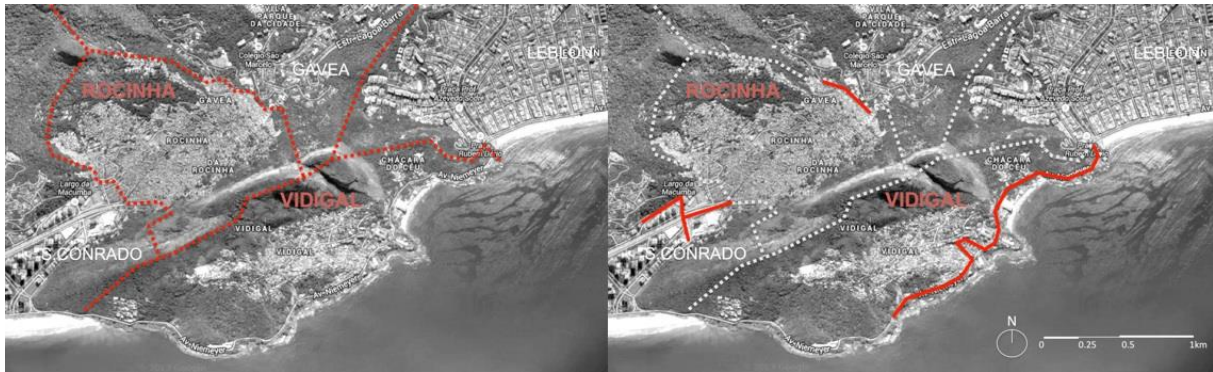
Figure 1: Geographical-relation between neighbourhoods' boundaries and topography in Rio´s southern favelas (left) and borderline between formal and informal city (right).

More recently, Rio de Janeiro seems to be compelled to cope with the matter and considerably steps towards a better territorial integration have been perceived. Joined initiatives from municipal, state and federal spheres have unveiled massive investments to recover the historical absence of the state, tackling infrastructure shortage, halting violence and therefore paving the way for better socio-economic opportunities. New housing developments within the favelas for those living in risky areas, water supply, extensive sewage connections and local transportation are among the basic services under provision, addressing most of spatial deficiency. The efforts to strengthen police presence, to seize control and consolidate peace by large community-based police pacification programme, have also taken back territories where drug lords of heavily armed factions previously laid down (Henriques and Ramos, 2011). As an immediate result, these actions has sparked interest from the private sector and encouraged local entrepreneurs to settle down business. Services previously inexistent in those communities and mostly accessed in the nearby formal city started to pop up in the boundaries and within the favelas since then.

Whilst it has collaborated to better integrate once marginalized favelas with the wider city, the complexity of these highly fragmented territories entails much more than any response given. That is, the simplistic and dismissive way in which informal settlements have previously been perceived no longer match the current favela dynamics within the bounds, but still come up against the yet materialized mental borderlines that for decades overlooked inequality. Unlikely other cities where the boundaries of neighborhoods are not clearly defined by their morphological patterns or topoceptive dimension, Rio highlights a more on-the-ground and practical definition of limits and urban identities, a perfect patchwork quilt where formal and informal territories hardly overlapped.

Nevertheless, favela dwellers still commute everyday to the outside city in search of jobs, services, as well as recreation and leisure. Moreover, a certain territorial tolerance has long been a cultural symbol of Rio, meshed by both what is usually considered the formal and the informal parts of urban life. Despite some uncertainty and criticism concerning the rising cost of living among residents, there's a growing sense of belonging and activism issued from the latest developments and somehow the persistent stigma of exclusion and invisibility seems to have lessened. But greater and long-term efforts are needed to push favelas to articulate firstly with its adjoining neighborhood and later with the rest of the city.

Digital platforms and technology democratization are one of the considerable gateways to promote social, economic integration and approach both realities. Where once affordable Internet cafés met an important role in connecting the favelas residents to the world – computer possession and broadband connection were very scarce comparable to the neighboring wealthier districts – now affordable ubiquitous and mobile gears have allowed the rise of freelancer opportunities, access to information, education, and therefore an increase in the digital paths inside the communities. Following the development plans, the government has launched a policy to set up free wireless Internet networks in the most dense populated favelas as part of a broader plan for digital insertion to achieve computer literacy, foster cultural interchange and professionally qualify low incomers (Secretaria de

Ciência e Tecnologia - Rio Estado Digital; Ministério da Cultura- Pontos de Cultura). This may also bring up significant discussions on citizenship awareness and the right to the city through the visibility and legitimacy of these spaces.

4. Mapping the boundaries

For decades, general cartographies of Rio de Janeiro simply did not portray its nearly 1,000 favelas on the slopes of the rich south and the city's poor north and west zones (Peteranderl, 2013). Nevertheless they were easily identifiable on maps by either green or blank swaths with no streets, landmarks or other signs of settlements. Along with the previous cited movement towards the increase of visibility of these communities and their insertion in the planning practices, an intriguing question on how to represent their shapes and dynamics has arisen. Contradictorily, in a more polemic attempt to reduce the prominence of the negative connotation of the favelas, an important map server was formally asked by the city's tourism secretary to ditch the word 'favela' from its database, replacing it by the single name of the settlement, an example of the ambiguous official posture concerning the issue. In the meantime, where map data is scarce and official acknowledgment is pending, the engagement of these communities is a crucial step towards the real citizenship and a symbolic takeover of their historical stigma of abandonment.

Few mapping projects, initially tackled by grassroots organizations aiming to promote social progress within their communities and engaging volunteer youth from poor communities, have harnessed geo-social medias to create a collaborative platform relying on geocoded data of nearby points of interest (Viva Favela ; Wikimapa; Redes da Maré; Lucas, P., 2012). Since the mapping purpose was not simply to cull data and present it objectively, but rather represent the perspective of the cartographers, young correspondents could contribute not only outlining objectively the labyrinthine alleyways, stairs, dead-end roads and other passageway of their communities, but also including vast forms of multimedia such as videos and audio recordings, detailed information on local shops, foodies, bars and other local buzz. Enlarging the discussion, it is feasible that any connect residents could contribute to the making of a comprehensive collective map, even if unintentionally. Virtual performances ranging from messages, social media posts and other possible open generated data – especially geo-tagged ones– culled from the Internet may subsidize the information necessary to feed those maps. Local meaningful spots and identity always left on the wayside of digital platforms may enable a further step to their recognition as part of the wider city.

Traditional maps are blank canvas with nothing on them other than streets and sometimes the most remarkable buildings or touristic venues. The understanding of this new cartography with abundant amount of sensitive information is an emerging research field to address problems and solutions to the planning practices, especially in rapid growth contexts like metropolis in the developing world, where formal and informal settlements are a distinguishing feature and live side by side.

This study stands on the fields of social sciences and urbanism, aligned to traditional theories of citizens perceptions over the territory and their interactions (Jacobs 1992; Milgram 1977) and more recent investigations on the effects of mobile technologies over the physical boundaries of the city (Schwartz 2012; Rainie and Wellman 2012). This study aims to analyze the shaping of the digital urban territory through geo-social networking systems, ultimately Foursquare and Twitter, mining their open data and mapping what it may denotes the interconnected flows of public services and commercial activities, additionally with relevant open spaces.

This study foster what appears to be a potential tool and growing methodology of contemporary urban studies, especially in the field of urban planning. Targeting Rio´s most representative slums that are recently emerging to formalization, it methodologically proposes tracking geo-coded information that suggests access to these activities within the boundaries of formal and informal city, anticipating discussion on the yet some degree of dependence of favelas out of their physical boundaries. In this case specifically, the analysis of geo-social networking activity in the boundaries of those neighborhoods delineates the extension of existing formal-informal overlapping services. Using the open digital data generated by citizens of both sides may exemplify the relation of formality and informality in Rio de Janeiro. Case studies in four different zones, the bounds of Rocinha, Vidigal, Maré and Alemão are conducted as paradoxical examples of how digital paths can be taken into consideration while analyzing and re-conceptualizing the dynamics between neighborhoods within a near distance.

4.1 Outlining services

Geo-tagging a message, picture or tweet is based on the coordinates of the user's location by the time of the message, which is typically provided via GPS, wireless or cellular triangulation. It is reported that the majority of geo-social networkers are not location-based influencers, and those who are, aggregate, for instance, place names and personal pictures or tagged messages including other users. The amount of data produced a day counts on quintillion of bytes (IBM, 2012), and the expansive glut of news, shopping, games, music, forums and the like have gone hand-in-hand. Despite social medias playing such a prominent role in citizens´ lives, recent studies estimate, for example, that on a typical day, roughly 2 to 3% of total tweets (as Twitter 140-character messages are called) contain any location name or location positioning added (Kalev et al), which is still irrelevant to conduct extensive studies that cannot count on statistical biases. Despite this, about 15 % of geo-tagged tweets contain URLs links to multimedia content, including here Foursquare, Instagram, and Facebook accounts, a wealth of data being generated that may open up future possibilities of researches on social sciences and behavioral studies.

The popular micro-blog Twitter offers releases a publicly available, spatially embedded network dataset that can be fruitful for any territorial analysis (Butts and Acton, 2010). Accessing the totality its tweets requires access to a special service - Twitter's Firehose : the unfiltered deluge of 1 billion tweets produced in the lapse of a couple of days - that has limited access to non-cooperators and can be restrictive in terms of cost for academic researches.

Figure 2: An example of geo-tagged tweet referring to some qualitative information about Rocinha.

The location-based social network Foursquare works like a social recommendation engine, giving its users a chance to timely check-in to places, share their location, search and add place recommendations, contact another nearby user. It is also very business-oriented and the tools are developed to improve personalized content to its users. A recently path towards a more public interface was the deployment of interactive map showing the 500 million check-ins made by its users in the past three months, making it possible to visualize human activity in big cities with considerable accuracy, so that it could become a useful tool to analyze citizens' behaviors and mobility. Foursquare check-in data contains context, has some structure and is short and many Foursquare and Twitter accounts are linked, providing public access to check-ins and posted information even if the account is private.

This study geographically filters this data, relying on the already released information from both servers. In the following pieces, this information is arranged in nodes connected by narrative threads, based on few themes captured from the geo-tagged information. These pathways create networks of meaning, blanketing the terrain and connecting individual action to a broader and collective context. Predictably, favelas show very sparse Foursquare and Twitter activity to subside an accurate analysis, whilst most of tagged information is observed in business districts and middle-class neighborhoods. Highly dense tagged areas depict locations where most probably have more access to Internet, that being infrastructural or income related, or most popular places within a city. Middle and upper classes neighborhoods are normally known as a hotbed of social networking activity. In Rio this is even more emphasized due to high concentration of shopping, leisure and cultural activities within those formal grid. Foursquare maps zoomed in the cited favelas show a scattering of small local business such as groceries, bars, gyms and foodies, rather than public spaces and recreational spots frequently identified in other neighborhoods. These activities are based located close to the communities' main accesses and along the few broader traffic routes connecting lower and upper regions (Figure 3).
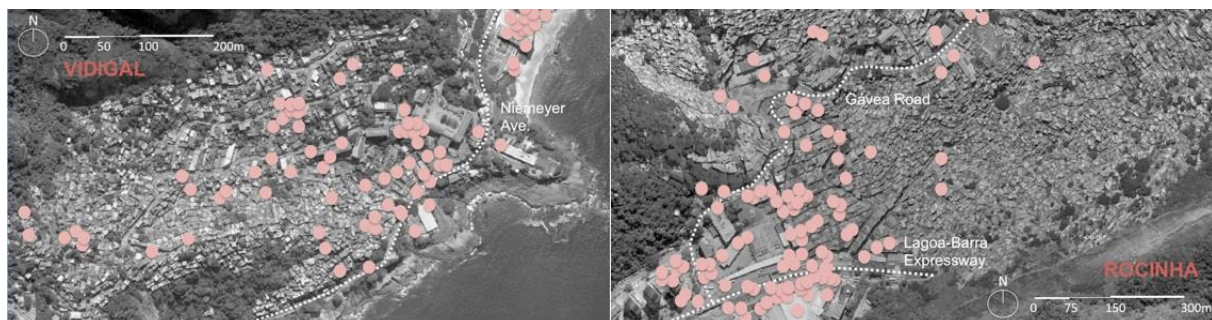

Figure 3: Foursquare check-ins within 500m distance from the community main access: Vidigal (left) and Rocinha (right).

Nevertheless, services target to the tourism sector are some evidence of the new values and uses added to the informal hilly communities in the south zone after pacification. Vidigal and Rocinha crawl up the once hilly forest above within a short distance to city's wealthiest and touristic beachside districts and have postcard views over the city. The increasing number of youth hostels and guesthouses venturing up the steep roads, for instance, related to its geographic proximity to the main touristic venues and landmarks evidences the tourism-related vocation of pacified communities (Figure 4). Some ocean-view properties perched on top of Vidigal are also turning into trendy foodies and terrace restaurants, as described by pictures and comments.
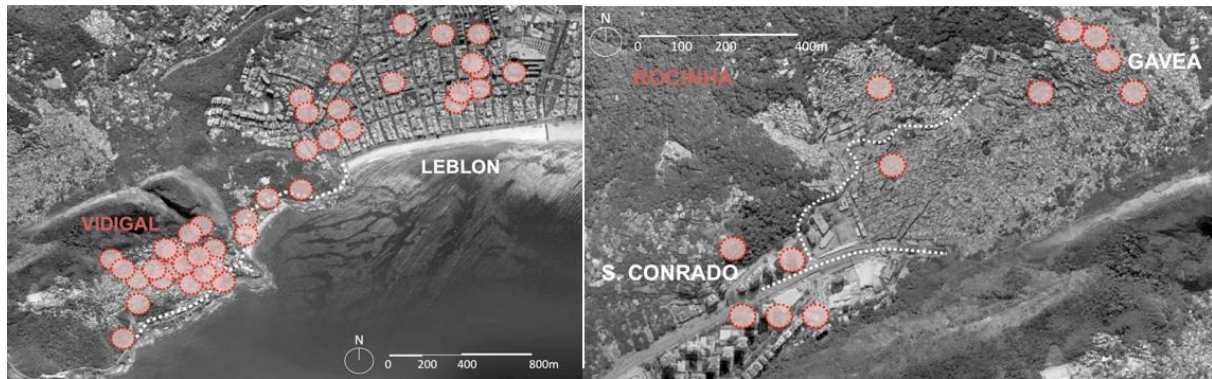
Figure 4: Foursquare check-ins in youth hostels and guesthouses in the neighborhoods of Vidigal/Leblon (left) and Rocinha/S.Conrado (right).

Very far from the tourist-friendly south zone, Complexo da Maré's 16 favelas- which some 130,000 people call home- stretch between two of Rio's main highways (Avenida Brasil and Linha Vermelha- highlighted in red line in Figure 5). Far from being just a dormitory district that serves as cheap labor force to the city, the strip formed by local business and services along Avenida Brasil, Rio´s longest transportation hub, configures a lively alley also in the digital world, with considerable concentration of check-ins and tweets (Figure 5-left). Throughout its extension, Avenida Brasil was one of the first public spaces to be wireless-connected (Secretaria de Ciência e Tecnologia- Rio Estado Digital), empowering the construction of a digital datascape in the borders of at least 28 neighborhoods, home of over 1 million people.

Local businesses existing within Maré are more homogeneously spread throughout the zone and more commonly found in the core of the communities. Check-ins in immediate services such as eateries, foodies and cafés, for instance, are well distributed. On the other hand, the nearest formal district, Bonsucesso, historically served the communities with public services. Taking the example of educational services, check-ins in nurseries, schools and technical courses are observed in transversal movements outwards, crossing the borderline to the district (Figure 5-right).

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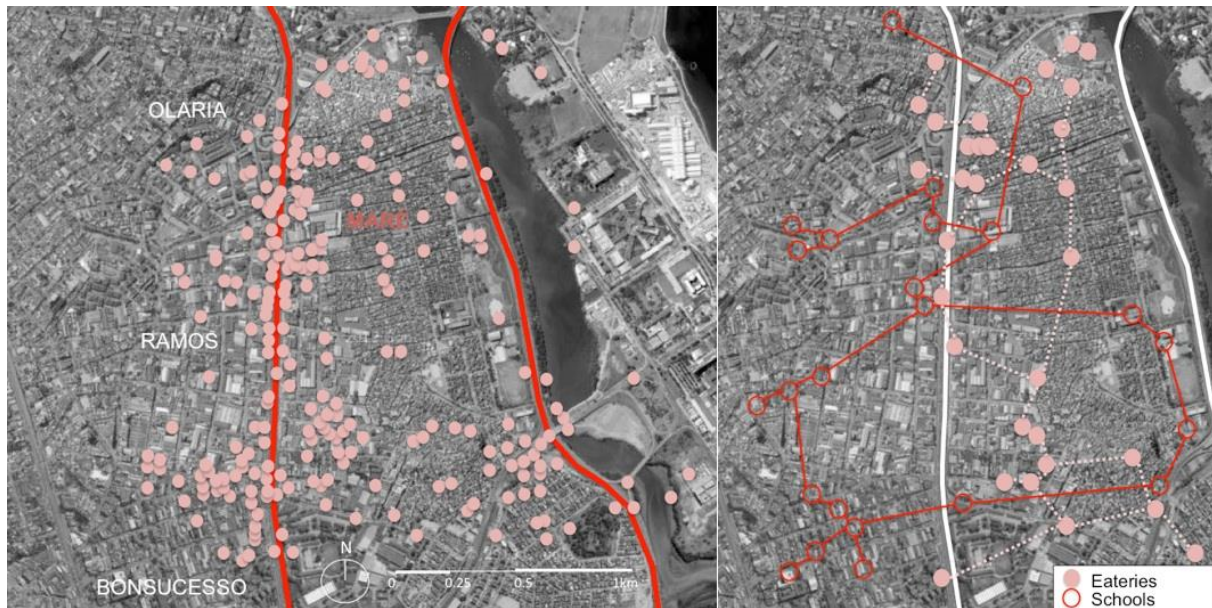
Figure 5: Foursquare check-ins (light red circle) around in a radious of 500m of Maré´s main borderlines (red line) Avenida Brasil and Linha Vermelha (left image). Network of geo-tagged information on local eateries and foodies (light red circle) and schools (red circle) in Maré and nearby Bonsucesso (right image).

4.2 Outlining public spaces

An overall view of geo-coded messages suggests a discrepant concentration of leisure and recreational activities in the formal rather than in the informal neighborhoods. Despite the increasing investments to promote open public spaces within the limits of the favelas, due to its urban plot, very few non-built areas are possible. When existing, such as the case of soccer playing fields, they still do not count on a digital counterpart. In the south zone the beaches have always played the most important role in promoting outdoor sports and leisure, even for the nearby favela dwellers.

Repeated Foursquare check-ins and social circles influence over opting for a place rather than others. This may influence the choice regarding commercial and leisure-related activities. As for the tourism sector it may be useful orienting visitors and relating nearby landmarks. An interesting feature observed while mapping out the districts of Vidigal and nearby Leblon and Ipanema, was the sequence of outdoors activities and observation spots climbing up the hill and drawing a clear line of touristic and leisure continuity (Figure 6).
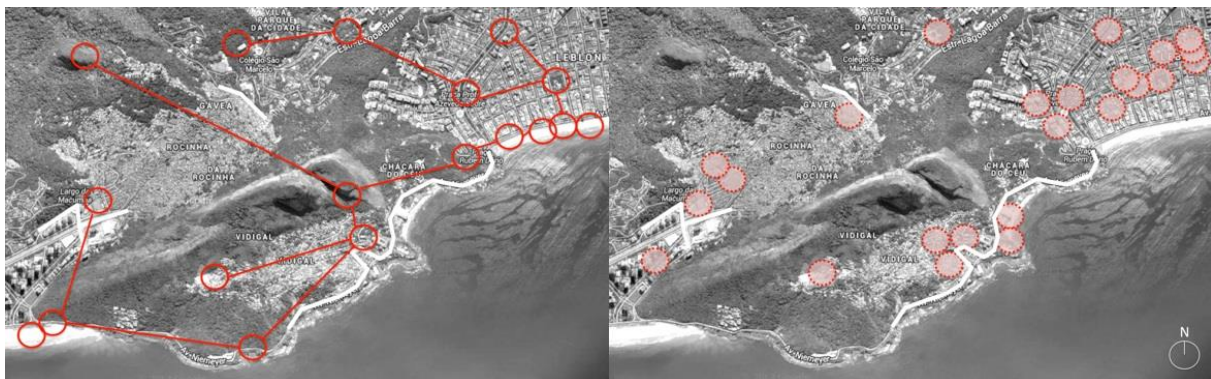

Figure 6: Foursquare check-ins around Rocinha and Vidigal in places related to outdoor sports (left) and indoor sports/fitness centers (right), suggesting the lack of open public spaces within the favela limits.

The Complexo do Alemão is one of the most deprived and underdeveloped corners of northern Rio de Janeiro and home of around 70,000 people. Made by the haphazard conurbation of 15 different favelas over several decades, urbanization developments have physically integrated the complex with nearby districts: housing programme in strategic vacant lots, new paved routes and Brazil´s first mass transit aerial lift passenger system, consisting in cable cars stopping at the top of hills allied with educational and social-related buildings around the stations. It has since been noticed a notable tourism growth inside the community, verified by the concentration of check-ins and tweets suggesting the new vocation for scenic view. Sequential check-ins from the same users are observed, denoting a clear displacement from the first point- the train station, within the district of Bonsucesso towards inner points of the favela (Figure 7).

Figure 7: Sequential theme-related Foursquare check-ins in the aerial tram system of Complexo do Alemão (red circles), with comments and pictures shared in Instagram.

The nearby districts of Bonsucesso and Inhaúma have historically provided public and private services for Alemão´s dwellers. The traditional borderline between the districts and the favelas used to be the railway line in the eastern limits of the complex and the main roads sketching its valleys. The recent digital footprints observed in both Twitter and Foursquare suggest a rearrange of services and other activities towards previous impenetrable and economically neglected regions inside the community, notably small regulated and brisk business. As suggested in Figure 8, new centralities around the cable stations promoted by programmatic combinations, establish continuum spaces that take part of the topography and shrink territorial segregation. Along with the delivery of basic social services, these centralities enabled, most of all, the knowledge of the landscape, improving orientations, adaptations and definition of spaces where the previous immense maze-like configuration reigned. The idea of improvement of public spaces as promotion of social and economic changes is therefore reinforced.

Figure 8: Observed check-ins (light red) within and out of 200m-radius distance from the new cable stations (red circles).

The analyzed maps reinforce the extent to which boundaries of formal and informal are still remarkable in the digital world. The findings suggest that the tendency of more cross-social tolerance in some cases, mostly among more consolidated boundaries, stage of some advances in social and security issues. Beyond the placement of text and photos by individuals in the diverse universe of social networks, it should be further discussed the potentiality of crowdsourcing map as a tool of urban analysis and a future referential platform to integrated discussions on the policies and planning practices.

The increasing API integration with other applications and web services may enhance this theory, allowing users to indirectly cooperate. However, there is an increasing concern on the vulnerabilities and privacy risks that can be exploited to violate users' location privacy in geo-social networks. Such vulnerabilities and privacy risks are actually caused by both system's design flaws and users' incautious activities.

5. Concluding remarks

Favelas shelter over one billion people in impoverished contexts all over the world. Territorial solutions are far from being resolved, while local strategies of urban intervention or public policies are aiming at improving their living standards. It has been proved the positive effect of recent urbanization and pacification plans in Rio´s main favelas and it may emerge as a gateway to future achievement of full citizenship.

The purpose of mapping the emerging activities observed after those plans is two-fold. Firstly, information democratization, that is to portray favelas from the perspective of citizens and visitors, free of the stigma that often appears in related stories by mainstream media. Synchronized with upcoming events, it is an accompanied opportunity to shed light on life in the Brazilian favelas for the rest of the world. Secondly, pointed evidences of the creative and economic potentials that exist touching the boundaries of formal and informal city. The legitimacy of these potentials has not been properly recognized yet. Many are skeptical, however, arguing that innovative practices of governance go beyond the expected roles of digital platforms in the fields of planning and managing cities´ land use regulation.

Regardless, to develop a holistic understanding of the ways in which our digital relationships to territory govern everyday life in urban morphology is a burning issue. Despite the access to the Internet and especially portable connectivity has skyrocketed, few local content is produced by slum residents in comparison with their neighboring districts. To encourage connected residents to take part more fully in the construction of digital space and to instill a technological interest of those still not connected are challenges existing grassroots organizations might bear at first.

This study needs a more profound and comprehensive analysis, which right now highlights the most important and relevant findings counting on the available data. Concluding, it is still anticipated to suggest, counting on mapping biased geo-coded information, a radical change in the urban land use emerging from the dynamics of citizen´s digital lives. Meanwhile, as argued by Corner (1999, p. 213), "the function of mapping is less to mirror reality than to engender the re-shaping of the worlds in which people lives".

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IBM Research: http://www.research.ibm.com/news.shtml
Pontos de Cultura: http://www2.cultura.gov.br/culturaviva/
Redes da Maré: http://redesdamare.org.br/
Rio Estado Digital: www.proderj.rj.gov.br/inclusao_digital.asp
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