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Digital narratives: mapping contemporary use of urban open spaces through geo-social data

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Abstract

Over the last decade, new spatial means have been keenly developed on geo-social, location-based networking systems and more recently through mobile applications, with significant personalized digital content, full of cognitive and perceptive clues. Culling this information and having it as the main source of analysis, this study explores the cartography of the city of Rio de Janeiro, portraying some of its outdoors recreational activities that are partially invisible in the daily life, advocating the potentiality of this methodological and theoretical framework to disrupt traditional spatial paradigms and contributes to urban research, design, education and representation.

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Keywords: Digital cartography; urbanscape; locative media; geo-social networking; crowdsourcing.

1. Digitalizing the urbanscape

Over the last ten or fifteen years, ubiquitous computing has been mediating our experience of urban landscapes and open spaces. Digital tools, networks and applications are merging with our physical environment, allowing us to capture, produce and process information in real time and communicate it back to our cities. As earlier advocated by Castells[1], the vertiginous popularization of new ways of communication would collaborate to sharpen urban life

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through new dynamics and flows. Serra[2] later addressed the strengthened role of citizens as innovative actors in this environment, affording immediate impact in public spaces. The citizen is at the core of this new urban condition: empowered by digital technologies, our capacity to make smarter decisions and to contribute to the place we live in is greatly enhanced.

In more recent years, new spatial means have been keenly developed on social networks, some of which seem less tied to traditional perception of the surrounding environment. Cuthbert[3] has once argued that the physicality of urban landscape and its configurations are not yet seen as products of social and political processes, although web and mobile-based networks have recently been playing a central role in promoting debates. Widespread geo-social or location-based networking systems have been shaping a parallel digital space based on the interactions between citizens and the urban open spaces. These medias 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. Geosocial networking has repercussions in a number of fields. They have since been producing a new hybrid geography, characterized by decentralization and horizontality, where people are yearning to some extend to move beyond its Cartesian representation.

Innovative real-time visualization, interaction and interpretation metaphors are emerging to picture this tendency, and it is already feasible that any connect citizen could contribute to the making of a collective representation of cities. 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 new cartographies with abundant amount of sensitive information. Therefore, the roles played by the digital space, as well as by its visual analysis, in the construction of public spaces bring an emerging field of contemporary research that that is yet to be further explored by both academy and experts. According to Mitchell[4] , more interdisciplinary approaches are necessary to better understand this tendency, and, being able to conceive and explore alternative futures, we may find opportunities to intervene, sometimes to resist, to organize, to legislate, to plan, and to design.

Mapping and disclosing visualizations are already part of general connected citizens. Rendering map tiles from some kind of geographic data has become a challenging job for both programmers and designers. Major datasets from both public and private servers with staggering billions of logged city data may offer a widely comprehension of contemporary urbanscape. Data visualization is necessary to extend the cartographic metaphor beyond its visual analogy and expose it as a narrative model and a tool of reproduction of meanings and spatial cognition and representation of its heterogeneous and dynamic realities.

2. Urbanscapes of motion

This case study stands on the fields of social sciences and urbanism, aligned trans-disciplinary to the theories and methods of recent investigations on the computational visualization over the territory and the physicality of cities (Flowing City; Visual Complexity, Urban Sensing and Mashable, to cite some).

Recent researches in social and computer sciences have stated the possibility of using the vast geocoded data for the analysis of online and offline human interactions (Gordon and de Souza e Silva[5]; Cranshaw et al[6]), in relation to the urban environment (Cranshaw and Yano[7]; Noulas et al[8]; Chang and Sun[9]). Among them, the majority of suggested methodologies counted on third parties´ generated content, commonly called crowdsourcing. Those also include remarkable concepts like geospatial web, neogeography, locative media and geo collaboration.

The human movement in urban space is a spatially social contextualized practice. The invisibility of certain urban activities (recreational, sports and occupation, to name a few) is latent. This fact coincides with the contemporary discussion of the new uses and spatial appropriations arising from rapid behavioral changes in society, which contrasts with the slow practice of urban planning and design. Today, when we see connected crowds outdoors in their daily walking and cooper routine, touchscreen swiping their latest smartphones, creating improvised and spontaneous routes, we realize how much power there is in the journey and how much of it is being wasted.

Moving from the densely built-up and congested areas to the airier, less built-up areas offering pleasant appropriation conditions, cleaner and healthier environment is a growing tendency in contemporary urbanscapes. Within large cities like Rio de Janeiro, cycling and running activities, for example, have become a symbol of the promotion of better health, fitness and ideological alliance against car-dependent societies.

Inspired by avid marathoners, cyclists and the general outdoorsy crowd, amateur sport practitioners are feeling more encouraged to go on training and experiencing the urban landscape. One of the many great things about running, for example, is that it can and cannot be a solo sport: running with friends is fun, social and encouraging; running solo helps taking the pressure off. For the eyes of cyclers as well, besides mediating their sensory exposure to the urban environment, commuting to work is also a growing tendency, especially with recently public investments on bicycle sharing system.

To help enhance performance and interaction among practitioners, there's no shortage of health and personal fitness applications and it keep increasing in numbers and functions available. Very convenient for tracking distances, the user is also given a handful of useful metrics (time, pace, route and calories burned), besides some of these apps offering audio alerts and real-time feedback cheers from friends through social networks. Users´ profile and account, usually used to log their data after the training, is published with more graphically and easy to understand interfaces. Participants in this practice are to be seen as a form of self-mapping that positions the self in relation to a given performance space. Therefore, the cartographic power of such practices needs to be studied from the participant's perspective.

This research aims to address a methodological challenge through the framework of geovisual analytics. Having digital information and data mining geo-social networking systems as the main source of analysis, it explores the cartography of the city of Rio de Janeiro, portraying its outdoors recreational activities recorded by connected sportsmen. This study looks at how open-air sport activities may reverberate on digital landscape construction. It aims to map continuously and pervasively how the related geo-tagged information is disclosed, tracking down quantitative and qualitative data, displaying their narratives as a collective operation with a multiplicity of experiences and meanings.

The purpose of mapping the outdoor sports activities is two-fold. Firstly, information visualization, that is to portray uses from the perspective citizens, free of the stigma that often appears in related planning practices. Synchronized with the upcoming sports events, it is also an accompanied opportunity to shed light on Rio´s vocation for outdoor activities and give voice to its outdoors sportsmen. Secondly, pointed evidences of territorial use and timely appropriation of public spaces. The legitimacy of these and other not-reported activities may open up opportunities for more innovative practices of governance, beyond the commonly expected roles of digital platforms in the fields of planning and managing cities´ land use regulation.

3. Mapping performances

Mapping and interpreting Rio´s most performed outdoor activities could help synthesize associations between physical spaces and the uses as a product of their local social context. Could open doors for discussions and experiments, temporal considerations and uncertainties, including in the planning field, and avoid preconceived approximations of spatial models and functional signatures for open spaces.

In this study, thousands of GPS waypoints from mobile devices were culled from public profiles on the most used fitness applications, such as Endomundo, Strava, Runkeeper, Runtastic, MapMyRun, Runmeter and Smartrunner. Because those waypoints are gathered at specified locations, they are most typically hyperlinked also to photographs, video, URLs, or text with the intention to be shared among friends in the main social networking systems. Some mobile applications are also used as ways of collecting those waypoints. Although some noise is found in the accrued data, due to common blips in GPS data collection via mobile devices, which isn't exactly 100% reliable, those mobile services count on hundreds of users, providing a rich database of performative actions in the city to be deciphered, interpreted and therefore visualized. Data collected for the whole municipality in either .GPX or .CVS format were all compiled into mapping resources or segregated by modalities to speculate about its spatiality (see Figure 1).

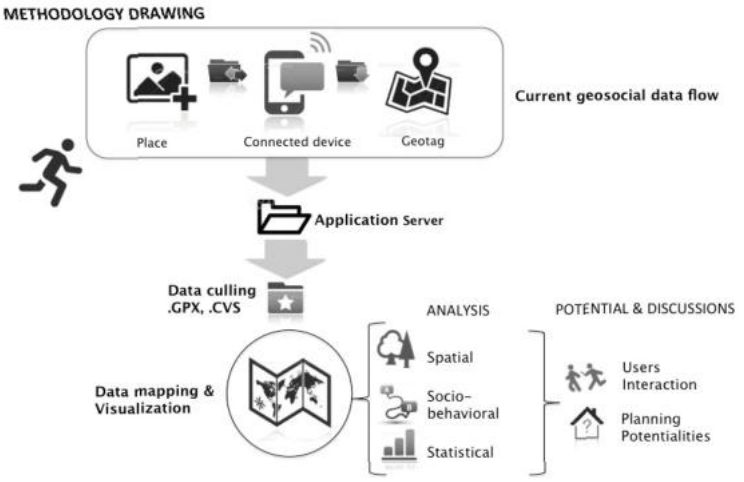
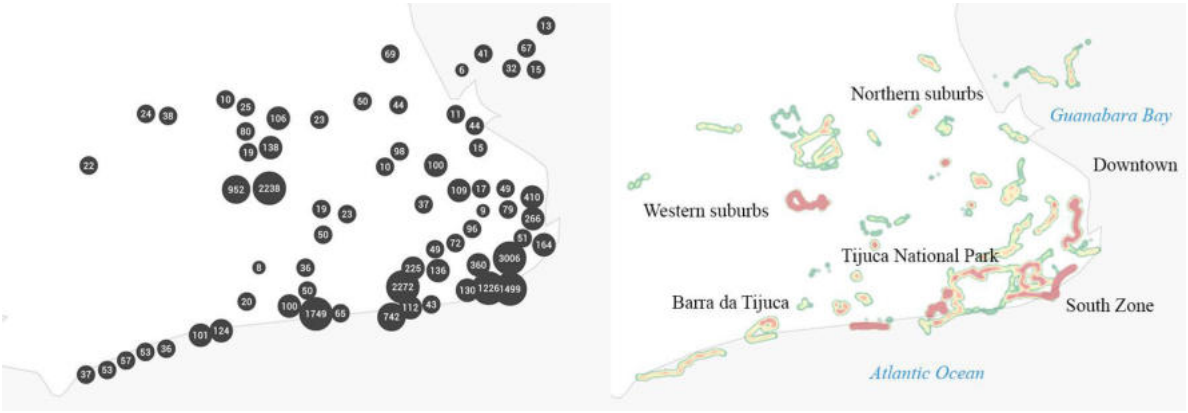


Fig. 1. Methodological steps of this case study.

Arguably best known and loved for its natural beauty, a combination of extensive vegetation, diverse topography and built environment, the coastal city of Rio de Janeiro provides the ultimate playground for locals and tourists alike, while many activities are centered outdoors, reflecting in the active lifestyle their residents enjoy. Open-air recreational activities have constantly played an import role in the city identity throughout the last half of the 20th century until today, and there are a number of those activities locals and visitors can take full advantage of Rio's extraordinary landscape and geography. Taking a refreshing stroll in the outdoors has since been a common way to admire the natural beauty of the city for both locals and visitors. Walking and jogging have been also observed in the city´s daily life and a growing number of other sports' practitioners are adding more dynamism to its landscapes. These include a variety of sports modalities in different landscapes such as nature treks, sports on sandy beaches, surfing, cycling, hiking paths, rock climbing, rappelling, mountain bike trails and water sports in both ocean and lakes, to cite some. This sports mad city is recently in worldwide spotlight for hosting the biggest sporting events like 2014 FIFA World Cup and the 2016 Summer Olympic Games.

In the following visualizations, by culling the public and geo-referenced data from those virtual services and using opensourse-based softwares as ways of mapping them, we display spatial distribution of all types of outdoor activities within the limits of Rio de Janeiro municipality (see Figures 2 and 3). From short waymarked routes through its green mountains to longer-distance ocean and bayside routes, Rio de Janeiro offers dozens of preferable places for sport lovers. Rio´s most sought-after neighborhoods offer a variety of workout possibilities in their open spaces. Running and cycling-friendly spots are hotbeds for workout enthusiasts, offering picturesque paths and close-to-perfect climates yearlong. Waymarked jogging routes and cycling paths take practitioners through some of the city's best sights, famous tourist attractions and buildings. Morning and night time runs are more often seen and whereas most pedestrians stride calmly along the sidewalks enjoying the ocean view, a growing number of amateur athletes pop up from any route's easy on-off access from almost any perpendicular street, lace up their running shoes and take a jaunt around runnable and bikeable districts of the city. The city also holds top-notch running clubs and major competitive races on weekends and holidays, plenty of them friendly to first-timers.



Figs. 2 and 3. Culled data from GPS waypoints for all outdoors activities in the city limits of Rio de Janeiro. Distribution by logged points (left) and density (right), the last one varying from yellow (scarce) to red (intense). Source: Authors.

Fig. 4. Collection of GPS waypoints from servers focusing on Rio´s southern districts, displaying the distributions of public space appropriations by sport. Source: Authors.

Higher concentration of those outdoor activities were observed alongside natural features like the ocean, bay and forest, as characterizing more linear routes, whereas more dense built environs, providing less public recreational zones, more closed, around buildings routes are more often drawn (see Figure 5). Rio´s famous south zone apparently offers the best places for outdoorsy types. The majority of spots appeal to locals and tourists alike, such as the multi-use beach-long paths, well known for serving sport practitioners of all levels and kinds: casual joggers, bikers, rollerbladers and skaters share the same space to performance their hobbies (see Figure 4, letters A, B and G). Since there is no signature running path or loop, the paved concrete route covering most of south zone and is also a great option for long distance and elite runners who want to take cool breezes from the ocean and to avoid vehicular traffic and intersections. Additionally, Sundays are free of traffic in the main coastal roads, attracting families to appreciate the amenities of urban life, a leisure activity affordable for a wide range of people.

Fig. 5. Collection of mapped routes by outdoor sports practitioners, displaying a variety of scenic appropriations and circuit configurations. Main source: Runkeeper.com.

Bicycling is part of the city culture and is still a dominant outdoor activity. Rio offers a large and expanding network of cycle paths that stretches mainly along its oceanfront. There are separate cycle lanes along the beaches where, whether alone or in tow, cariocas enjoy this activity as means of weekend and late afternoon leisure, although nowadays they feel more encouraged taking this as an option for commuting due to the heavy traffic congestion. The most ordinary cycling areas in Rio de Janeiro are the coastal avenues along the beaches of Copacabana, Ipanema and Leblon (approximately 7.5 Km), the bayfront park of Aterro do Flamengo until the Sugarloaf Mountain (approximately 8 Km), and the coastal flat path that runs from districts of Barra da Tijuca to Recreio dos Bandeirantes (approximately 16 Km). For more seclusion, though, several lofty hills are all within easy reach and are great for nature lovers, such as the bike paths in the Tijuca rainforest and more wild routes in the west zone districts.

Other main cycling lanes are alongside main roads and avenues that are connected to the beachfront ways. Cycling addicts also find in Rodrigo de Freitas Lagoon an ideal track. Framed by green mountains and embraced by the statue of Christ the Redeemer, the lagoon also counts on 3 parks, which are among the best-equipped areas of entertainment of the city. Pedaling in more challenging rides through the rainforest of the Tijuca National Park, a rainforest wrapped around the city with exotic tropical flora and known as the largest urban forest in the world, where practitioners can enjoy the cooler breeze of the woods, stop at several waterfalls and for a couple of lookouts over the city. The trips usually start in the hilltop and charming 19th century district of Santa Teresa or through the

leafy streets of the districts of Gávea and Jardim Botânico, reaching the top of the mountainous area that stretches over almost 4,000 hectares and enjoying the scenery from different angles (see Figure 4, letter I).

Cycling activities in the above routes are often observed on weekends. Among other routes described by cyclers it is common to notice some mentions to commuting routes. Mostly of such descriptions are observed in central districts, as well as in the coastal neighborhoods. Distances for those itineraries range usually from 1 to 3 kilometers, which may indicate that leisure and training are conducted at the same time as people commute. We may find and speculate many reasons for that contemporary trend, from busy daily routines to avoid congested roads.

From the same forest cyclists pedal, there are also many medium to difficult trails available in the same forest for those who enjoy a good hike, some of them guiding to hidden waterfalls abundant in the park. Trekkers are reward with a lush nature, some of the city´s best panoramic overview and may have the opportunity to encounter small monkeys, toucans and other typical fauna, adding an extra allure to the activity (see Figure 4, letter J). Hikers also enjoy breathtaking views from the lookout points and rocky summits within the park.

Characterized for its forestry mountainous terrain, in Rio avid climbers certainly enjoy the rocky massifs that can be seen from everywhere and are among the most famous postcard images of Rio. Climbing up the highest natural symbols of the city has become notorious among runners of high fitness levels, where they can glory in the visual and air quality. Mixed types of training, getting up to hilly obstacles such as Morro Dois Irmãos, Pedra Bonita and Pão de Açúcar are also sparsely data logged (see Figure 4, letter E). Rappelling, a common name for abseiling, has also become very popular among more experienced practitioners in the rocky massifs of the city, notably observed slipping down the ropes in Morro da Urca, Pedra Bonita and impressive granite mountain of Pedra da Gávea. Combined with hiking expeditions, the controlled descent is an enthralling way to interact with the landscape.

With 80km of seafront, Rio has much of a beach culture, where many activities are focused around the beach and ocean. Rio´s vocation for water sports and beach activity is in abundance as volleyball and football are played day and night along the idyllic setting of the miles of sand of Rio's Atlantic beaches. Besides football is still the national sport and the country's most popular outdoor activity - it is an omnipresent activity in any public open space, plenty of other activities are getting increasingly more popular on its coastline. The warm waters of both Atlantic Ocean and Guanabara Bay also provide the ideal conditions for a variety of water sports. From the traditional surfing and body boarding to the more recent trendy and not so widely publicised kite surfing and SUP (stand-up paddle), the landscape of its southern oceanic beaches are now composed by a hive of timeless activities. Other examples are wakeboarding, kayaking and swan pedal boating on humming Rodrigo de Freitas Lake, with its stunning views of Christ the Redeemer, the mountains of Tijuca rainforest, and the massif of Pedra da Gávea.

Amateur swimmers usually take to the brackish and calmer waters of Copacabana beach, although the murky waters of Ipanema also attract more challenged ones. Open-sea races and water competitions are usually held there. Strolling down the beaches on early mornings and late afternoons dozens of surfers are seen in action. Surfing is as big in Rio as the waves that pound the beaches all along the coastline, especially in inner beaches such as Arpoador and Leblon. Kayaking has also found its territory on the calm waters of the mouth of Guanabara Bay. Routes usually are identified closer to the fortresses complex between Rio de Janeiro and Niteroi- the city situated on the opposite side of Guanabara Bay facing Rio, with panoramic views of Christ the Redeemer, Sugar Loaf Mountain, Botafogo and Flamengo beaches and Tijuca Forest (see Figure 4, letter C).

Stand up paddle surfing (SUP) is a fairly new sport that is gaining in popularity in Rio´s calmer coastal waters and lagoons, notably in Copacabana Beach, next to the Copacabana Fort, but also practiced in Canal de Marapendi, a clear water lagoon in Barra da Tijuca neighborhood, Guaratiba and Canal da Barra (see Figure 4, letter D).

One of the fastest growing activities off the beach in Rio is recreational running. Most of the neighborhoods do not count on segregated or safe running paths. Most of runners stroll along some portions of the cycling lanes whereas bikers tend to performance longer trips. In these case, practitioners usually loop around the outer limits of local squares and parks, which are usually the only pedestrian-friendly public and tree-shaded areas nearby, such as the case of Campo de Santana (see Figure 7), Parque Madureira, Quinta da Boa Vista, Bosque da Freguesia and many others, concentrated mainly in the north and western portions of the city. Other parks or squares with relatively proximity to the coast are also stage of loop-like routes like Praça Paris (see Figure 7), Afonso Pena, Estácio (see Figure 8), Bosque da Barra (see Figure 7), to cite some.

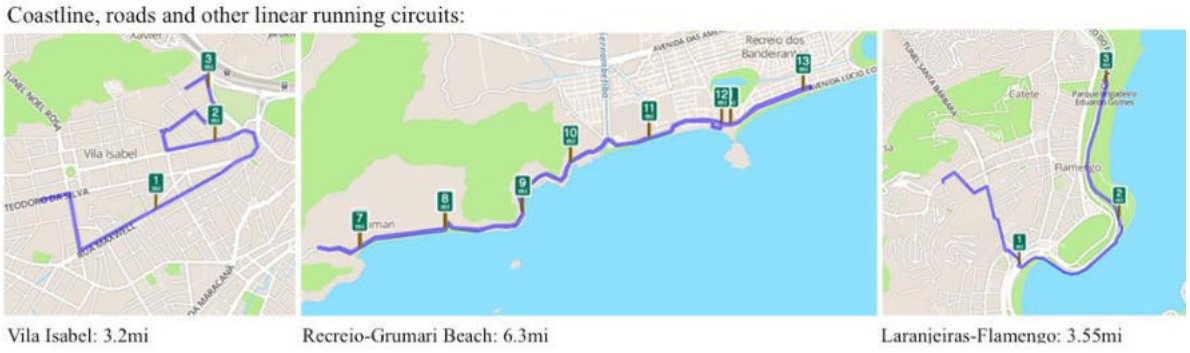


Fig. 6. Drawn routes from collected GPS waypoints of long-running linear-like trainings. Main sources: Runkeeper.com and Endomondo

Fig.7. Drawn routes of closed circuits from collected GPS waypoints. Main sources: Runkeeper.com and Endomondo

Likewise, routes detected along streets and avenues with high traffic are mainly observed in regions with lack of open spaces and parks, far from the coast or any other visual privilege of nature landscape (see Figure 6). In northern and western districts, some routes are observed alongside enclosured canals and railway lines. Other routes are drawn along calm residential streets inside private gated condominiums (see Figure 5, letter A) and in the neighborhoods of Jacarepaguá, Vila Isabel (see Figure 5, letter B), Vila Kosmos and mainly Campo Grande. Additionaly, some shorter and loop-like complete circuits are found inside hypermarkets and mall´s parking lots in those regions.

More hardcore runners also challenge up in the mountainous expanse of Tijuca National Park to experience more scenic courses through the park, featuring a breathtaking combination of verdant woods and urbanity views. This activity is increasingly popular, despite its difficult access and concerns on security. Its real appeal counts on the slew of forest roads, park paths and routes just outside of the city center, where runners can experience strenuous inclines to boost their performance while relishing of daily life stress. Runners can also benefit from plenty of shade throughout the run and temperate climate, with average lower temperatures in comparison with the coast and park routes, important to enhance their performance.

For those who still opt to urban scenery, the hilly streets of Santa Teresa combines a variety of routes starting from different points in the surrounding districts and ending up the in the premises of national park (see Figure 8). Steep streets and roads can intimidate even the most experienced of runners.

Some of militarized zones also present high performances as complete circuits. Usually having as benefit plenty of green and open fields for military training, those gated headquarters are also made as running fields out of their walls by people in search of well maintained pavements and safety. Some sportive designated complex, like Maracanã (see Figure 3, letter C) and Engenhão Stadium, as well as in the olympic villages in suburban areas are also chosen for the same reasons.

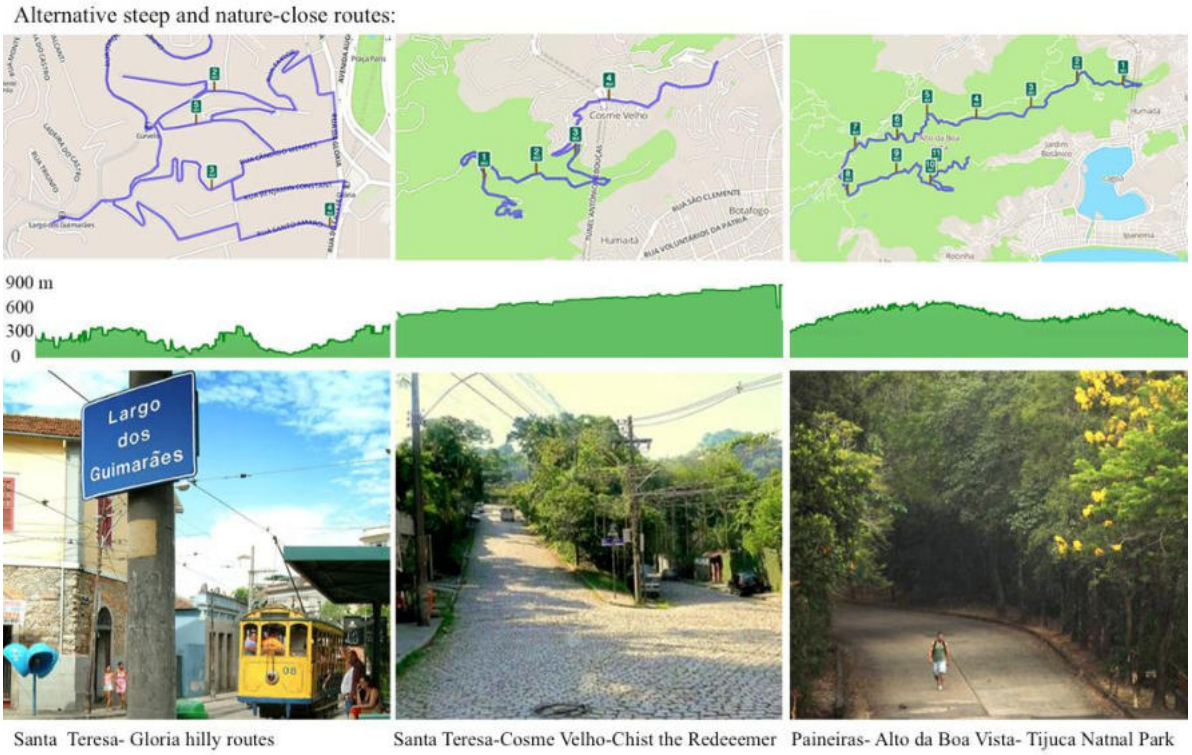


Fig. 8. Cartography of collected GPS waypoints of running activities in steep and natural contexts. Source: Runkeeper.com and Panoramio.

It is important to stress the purpose of training as for some of the routes from more committed runners. Different tracks from the same users are observed with descriptive comments concerning the quality of pavements, topography, shading, and mainly visual aspects, such as the routes drawn in the mountains with privileged viewpoints to the city. Other combining factor scores with control variables like competition, traffic and steep terrain, which gauge impediments to walking and bicycling. Beach running, for example, is observed in Ipanema, Leblon and Barra (see Figure 5, letter E), where high skilled runners can stride at their own pace without the worry of a wayward biker weaving into their path.

Recreational and competitive running routes lies side by side. Distinctively, in more recent years many competitive races and events shaped routes within the city´s diverse sceneries. Among those, some take place in the pacified hilly shantytowns in south and north zones, gathered endurance runners to climb hundreds of meters in the labyrinthine streets and organically shaped narrow stairways, places with clearly no adequate infrastructure and design for athletes.

Some possible obstacles related to running activities were identified. For example, heavy traffic roads and expressways, long tunnels and bridges or a combination of both, such as the case of discontinuity in the coast observed from the coastal districts of Leblon, São Conrado and Barra da Tijuca. It may also has to do with the claustrophobic sensation observed in a high percentage of runner performers, a feeling that they may not want to experience while opting for training outdoors. Little geocoded data was accrued in those locations, except those for occasional designated events and race competitions where competitors were logged into location-based services.

Analyzing these and other circumstances detected through this mapping, some questions can be raised concerning whether the design makes any influence in the runners choices for elected performed routes. As for the example of Parque do Flamengo, a route flanked by the busy park full of people, where both options for running alongside the beach and within the park through the cycling lane are detected, as well as among many beaches where both

modalities are experiences, in the sand and along the design lanes or sidewalks. There is no clear relation for those options besides individual choices.

4. Concluding remarks

Additionally to the presented audit of Rio de Janeiro outdoorsy actions, the final aim of this research is to extract and map frequently used routes from massive public workout data by developing scalable algorithms for spatio-temporal clustering of the outdoor trajectories. This short case study has shown through visualization and mapping methods that the digital space may play a relevant role in publicizing and enlightening new forms of spatial appropriation. The use of geo referential information on outdoor activities should picture growing tendencies towards the contemporary uses of urbanscapes. The cartographic power of such practices needs to be studied from the participant's perspective. Additionally, to develop a holistic understanding of the ways in which our digital relationships to territory govern everyday life and changes urban landscape is a burning issue.

Despite the access to the Internet, especially to social medias and mobile applications, has skyrocketed in the last decade, still very few studies embrace the rise of content and data from spontaneous outdoor activities to give them visibility. Citizens´ digital footprints, such as the case of geo-tagged information from sportsmen, contain performative actions in the territory, where current landscape codes are part of a new metaphor we have to learn how to interpret and better deal with. The practical power behind this methodology is the use of real athlete data, to other athletes, which helps recommend the best tracks around each time they hit the roads, waters or the trails. However, there are still a number of issues that should be reviewed in order to effectively improve its potentiality.

Outdoor sports are an important part of city open space system and ultimately one of the most democratic means of interaction with and within the urbanscape. In a predominantly car-oriented society, the recognition of such pedestrian activities as an equal part of open spaces and traffic, where today play an almost negligible, minor role, should require full responsibility and commitment of both governments and civil society. Key elements may include span the needs of practitioners, efforts to construct necessary infrastructure and the embodiment of city landscape ecology as part of improving amenities From the angle of landscape image analysis for planning and design of cityscape, it can reverberates and help redefine what to expect from designing outdoor furniture. However, the real impact of citizens' contribution to landscape planning and transformation through such digital information still needs to be checked, as well as the extent to which their claims can be met.

A lot more is needed from the governmental side to take advantage of the virtual behaviour of citizens in general. This case study concludes advocating the potentiality of these tools as emerging methodological and theoretical framework in the contemporary planning practices. The geo locative medias may be used to disrupt traditional spatial paradigms and contributes to contemporary visions for urban open spaces through the acknowledgment of uses, and the impact of this technological choice is still unmeasured.

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