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ABSTRACT

The massive presence and use of digital technologies in urban areas generate a growing amount of data. This new knowledge, from one side, assigns to the city the new posthuman image of a smart system; from the other side, the polyphony of data-sources interferes with the narrative structure of the city, increasing its complexity and multiplying both the possibilities of its explorations as the management and design of its futures.

In fact, the integration of digital tools for the collection, analysis and visualization of data enables the simulation of possible transformation scenarios. But how this system of fluctuating parameters relates to the physical space of the city? How these multiple virtual possibilities change the urban narrative?

The intersection between digital mediation and physical urban space is the object of this paper, that moves from an interdisciplinary perspective, between narratology and urban design. We analyzed three case studies (Saint Petersburg, Bologna, Barcelona), representative of how the use of digital technologies transforms the representation of the city.

In Saint Petersburg we have reshaped the (semantic) landscape of the city through Instagram data; in Bologna we have followed the (digital) traces of the temporary community of students, investigating the interaction and interference between the 'univercity' and the physical urban environment; in Barcelona we have analyzed an urban fragment (the street of La Rambla), considering it as a microcosmos of data.

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Digital Urban Narratives: The Images of the City in the Age of Big Data

INTRODUCTION

The narrative act is etymologically linked to the process of sharing knowledge. It differs from the act of telling, which means to calculate, to order and, consequently, to restitute information in a proper and understandable sequence. However, the tale could be considered a logic premise of the narration, rhythming the knowledge in sharable and understandable forms (information) and weaving the semantic elements in whole interconnected textures, both in diachronic dimension (storytelling), and in spatial configuration of images. When in 1960, urban theorist Kevin Lynch published his investigation on the form of the city he precisely understood the link between visible shape and knowledge, in terms of visualization, memorization and use, giving to urban planners a methodology to turn the narrative structure of the city into a significant input for urban design.[1]

However, the narrative process is not neutral: it implies the agentivity[2] of a subject, who translates the experience of the urban object into urban images or stories. This mediation depends primarily on the human cognitive system, but it is also influenced by the medium of technology.[3] The city in itself is a technological device that tends to turn a smooth space, "fluid, plane oriented and unbounded", in a striated one, "linear, point oriented and Cartesian."[4] A telling of connections, limits, preferred directions, hierarchy or recurrent patterns of elements, that generate a (narrative/sharable) form.

As underlined by Lynch, the legibility of the cityscape generates from "a vital ability among all mobile animals":[5] an integration of senses and cognitive processes with the aim of recognizing the structure and identity of the environment. Updating this observation to the last discoveries in cognitive science, the three pathways model reveals an integration between perception, movement and representation: the structure of the object is not based only on its spatial configuration (size, orientation, distance) but also on the relation with the subject in terms of potential actions and use.[6]

However, the morphology of the city does not only generate from an immediate perception and representation: the urban semiosphere results from the intersection of several narratives, vehiculated through different media.[7] Thus, these informative layers do not depend only on immediately visible/perceivable elements, but the medium permits to recognize, or generate, the semantic relevance of some places, objects, activities in the urban space.

Affecting the relationship between people and the urban environment, the narrative mediation of the city influences both the citizens' movements and actions, and the choices of urban planners. This dynamic is inscribed in the general condition of *surmodernité*, described by French anthropologist Marc Augé through the three "figures of excess": "excess time" (due to the experience of simultaneous events provided by the speed-up of information flows), "excess space" (due to the acceleration of transports and multiplication of iconic references) and "excess individualism"[8] (depending on the individualization of the interpretation and the related individual production of sense). This cultural framework is generated by (and generator of) a technological development that, making available new media, can significantly reshape both the perception and the representation of the city, exceeding its time/place and tending to reduce its social dynamics to individual explorations.

In the last decades, the introduction and diffusion of digital technologies in the management, design and use of the urban environment have started to interfere with its narrative structure. The metaphorical background of the digital idea is not so far from the *count* (that maintain both the meaning of

calculation as of tell): it consists of a computation that, moving from the limits of the hands to the automation of the machines, can be replicated many times on many data.

Thus, digital technology requires as a preliminary operation to make the object computable, countable, and measurable, in order to find parameters that can be given to the machine as inputs to receive outputs. Data are the core of digital technology, representing the necessary link to apply the potentiality of automatic calculators to the real environment. Its "datafication"[9] is the first consequence of the introduction of digital technologies.

The urban environment has progressively become a generator of data: sensors, monitoring systems, especially personal mobile devices produce a continuous stream of invisible real-time data, collected both by private and public actors, analyzed to enhance the knowledge of the city and to set the base for sophisticated services that can let imagine the city as a sentient and responsive being. The idea of *smart city* is deeply grounded in this technological mediation: in some way, it celebrates the technical power turning a specifically human attribution, the smartness, to a posthuman image of an urban system capable to react to the stimulus, to develop a behavior and to interact through an input/output exchange.

However, this *smartness* maintains the etymological duplicity of intelligence and terror, because when the physical environment becomes an interface that hides a digital system, able to control the behavior of urban elements, the cognitive relationship between subject and object is subverted, and people passively receive procedural information with an opaque filter on the structural back end. Referring to Tomas Maldonado, the surface of digital technologies seems to be less transparent than the traditional ones, because their "constitutive structure remains occulted, inaccessible to the observer."[10] Data have no shape in themselves[11]: they are numbers, variables, ready for a calculation, easy to be interpreted by the machines, but less transparent to human perception. Thus, the digital mediation requires a morphological synthesis that turns the computation – tale – into information – narrative.

This passage from the input to the output, due to the technical evolution of the digital tools, is becoming more and more immediate, canceling the bias between the digital map and the territory.

> Saker and Evans explore how not only is online data is not just a consequence of the use of space, but in many cases it also influences users' own spatial experience by generating new interactions; they introduce the term "phoneur"[12] to refer to users of urban space, who use it simultaneously in the physical and virtual realms. Similarly, Boyd and Ellison[13] discuss how location-based social networks (LBSNs) and web services "are re-shaping offline social geography."[14]

The digital mediation influences the movement in the urban space, along with its perception and use, integrating the physical and visible elements of the city with a new information layer, generated by the production and extraction of data and their computation. This process offers an augmented experience of the urban environment and, consequently, transforms the urban

narratives, providing both tools to explore the hybrid space of the city as media to organize and tell this new knowledge in shareable information.

The digital representation of the city does not rely on the immediately legible elements of the urban space, but it results from the spatialization and temporalization of data in narrative forms. Thus, the morphogenesis of a digital image of the city is not driven by the outstanding characteristics of some specific urban elements, but it comes from the choice to select and visualize some data as outstanding elements.[15] Thus, the digital mediation changes the role of urban imagination as an input to investigate and design the city.

The integration of digital methods and tools in urban planning permits to mediate the urban environment, including temporary, ephemeral, invisible phenomena, in a computable set of data, and to generate dynamic and responsive visualizations, where the traditional, anatomic spatial/temporal fixity of the map is broken by the enlargement of the present, animated through real-time data streams, and by a multidimensional space, where multiple information layers coexist.

This process requires a methodological awareness of the opacity of digital mediation, along with a critical and ethical approach to the workflow generated by data, from their collection to their visualization. In fact, the data are not neutral and all the simulations, calculations, and visualizations provided through digital technologies depend on the collection, selection, and elaboration of data.

In the following sections, this critical issue will be explored presenting three projects that, from the collection to the visualization of urban data, aim at generating digital urban images, reducing the opacity of the medium, reshaping data into shareable forms and exploring the interference between these forms and the physical space. These projects have been developed in both different times and urban contexts, and with different technologies, but they have the common objective to let emerge, through the digital mediation, invisible urban phenomena, and they tackle a common methodological problem, working on the availability of data and on their representation.

The three projects follow a common workflow: a digital mediation of the phenomenon in one or multiple dataset; a classification, analysis and interpretation of these data, to understand the connection between the phenomenon and the urban environment; a visualization (mapping) of the city, inclusive of the phenomenon, and able to generate new knowledge. Thus, this process opens a comparative perspective, not based on the proximity or analogy of the urban environments, but on the application of a similar method to different objects, offering an abacus of strategies for a critical approach to the digital (re)imagination of the cities.

SAINT PETERSBURG.
A SEMANTIC URBAN DATASCAPE

In 2016, during the workshop *Digital traces*[16] organized by the European University of Saint Petersburg and the Spin Unit Lab, we have worked on a dataset of 424'089 items from Instagram, collected with Instagram API during one-year period from the 1st of July 2014 to the 30th of June 2015, and geolocated in

the city of Saint Petersburg. The objective was to investigate the main digital urban narratives, shared by the Instagram users, focusing on their semantic structure and their spatial distribution in the urban space. For each item the starting dataset contained an image, a time stamp, geographical coordinates, user's ID and user-generated hashtags. From this dataset, 47'410 images were additionally processed with Google Cloud Vision API service. As a result, these images received 3'882 artificial tags describing recognized entities, one or more tags per image.

To extract semantic domains, to which images may be assigned, we represented our data as a network of tags co-occurrence with IFRIS Cortext Manager online software (http://managerv2.cortext.net/). Next, each image was assigned to one or several semantic clusters with Cortext software. All images appearing in a particular cluster were plotted on the geographical map of Saint Petersburg according to geospatial coordinates of those images with QGIS software.

The distribution of the items revealed high density areas for each cluster: some urban elements were more represented quantitatively in relation to semantic categories (nature, architecture, shopping, etc.). This outstanding quality could depend on different reasons, connected to the physical structure of the elements, to their perception and use or to an attractiveness that stands on other information layers. Thus, resulting from the sharing of information among Instagram users, it reveals a structure of digital landmarks not immediately legible in the physical space, but highly relevant for understanding the urban narratives, and their impact on the use of the city. The visualization of this invisible layer of outstanding elements has arisen methodological issues, connected with the need for a dynamic representation (the starting dataset has revealed some digital landmarks, but their relevance could have changed, depending on the variation of data), and for a simultaneous representation of the distribution of the different semantic clusters.

Firstly, it has been explored the possibility to overlay the map of the city with a network of edges/nodes, to represent the digital landmarks, and their distances, in an abstract form, with the aim of comparing the spatial distribution with the semantic one.[17] However, the limit of this representation has been the difficulty to generate a comprehensive and clear image of all the semantic clustering, and to show the impact of the digital narrative structure of the city on the physical space.

Thus, we have moved from an abstractive to a mimetic strategy, turning the physical topography of the urban environment into a digital semantic urban datascape, through a dynamic 3D model. The variation of the ground level of urban areas influences not only the morphology of the city, but also its symbolic interpretation: the semiotician Jurij Michajlovič Lotman underlines the role of the spatial modelling as a "universal language"[18] for humans to understand the environment, developing narratives that spatialize the knowledge, linking physical and symbolic information.

The interconnection between the practical issues of safety, isolation, control and the semantic value of highness dates back to the most ancient urban settlements, where the location of buildings connected with political, military, religious power took
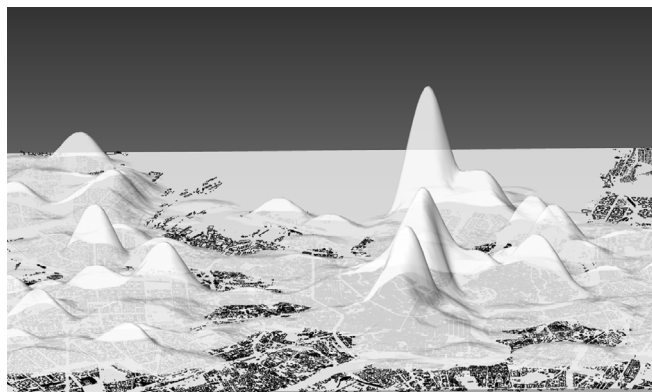
1

advantage of the physical topography. The highness implies visibility, protection, domination and the urban elevations have often been populated by landmarks and significant elements for the narrative structure of the city.

Saint Petersburg is located in a flat area on the seaside, where the physical topography does not present any particular elevation: the 3D visualization project has been based on the idea that data can reshape the urban landscape, increasing the highness of some outstanding areas. The vector layers of the semantic cluster's distribution have been rasterized in grayscale density maps, which translate the number of elements to a gradient value per pixel.

These grayscale images have been imported in the modeling software *Rhinoceros* through the plug-in *Grasshopper*, to convert the raster to a surface interpreting the values per pixel as the height of the surface points. **Fig.1**

Finally, we have projected on the surface the map of the city, with the aim of visualizing the density variation of the different clusters as a metamorphosis of the urban topography.

The advantages of this representation have been: obtaining a dynamic model, able to visualize the variation of the data, maintaining an understandable form, the integration of the multiple semantic datascapes in a comprehensive 3D visualization, the development of an image of the interconnection between the digital information and the physical space, making visible the variation (both quantitative and qualitative) in the semantic values of urban areas through a manipulation of a recognizable element – the topography – and its physical and symbolic structure – elevation.

The choice to shape the 3D visualization as a terrain model is arbitrary and it is connected to a more general narrative strategy, that plays with Lynch's legibility of the city, based on the use of sight in order to give a structure to the environment, underlining that the relevance of some urban elements is not given, but generated, and that it does not depends only on its aesthetic configuration, but also on other informative layers.

The risks of the mimetic strategy are connected to the enhancement of the opacity of the digital mediation: the analogic visualization of data as physical elements of the urban space enforce the identification of the territory with the map, removing the subjectivity and partiality of the digital
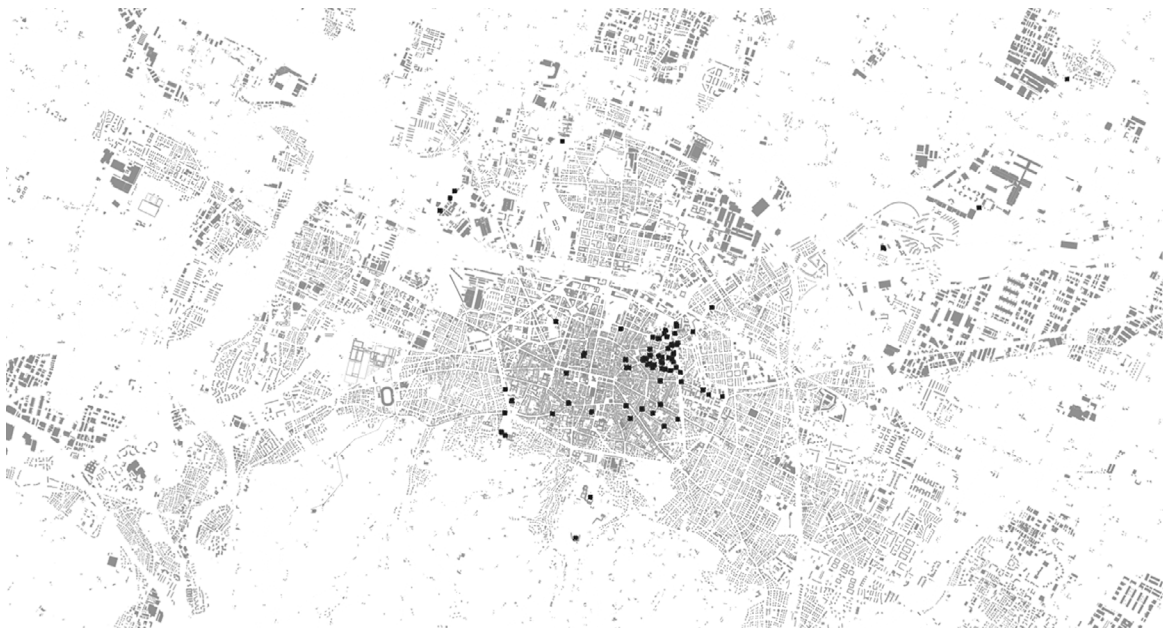
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representation. However, in this case, the selection of an urban element – the topography – detached from the information described by the data has helped to clarify the formal nature of the analogic connection, avoiding a confusing identification between a phenomenon and its representation.

BOLOGNA.
THE CITY OF A TEMPORARY COMMUNITY

The *Univercity* project investigates the interaction between the temporary community of students and the urban environment. It aims at defining a methodological framework to analyze and compare different urban contexts, where the presence of a university works as an attractor for external people, generating social, cultural, and economic dynamics that impacts on the urban system. **Fig.2**

In the *Univercity*'s workflow, digital mediation plays a double key-role. From one side, representing the principal medium for sharing information among the students, it permits to follow their movement and action in the city through their digital traces. From the other side, it gives the opportunity to visualize the *univercity*: a hybrid space (both real and virtual), a city in the city generated by the interference between the student perception, experience, narrative and the physical urban space. The first case study of this project, in 2017, has been the historical Italian city of Bologna, which hosts one of the most ancient universities in the world (founded in 1088) and one of the biggest athenaeums in the country.[19] Since the beginning of its activity, the university has been an attractor for students

with different origins: in the past, this external community was not included in the urban administration, but it was organized in specific groups (called *nations*) under the jurisdiction of the rector. Even nowadays, around a half of the students moves to Bologna for studying, generating a temporary community that affects the demographic balance, doubling the local population between 18-30 years old.[20]

The *Univercity*'s workflow started from the collection of the available data: the official statistics (both from the University of Bologna and the Italian Ministry of Education) have defined the amount and origins of the student community, along with the characteristics and distribution of the university buildings in the city. The Municipality of Bologna provides also open datasets, with information on many aspects of the urban system (transportation, culture, economy, demography, etc.), that have been integrated to define the characteristics of the urban context.

However, these data provided a top-down institutional perspective, lacking information about the student experience, perception and representation of the city, and of an adequate granularity, to locate students' activities in the urban space, out of the university areas. To fill this gap, we have explored the digital infosphere, mining data from websites and social networks, where the digital mediation leaves traces of the passage and action of students (and people in general), providing significant information to understand social dynamics, particularly connected to temporary events or processes. **Tab.1**

Source	Method	N. of places	N. of items	Type of items
Facebook	Facebook API	5,725 (40 university places)	10,129	Events
Instagram	Scraping	527 (32 university places)	25,753	Posts
Foursquare	Foursquare API	9,854 (19 university places)	-	Places
Twitter	Twitter API	10km radius from the university areas	1,027	Tweets
Just Eat	Website mining	-	322	Restaurants
Idealista	Website mining	-	1,000	Rental advertisements

Tab.1
The authors, 2020

Specifically, the social networks based on geolocation [...] are constantly linked to the spatial environment through the introduction of the GPS technology to convert the visited place in public content. The material shared on the LBSN represents a digital trace that connects an online interaction with a physical place, thus its investigation can provide a potential socio-spatial data source about behaviors, models and characteristics of urban environment.[21]

The dataset has been organized according to four macro-categories (sleep, eat, study, enjoy), that classify the ordinary life of students, to investigate how, performing basic actions, they interact with the urban space, both inside and outside of the university areas. Considering the institutional data on the main services related to the student's life, the morphology of the univercity presented a highly centered structure that gravitates around the university spaces, situated in the historical city center. However, the integration of social network data revealed a significant difference in the spatial structure of the univercity. In particular the analysis of the Facebook events, that contains the list of attending or interested users, has permitted to identify, with reasonable approximation, the university students, as users who have been active (attending events or posting contents) on the 40 university places. Thus, looking for their presence in other places and events in the city, we have found 20 locations, attended by more than 25 university users, that pertain to different categories (bars, restaurants, museums, theatres, gymnasiums, shops, etc.), immersed in the urban texture, without any specific reference to a university target. Furthermore, some of them are situated outside of the surroundings of university buildings, generating a network of micro-attractors that push the movement of students in different parts of the city, even in peripheral areas.

This information relies on the approximation inscribed in the workflow and, to avoid the risk connected to the opacity of the digital mediation, it has to be clear that these polarities emerge from a calculation that reduces the student community to the users active on the Facebook university pages. Considering that a high percentage (almost the totality) of the youths between 18-30 years old are active Facebook users, it seems not unfounded to interpret these data as traces of the presence and movement of the students. Also because the selected places are not universally popular in the community of the social network (considering, as parameters, the check-in count and the tag in the place), but they are specifically selected by the digital community that gravitates around the university Facebook pages.

Thus, as for the Saint Petersburg's project, the social networks data allowed to recognize digital urban landmarks, which outstanding value is not necessarily connected to their physical structure and, as a consequence, which are not immediately legible in the urban space, but the *Univercity* project increases the granularity of the analysis, looking for the narrative generated by a specific community.

When users choose to broadcast their location in relation to a specific venue, they are relating themselves with the values and social groups that are represented by that specific physical place. In this way, users are building their online identity through attaching themselves to the specific narrative of a physical place.[22]

The temporariness of the student community makes the centrality of the selected polarities evanescent and rapidly changing in time, constantly reshaping the topological structure of the univercity. More generally, if the university represents a durable physical, functional, symbolic element in the urban system, its interaction with the city, generated by the attraction, presence and activity of the students, remains invisible, due to its ephemerality. Thus, the *Univercity*'s workflow aims at developing a visualization, able to represent this process as a dynamic urban image, structured by the interference between the student narrative and the urban context.

In this case, we have chosen to restitute the univercity as a network of nodes (digital landmarks, outstanding points for the student community) and edges (preferred pathways/connections). This graph structure maintains the adequate abstraction to avoid a mimetic substitution of the physical space of the city, that risks to generate a perceptive switch between two different images of the city, losing the dialogic nature of the univercity. However, the image of the univercity is not isolated in a totally abstract and topological space, but it is anchored to the urban context, localizing the nodes on a map of the city, to show their double nature of physical elements and of outstanding places for the student community.

In this visualization, the traditional representation of the urban space (a map of its buildings and streets) is augmented through an abstract, but geolocated, dynamic image of the univercity, structured by its core elements. The adoption of an abstract representation depends also on an ethical issue, arose during the workflow of the project. In the last years, the policies of the social network API have been modified to limit the possibility of collecting personal data. And the recent European General Data Protection Regulation (GDPR) considers the geolocation as a sensible information. In fact, the data collection process used for Bologna cannot be replicated in the same way.

However, even before these restrictions, working on this case study, the facility to collect lists of names and surnames, linked to geolocated places and temporal coordinates (timestamps), has generated methodological questions on the opportunity, even with the positive aim of academic investigation, to use and visualize these data. This critical point is still present in our research projects. In the case of *Univercity*, we have adopted two strategies: we have maintained the most abstract level possible to represent the connection with the urban context and to avoid the individual scale of the tracking of personal movement; following the proposal of a high level human relational ecosystem for the production and elaboration of data, as suggested by Salvatore Iaconesi, we have thought about the visualization as the medium to give back to the community (both the local as the student one) a new narrative of the city, inclusive of students' perspective.

Subtopic	Source	N. of Items	Type of items
Accomodation	Municipal open data	171,544	Civic numbers
	Airbnb	17,087	houses/rooms
	Tripadvisor	1,974	hotels
	Municipal open data on touristic apartments	9,581	apartments
	Open Street Map	204	Accommodation amenities
Food	Tripadvisor	9,640	restaurants
	Open Street Map	1,490	Food amenities
	Municipal open data	9,680	Eating and drinking activities
	Municipal open data	5,580	Terraces
Shopping	Municipal open data	78,033	Commercial activities
	Open Street Map	2,680	Amenities
	Website *Amics de la Rambla*	178	Commercial activities

Tab.2
The authors, 2020

BARCELONA.
A URBAN MICROCOSMOS OF DATA

The urban narrative organizes the experience and knowledge of the city in a structured, understandable and shareable form, but there is no singular, unique or universal way to tell the urban environment.

> There seems to be a public image of any given city which is the overlap of many individual images. Or perhaps there is a series of public images, each held by some significant number of citizens. Such group images are necessary if an individual is to operate successfully within his environment and to cooperate with his fellows.[23]

Thus, the imagination of the city results as an intersection, interference, negotiation of multiple narratives generated by the presence, movement, action of different communities (both local and external) in the urban space. Considering the *community* as a group of people who share something, the narrative process, as a sharing of knowledge, is a key process for the imagination and generation of a community.[24] In the urban areas, it happens for the local communities, where the "production of locality" consists in a narrative act of socialization of time and space, but it concerns also the temporary communities, joined precisely by the sharing (and mediation) of a common (temporary) experience of the city. Thus, the imagination generated by external people can have more durable and impacting effects than their ephemeral physical presence, interfering with the local narratives. In 2019 as an outcome of the workshop *Code and creativity*[26], we have worked on the visualization of this interference, focusing on the economic activity of a specific urban segment: the 1,4 kilometer street of La Rambla, both an historical and symbolic place for the local community as an attractor for massive tourist flow.

In this case, the digital mediation has permitted to return to a more comprehensive representation of the touristic phenomenon, overcoming the reduction of its impact to a trend of economic indicators, through the collection and integration of heterogeneous datasets (from official statistics to social networks, from touristic apps to websites). Although the touristic *invasion* can be physically perceived, and its economic outcomes can be measured, the consequences of this process in terms of transformation of perception and representation of the street are less evident.

As a starting point, we have classified the economic exchanges in three subtopics (food, accommodation, shopping), representative of the locals-tourists interaction, collecting data both from local sources as from touristic media. **Tab.2**

We have integrated these datasets with a field recognition of the unofficial economic activities (temporary kiosks, peddlers, etc.). Furthermore, we have collected a dataset of 31.018.113 Instagram posts, located in 297 places in the city, where it has been used the most common hashtags connected to La Rambla (*rambla, larambla, lasramblas*).
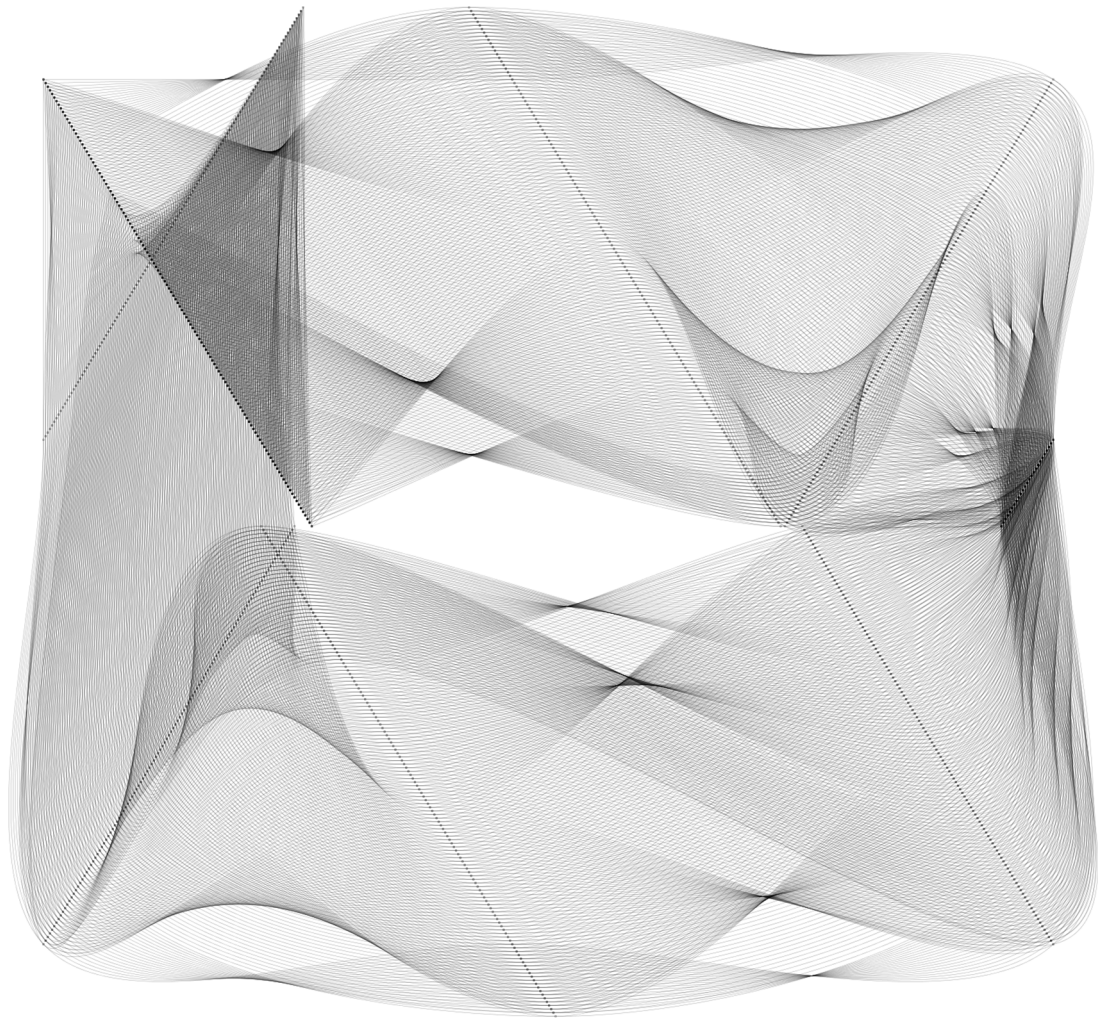
Data have been analyzed to extract temporal information (opening time of the activities, occupation of the accommodations, variation of the Instagram activity), spatial information (geolocation), quantitative information (cost, prices, ranking, number of likes, number of posts, density, etc.), qualitative information (category of the activity, local/tourist target, visual characteristics of Instagram images, etc.). Finally, we have visualized these data with Processing, developing two generative design outputs, where the economic activities work as a transformative system of forces, able to reshape the form of the street in the first, and to reorient the movement of the people in the second.

The first representation, *La Rambla − Metamorphosis*, plays with the recognizable linear shape of the street: a geometrical rectangle sets the initial condition; then, some deformation agents activated by the economic dynamics start to reshape it. The presence of commercial activities in the street generates centripetal forces that tends to maintain, or return to, the original form, while the activation of touristic economic exchanges in the surroundings (particularly considering the nearby areas of *El Raval* and *Barri Gòtic*) start the deformation, initially visualizing the reconnection of the street to the urban scale and, finally, through the global fluxes of Instagram users and Tripadvisor reviewers, extending the transformation out of the local dimension.

The digital mediation permits to translate the economic exchanges in a diagram of forces that impact on the street as a metamorphic movement. The image of La Rambla is detached by its physical constraints and its spatialization is determined by external polarities that progressively generate more complex and wider shapes, losing the analogic reference to the linearity of the street. **Fig.3**

The second visualization, *La Rambla – Seduction*, considers the presence, distribution and characteristics of the economic activities as attractor points, able to modify the linear path of the promenade and to reorient the flux of people. Depending on a simulation of the daily hours, a variable number of particles (determined by the timestamp of Instagram items) are generated on the screen, representing the pedestrian pathways. The economic activities, abstracted in circular nodes, and distributed according to typology and density, generate attraction forces (weighted by quantitative parameters like ranking, price, etc.), in relation to their opening hours and their localization. As a result, the linearity of the movement on La Rambla is broken by vortexes of particles that start to gravitate around the polarities of economic activities. **Fig.4**

In both representations, the digital mediation abstracts the physical and legible structure of La Rambla in primitive geometrical elements (a line for the space, particles for people), programmatically erasing any mimetic connection or recognizable landmark, to let emerge the economic system as a diagram of forces. The resulting images are abstract but not metaphorical: they offer a new spatialization of the street, substituting the physical constraints with the economic dynamics.

These outcomes aimed at critically reviewing the traditional representation of economic indicators as graphs that show a quantitative variation in time, adding new dimensions and integrating more data to the representation. Even in its partiality, the visualizations provide images of the new spatial configurations produced by the touristic fluxes. Furthermore, the abstraction of the generative outputs shows how the digital mediation permits to translate heterogeneous data in a common spatial language.
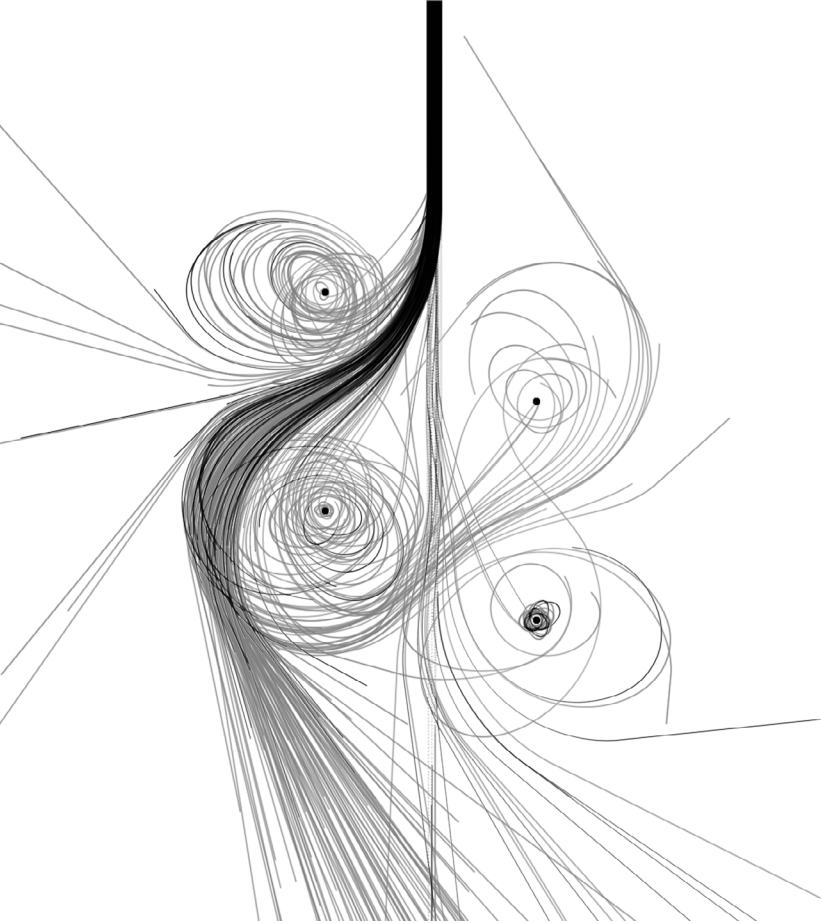
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CONCLUSIONS

From the macro scale of a city to the microcosmos of an urban fragment, following the digital traces of people-users, the three projects give a sample of how data, generated by the digital technologies, can reshape the image of the city. The three projects follow different strategies (from the mimesis to the abstraction), but they are linked by the common aim to let emerge invisible and ephemeral phenomena, showing the polyphonic nature of the urban narratives.

Digital technologies play a key role in this process, permitting on one hand, to integrate multiple datasets and to provide them with a shareable form, arising also critical and methodological questions, connected in particular to the approximation implicit in the digital mediation, to the flattening of the difference between map and territory, and to the collection and management of personal information.

The digital mediation is the most peculiar aspect of the legibility of the city in the age of big data, because the *telling*, the analytic phase, is outsourced to the computation of the digital machines and the same happens with the narrative synthesis. As observed by Maldonado, digital technologies produce a more opaque relationship between the technical background and the final user, and speaking about the urban system, this opacity can affect both the use and the design of the city.[23]

The visualization of the invisible digital infosphere[28] can provide all the stakeholders involved in the urban ecosystem with useful information to investigate the urban environment, design its development and enhance its knowledge, but due to the particular characteristics of digital technology as a medium, it becomes fundamental to maintain a coherent and transparent workflow that brings from the data collection to the output.

Furthermore, the digital mediation can set the base for a comparative approach between different urban contexts: as stated in the introduction, the three projects have not been developed in a comparative perspective, but they represent three examples of the same workflow, applied to different cities, able to restitute comparable images. The digital urban landscape, the topological relation between urban space and temporary communities and the morphogenesis of an urban microcosmos are possible starting points for further comparative analysis, involving other urban environments.

[1] Kevin Lynch, *The Image of the City* (Cambridge: MIT Press, 1960).

[2] In linguistics *agentivity* refers to the possibility of a grammatical agent to perform the action of the verb.

[3] Marshall McLuhan, *Understanding Media: The Extensions of Man* (New York: Mentor, 1964); Michael Jakob, *What is Landscape?* (Trento: Listlab, 2018).

[4] Mark Nunes, "Virtual topographies: smooth and striated cyberspace," in *Cyberspace Textuality: Computer Technology and Literary Theory*, ed. Marie-Laure Ryan (Bloomington: Indiana University Press, 1999), 62. See also Gilles Deleuze, and Fèlix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*, trans. Brian Massumi (Minneapolis: University of Minnesota Press, 1987), 474-500.

[5] Lynch, *The Image of the City*, 3.

[6] David Milner, and Melvyn A. Goodale, "Separate Visual Pathways for Perception and Action," *Trends Neurosci* 15, no. 1 (1992): 20-5; David Milner, and Melvyn A. Goodale, *The Visual Brain in Action* (Oxford: Oxford University Press, 1995).

[7] Jurij Michajlovič Lotman, *Universe of the Mind: A Semiotic Theory of Culture*, trans. Ann Shukman (London: Tauris & C., 2001).

[8] Marc Augé, *Non places: An Introduction to Anthropology of Supermodernity*, trans. John Howe (London: Verso, 1995): 103-5.

[9] Patrick Biltgen, and Stephen Ryan, *Activity-Based Intelligence: Principles and Applications* (Boston: Artech House, 2016), 139.

[10] Tomás Maldonado, *Lo real y lo virtual* (Barcelona: Gedisa, 1994): 114. Translation by the authors.

[11] Salvatore Iaconesi, "Data is an Opinion: la spettacolarizzazione dell'informazione" (paper presented at the Infografica and infoestetica conference, ISIA, Firenze, 10 March 2017), https://www.academia.edu/32442469/Data_is_an_Opinion_la_spettacolarizzazione_dellinformazione, last accessed on 05/09/2020.

[12] Leighton Evans, and Michael Saker, "Everyday Life and Locative Play: an Exploration of Foursquare and Playful Engagements with space and place," *Media, Culture & Society* 38, no. 8 (April 2016): 1169–83.

[13] Dana Boyd, and Nicole Ellison, "Social Network Sites: Definition, History, and Scholarship," *Journal of Computer-Mediated Communication* 13, no. 1 (October 2007): 210-30.

[14] Jesús López Baeza, "Unveiling Urban Dynamics: An Exploration of Tools and Methods Using Crowd-sourced Data for the Study of Urban Upace" (PhD diss., University of Alicante, 2020), 18–9.

[15] Salvatore Iaconesi, and Oriana Persico, "Constrained Cities: Echo Chambers and Filter Bubbles in the physical spaces of the city" (presented at the Post Internet Cities International Conference, MAAT, Lisbon, 26 May 2017), https://www.artisopensource.net/network/artisopensource/wp-content/uploads/2017/06/ConstrainedCities.pdf.

[16] Damiano Cerrone, "Urban Meta-Morphology," in *Digital Traces Lab 2016* (Saint Petersburg: European University of Saint Petersburg, 2016), Available from: https://eu.spb.ru/digitaltraces2016/main, last accessed on 5 Septembre 2020.

[17] Yuri Rykov, Oleg Nagornyy, Alexander Kremenets, et al., "Semantic and Geospatial Mapping of Instagram Images in Saint-Petersburg," in *Proceeding of the AINL FRUCT: Artificial Intelligence and Natural Language Conference 2016*, eds. Sergey Balandin et al. (Saint Petersburg: AINL, 2016), 110–3.

[18] Edna Andrews, and Jurij Michajlovič Lotman, *Conversations with Lotman: Cultural Semiotics in Language*, Literature, and Cognition (Toronto: University of Toronto Press, 2004), 162. See also Jurij Michajlovič Lotman, "The place of art among other modelling systems," trans. Tanel Pern, *Sign Systems Studies* 39, no. 2-4 (2011): 250-70; Jurij Michajlovič Lotman, "On the metalanguage of a typological description of culture," *Semiotica* 14, no. 2 (1975): 97–123.

[19] The sixth per number of students (around 60 thousand), the first in Italy per percentage of the local population (15%).

[20] The 49% of the university students in Bologna come from cities that are out of a reasonable range for commuting (set at 100km); thus, around 30.000 move to Bologna, while the resident population between 18-30 years old is 46.443 (Sources: MIUR, ISTAT).

[21] José Carpio-Pinedo, and Jesús López Baeza, "La producción de identidad de los nuevos desarrollos urbanos a través del place-based social big data: los crecimientos del área metropolitana de Madrid durante la burbuja inmobiliaria (1990-2012)," *EURE Revista Latinoamericana de Estudios Urbano Regionales* 47, no. 140 (2021): 9. Translation by the authors.

[22] Raz Schwartz, and Germaine R. Halegoua, "The Spatial Self: Location-Based Identity Performance on Social Media," *New Media & Society* 17, no. 10 (2015): 1659.

[23] Lynch, *The Image of the City*, 46.

[24] Benedict Anderson, *Imagined Communities: Reflections on the Origin and Spread of Nationalism* (London-New York: Verso, 1983).

[25] Arjun Appadurai, *Modernity at Large: Cultural Dimensions of Globalization* (Minneapolis: Minnesota University Press, 1996): 178.

[26] The workshop was organized in Barcelona by the Italian art academy Abadir, and tutored by the architect Marcel Bilurbina.

[27] See note no. 10.

[28] Luciano Floridi, *Philosophy and Computing* (London-New York: Routledge, 1999).

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Narrative urbane digitali: le immagini della città nell'era dei *big data*

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digitale; dati; visualizzazione; social network; GIS

ABSTRACT

La presenza e utilizzo delle tecnologie digitali nelle aree urbane genera una crescente quantità di dati. Questa nuova conoscenza da un lato assegna alla città la nuova immagine post-umana di sistema smart; dall'altro rivela una polifonia di fonti, che interferisce con la struttura narrativa della città, aumentandone la complessità e moltiplicandone sia le possibilità di esplorazione, sia quelle di gestione e pianificazione.

Infatti, l'integrazione di strumenti digitali per la raccolta, analisi e visualizzazione di dati permette di simulare possibili scenari di trasformazione; ma qual è la relazione tra questo sistema di parametri fluttuanti e lo spazio fisico della città? Queste molteplici possibilità virtuali come trasformano la narrativa urbana?

L'intersezione tra mediazione digitale e spazio fisico (urbano) è l'oggetto di questo articolo, che si sviluppa a partire da una prospettiva interdisciplinare, tra narratologia e urbanistica. I tre progetti che proponiamo sono esperimenti sviluppati in contesti urbani diversi (San Pietroburgo, Bologna e Barcellona), ma significativi di come le tecnologie digitali trasformano la rappresentazione della città.

A San Pietroburgo abbiamo lavorato sul paesaggio (semantico) della città attraverso i dati di Instagram, a Bologna abbiamo seguito le tracce (digitali) della comunità temporanea degli studenti, indagando l'interazione e interferenza tra la 'univercity' e lo spazio fisico urbano; a Barcellona abbiamo analizzato un frammento urbano (La Rambla) come un microcosmo di dati.

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