Seeding Context, Cultivating Perspectives.

A situated method for urban cartography to explore temporal patterns in the contemporary city.

Politecnico di Milano
Facoltà del Design
—
M. Sc. in Communication Design
A.A. 2018/2019
25 luglio 2019

Politecnico di Milano, Facoltà del Design

Candidata: ..... Francesca Morini
MA CANDIDATE

Relatore: ..... Paolo Ciuccarelli
THESIS ADVISOR

Urban Complexity Lab
Fachhochschule Potsdam University of Applied Sciences

Correlatore: ..... Marian Dörk
CO - ADVISOR

Mapping Temporal Landsca-pes.

Time as an urban dimension has always been problematic for urban researchers due to its highly abstract and context-dependent nature, in this work I present a method to critically address temporal data through contextual information.
The growing interest in critical studies on data is leading to promising frameworks and theories on how to acknowledge and appraise data context and multiple perspectives. Feminism, urban geography, digital humanities and other fields are slowly absorbing these theories and are developing interesting approaches to practically make use of them. However, urban studies still lacks a scalable and reliable method that operationalises these ideas for the city:

Therefore, how can spatio-temporal data be examined critically to visualize meaningful and contextualized temporal patterns of the urban environment?

In this thesis, I summarise existing methods to represent the city and map out controversies, from distant and general maps to situated and specific views. Starting from existing contributions in prior work, I will present one method to untangle time-sensitive patterns inside the city by gathering and representing historical, emotional, spatial and personal contexts on temporal data.
By exploring alternative techniques of urban cartography, I will discuss the impact of technologies and big data on urbanism, how to bring back situated perspectives and subjectivities into urban representations and finally how to intertwine distant and general views with close and situated ones.

How *smart* is the urban clock?

REFLECTIONS ON SMART CITIES AND URBAN TIME

0.1

The academic debate around the concept of Smart City and its influence on society, economics and academia itself is active and growing since the early 1990s [Wolfram M., 2012].

Environmental challenges, Urbanisation and Technology convergence are some of the factors that nourished the today 'Smart City' narrative in many fields.
For Wolfram [2012] :

"[...]A 'smart city' is conceived of as a specific type of innovation system, namely one that is deeply rooted in urban spaces, their institutions and actor networks, while also fostering the use of novel web-based ICT applications to support the pertinent interaction processes, learning and creativity."

This definition frames clearly the positivistic approach behind the use of ICT in understanding and uncover urban issues and controversies. The rise of the big data era opened new perspectives for the urban research: from a position of relative data scarcity, the situation is turning to one of data deluges [Kitchin R., 2015]. The continuous flow of granular and heterogeneous data produced by transport schedules, sensors, cellular grids, apps and other technologies attracts various scholars and stakeholders who are determined in reducing the city complexity and uncover patterns, behaviors and issues.

As we will see, entirely relying on big data for urban representation can be a dangerous and weak choice, especially when dealing with high complex dimensions such time.

THE WEAKNESS OF A DATA-DRIVEN APPROACH: CITIES AS UNIQUE ENSAMBLES OF ENTITIES

0.2

Specifically regarding Urbanism we are witnessing a transition in terms of analytical and mapping techniques, data-informed urbanism is increasingly being complemented and replaced by data-driven, networked urbanism [Kitchin R., 2015]. Today cities can be explored and analyzed in real time, by visualizing this constant flow of data through highly dynamic and flexible interfaces.

This approach based on trust in big data and their self explanatory powers has been strongly criticized for its superficial and technology determinism tendencies. First of all, as again stated by Kitchin [2015], in this framework cities are often treated as linear and knowable systems that operate in a mechanical and standardized way. Moreover cities interventions increasingly underestimating historic, geographic and social differences, treating cities as if they are all alike in terms of their political economy, culture, and governance [Greenfield A., 2013].

Every city should be treated as a unique ensemble of entities [Henckel D., Thomaier S., 2016], therefore cities are rarely directly comparable between each other. This is a very delicate and well debated topic that is involving urban scholars as well as data analysts that deal with city controversies, urban cartographers and map makers. This idea of cities as unique ensambles of entities is strongly linked to the topic of time, one urban dimension that has been central to many debates in the field of urban sociology. Henckel and Thomaier [2016] discuss how different tools that inspect time as a central category are being recently developed, but they also remark the importance of interpretation and the correct recognition of differences in urban environment. Data driven urbanism as a systematic and recurrent approach entirely based on data is contribu-

ting in raising awareness of temporal controversies inside the city, however it is not a reliable approach per se, as it would reduce the deep complexity bounded to time analysis. Blindly trusting data based on their assumed neutrality and descriptive power is a poor strategy, that could lead to superficial and even wrong conclusions. Many voices are critically addressing the data driven approach, recognising its important role in urbanism, sociology and urban sciences, but nonetheless challenging its limited premises.
Data driven urbanism rarely deals directly with those aspects and considers data richness as a synonym of analytic accuracy, I will explore how other approaches are challenging this perspective by carefully embedding context and multiple voices inside their analysis.

MULTIPLICITY IS KEY: WHY WE NEED TO INTERPRET THE CITY WITHOUT LOSING ITS CONTEXT

0.3

Many scholars from different fields theorized methods to deal with urban complexity and big data in a more responsible and careful way. The interpretation of data passes through understanding context. Context can be defined in two ways in the scope of this work: context on data - their source, categorisation, reliability, etc. - and context on space - history, emotions, inhabitants perspectives, etc.

Context on data has been widely explored by boyd & Crawford [2012] that explored the importance of being critical and raise questions about the nature of big data themselves, Drucker [2010] argued on the necessity of thinking about data in a humanistic perspective as capta, not abstract given entities that wait to be displayed, but human shaped objects that need to be challenged, deconstructed and carefully looked at.

Loukissas [2017] define a methodological framework to operate consciously with big data in the Digital Humanities field, introducing the concept of "local reading", a technique to discover and acknowledge all the imperfections in the data, another comprehensive method to deal with context on data comes from D'Ignazio and Klein [2019]; from this perspective big data are not to be taken as perfectly representative and neutral information, but the nature and the structure of them is observed carefully.
Looking for metadata or data dictionaries require as much effort as the data collection and analysis itself. Sharing with readers and users knowledge about context in which data are collected, the internal rules for collection, how they are stored, etc. is an empowering technique that leads to a better comprehension of the problem and to better insights based on data.

When it comes to urban analysis, however, the context of big data production is not the only context observed, context on space needs to be addressed as well.
The observed area itself needs to be contextualized, understanding the meaning of a place, its historic development, social rules and culture.
As Knigge and Cope [2006] point out in their work about qualitative and quantitative data visualization for human geography linking subjective and contextual data with official and broader sources works as an opportunity to connect personal experiences, multiple representations and perspective with large social patterns.
The scholars argue that by applying an iterative method combining data analysis and qualitative data collecting can make "situated knowledge" about a place emergent and central and defying the Haraway [1988]'s concept of "God's Eye View".
D'Ignazio and Klein [2019] approach pays high impor-

tance also to context on space as a strategy to generate knowledge and powerful insights that can challenge the existing status quo.
Solid methodologies in data collection and analysis already exist, both for unveiling data context and a physical space context.
If we return to the definition of cities as unique ensambles of entities, impossible to easily analyse through large amount of data, we can see how various types of context can help us unravel the complexity of the urban environment and its possible controversies.

DATA VISUALIZATION: OUR CRITICAL TOOL TO EXPLORE URBAN COMPLEXITY (WITHOUT LOSING CONTEXT)

0.4

Urban scientists largely imply visual techniques to explore the city, both cartography and data visualization have been massively used, especially in the last year with the raise of data driven urbanism.
This is true also for time controversies in the city. Many works are enriched by the usage of graphs, visual protocols and other visual elements to make the topics discussed more clear and visible. For example, the detailed work of Mareggi [2012] on the Italian city of Piacenza or the deeply documented doctoral research on night workers in Milan by Vitrano [2017] are already using data visualization to display large datasets and patterns.
However data visualization is used too often (it is important to specify that this is not always happening, as for the above mentioned works) uncritically and visual representations are not directly dealing with contextual and subjective data. Visualizations are always a support for the text and the written part, where context is properly treated as a discursive object. Visual

landscapes are used to reinforce opinions or to give patterns an immutable and falsely objective appearance. Even fewer projects try to communicate information about the nature of the data used, especially when big quantitative datasets are involved.

Data visualization and communication design could work as a critical tool to interpret data, providing a quick and visual way to display contextual information in maps and charts.
This could be useful especially for non-spatial urban data, such as time analysis of specific places, cities or entities. Collecting and visualizing small data along with big ones in a comprehensive and structured way could open new ways of dealing with time inside the city, gaining comprehension on how unstable and subjective this dimension could be compared to other, spatially situated ones.
As information designers is important that we pay importance to a fair and complete representation of the city, data visualization can be a powerful way to hack data driven urbanism from the inside by providing new and creative ways to embed context, big data and multiple perspectives all together in comprehensive representations.

Therefore, how can spatio-temporal data be examined critically to visualize meaningful and contextualized temporal patterns of the urban environment?

This work is an effort to build a practical framework for urban map makers, to help them analyse temporal

controversies in the city, using big data and some functional aspects of data driven urbanism, but without losing sight of context, both on data and on the physical space.
In the next pages, I am gaining inspirations by existing works and frameworks that deal with context in extensive ways. I will present one design challenge on the city of Berlin and through its analysis I will outline a practical method to merge big data and personal, subjective statements and observations harvested during the analysis process, to build an extensive and clear picture of one specific location in the city.
The final aim of this method is to help designers and map makers to convey properly the complexity of temporal urban issues, challenging the Smart City perspective and disrupting its potentially dangerous simplicity.

Urban Visualizations.

1. History and Critiques on Urban Cartography

“The lack of cartographics ‘buts’ and ‘ifs’ gave the cartographer ‘much less leeway’ to remind the map-reader of the interpretative nature of the mapping process, and, as a result, ***the map-reader easily falls into the habit of seeing ‘the map as a precise portrayal of reality”***

PICKLES, J. 2004

“[...] Maps (and atlases) are always political.”

HALDER, S. ET MICHEL, B. 2018

VISUALIZATIONS FOR URBAN COMPLEXITY

1.1

Visualization plays an important role to convey findings about the urban space (and - as we will see - time). Since the first big cities became the cultural and economic centre of empires, humans have always been deeply interested in finding new ways to store their knowledge about the places they live in [Buisseret, D. 1998]. Urbanism has always been using cartography to “talk” about the city, to display patterns, events and other phenomena difficult to define or analyze.
The raise of ICT technologies and big data have prompted a new era for cartography and a novel approach to mapmaking entirely based on big data and real-time visualization is becoming more and more adopted by scholars and urban planners. [Kitchin, R. 2015] However different cartographic approaches resist, mapping operations that question critically the social and political nature of maps and the necessity of interpreting and studying data at a deeper level.
In fact, two main approaches can be distinguished: a top-down mapping technique, where the mapmaker is guided by data and plot them according to their structure and appearance, and a more bottom-up strategy, where the mapmaker constantly question the nature of data by deconstructing them and expanding his knowledge and perspectives on the phenomenon.
This top-down approach can be identified with data driven urbanism, the approach described and contested by Kitchin [2014] in its critique of the smart city hegemony.
By making data visible and understandable to the human eye, often map makers are granting them a position of neutrality, phenomena are represented and therefore can be discussed, while data that represent such phenomena are always accounted as truthful and reliable.

Feminism, critical geography and qualitative explorations - mainly in the field of human geography and its disciplines - offer us the solution to avoid this perception of neutrality: a bottom-up approach where *"the goal [...] becomes to connect knowledge back to the bodies of its producers and institutions, with their particular histories, values, limitations, and oversights. In short, to consider context in relation to data."* [D'Ignazio, C. and Klein, L. 2019]. Data are made visible together with their nature and discrepancies, multiple representations of the same phenomenon are possible, therefore not only the phenomenon itself is discussed, but also the nature of data and the context surrounding the phenomenon itself.
When observing how time has been visualized in the city, especially in the human and time geography fields, it is noticeable how this bottom-up approach has always been preferred. This is due to the necessity of representing subjectivity, a strong component of urban time and time related phenomena.
In this chapter we will explore the historical roots of urban cartography and after how top-down and bottom-up contemporary techniques lead to different results, why and where they were adopted and their limitations.

URBAN CARTOGRAPHY: A HISTORICAL REVIEW OF REPRESENTATIONS

1.2

In the history of the human civilization, town plans and maps have played a fundamental role in many fields. Buisseret [1998] defines them as *"probably the oldest form of map [...] produced in great numbers".*
Starting from the 15th century, almost all the popu-

lations around the globe had represented their cities in some way, starting from the Middle East, including China, Europe and the classical West [Buisseret, D. 1998]. Over the centuries different techniques have been developed by cartographers and scholars.

However, it is interesting to notice that in almost every ancient culture, urban cartography was not used with the sole intent of representing the city for planning or military purposes. It is widely documented how urban maps and models were used as political and power tools, representing the ideal form of the city
The Chinese mapmaking tradition, one of the most ancient, is an example of how analytical cartography - where incredibly detailed maps were produced for military purposes - co-existed with a more cultural and artistic form of mapmaking. Descriptive cartography was considered by all extent an artistic discipline, like music or painting.

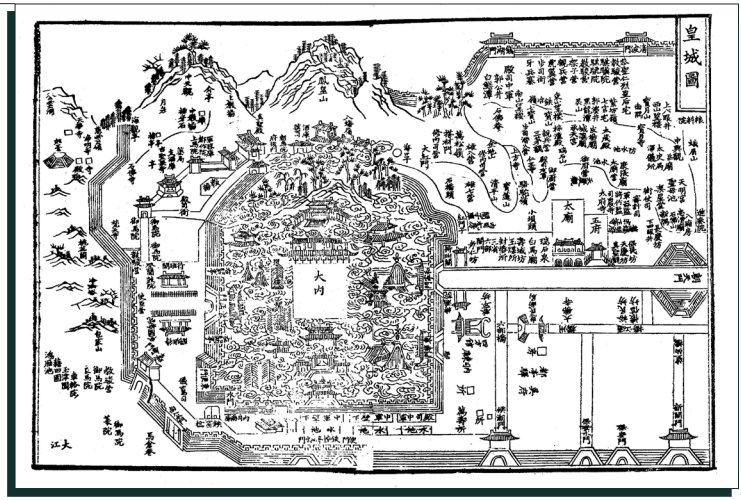


FIGURE 1.1
Huangcheng tu [the imperial city (Lin'an)]. From *Xianshun Lin'an* zhi, 1867 rev. ed. of thirteenth century record.

Therefore the mapmaker was encouraged to take arti-

stic license and make the map that best serve a specific purpose (which was often to delight the Emperor or the cultural élite) [Shatzman Steinhardt, N. 1998].

The resulting maps were representations of events or journeys, always crowned by detailed text annotations. Even if subjective in their final representations, ancient Chinese maps were incredibly accurate in their techniques. Orthogonal lines were often used to draw maps that would be considered of unquestionable accuracy. Grids were used to divide the map harmoniously, to create an effect of order and perfection and to reflect the writing and reading techniques of the Chinese language. [Shatzman Steinhardt, N. 1998]
The political nature of maps, as a way to establish the power of one kingdom or civilisation has also been known in the Western culture, evolving through the Roman Empire to the Medieval Age. Maps features were carefully bent to envision power structures and strength.

In the Fifteenth century a new way of representing topographical reality came into fashion: detailed and realistic models of cities were built in all the major European courts. [Buisseret, D. 1998] As it was for ancient forms of cartography, two main purposes lived side by side.
Models were used for military and planning purposes, but also to express the richness of emperors and kings that would order realistic and detailed models to impress their potential allies or enemies.
Model making was a precise science able to produce accurate and realistic representation of boroughs and cities. In 1691 *“they eventually came as well both to*

have strong aesthetic appeal and to offer remarkable historical source" [Buisseret, D. 1998], mainly due to their realistic precision and scale.
Models were work of pure representation and their aim was not to provide analytical tool for planning (except in some isolated cases and in military context), but to frame on a smaller scale the form of the city.

Together with models, urban cartography continued to evolve. Multiple urban views were introduced to provide a fuller portrayal of the built environment [Danzer, G.A.1998]. The first testimony of this phenomenon is from 1500, with Jacopo de Barbari volume on Venice and it will evolve fully into a way to display local pride, urban achievement and create consciousness about the urban landscape. Maps started to become a tool to model and envision the city, a way to present possible solutions and projects.

One perfect example of urban cartography as a tool to model the city is the 1909 "Plan of Chicago" by Daniel H. Burnham and Edward H. Bennet. It was a composite volume combining text, illustrations, diagrams and maps, its aim was to describe the current structure of Chicago and envision possible plans for its evolution. The same subject - the city of Chicago - is portrayed on a variety of media, different point in times and from various perspectives. One single master map would not be able to capture and define the complexity of Chicago. The same vision is reiterated in many formats to paint a bigger and composite picture of one place. The "Plan of Chicago" must be accounted as a major achievement in urban cartography [Danzer, G.A.

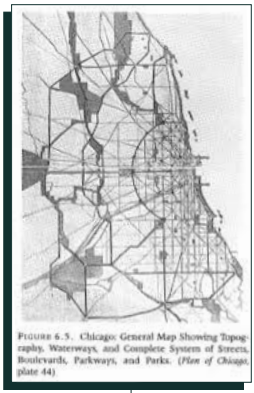


FIGURE 6.5. Chicago: General Map Showing Topography, Waterways, and Complete System of Streets, Boulevards, Parkways, and Parks. (*Plan of Chicago*, plate 44)

FIGURE 1.2
Plan of Chicago, plate 44 [Danzer, G.A. 1998]

1998], due to its application of the long urban cartography tradition for analytical purposes.
Today urban cartography is largely used in urbanism as an analytical tool to highlight problems and envision the future of a city. The advent of big data has even stretched this use of cartography, mapmakers can rely on large datasets to represent urban phenomena.
As Wolfram [2012] notes the idea of cities as “smart” or “intelligent” started spreading from the 1990, together with the exponential interest of research for networked information and communication technologies related to urban studies. A ‘smart city’ is a city where complexity is tamed and reduced to be made observable, this is why the very concept of it attracts stakeholders, investors and big companies that are willing to represent and shape cities following their vision.

FIGURE
The Centro De Operacoes Prefeitura Do Rio in Rio de Janeiro, Brazil. Source George Magaraia,

http://ultimosegundo.ig.com.br/brasil/rj/2012-05-03/ig-visita-o-centro-de-operacoes-do-rio-de-janeiro.html

This idea of the city as ‘smart’ or ‘digital’ has been shaping the current research approach and techniques in urban studies.

In the next paragraphs I will present the current major techniques for urban analysis and representation.

1

Are based on big data and ready-to-use datasets created by machines

"[...] transportation (e.g., roads, rail lines, bus routes, plus the vehicles/carriages) and utilities (e.g., energy, water, lighting), have become digitally networked, with grids of embedded sensors, actuators, scanners, transponders, cameras, meters and GPS producing a continuous flow of data about infrastructure conditions and usage." [Kitchin R., 2015]

This technology embedding in infrastructures are, in fact, continuously producing accessible data that can be downloaded or requested by citizens. This affordability of big tables of data is the real basis of data driven urbanism as it offers a possible interpretation of isolated phenomena.

2

Involve the combination and aggregation of multiple large datasets

Often more than one datasets are produced for the same phenomenon. Multiple dimensions can be paired and aggregated to invest complex events that could not be described by one single dataset.

3

Involve the use of computer science techniques to deal with the large amount of data

In data driven urbanism both scraping and analytical techniques are involved to sample, model and reduce the larger amount of information the reader have to deal with.

4

Their main purpose is to solve large scale urban problems by generating findings from data analysis and visualization

The final aim of data driven urbanism is to solve large scale problems and convey (often real-time) information about the urban environment conditions.

Are rooted in the positivistic and liberal conception of smart and networked city as a knowable and linear system

and

big data are used to tame the city complexity and generate insights

5

Data driven urbanism is often based on the assumption that using automatically processed data to visualize a controversy is automatically offering the unquestionable solution to the observed problem. This is what Kitchin [2015] defines as “urban informatics”:

“These analytics rely on machine learning (artificial intelligence) techniques and vastly increased computational power to process and analyze data. Moreover, they enable a new form of data-driven science to be deployed that rather than being theory-led seeks to generate hypotheses and insights ‘born from the data’”

Data driven urbanism can be defined as a group of strategies to analyze the urban environment that: Smart urbanism should not be criticized a priori, since it has proved to be useful and practical. However, at the same time it is fostering the idea of a technology driven, liberal and growth centered city. [Kitchin

among others] As we previously argued this straightforward approach to urban phenomena has the tendency to leave context, perspectives and involved actors out of the final representation. There is no space for doubt, because providing fast and straightforward answers to complex problems is the main core of the technique itself.
Observing the city from a distance can be really useful in some situations, for example when dealing with climate, demographic or mobility problems and in general when mono-dimensional patterns and phenomena have to be initially visualized and understood.
The advent of computational techniques and digital tools fostered the innovation in the cartographic field by adding even more sophisticated representations: real time data can be displayed and updated constantly, giving the illusion of an understandable and simple city. [Kitchin, 2015]

CASE STUDIES:

- DISTRICT MOBILITY PROJECT
- CITY WAYS
- *URBANSENSING

1.4

I will present four main case studies that rely on urban cartography and data visualization to make visible city data. The first case studio is an urban cartography project from the local government of Washington DC in the US. The second case study presented is City Ways, a project by Senseable City Lab at MIT, where interactive maps of San Francisco and Boston displaying how human physical activity is taking place during the year. The third is *Urbansensing, from Lupi [2014] and Accurat, a platform for studying social media flows of data related to the urban environment.
The first example provided is the “District Mobility

Project" by the Washington DC government and Cleverfranke studio. This website provides six chapters about multimodal transportation in the city of Washington, each chapter present one aspect of moving through the city. Data are collected and analyzed by the city itself to develop short and long term strategies to shape the urban environment. The general concept of the project is a divulgative storytelling divided in chapters, for each chapter a map of the city is shown and by toggling commands on the left side of the screen is possible to interact with the map by revealing different scenarios.
Users are provided with updated snapshots of the city mobility. Data are carefully weighted through a measu-

FIGURE 1.4
Screen of the District Mobility Project by DDOT and CleverFranke.
Source

https://www.districtmobility.org/stories/commuting

rement and the platform itself provides further information on how the data are collected and measured. This is a really good example of quantitative urban cartography that could lead to urbanist interventions on the city. The concept behind District Mobility Project is aiming at transparency and good data practices, however the design techniques used to visualize data

and the resulting city pictures are optimistically relying on the reader background knowledge of the city and ability in observing meaningful patterns.
What insights are fostered by looking at the variety of heatmaps offered on the website?
Little or no context at all is provided to the reader with the exception with the contextual information on how data were treated, which is already a good step in a more deep and curated representation of phenomena. By looking at maps it is possible to spot some patterns and general recurrences, however this information say little or nothing at all to someone that doesn't know the city or has no tool to evaluate what is shown.
The second case study that I am introducing is "City Ways" by MIT Senseable City Lab.
The project is a detailed analysis of two US cities, Boston and San Francisco. Data from self-tracking applications were harvested and visualized to monitor human outdoor activities and study what factors (such as weather, day time and others) are influencing the yearly activity.
By providing two twin interactive interfaces, City Ways allows the user to see how walking, biking and running patterns of people are evolving during the year, the time animation can be stopped and it is possible to check one specific time of the year. Information about weather, outside temperature and day are always visible, together with a complimentary bar chart that visualize the age span of the data producers.

Despite the really high quality of the produced output, both in terms of design and analysis on data, "City Ways" portrays really interesting information without addressing the specificity of it at all.

FIGURE 1.5
Screen of City Ways by MIT Senseable Lab [2017].
Source

http://senseable.mit.edu/cityways/app/

The main aim of the project is to discover possible weather influenced patterns, however the observer is left alone with this representation and very superficial insights can be produced.
There is no context available, only few specific labels about the average temperature of the period and what is the predominant age of monitored people.
“City Ways” is succeeding in its aim of depicting temporal patterns for outdoor human activities, however it is not conveying an effective picture of the phenomenon (at least in terms of visual representation).

*UrbanSensing is a platform designed by Giorgia Lupi and Accurat in 2014. The main project aim is to allow users to explore social media data on the city, previously harvested and analysed. This platform is, in fact, an analytical tool that through its visualizations - arranged in various dashboards - would create an easy to navigate landscape of the user generated city.
Lupi [2014] herself argues that:

*“The *UrbanSensing assumption is that by conducting an analysis of data sets based on text data extracted from geo-referenced Social Media data there is the possibility to recognize multiple stories, as they emerge, overlap and influence each*

other, unfolding from city users' mental representations and spatial experiences of city spaces. ***The aim is to constantly extract indications on urban emotions and well-being through a real time harvesting on social media generated content*** *and to combine them with data sets (e.g. urban morphology, architectural types, city budget, opportunities, public services).”*

FIGURE 1.6
*UrbanSensing prototype.
Lupi, G. and Ciuccarelli, P. [2014]

Therefore it is possible to recognise here the strong idea of using user generated content to perform analysis on the urban landscape. The researcher herself recognises how this information is not self explicative and the role of the designer is to analyse and arrange such information to make narratives emerge. However, the final result is still working more on a synthetic view of the city, without embracing its own specific rhythms and elements.
Introducing those examples of urban visualizations

built through big data, makes transparent the real problem of using those representations in the urban planning procedure: the apparent lack of context of the phenomenon itself.

The reader is free to draw his own conclusion on what he is looking at, without being warned of the possible bias and missing information that he could encounter while reading.The visual consistency and crispiness of those projects is dramatically covering the lack of context. Context is lacking both for data and location, having a geographic map as the basis layer is not sufficient to make a phenomenon local.

QUALITY DRIVEN MAPPING: CITIES OF EXCEPTIONS

1.5

Another approach for visualizing urban phenomena is more bottom-up and rooted in context than the data driven one.
Qualitative analysis is a well known approach in the urban studies field. Interviews, qualitative data gathering, spatial exploration, audits, cartographic surveyings, questionnaires and diaries are important tools for the urban observation.Qualitative analysis in the urban environment require iterations, non linear reading of the data and small patterns observation. [Cope M., Knigge L., 2006]The research strategy to perform successfully those kind of tasks can be borrowed from three different fields: critical geography, time geography - branch of the more general field of human geography - and feminism.
Cope and Knigge [2006] define a research strategy based both on feminist grounded theory and data

visualization, they call it “Grounded Visualization”.
The main idea is to iterate quantitative data analysis, data visualization and highly qualitative techniques to uncover “multiple representation” of the same space and connected phenomena.
This critical approach to cartography has been discussed also by Hägerstrand [1983] and Ellegård [2019] regarding Time Geography and how to uncover temporal phenomena in the urban environment. Studying an unstable and complex dimension as time pushed those scholars to prioritize qualitative analysis methods over quantitative, providing multi perspective views of the city time schedules and how individuals deal with temporal inefficiencies and boundaries.
However this solid analysis approach is still not strongly implemented in the visual part: charts are a tool that often complete the text and not vice versa.
Finally, feminism offers an approach to perform close reading on data and on urban phenomena. Similarly to Cope and Knigge approach, the idea of multiple representation of a physical space is present. Maharawal and McElroy [2017] define feminism cartography as part of the counter cartography practices:

“[...] a set of critical cartographic and feminist data visualization practices that seek to render visible the landscapes, lives, and sites of resistance and dispossession elided in capitalist, colonial, and liberal topographies.”

This approach question the very nature of maps and seek to deeply analyze context, actors involved and power relations.

QUALITATIVE MAPPING CASE STUDIES:

- COMMUNITY GARDENS
- COMPLEXITY MAPS
- THE ANTI-EVICTION MAPPING PROJECT

1.6

There are multiple works that present urban controversies that follow the human geography approach. Here I will present three projects focused on specific areas of the city: two - Community Gardens and Anti-Eviction Mapping Project - will represent geographic and demographic patterns to track the composition of the studied areas, one - the Complexity Maps workshop will focus on interviews, sensor and emotional data to map controversies of a marginalized area of Turin, a city in northern Italy.

Knigge and Cope in their community gardens project, mapped the community gardens in the area of Buffalo, NY to discover how different groups of neighbors form an attachment to place and shape the surrounding according to their ideas. [Cope M., Knigge L., 2006] Their approach is highly qualitative, after collecting quantitative data about the area they started exploring it, involving the communities in workshops and interviewing people on the street. Quantitative data were used to map possible points of interest and define which communities should be involved in activities. The area exploration required several months and reiteration of activities. Quantitative data analysis was constantly challenged and expanded through qualitative explorations and interviews. [Cope M., Knigge L., 2006]
The final output is a single geographic map created with a GIS software of the neighbor where areas are colored according to their usage. Each smaller area is expanded through a tooltip connected to a picture or an icon representing some piece of contextual information: in the majority of cases some photos are provided, both from the area, both from the software

interface, icons are used to let the reader know that also complete transcripts from the interviews and audio/video recording are available.

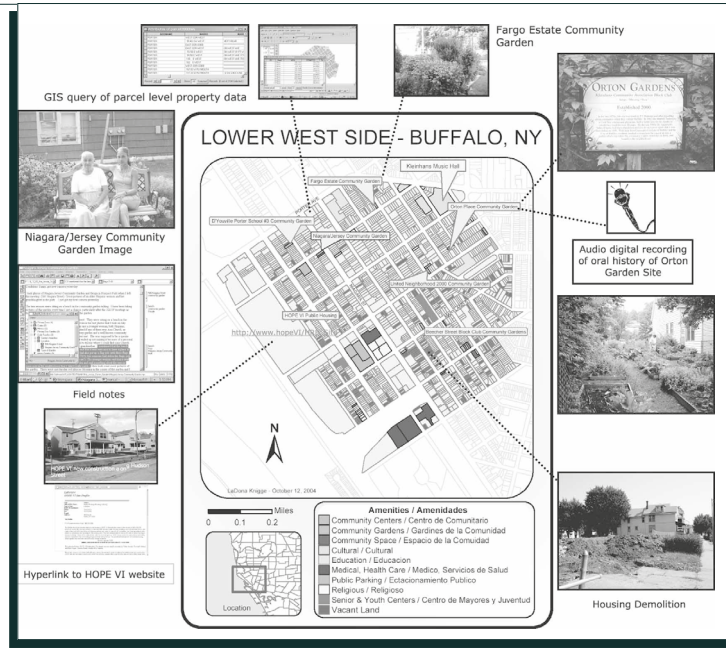


FIGURE 1.7
Multiple representations of the Lower West Side. Knigge, L. and Cope, M. [2006].

The Anti-Eviction Mapping Project is an extended mapping project that has been carried out from several years.
McElroy and Maharawal [2017] outline the project by describing its communal nature: citizens and activists decided to take action against the wave of evictions in San Francisco. One form of activism consisted in mapping stories of eviction and make them visible to involve the public opinion.
The approach used to map the eviction cases resonate with Knigge and Cope's for the Buffalo community

gardens: interviews and community workshops were carried out in order to establish the map content. Perspectives and multiple views are made visible and present to the map reader, at some point the geographical displacement of evictions become secondary to the emotional level created with pictures, videos, testimo-

FIGURE 1.8
Oakland Community Power Map, made in collaboration with the Betti Ono Gallery and the Oakland Creative Neighborhood Coalition.
Maharawal, M. M. and McElroy, E. [2017].

"Over the last four years we have produced over 100 digital counter-cartographic pieces, over 100 oral histories and video works, several reports, murals, projection projects, protests and community events. [...] ***Inevitably, we bring our own situated knowledges to our analytic approach****, and as such invoke feminist, antiracist qnd decolonial spatial analysis."*

MAHARAWAL, M. M. AND MCELROY, E. [2017]

nies that aim at rendering lives and communities. The project has evolved in time from a single map to a set of tools: articles, maps and other pictures that can be used to advocate the eviction problem in the US.

The Complexity Maps workshop is part of a series of activities that took place in Turin. Lead by Christian Nold, together with Donato Ricci and Paolo Ciuccarelli, the main aim of the project was to map and analyse Stura Park a problematic area where various controversies and inefficiencies were creating difficult life conditions. The area was inspected through “people’s thoughts, issues and desires” [Ciuccarelli P, Ricci D., 2009] and visualization was used as a social and political tool to provoke a debate and provide elements for a new strategic vision of the future developments in the area [Ciuccarelli P, Ricci D., 2009]. Various groups of students were involved, a series of topics were defined and assigned to groups. Each group had to produce a map, combining data from official sources (such as newspapers, sensors and so on) and local knowledge from inhabitants.
Assigned topics covered from mobility to environment, through social security and history. Five maps were produced, each one covering a different issue and combining various design techniques. Local dynamics were made transparent and carefully observed.
It is interesting how in the scope of the project the designer becomes a local expert and identifying local context becomes a work of emotional, psychological and physical involvement [Ciuccarelli P, Ricci D., 2009]. Visualization becomes a political tool able to transform single instances from citizens into a hete-

rogeneous ensemble of voices that constitute knowledge about the local area.

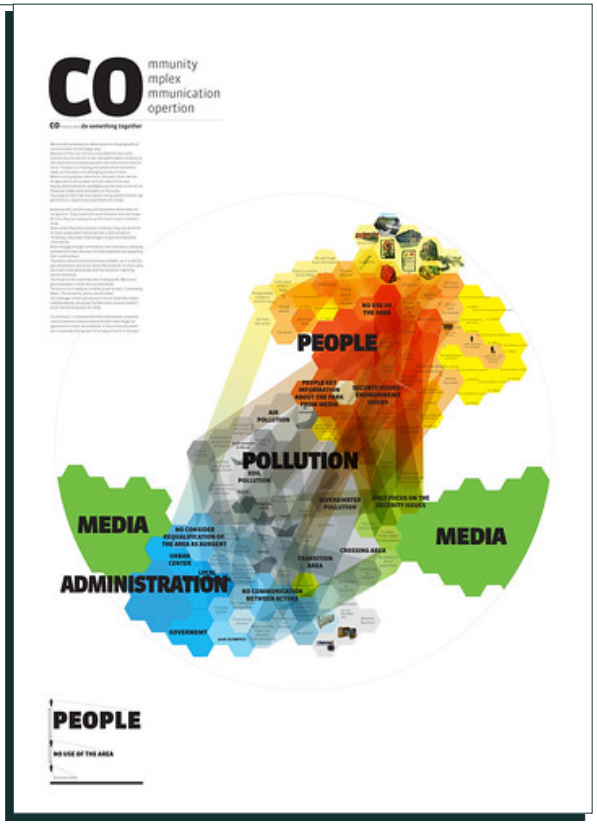


FIGURE 1.9
Environment Map for Stura Park in Turin.
Park, H. and Kim, H. [2009]
Source

https://www.flickr.com/photos/densitydesign/2728558272/

If we look critically at this qualitative approach to urban controversies, it is clear how powerful this technique is, but also how demanding and difficult to frame is both for the mapmaker and the reader.
This constant operation of questioning, gathering voices, perspectives and small insights to build a solid contextual frame for the map works really well theore-

tically speaking, but on the visual and divulgative level we are still far from finding efficient ways to represent and make this knowledge visible and understandable for everyone. The Anti Eviction mapping project could be considered one of the most well executed attempts in portraying urban complexity in its particular shades, starting from this interesting work I will try to develop a mixed approach for qualitative mapping that aim to frame the big picture without leaving out the contextual complexity.

IS A NEW METHOD POSSIBLE?

1.7

Visalizing urban data is a very common and developed practice not just for information designers, but also for sociologists, urban scientists and planners. In this chapter I presented two valid approaches to visualize and discuss urban phenomena. Each of them have positive aspects that help researchers, urban planners and generally map readers in understanding the city, however, both present weaknesses.
Moreover, while urbanism is becoming more and more rooted in big data, the qualitative approach is seldom used due to its cost in terms of time and money.
However this enthusiasm for clean and straightforward urban representations is leaving behind an important piece of information: context.
Approaches as Knigge and Cope Grounded Visualization, data feminism and Counter Cartography are bringing back context in many forms, trying to answer the questions that data driven approaches are discarding and claiming the medium of maps as a powerful inclusive tool. [Halder S., Michel B., 2018] The local

and specific nature of this approach, however, prioritize localities over the entire city creating scattered pictures difficult to bring together in an organic representation of the urban complexity.
When dealing with complex issues and dimensions - such as time, for example - both approaches might not sufficient to portray all the perspectives and other aspects involved. Especially when dealing with time, the map maker often struggles with the vast proportion of temporal phenomena that still need to be explained through situated context, both regarding data and space. Urban cartography for temporal analysis would be less efficient or even deceiving by representing just broad and geographically contextualized patterns, the subjective and situated level of knowledge can't be ignored. Is it possible, then, to design maps that could bring together both comprehensive and broad views with details and granular, rich data? In the next chapter I will argue how those two approaches, if carefully merged in the design process can solve each other weakness conveying general patterns and phenomena representation, without erasing the existing context and the multiple perspectives naturally present in the urban environment.

The city as an archive.

2. Similarities between Urban Cartographies and Digital Humanities

Using web scraping and computational tools to analyze data and visualize emerging patterns and outliers on a large datasets has become popular in Urbanism. “Spotlighting the data has been widely (although not exclusively) a strategy of urban research driven by instrumental aims in social policy, planning and economic development and rarely exhibiting much concern for the contingencies involved around data collection, processing and application.” [Coletta, C. and others 2017] Data driven urbanism has been deleting the artifacts of the smart city by doing so, flattening complex knowledge into mono-dimensional information. [Coletta, C. and others 2017]

In the data driven perspective, Kitchin [2015] observes how cities are treated as a knowable and linear systems, differences are hardly taken into account and superficial, general insights are produced.
Farias and Widmer [2017] among others argue how “cities are indeed multiple objects, where different forms of governing, knowing, valuing and practicing the city interact and enter in conflict with each other.” Therefore, the acts of simply analysing and representing large patterns could be not sufficient to convey a realistic image of the urban environment. Exploring specific parts of the city can be the key to understanding the political and commercial affordances of these objects. Using parts of the city as proxies for the city itself uncover the high complexity of urban assemblages and consciously require grounded data practices to build urban knowledge, while on the other hand the broad picture is preserved by exposing how actors, policies and other human factors collide with ICT projects, infrastructures and data collection at a city

level.
Many other scholars are drawing similar conclusions: the smart city can't be observed from afar anymore, not in the sense of a detached and automatized observation through data; context, critical and feminist approaches and grounded analysis have to be included and made transparent to the reader.

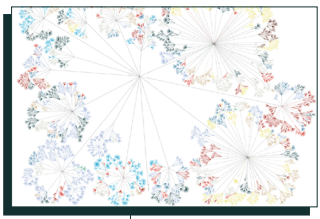


FIGURE 2.1
Distant reading example shows the structure of and the themes in Jack Kerouac's "On the Road" [Posavec, S. 2007]

This tendency of hacking the smart or data driven urbanism seems to be going in the same direction as another, apparently distant field: Digital Humanities. The theorisation by Franco Moretti [2013] of "Distant Reading" as the practice of making abstract, categorized and aggregated vast cultural collection to observe patterns and outliers has prompted an important yet controversial evolution in the field. Moretti [2013] himself defines Distant Reading as "a little pact with the devil", the scholar is challenged to learn to not read texts.

Close Reading - as it is called the traditional way of analysis - of single texts is not a required action anymore: knowledge on a specific topic can be obtained or reinforced through a general observation of a larger dataset visualized to generate conjectures.
Strong criticism and critiques have emerged from the Digital Humanities field, to directly quote Kirschenbaum [2007]:

"[...] it must be understood and acknowledged that there is a deep tradition of skepticism towards quantitative and empirical techniques among humanists, which too often smack of

positivism and objectivity in domains for which interpretation, ambiguity, and argumentation are prized far above ground truth and definitive conclusions. The humanities embrace a culture of conversation, not problem-solving. Humanists do not seek to address the "problem" of Emily Dickinson in order to move on to the more vexing problem of Walt Whitman."

FIGURE 2.2
Example of Close Reading in the Theodore Fontane archive visualization[Brüggemann, V.,Blundau, M.J. and Dörk, M. 2019]
Source

https://uclab.fh-potsdam.de/ff/

The author defines the necessity of properly incorporating these new computational methods to observe collections. Various types of reading are possible and the scholar should be ready to merge traditional and highly specific techniques with "non reading" and other statistical strategies to read patterns.
Digital Humanities scholars, in fact, should use **Distant Reading** as a provocation to test and challenge their knowledge and capability of generating insights about texts and collections [Kirschenbaum M., 2007]. Some detailed descriptions on how to build tools for Distant/Close reading have been provided in the last 20 years. For example, the interplay between visual elements when it comes to build tools in the Digital Humanities has been investigated by Unsworth [2000] and later adapted by Palmer [2009]. The more important aim of this investigation is to build "Scholarly Primitives" [Unsworth J., 2000] *"a list of (recursive) functions that could provide the foundation for tool building in the arts and humanities".* [Anderson S. et al., 2010]

Without focusing into detailed descriptions of primitives or specific methodologies, it is clear by reviewing the scientific literature in the Digital Humanities field

that strategies to implement various reading techniques have been developed and investigated.

Analogies between urbanism and digital humanities can be drawn when it comes to analysis, if we consider the city as an archive and single parts of its texts, constantly rewritten and updated, we could also argue that similar visualizations and representations could be adapted. The approaches I presented in the previous chapter are, in fact, already quite similar to different techniques in the Digital Humanities field. While the “Distant Reading” approach in urban studies could be compared to the well known and diffused as smart urbanism, “Close Reading” techniques for urban studies are qualitative urban explorations, that today tend to be marginalized and not always successfully integrated with a broader analysis. This analogy will serve as a core approach to explore the smart city through data: by resembling data driven urbanism with distant reading and critical mapping operations with close reading, creating scale shifts between these two become easier, since we would follow the Digital Humanities path to integrate them. Distant Reading and Close Reading should be combined more often, Close Reading should come to support the generation of specific knowledge about a topic, by a slow and qualitative work on single dimensions, spatial history, cultural context, time schedules and specific voices, while Distant Reading could serve as a magnifier lens for possible problems, general questions, conjectures, but also as a provocative tool to highlight new controversies, elements and possible perspectives. Just as cultural studies are using distant reading as a support to close reading in cultural collections, we can inter-

twine big data analysis, collection and visualization with qualitative operations and iterations. This could be an important step to overcome or at least start to unravel the critics to data driven urbanism itself, as it is done in digital humanities, where combining Distant Reading with other more specific techniques has been the key to avoid superficial analysis.
How can those two approaches apply to urbanism and smart city studies? What strategies can be used to merge them together?

DISTANT READING
2.2

In the previous chapter, I defined in few points what data driven urbanism is. I will now frame the concept of distant reading to investigate whenever it is possible to draw a direct comparison between the two approaches.
Distant reading could be defined as an alternative to traditional reading techniques [Kirschenbaum, M. 2007] *"that aims to generate an abstract view by shifting from observing textual content to visualizing global features of a single or of multiple text(s)"* [Jänicke, S. Franzini, G. and others 2015].
This shifting from content to its global features is really similar to what happens in data driven urbanism and cartography. However, distant reading can't replace the action of reading the text itself as Moretti suggested in the first place, but it supports the work of the scholar by providing further information through a global view.
Therefore, the scholar has to take care of some aspects in order to capitalise the Distant Reading te-

chnique when building an explorative tool:
She has to have a deep contextual knowledge about the subject that is being visualized, such as a collection of objects or texts. This “ground truth” (if we want to improperly borrow a term from machine learning that indicates the real objective truth about a phenomenon) will serve as an interpretative keys to the findings provided by visualizing global feature of the said subject,
she has to include close reading operations as a core part of the final tool,
she should harvest and categorise metadata and other kinds of perspective dependent knowledge to provide the user with.
There are many examples of cultural collections visualizations that use the distant reading approach to make entire corpora visible and understandable.
Data driven urbanism is in fact a type of distant reading. The object analyzed is not a cultural collection or an author’s corpus, but the urban environment. However the techniques and the ultimate goal of observing general patterns is present.

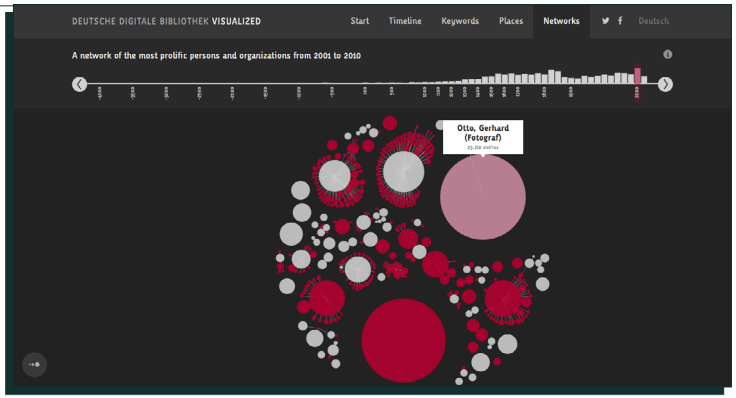


FIGURE 2.3
Visual representation of the Deutsche Digitale Bibliothek digital archive [Bernhardt, C., Credico, G., Pietsch, C. and Dörk, M. 2014] Source

https://uclab.fh-potsdam.de/ddb/networks/#

Moretti has been strongly criticized for the distant reading approach on cultural collections, the scholar has to trade something (the close and specific reading of one text or a paragraph), in order to achieve something else (a more general and broad view of the corpus). This general knowledge is depicted by Moretti and other scholars that fully embraced Distant Reading as the only fundamental aim in cultural collections studies, it is implied that through this view from a distance the entire nature of a collection could be understood and fully comprehended. [Moretti F., 2013] However, as argued above, other scholars such as Kirschenbaum, Unsworth and Palmer are claiming back close reading as the real turning point for a cultural collection comprehension, finding new and creative ways to combine a more general and distant overview with specific references to texts and books.
Therefore one big difference between distant reading in digital humanities and urban mapping is that for the former close reading is still considered to be the final aim of the visualization in the vast majority of cases and distant reading - in fact - can only support and enhance the reading experience or the knowledge of one particular text, while for the latter distant reading can be considered self-sufficient in explaining phenomena and controversies.

This is the main - but not only - driver for mapping in data driven urbanism: to convey a distant and general picture of one or more events, regardless of their connection to the specific area observed.
Would it be possible, then, to move in the direction of having combined Distant and Close reading also for urban mapping operations? Could it be helpful for map

readers (whatever are their reasons to interact with a specific map) to go from distant views to specific data about areas of the city in an organic and smooth way? Before defining possible strategies to deal with distant reading in urban cartography a proper definition and identification of Close Reading should be provided.

CLOSE READING
2.3

Nancy Boyles [2013] define Close Reading as it follows:

"Essentially, close reading means reading to uncover layers of meaning that lead to deep comprehension."

A classical way of performing close reading is by searching for specific words, concepts and patterns inside a single text or paragraph. This highly qualitative approach is well documented in the digital humanities field and scholars are trained to perform this kind of analysis to uncover text characteristics.
As discussed above, combining close reading with distant reading could foster innovative insights. By using various visual techniques and interactions, the user can control the level of detail during the exploration task: an entire corpus of works can be shown as well as a specific page of one single book.

By analysing the characteristics of the Close Reading technique, following Boyles [2013] dissertation, it is possible to see how powerful it is as a method to uncover specific information and deal carefully with big data and perspectives in representations:

1	Close reading can generate contextual knowledge and completing the results with rich observations and comments
2	General insights can be further explored by embedding a specific and meaningful piece of information
3	The reader (or user) gains a more balanced view on data by being able to access detailed granular data on texts and collections.

In the urban cartography field qualitative analysis exists, but is often shadowed by the apparent easiness in which big data can be now obtained, used and visualized.
This unbalance might be problematic and is happening out of many reasons.
One factor, as already discussed, is the transition between data scarcity to data richness thanks to the advent of urban ICT technologies [Kitchin, R. 2015] is leading to a scenario in which big data systems are prefiguring and setting the urban agenda and are influencing and controlling how city systems respond and perform. [Kitchin, R. 2015]
Big data usage is fostered also from the various problems and difficulties that can derive from a proper qualitative mapping operation.
First of all, qualitative analysis can observe a limited amount of phenomena in a small physical space, it is not possible to scale it up to the entire city for time and economical reasons. Then the implied methods are solid and representative, but can also be prone to bias that could challenge the solidity of the data

gained.
In other words, qualitative mapping operations need to be balanced out to be effective and representative. This is the case of the above cited Anti-Eviction Mapping Project where a broad view of a phenomenon is enriched and carefully made visible through subjective data mapped together with quantitative information. The deeply feminist nature of the project defined the grounded and participatory nature of the map, balan-

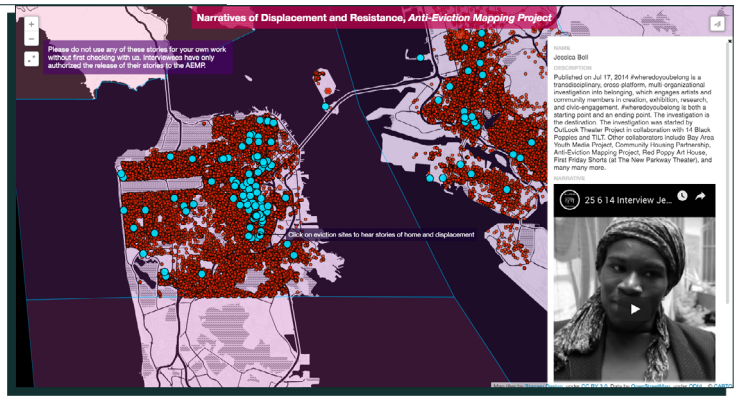


FIGURE 2.4
Narrative of Displacements, an example of subjective data and qualitative analysis on urban controversies. [2017]
Source

https://www.antieviction-mappingproject.net/narratives.html

cing out the ability to show a large, city scale phenomenon without losing the granular perception of it with its discrepancies and human elements.
However close reading operations in the urban cartography field are key to a more respectful and careful usage of big data. This reading technique could help cartographers in similar ways as it is helping digital humanities scholars by providing rich contextual information and specific local knowledge, bringing back voices and bodies in the narrative through single instances [D'Ignazio, C. and Klein, L. 2019] and by challenging the idea of data as capta, that following

the argument by Drucker [2011] is the common perception of data as immutable and neutral objects, through multiple views and perspectives on the city. It is by challenging and disrupting Haraway [1988]'s "view from nowhere" that we can build a method and a visual landscape for both general and contextual data. Feminism is foundations to this method, providing the theoretical elements needed to provide and incorporate context in mapping. The debate around objectivity is, in fact, deeply rooted in feminism. When discussing about data and their apparent status of given entities, it is feminism that draws the importance of acknowledging the multiple aspects of studied phenomena without erasing important voices, perspectives and information. [D'Ignazio, C. and Klein, L. 2019] Data feminism is also offering various practical techniques to build balanced dataset and analysis [D'Ignazio, C 2019], that later I will present and discuss in the fifth chapter.
However, one question among others remains unanswered: how do we convey this knowledge through urban cartography without making it overwhelming for the reader?

EMOTIONAL CARTOGRAPHY AND DEEP MAPPING

2.4

Lately, efforts to map context and perspective have been done to compensate this data driven tendency in urbanism.
Mainly two existing methods for qualitative mapping are dealing with perspectives in cartography by using personal and context dependent data.

Christian Nold's [2009] "Emotional Cartography" and Shannon Mattern [2015] "Deep Mapping" . Both methodologies are framing the necessity of operating close reading on cities while building a more general and distant layer.
The first method is entirely built on collecting bio data through sensors and mapping people emotions during walks. By creating a record of feelings, the designer is able to decode what happened during the walk with the active help of the participant. Recording physical data for cartography is used as a political and social tool to investigate the shape of the city and its effect on people. [Nold C., 2009] In Nold perspective people and their bodies are keys to read the complexity of the urban environment, as Nold [2009] himself states: "Bio Mapping functions as a total inversion of the lie-detector, which supposes that the body tells the truth, while we lie with our spoken words. With Bio Mapping, people's interpretation and public discussion of their own data becomes the true and meaningful record of their experience."
Bio data and GPS positions acquired during the walks are constituting the objective and general layer on which specific personal data are plotted together with stories from the people that produced those data. Emotional Cartography and Bio Maps are particularly interesting because objective and sensors data are used only as frames for participants experiences. Using sensors to generate data gives structure to the final method, making it equally reliable and qualitative.

"Deep Mapping" focuses on expanding the designer knowledge about "technologies, architectures, econo-

mies, social practices and so on" [Mattern S., 2015] to deal with complex city dynamics and forces. Juxtaposing qualitative and quantitative conceptions of space, using official data and fuzzy personal ones allows the user to deep dive in the city structure, beyond the surface. To achieve this extensive picture of a "Kinetic City" [Mattern S.,2015], the designer should investigates and maps current and past infrastructures, both physical and historical. Validation strategies for data are another important part of this method: "potholing, ground truthing and data gathering to corroborate remotely sensed or government/corporate-issued data" [Mattern S.,2015] will lead to deep networked maps capable of outlining general landscapes and specific events all together.

DESIGNING FOR UNSTABLE AND MULTIPLE DIMENSIONS

2.5

The complex nature of cities has always challenged scholars and cartographers. Their mutative structure, the hundreds of influences and events happening, require a constant reading of the city and its part, an endless exploration that can be overwhelming and difficult.
Urban scholars and cartographers have always framed scattered pictures of the city, single photographs used to interpret and describe the urban environment. Big and real time data could allow us to finally display the city in real time, however we should always keep our representations open, questionable and rich of context and perspectives.
In the next chapter I will deeply focus on distant and close reading for the urban exploration, arguing that

they can meet halfway: we can use big data at every scale to represent patterns and large phenomena, however we can merge them strategically and provide more consistency by intertwining qualitative and small data as well.
As demonstrated by Mattern [2015] and Nold [2009] methodologies, intertwining contextual data with big data could strengthen knowledge about broad phenomena that seem to be completely detached by the actors that caused them, such as time schedules and localities perceived rhythm and atmosphere.

Time, in fact, will be a central topic for this design challenge, due to the very nature of this dimension: its high subjectivity makes mapping operations really difficult. However if observed carefully time is revealing the very nature of one location, if treated as the main dimension in the map making it can be key in building context around a place.
Time is ground for discussion, perspective and multiple representations that are often left out for clarity and visual synthesis. To be clear, I am not stating that time is not recognized as an important urban dimension either from cartographers, designer or urbanists. Effective visual representations and studies on time in the urban environment has been and are carried out with great results. Dedicated visual models are designed and used to give time the importance it deserves. Time representation is still an open, vital and discussed field, therefore my work will be just a small contribution of the possible use of time in urban cartography and its visual models.
However, as stated, I will try to build the image of one specific city, trying to mainly rely on time data and

contextual information to see whether it is possible or not to enhance the comprehension of complex phenomena in the city through the rendering of a contextual layer.
The final aim of my work will be to present a general method to deal with contextual information in the urban environment and time will serve me as exemplifier of a possible complex controversy.

To do so, I will present one design challenge about the city of Berlin, that helped me shaping the method that will be presented extensively in chapter 5.
The challenge will concern how to make the nature of one specific area of the city visible, starting from a broader view of the urban landscape and gradually focusing on one specific neighbors and its exceptions: time patterns, perspectives from users and recurring activities.
Both data collection and visualization critical approaches will be tested and commented.
Narrative structures for guided explorations of temporal patterns in the city will be presented with an eye on how to provide additional contextual elements to the reader. The scale variation between the two work will be analyzed in order to understand how distant and close reading in the urban scenarios require different approach to visualize context information.

Undoing Urban Time

INTRODUCTION

3.1

While in the previous chapters I carried out a general critique of data driven urbanism and the use of data visualization in depicting urban phenomena, while trying to establish a correlation between the definitions of close and distant reading in the Digital Humanities, in this chapter I will present one design challenge where I tried to practically build and insert contextual layers of data, on the one hand to dismantle this tendency on relying a-critically on data, on the other to create a cohesive and organic visual landscape of the urban schedule for the reader.

The project I am going to introduce is dealing with the city temporal dimension. Its aim is to make visually understandable the time schedule of one specific area of Berlin, Rosenthaler Platz, without losing a more general overview on the district and the broader context of the city.

The challenge will be presented following this structure: first, the concept will be discussed, followed by observations on data collection, visual design and strategies to gather and embed context data. One further appendix to this chapter will be provided to discuss findings on data, visual techniques, models and interface interaction flows.
Finally, some general considerations on the outcomes will be discussed in order to present a general methodology for contextual data harvesting and visualization.

I. Introduction

Make time in the urban context visible and relevant is an interesting challenge. Many scholars, mainly from urban sociology and human geography, have been discussing the importance of time and the necessity to make it comprehensible for non specialized readers as well. As discussed by Kasja Ellegård [2018], when introducing the time geography approach, spatial policies and interventions are often considered fundamental by public opinion and policymakers to maintain the urban environment balanced. Spatial problems, even when complex, can be understood and solved by advocating and discussing around them. Time related problems, on the other hand, are much more difficult to observe or even explain. This is mainly due to the nature of time itself, highly subjective and deeply intertwined with a large number of other dimensions.

Time as an urban and social dimension started to gain importance in the 60's with the work of Torsten Hägerstrand, therefore tools and methods to explore temporal phenomena are recent and difficult to manage. [Vitrano, C. 2017]
The importance of time in the city should be visible also for non specialized readers and activists to properly address complex issues that deal with time. Therefore, before even discussing about time related injustices and problems, it would be valuable to explain and make urban time visible and understandable to everyone.
The Rosenthaler project aims at making abstract concepts regarding time more concrete by providing tangible snapshots of urban temporal phenomena.

The examples provided will build an “image” of Rosenthaler Platz that can be considered as descriptive as official reports and local testimonies on the area.
I decided to choose one specific location in the city and use it as a proxy to present elements that contribute in generating rhythm in the much bigger and difficult to frame city landscape.

Choosing one specific location allowed me to speculate on the peculiar nature of urban rhythm that constantly change inside the same city due to contextual differences between spaces. This is the first point of access for context: gathering information about Rosenthaler Platz fostered me to reflect about how harvesting data about particular elements of the space - not directly connected with time - could be an important layer to display in the final project output.
The divulgative nature of the project needs to be taken care of with a proper narrative path and engaging structure to make the topic accessible to all readers, from curious people to domain experts.

Every step, from knowledge gathering to data collection, has been carried out independently due to the spontaneous origin of the project that has no committee and was independently pitched.

II. Rosenthaler Platz

Rosenthaler Platz is a fairly famous location in Berlin. Located in the Mitte district, this intersection was formerly one gate of the Berlin wall, dividing West and East Berlin. Today it is functioning as an urban junction with several public transport stops, connections, and

main roads crossing by. According to various testimonies, Rosenthaler Platz appears almost as a non-place, an intersection in the urban landscape that facilitate connections between different parts of the city centre. However this perception is as far as possible from the truth as a large number of activities is taking place directly on the place and nearby.
The city of Berlin compiled a very detailed report on the surrounding neighbors, presenting this area as interesting for tourists and young people, lively yet not inhabited by a strong community rooted in the territory.
Rosenthaler Platz has, in fact, multiple natures that are not easy to distinguish through a quick exploration: it serves a transport (both public and private) junction, but there are also a variety of services, shops and entertainment venues that determine the presence of different flows of users and specific time schedules. One famous Berlin hostel, The Circus Hostel, is located directly on place, attracting young tourists, while bars, restaurants and beer gardens are transforming the area in the weekend.
These multiples of Rosenthaler Platz are one of the reasons why I focused on the area: various “descriptions” of this place can be made through context. Other reasons included the availability of data for this area, the possibility to access it without limitations and its demographic diversity. The area itself does not present structural or accessibility problems, a constant public transport flow connects it to many areas in the city for almost 24 hours a day. Some business activities present are open 24/7 as well, while others have fixed opening and closing hours that affect how the area is used by people.

The experimental aim of this project lead me to choose a location where I could apply all the quantitative and qualitative data gathering techniques without focusing on other controversies than time itself.
In fact, even if it could have been effective to test this method by focusing on a specific controversy, it could have hindered my attempt at covering various techniques and visualization models for the task.
This is why, as we will see in the next paragraphs, I decided to personally collect and filter the data entirely on my own, experimenting with mixed techniques and re-iterating some steps of the process.

III. Data Collection and structure

I started without an available and ready to use data source. Therefore, data collection process had to be defined in the first place, to find data about the topic of urban time.
The first round of collection was carried out by mapping possible open sources for data that could provide me with information about time schedules in Rosenthaler Platz.
I divided the data in two main categories: business activities and public transports. My first attempt to find private transport and pedestrian flows open data failed, as data exist but are privately owned by companies and often expensive. This partial availability of data is one of the first obstacles encountered, as I should have either paid to access information or come up with a strategy to collect data on my own. Due to privacy, time and technology problems I decided to work only on publicly available data.

To explore public transport schedules I used two main sources: the static GTFS feeds from VBB (available on the Berlin Open Data portal) and the real time GTFS feeds from the BVG API.
GTFS stands for General Transit Feed Specification, quoting directly from the API documentation GTFS *"defines a common format for public transportation schedules and associated geographic information. GTFS 'feeds' let public transit agencies publish their transit data and developers write applications that consume that data in an interoperable way."*
Static GTFS are meant to be complementary feeds for real time data. Routing systems and public transport providers access those data to inform users on scheduled trips, departures, delays, possible connections,etc. Static GTFS store planned trips and schedule for all the means of transportation, regardless of real time status of vehicle or service. Real-time GTFS provide constant update on the service status, by reporting delays, exceptional events and waiting times at the stops. Public transport agencies produce both static and real-time GTFS feeds and make them available on the city open data portal. While static feeds are available for everyone to be downloaded, real-time feeds require API keys that can be obtained by writing to the service provider at no cost.

Information about commercial activities was easily obtained by combining three data sources. Two are privately owned, but publicly accessible for research purposes: Yelp! and Google MyBusiness, the third one is public and open source: Open Street Map.
Yelp! is a platform that allows users to rank and comment businesses such as restaurants, shops, doctors

and more.
The services provides an API that can be scraped to obtain information about closing and opening hours, average rate, position of the business, category, comments by users and average pricing of products.
Google MyBusiness is part of the Google Suite tools for businesses. It allows to add information on one business on Google Maps and Google search pages. Similarly to Yelp!, Google provides an API that can be scraped partially on a free subscription plan. Through this API various data are available: opening and closing hours for businesses, name, category, geographic coordinates, the average time a customer spends at the place and a popularity score for each hour.
Open Street Map *"is a collaborative project to create a free editable map of the world. Rather than the map itself, the data generated by the project is considered its primary output. The creation and growth of OSM has been motivated by restrictions on use or availability of map information across much of the world, and the advent of inexpensive portable satellite navigation devices. OSM is considered a prominent example of volunteered geographic information."*
OSM make accessible through its API information about commercial activities as well, providing name, category, coordinates and opening/closing hours.
These three sources can generate similar data, that later in the process have been grouped together and cleaned to obtain one comprehensive dataset for commercial activities.

Details on Transport Analysis

Static GTFS feeds consist in a folder of .txt files that

can be joined together to read information about every single planned trip for every mean of transportation. Detailed documentation is provided to ensure a correct interpretation of each column field and its connection to the others.
Initially I collected and filtered the GTFS static feeds for the city of Berlin: using python to deal with the large dataset, I isolated information about the lines (U8, M1 , M8, 142, N8, N40) crossing Rosenthaler Platz and combined parts of each sheet together to obtain a list of single trip scheduled on a hypothetical week.
The table was structured as it follows:
At this point the dataset presented some inconsistencies. N8 (the night bus substituting the U8 train), for example, was not present on the weekends, while in some hours the number of M1 trams stopping at a certain endstation seemed to not correspond to the number of vehicles arriving at the other end of the line. Another problem was the U8 trips frequency that seemed to be too high for one hour timeframe.
To check inconsistencies in data I established two separate strategies: the first one would be to routinely plot data and see if some calculations were wrong using real-time feeds to validate the static data I aggregated in the first place, the second one would be to physically check the transport lines by spending time in Rosenthaler Platz and on transports.
While this first strategy is more common and easy to perform, the second one is highly qualitative and granular. By walking to bus stops or sitting in stations I could count and verify the transport behavior on my own by starting to gather observations about the real space without deducting it through data.
For example, after spending one complete trip on M1

tram, it was clear that while the endstation in the city centre was common for vehicles, when going towards the outskirts tram tracks split in two as M1 line has two different end stations. Rides were basically split between the two final endstations, this variation was hidden in the dataset due to a mis-calculation, the-

trip_id	line	wkt_geom	day	start	end
number	string	string	date	number	number
identification-number of the single trip	name of the line the trip belongs too	string that encodes the geographic shape	day of the week in which the trip is occurring	start hour of the trip	end hour of the trip

TABLE 1
Structure of transports final dataset.

refore it appeared as half of the vehicles were disappearing from the tracks. After aggregating data again following a different procedure the second endstation was included and the problem was solved.
Both strategies were applied in a non-linear way on all the emergent inconsistencies of data at every step of the analysis process. Combining those validation techniques guaranteed me a clean and solid dataset, ready to be used and visualized.

Details on Commercial Activities analysis

When analyzing commercial activities I obtained a large and granular dataset by combining three different sources. However I decided to store data for names, opening and closing hours, average time spent in the location, popularity over time, geographical coordina-

tes, addresses and average ranking only.
This choice has been made for two main reasons: first I was mainly interested in time related data, therefore pricing and customers comments could be left out, secondly I needed to identify and provide categories for places, therefore name, coordinates, ranking and categories were maintained.
Not all sources provided the same data for each business, in some cases some information was missing or inconsistent from one dataset to another, some others entries were repeated for businesses. I merged the three datasets together carefully checking for double or incomplete entries to fix. The resulting table was composed by 85 rows per 8 columns, each row representing one business and each column containing information about name, category, coordinates, ranking, address, minimum and maximum time spent in the place and if there were data about opening/closing and popularity.

These two last entries were stored in independent tables, one for opening/closing, one for popularity and another one with both of them.

[Scheme of the different tables generated]
An initial check on the business dataset was made using QGis, an open source software for geographic representation, to plot locations on a Berlin map. I roughly checked that no location outside Rosenthaler perimeter had been enlisted during scraping operations and obtained a superficial picture of how the businesses were distributed on the map.

However, Rosenthaler Platz is a very dense area in

terms of commercial activities and to double check the precision of my data and include possible missing entries, I defined two validation methods.
First I used Google Maps again to virtually walk the place, then I took a real tour of Rosenthaler Platz and checked the position of commercial activities on the ground.
The first virtual walk through the location already led me to the conclusion that some location were not enlisted, therefore my dataset was incomplete. The reasons for missing entries might be both a miscalculation during scraping operations or imposed limitation to the free Google API trial I had access to.
I used Google Maps list tool to flag all the locations that were not present on my dataset and took a walk to confirm their exact position and obtain more information about the places, by walking I enriched the flagged entries on my map with further notes on opening and closing times.

Combining virtual and real walks is a very informative, yet not really time efficient, method. I approached my

TABLE 2
Structure of commercial activities final dataset.

ID	Name	Address	Rating	Max_AVG_time	Popularity	Open/Close	Latitude	Longitude
string	string	string	number	number	bool	bool	coor	coor
identification string for business	name of business	address of business	rating according to users	max time spent in the place (in minutes)	popularity data? (reference to other table)	open/close data? (reference to other table)	latitude	longitude

walk bringing along a printed map of Rosenthaler Platz with all the enlisted venues plotted on it and a digital map to list new entries. I started walking the streets from outside to the center of the intersection, starting from Rosenthaler Str. and moving clockwise. Everytime I encountered a new place I added it to Google Maps by flagging the position.
The combination of these two methods allowed me to collect 47 new entries and further information about commercial activities already enlisted in my dataset that had almost no given opening/closing data.
Checking for new places is also an effective method to validate scraped data. I found out that when the commercial activities were present in my dataset, entries tended to be correct and updated to the current status. 3 shops resulted closed or substituted by new venues, but in general the quality of data obtained by Yelp!, Google and OSM was high and reliable.

FIGURE 3.1
Digital version of the initial map of Rosenthaler Platz commercial activities. A printed copy was used to explore the area.

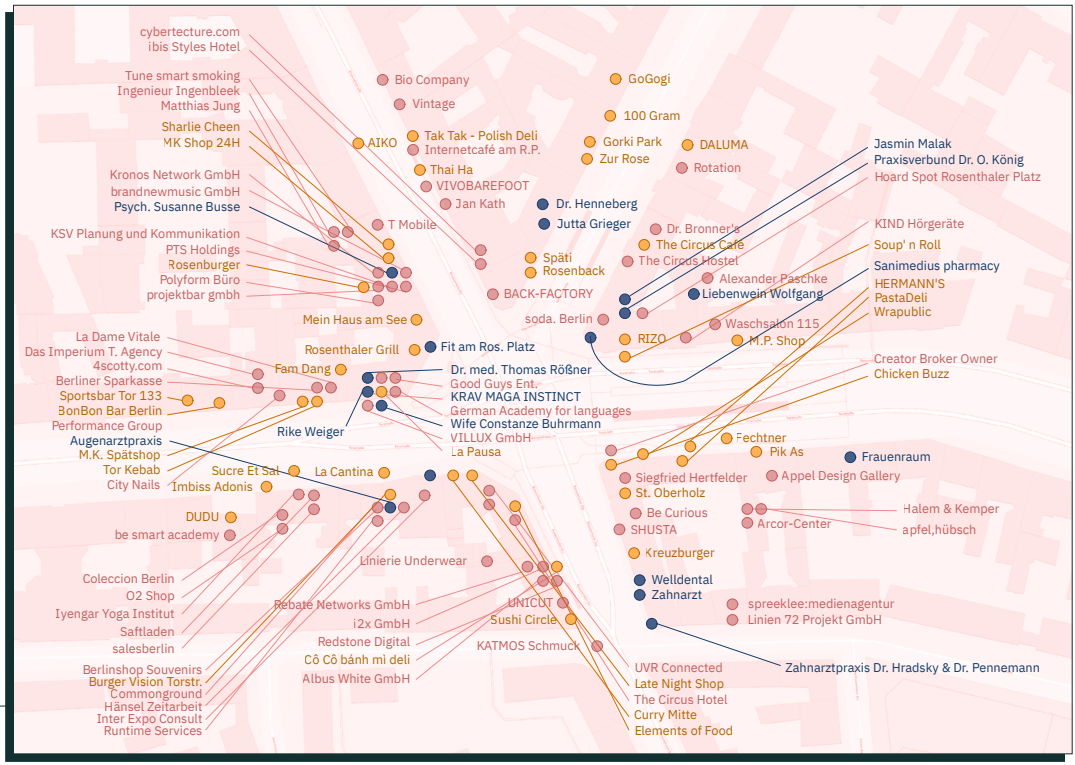
IV. General Storyline Structure

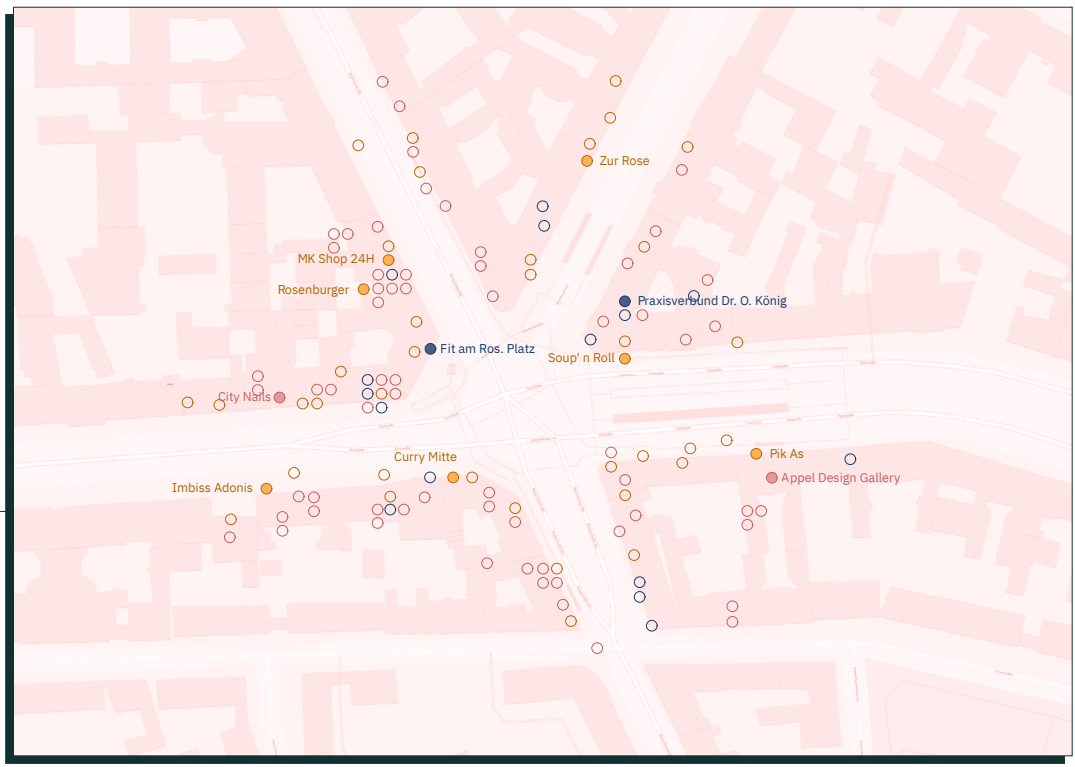
Defining the storyline structure is an iterative process that requires reading specific material on the topic, data observation, analysis and storyboard sketching. It is not a linear process, therefore what I am going to present is the result of various iterations on parts of material and corrections.

Chapters definition

Outlining chapters content and order helps defining what visual models and views on data will be shown to the reader. The structure of chapter should follow

FIGURE 3.2
Digital version of the filtered map with the random selection of shops for interviews (see point IV at pag. 80 for details)


cybertecture.com
ibis Styles Hotel
Tune smart smoking
Ingenieur Ingenbleek
Matthias Jung
Sharlie Cheen
MK Shop 24H
Kronos Network GmbH
brandnewmusic GmbH
Psych. Susanne Busse
KSV Planung und Kommunikation
PTS Holdings
Rosenburger
Polyform Büro
projektbar gmbh
Bio Company
Vintage
AIKO
Tak Tak - Polish Deli
Internetcafé am R.P.
Thai Ha
VIVOBAREFOOT
Jan Kath
T Mobile
Mein Haus am See
Rosenthaler Grill
Fit am Ros. Platz
Fam Dang
Dr. med. Thomas Rößner
Good Guys Ent.
KRAV MAGA INSTINCT
German Academy for languages
Wife Constanze Buhrmann
VILLUX GmbH
La Pausa
Rike Weiger
La Dame Vitale
Das Imperium T. Agency
4scotty.com
Berliner Sparkasse
Sportsbar Tor 133
BonBon Bar Berlin
Performance Group
Augenarztpraxis
M.K. Spätshop
Tor Kebab
City Nails
Sucre Et Sal
La Cantina
Imbiss Adonis
DUDU
be smart academy
Coleccion Berlin
O2 Shop
Iyengar Yoga Institut
Saftladen
salesberlin
Berlinshop Souvenirs
Burger Vision Torstr.
Commonground
Hänsel Zeitarbeit
Inter Expo Consult
Runtime Services
Linierie Underwear
Rebate Networks GmbH
i2x GmbH
Redstone Digital
Cô Cô bánh mì deli
Albus White GmbH
UNICUT
Sushi Circle
KATMOS Schmuck
GoGogi
100 Gram
Gorki Park
Zur Rose
DALUMA
Rotation
Dr. Henneberg
Jutta Grieger
Dr. Bronner's
The Circus Café
The Circus Hostel
Späti
Rosenback
BACK-FACTORY
Alexander Paschke
Liebenwein Wolfgang
soda. Berlin
RIZO
Waschsalon 115
M.P. Shop
Fechtner
Pik As
Frauenraum
Siegfried Hertfelder
Appel Design Gallery
St. Oberholz
Be Curious
SHUSTA
Arcor-Center
Halem & Kemper
apfel,hübsch
Kreuzburger
Welldental
Zahnarzt
spreeklee:medienagentur
Linien 72 Projekt GmbH
Zahnarztpraxis Dr. Hradsky & Dr. Pennemann
UVR Connected
Late Night Shop
The Circus Hotel
Curry Mitte
Elements of Food
Jasmin Malak
Praxisverbund Dr. O. König
Hoard Spot Rosenthaler Platz
KIND Hörgeräte
Soup' n Roll
Sanimedius pharmacy
HERMANN'S
PastaDeli
Wrapublic
Creator Broker Owner
Chicken Buzz


Zur Rose
MK Shop 24H
Rosenburger
Praxisverbund Dr. O. König
Fit am Ros. Platz
Soup' n Roll
City Nails
Curry Mitte
Imbiss Adonis
Pik As
Appel Design Gallery

an internal logic, to allow the reader to understand and gain knowledge organically.
I designed two main parts that reflected the initial data gathering: public transport temporal patterns and

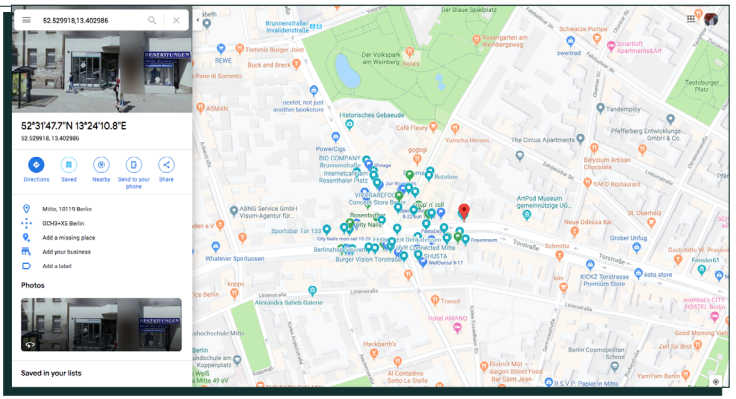


FIGURE 3.3
Screenshot from my Google Maps page. Each location that was not mapped in the beggining was commented and labeled.

businesses time schedules. Each part would be dedicated to time manifestations, how daily distribution of rides is impacting on public transport, what categories of businesses tend to stay open longer, etc.
Each smaller section would answer to a specific question through a dedicated visualization.
The choice of reflecting the data gathering process in chapters was made to re enact the discovery process I went through during my research. This specific point of view has been conveyed to easily accommodate personal observations and contextual data in the project and at the same time acknowledging the researcher influence on the final output.

It seemed already evident from the first storyline draft that a scale shift had to be made visible to help the reader in the beginning. This is the first big contextual

operation: by establishing the view of the reader on the city of Berlin then gradually zoom in to a specific part of the urban environment I could build inside the narrative a solid anchor to the bigger city ensemble while focusing on a reduced portion of it.

Once the reader is aware of the scale shift - from a distant and general view to a specific one - the four subsections are presented one after another.
Public transportation is the first topic discussed. Two small sections are unreaveling: weekly frequency of trips divided according to means of transport (buses, subway, trams) and hourly direct connections from and to other Berlin districts.
The first section is addressing the topic of frequency and accessibility for users, while the second one is exploring direct connections and how transport distribution could influence the user ability to directly reach a specific location.
Commercial activities distribution is the second main topic, three smaller questions are addressed in three sections: if a spatial distribution of similar activities is present on location, what kind of businesses are open longer and more popular during the week and how are they “behaving” during the week in terms of popularity and time schedule.
Each individual section has a dedicated visualization that cover one single question, allowing the user to read, learn and explore.

[The final structure of the story can be consulted at pg. 79.]

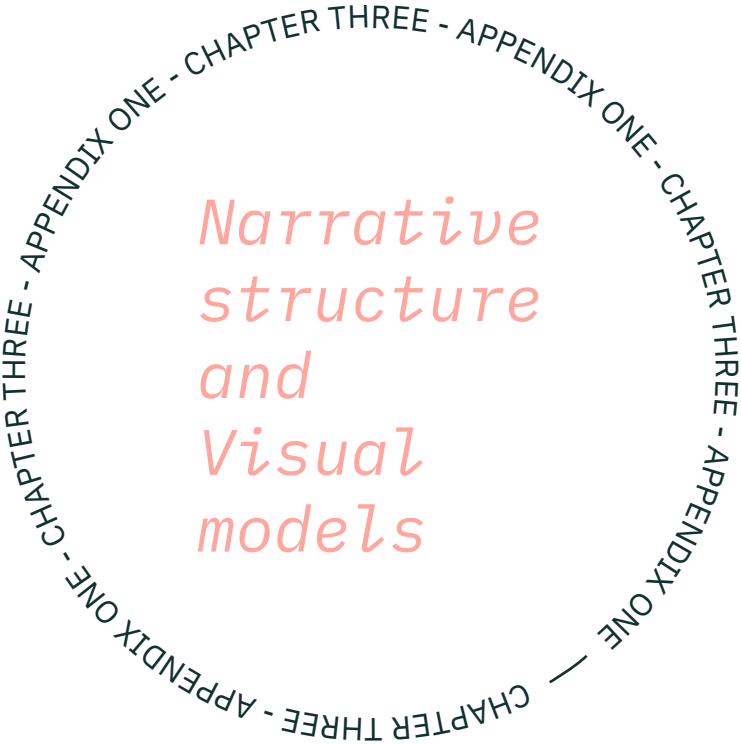
Visualization Sketches

After sketching out various models, I selected a few of them that could have been pertinent to my story. Sketching is a recurrent exercise that should be carried out while defining the storyline, these two tasks can be combined to build harmonic representations and consistent interaction flows.
When possible, I opted for a circular representation of time, bending the X axis to give data a more organic and continuous shape, by doing so the reader could easily rely on its ability of reading clocks their visual representation of time to understand the whole visualization structure.
When dealing with the spatial dimension in combination with time, I decided to reduce the former as much as I could by avoiding using a geographic layer when possible. Space is often really dominant in classic urban cartography, my intent was to keep the reader focused on time data, without convey redundant information on space.
Finally, I used small multiples, creating single glyphs for each element present in my dataset (businesses and hours). While small multiples could make a general reading of data more difficult, they help direct comparisons between disaggregated data and this is an important feature in this scenario where small patterns should be made visible.

[Sketches of preliminary visual models can be consulted at pg. 79.]

Reflecting on data and models fostered me to understand the importance of allowing granular comparison.

In this specific case, temporal differences on weekly schedules of Rosenthaler Platz present very small and granular differences. This is not by default the case with temporal urban data, but as soon as I noticed small and hard to frame variations, I understood that enabling visual comparison of specific data points could help the reader during the analysis.

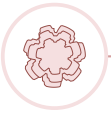

CHAPTER THREE - APPENDIX ONE - CHAPTER THREE - APPENDIX ONE - CHAPTER THREE - APPENDIX ONE -
Narrative structure and Visual models

Introduction

General introduction on Berlin and more specifically on Rosenthaler Platz district, Mitte. Focus on atmosphere and known characteristics of the space.

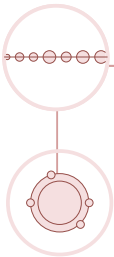
Chapter 1 - Public Transports

Analysis on temporal aspects bounded to public transportations: frequency, possible connections, user patterns of usage and so on.



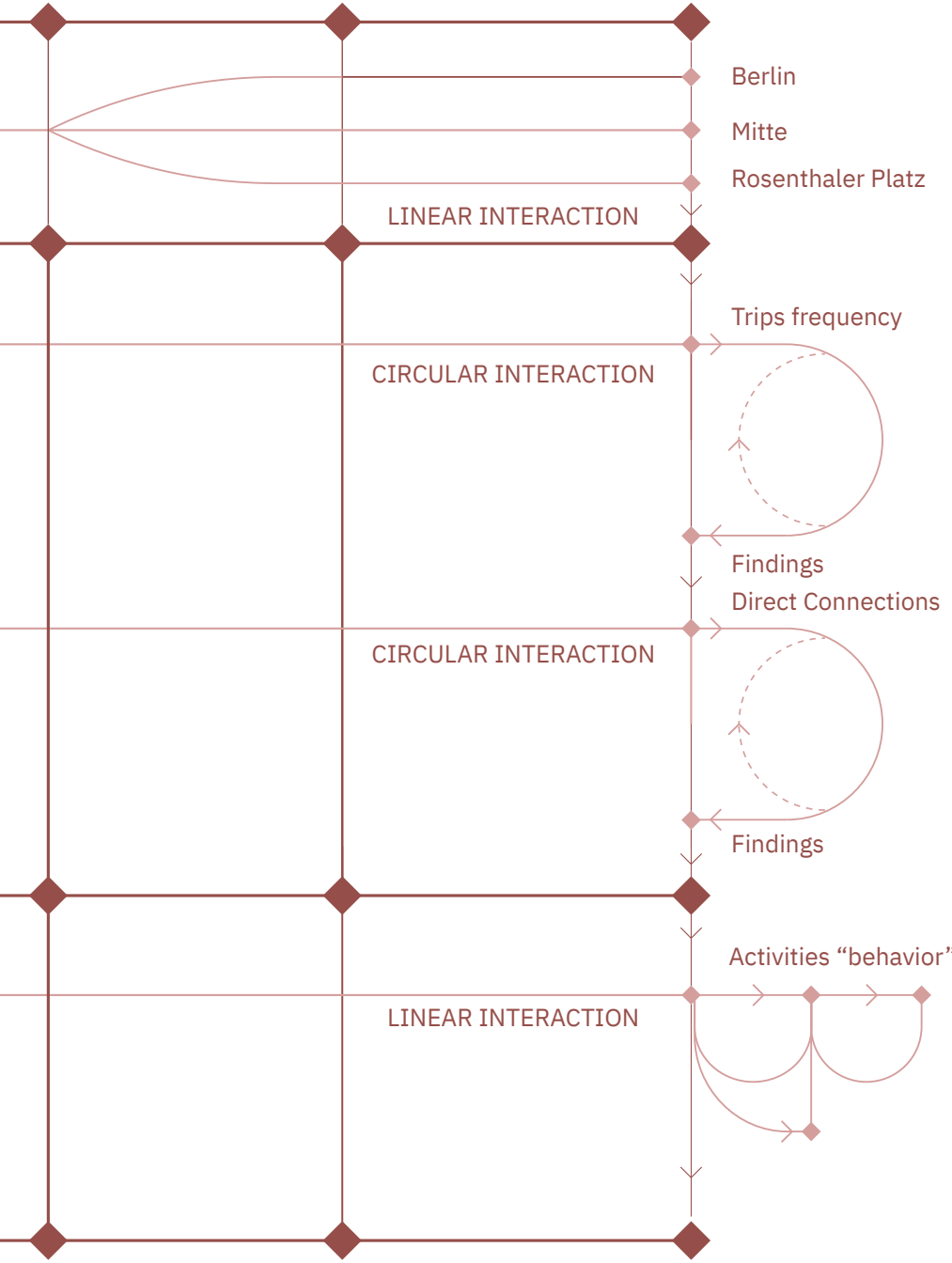
Chapter 2 - Commercial Activities

Analysis on the service offer in Rosenthaler Platz. The focus is always mainly on temporal aspects such as: time schedules, popularity and average usage time.

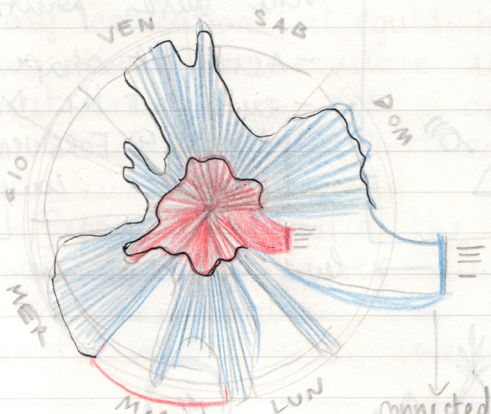


Conclusion

Zoom out on Mitte and short considerations on the temporal nature of Rosenthaler Platz. (Refrence to official Berlin reports may be used as grounf truth).


Berlin
Mitte
Rosenthaler Platz
LINEAR INTERACTION
Trips frequency
CIRCULAR INTERACTION
Findings
Direct Connections
CIRCULAR INTERACTION
Findings
Activities “behavior”
LINEAR INTERACTION

uld it be possible to filter according to transport con



connected districts?

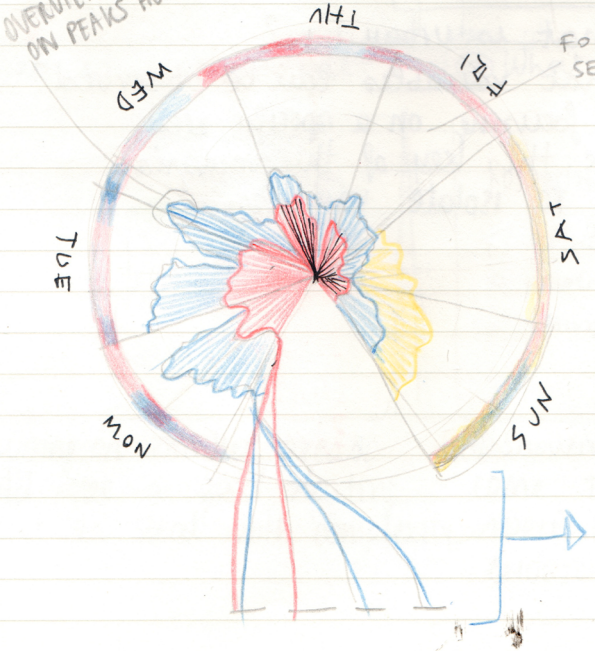
Detail screen for transportation

- plotting according to stops ways of transportn
- height: NUMBER OF RIDES IN THE HOUR
- color = mean of transportation / line

(3)

external band could be use to blend colours in percentage according to transports composition

OVERVIEW ON PEAKS HOURS



FOCUS ON LESS SERVED DAYS

Problematic with if the compared to the other time flower

color blending = overlapp services

district distribution ?

FIGURE 3A Time frequency for transportation.

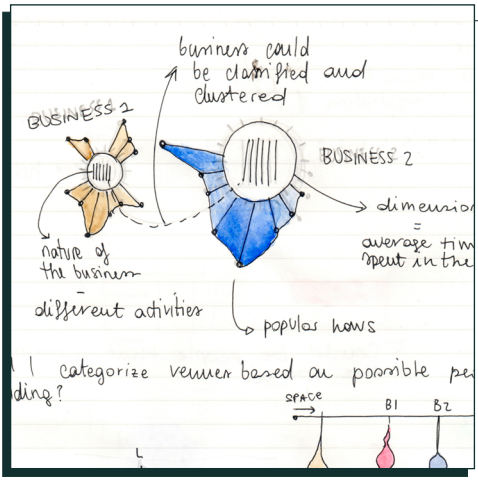


FIGURE 3B
Example of circular glyphs for commercial activities time schedules.

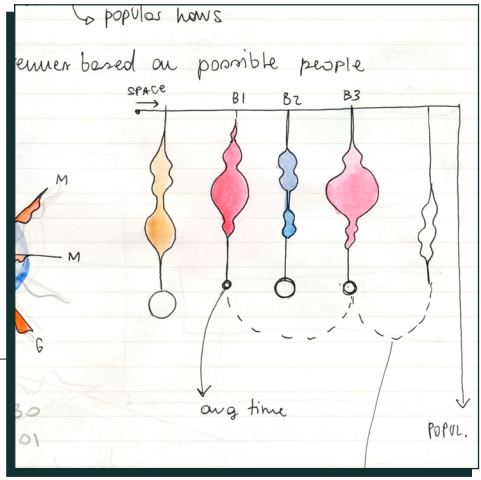


FIGURE 3C
Attempt at plotting time schedules on linear vertical axis.

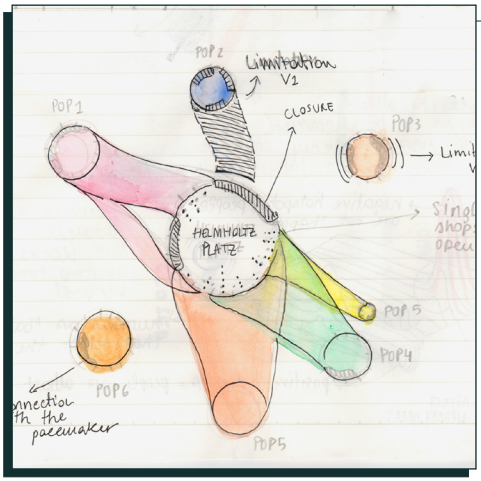


FIGURE 3D
First attempt at plotting one location time schedule. Later discarded due to the high complexity.

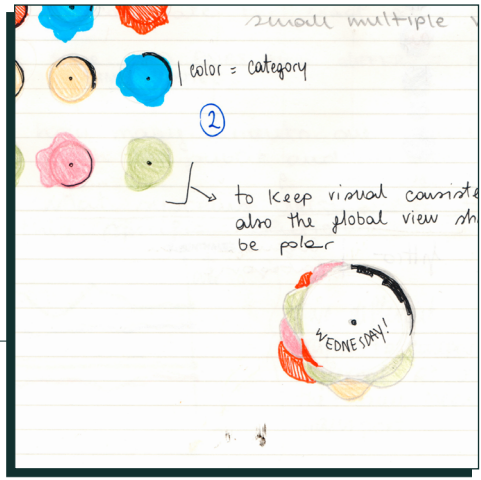
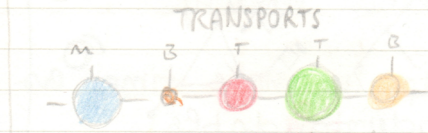
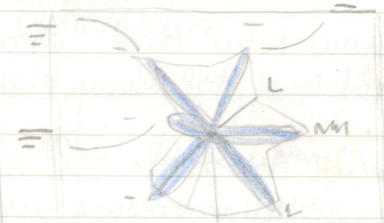


FIGURE 3E
Small multiples for activities (resembling the final model design)



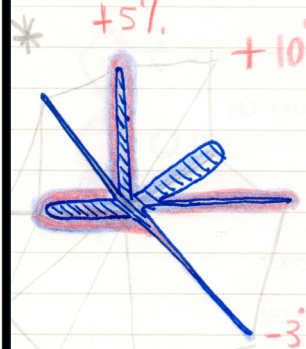
(5) isolate the first variable: TRANSPORTS

1. what lines did I took in consideration?



1 DAY | 1 ~~WEEK~~ | 1 HOUR

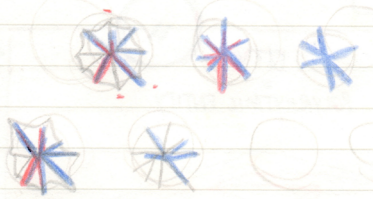
(6) View of district dist over one week How is Rosenthaler conne



As they are really similar differences should be highlighted

(rispetto alle media)

Toggle median



1 ~~DAY~~ | 1 WEEK | 1 hour

(6A) focus on the daily schedule

AGGREG. of ~~days~~ hours and averaging

zoomed in view for 1 single hour during the day

1 single day is triggered by clicking on the glyph

(6B) focus on single hour inside one day frame (24 glyphs)

COLOUR: could underline similarities between hours

less interest

more interest

between those two parts

external layer = personal area

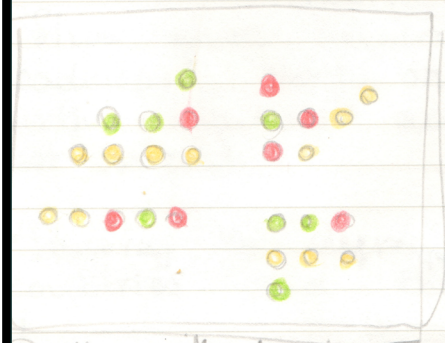
conn?

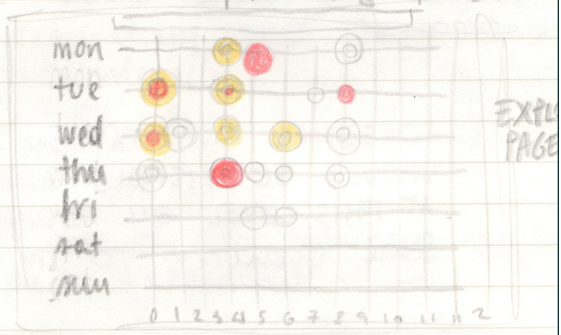
BUSINESSES

(7) View of different lines over the week

(8) Subdivision of categories

category select

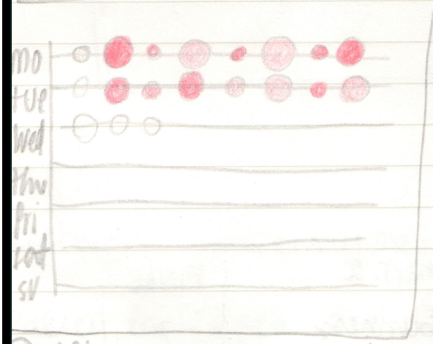


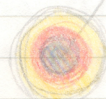


EXPL PAGE

(9) View with classical map and spatial arrangement, every shop becomes a dot

(10) After a spatial arr. we could show the grid according to hours





same graph, but color blending is stripped out

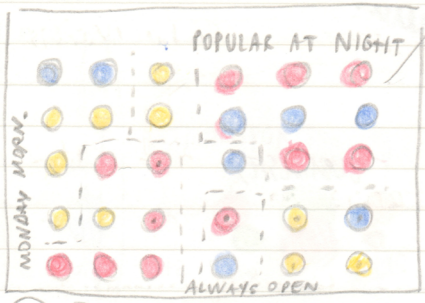
blending to highlight category

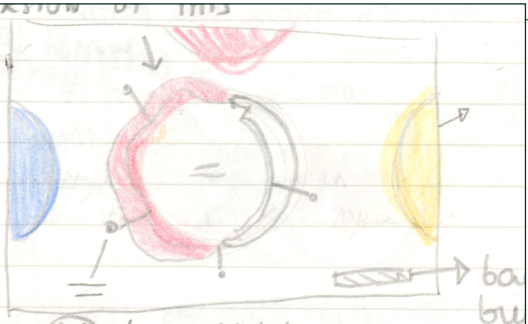
number of closed and open shops in 1 category

color intensity = spreading of popularity

(11) After a general view it should be possible to dive into specific categories by selecting them

"scenarios with annotations and insights could be prov

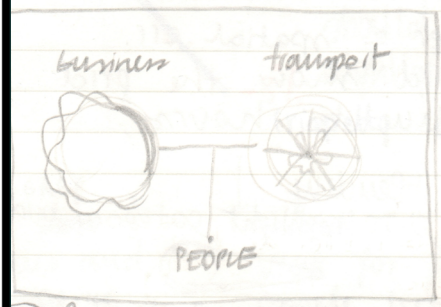


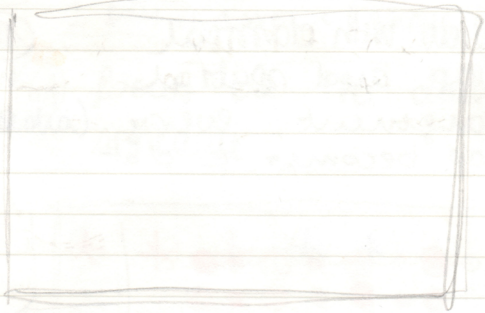


(12) Businesses should be re-ordereded also according to their similarity * be careful: the dataset should be created

(13) by clicking on glyphs it should be shown the business behaviour

↳ PERSONAL ANNOTATION SHOULD BE VISIBLE ALSO AT THIS LEVEL BY ADDING SOME element TO THE GLYPH.





(14) Conclusion

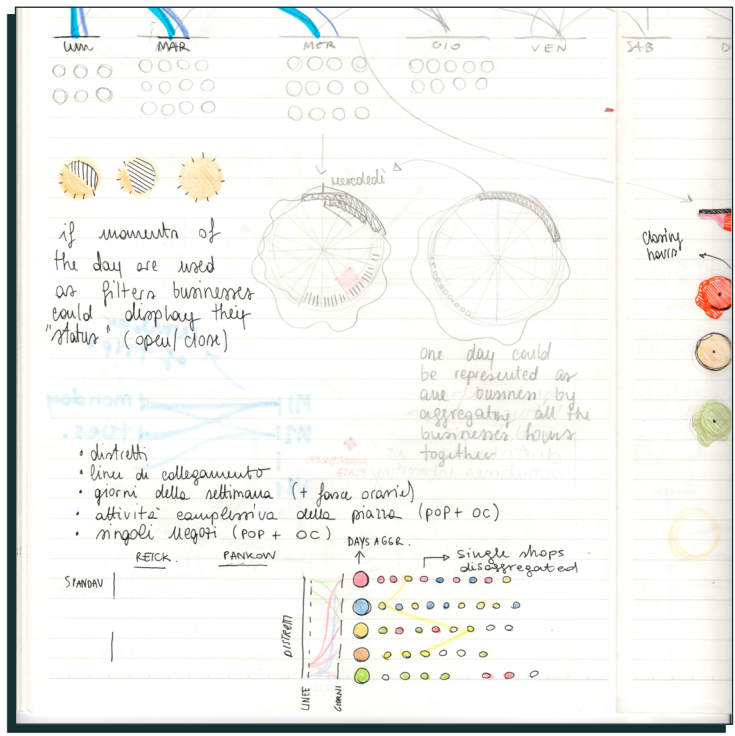
INTRODUCTION	CHAPT. 1	CHAPT. 2	FINAL
polyrhythmic city - how to handle all analysis - entities	- transport - Weekly means - Weekly connect.	- business - single patt. - weekly patt.	?

↓

FINAL OBSERV.?

FIGURE 3F - 3I
In the previous and current pages: storyboard sketches of the complete interface

Designing models to represent time is a particular challenge that requires a firm eye on data and various visual alternatives.
Deciding how to unroll time for readers is a long process that involves a lot of sketching and feedback sessions. The main challenge is, in fact, how to design time axis. Time can be represented both in a linear fashion or on a circular axis.
In the Rosenthaler Platz project both ways are integrated, however a strict UX path determines how users will be introduced to each visualization to help them understand and follow through.
Sketching helped me in providing the best visual models and the smoother UX for readers. Starting from basic charts (such as line charts, bars, etc.), I slowly developed glyphs and representations that try to cover temporal aspects in an understandable and pleasant way. Sketching also fostered my reflections on context, forcing me to taking into account the necessity of creating visual anchors and space for new data that were not included in the main visualization.



IV. Gathering perspectives

Context Embedding

Adopting models that could foster easier comparisons in data is an important step when dealing with time patterns. However further details could be added to the general picture to explain the nature of small differences and unexpected peaks. Variations in opening hours or popularity peaks, number of trips decreasing in certain hours or impossible connections with transports are originated from users actions, space elements and urban planning operations. Excluding information about what is actively shaping Rosenthaler Platz would have make the analysis less complete and not understandable for readers.

This reflection led me to the decision of formalizing all the contextual data already gathered during the first round of analysis, while at the same time I started to search for new ways of collecting even more data on commercial activities, transport and space.
To logically determine what kind of information I needed, I started a qualitative reading operation on data, isolating some dimensions from each dataset and reflecting on their structure. Just like highlighting paragraphs or pieces of text, inspecting small portions of data, plotting them in alternative ways and asking questions about them fostered a better comprehension of the place I was looking at.

In order to convert my observations in structured data I could use in my visualizations, I decided to experiment with some qualitative research techniques: time

walks and semi-structured interviews.

Time Walks

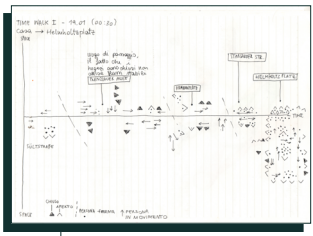


FIGURE 3.4
Scan of my first Time Walk in the neighborhood, when I tried to mapped open and closed commercial activities.

Radicchi and Mayr [2013] outline a method to qualitatively map urban time in specific locations: “time walks”.
Time walks usually involve a small group of people that gather in a location with the aim of explore spatio-temporal arrangements. There are several practices that can be considered part of the time walks method, I decided to practice with the most common one.
Together with a group of volunteers, three people in total, two designers and one social scientist, we gathered at a corner of Rosenthaler Platz where I distributed one blank sheet of paper and one pen to each one of them.
The instructions were simple:

- On the horizontal axis time should be represented, while the vertical axis is reserved to space
- You should pick one phenomenon that is happening in time around you
- You have 15 minutes to draw this phenomenon on paper, try to visually encode the variables you want to represent

The final output were three maps of three different phenomena.
One map was describing the rhythm of pedestrians walking along with the music rhythm inside the venue we were staying, the second one tried to depict how many pedestrians were in small group talking while

walking, the third one represented the moments when emergency vehicles (such as police cars or ambulances) were crossing the intersection, in which direction they were headed and if the sirens were on.

The exercise was understood and well performed by all the participants. However all of them reported how difficult the task was due to the speed of the phenomena they were trying to map and how this leads to an inefficient representation.
On a more general level it was interesting to register how all the three people involved felt like sound was an important component of their map, as if hearing could be a better mapping device than sight.
This test with time walks lead me to exclude them as a possible source of contextual data, mainly because:

- The outputs were too heavily encoded and a long decoding work would have been needed to make the representations useful sources of data
- The variety of phenomena depicted was too wide and general
- To obtain useful contextual information performing just one time walk would not have been sufficient, but several recordings would have been done over time making this data gathering technique inefficient.

On the other hand, time walks proved to be interesting mapping challenges that lead to very subjective and complex representations of urban time. It is an awareness exercise, because it requires attention and focus from participants making the complexity of urban time transparent and evident to them.

I would argue that structuring more topic related time walks, giving the participants a set of phenomena that have to be depicted, could be a good way to make use of this technique for contextual data gathering.
Moreover a better distribution of sessions over time could have helped in mapping a wide variety of moments.

Semi-structured Interviews

The second technique involved to gather context data was semi-structured interviews.
Interviews are heavily employed in the social science field, qualitative mapping is almost always rooted in interviewing sessions and exercises.
As I needed to gather knowledge about specific aspects of Rosenthaler, I decided to prepare interviews with different aim.
The first set was aiming at clarifying businesses temporal data, the second one was defined for transports and the third one for people memories and stories of the place.
A single interview for businesses employees and owners - for example - was composed by an introduction on my work, followed by some questions on the weekly schedule of the place. The second part was carried out with the help of a printed horizon graph with popularity and opening data plotted, the interviewee was asked to look at the graph and by using a pencil correcting or commenting directly on paper to signal if data were not accurate or if some popularity peaks were connected to specific events.
The third and last part of the interview was dedicated to this tool evaluation, the interviewee was asked if

the printed visualization helped recalling events or particular situations.

Interview structure remained the same while the topics changed based on the interviewee. For each topic different data were plotted. As mentioned, for business I prepared popularity and opening data, for transports I decided to show districts connections and trips frequency, while for stories and memories on the location, I wanted to provide the interviewee with a simple map with venues plotted as dots.
As I started my first session for commercial activities, I decided to randomly select a portion of venues from my dataset. This decision was made to reduce my potential personal bias to focus on some categories of places more accessible than others.
For every business I prepared a card with opening and popularity data.

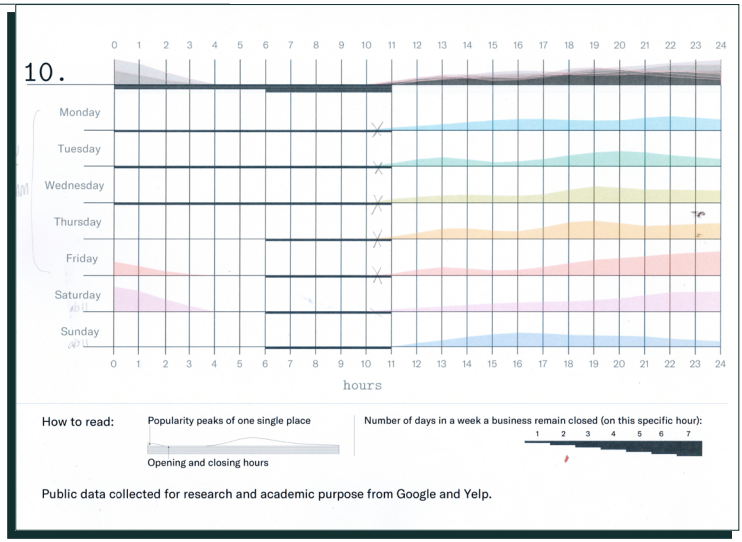


FIGURE 3.5
Scan of one card used to interview the shop owner. He crossed the hours when the shop was supposed to be closed.

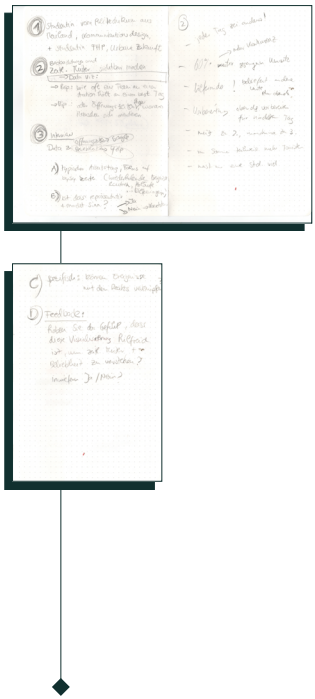


FIGURE 3.6, 3.7
Scans of the original notes taken during the interview.
Courtesy of Wachotsch N.

Not every business in the sample had information, so I decided to print the blank visualization layout and ask interviewees if they were capable of designing the popularity curves on their own.

By extracting a random sample of places from my dataset, I forced myself to get in contact with a wide variety of people.
Semi structured interviews are a really good way to gather context, especially if combined with data visualization. Time is a generally abstract problem to explain, while interviewing owners and staff from commercial activities this showed up as an obstacle in our way. However having a printed card with data fostered in interviewees the ability to understand better what I was addressing and to recognize the temporal structure of their own business. Visualizations worked as an anchor for interviewees, when words or explicit comprehension of the topic were lacking, by pointing at peaks and elements on the horizon charts some insights were generated and answers became more complete.
A major difference could be appreciated when non-compiled visualizations were used: providing only the layout without data was not as helpful as providing plotted data, interviewees had no direct visual anchor to answer questions, therefore it was almost useless to show them the layout, in some cases it could even be confusing for them.

Interviews were carried out in a span of three months, in two separate sessions: one in February and one in April. One german speaking colleague helped me in the process, as I do not speak German.

I planned 11 interviews, however 3 people refused to answer.
In total I gathered 8 interviews, each interview lasted 15/20 minutes.
Answers and feedback were generally positive and when possible data have been validated in each single occasion.
However, various obstacles had influenced the quality of answers.
The first main problem was the language gap, in some venues it was difficult to speak either English or German. Interviewees were struggling in understanding abstract questions in a different language from their mother tongue, therefore they were delivering incomplete or not clear answers. Some staff members refused to talk to us or treated us poorly due to their full working schedule.
However, when successful, this method is very informative and allow a granular context data collection.
One possible solution to amplify this method success would be to increase the number of interviews and select more carefully the venues.
The random selection, in fact, is good to avoid selection biases, however relying only on random businesses could lead to a higher number of negative answers and refusals.
Moreover some places tend to be “more interesting” than others in terms of time schedule and select them over others means prioritizing useful information for the reader.

In the scope of my project, I wasn’t interested in gathering specific contextual information on one single phenomenon. My attempt was directed to the general

method for collecting, reading and plotting contextual and subjective data. However, I would argue that semi-structured interviews with data can be even more informative if the investigated context is specific to one phenomenon.
The most problematic aspect is how time consuming is to gather this kind of information, however the very purpose of close reading - in Digital Humanities as well - is to increase the quality and detail of the studied matter. Time and effort are important aspects to enhance the quality and detail of one project and its findings, something that distant reading and data driven urbanism practices try to avoid. If our aim is to reconnect with the city and hack quantitative urbanism we have to actually spend time with our data and people that generated them or witnessed their generation.
Due to time constraints, I could not complete the sessions on transports, therefore only subjective notes and information from my explorations of the area have been gathered.
Context Collection and Storage
At the end of both interviews sessions I created a folder of notes with answers compiled or corrected data visualizations. I transposed my observations in a text document, along with interviewees comments and feedback.
I reviewed the cards and added points or corrections that the interviewees made while talking, but did not directly drawn, in order to create a comprehensive picture of the shop. After reviewing the cards I duplicated my business time schedule dataset and added columns to store contextual data.

ID	Name	Hour	Day	Popularity
string	string	number	number	bool
identification string for business	name of business	One number, 0-24 to reference the hour	One number, 0 - 6 to reference the day	popularity data, one entry 0 - 100

TABLE 3
Example of table structure for context data (only one business)

By doing so, I obtained two almost identical datasets, one picturing only official data with no context, the other displaying multiple perspectives on the same data.
The dataset shape has not been modified, new fields were added to the tables in order to always be able to trace back the original data.
The same operation was done for contextual information derived autonomously by walking the area. This includes photographs, notes on some elements that attracted my attention and open questions on phenomena that my data did not grasp interely.

As I proceeded in designing my storyline, I created an index of points in the narrative I was interested in showing specific contextual data. This index contains information about the positions in the story, the purpose of conveying it and the final visual form of subjective data.
I divided the data in 10 main categories based on the conveyed knowledge. Every single category has a definition. **[See table 4 at pg. 98]**

Open/Close	Pop-C	OC-C	Comment	Note
bool	number	bool	string	string
open/close data, 1 = open, 0 = close	Popularity entry corrected	Open/Close entry corrected	Comment for corr.	Note of the interviewer

This categorization aims at reducing data complexity to create consistency in the storyline. It should not be considered as a general and monolithic taxonomy per se, but as a good approach at keeping data tracked and meaningful in the story.
In addition to this categorization, I defined visual forms to represent the data. I chose 4 ways of embedding context through visual elements. All of them are known and used visual techniques for information design. **[See table 5 at pg. 99]**

As for the categorization, this subdivision of visual elements is not to be considered the only way in which contextual data can be embedded. However, it fits for my specific projectual needs.
After mapping this variables, I ended up with 30 positions in the story where contextual data could be embedded. Some of them are just single entries with one unique data point, others are entire layers of points plotted on top of the base visualization.

The general structure of the project evolved as my data gathering and analysis proceeded, becoming a

General Knowledge on the Topic	GKT	Expansions of concepts presented in the text, references to authors and other projects that would help the reader comprehension of the topic presented in the narrative
Opinion on time: seasons	OTs	Specific comments of people regarding time on a seasonal frame (winter, spring, summer, autumn)
Opinion on time: week	OTw	Specific comments of people regarding time on a weekly and recoursive base
Opinion on time: day	OTd	Specific comments of people regarding time referred to a specific day or moment of the week
Correction on data	CD	Numerical correction on data made by an interviewee
Link between data	LD	Link between entities or moments (generally extracted from the interviewer)
Other Content	OC	Photographies or other multimedial material describing the space
Dataset Structure	DS	Structure of the dataset used to create the visualization
Spatial Reference	SR	Reference to the space where the phenomenon is taking place
Emotional Reference	E	One personal take on the space by an interviewee

Table 1, previous page- Categorization of contextual data.

Annotating	A	Using one mark or shape that link a specific point in the story, by clicking on the mark a side note opens or the navigator (bottom right of the screen) is activated.
Redrawing	R	The visualization is partially or completely redrawn, by interacting the navigator is activated showing what data are being edited and why. The redrawn visualization is visually rendered as more important.
Highlighting	H	Highlighting consists in using colors to make an element dominant to the reader. The element with contextual data is colored differently by hue or saturation, by interacting with it the side bar shows the attached comment. One element triggered could activate also other elements in te visualization, if correlated.
Guiding	G	This technique consists in creating space in the UI for a semi-permanent element that could work as a supplementary guide for readers, to help them orientating in the story, on the map or in the dataset.

Table 2 - Taxonomy of possible visual encoding techniques for context.

parallel design operation.
The first findings on data were displaying no interesting features: no major pattern emerged to describe the nature of the place I was studying.
After some reiterations on data I noticed that a multitude of small patterns were emerging, but none of them seemed to be fundamental or comprehensive.
This is the very nature of urban time, everything is happening at once and while nothing seems to be the core of a general temporal structure, each element is contributing to it in its own unique way shaping the way people interact with the place and their perception of it.

OUTCOMES

3.3

Many scholars that are studying urban time related issues agree on this complex, highly specific and granular nature of time - Pucci and Colleoni [2013] for example, when they openly challenge scholars to define temporal injustices and global city rhythms.
This is why I decided to consider context and subjective information as a core part of the project.
Context, in this frame, worked as a key to understand Rosenthaler Platz time, confirming its importance in urbanism qualitative studies as a central dimension: without considering context we won't be able to understand the nature of places. [Linder, R. 2006]

In the next chapter I will present a methodological framework to operate with context in the urban environment. I will focus on techniques to combine distant and close reading on city data that could help the

mapmaker paying justice to contextual information. Some of those findings will be supported by human geography and feminist theories, the main effort will be to provide some guidelines to acknowledge and deal with multiplicity and perspectives without losing the broad urban picture.

Seeding Context/ Cultivating Perspectives

INTRODUCTION
4.1

As previously discussed, context is a fundamental piece of information either for building or reading maps. In this chapter, practical mapping operations will be presented, along with techniques to hack the current praxis and create space for context analysis and representation. An effort to depict strategies both for analysis and classification of contextual data will be made.
The aim of this chapter is to guide the mapmaker to move from previously discussed theoretical concepts of close and distant reading to one practical strategy to merge approaches.

As outlined in the first chapter, mapping practices have a long and mutually influenced relationship with urban planning since the fifteenth century [Buisseret, D. 1998]. This is true both for strictly geographic maps and statistical maps: urbanists - and many other professionals - have always been using various forms of representation to deal with urban complexity. Mapping usually precedes the planning practice, as it objectively identifies the terms around which planning projects are possible and should be developed.
As Corner [1999] points out, however, what remains overlooked in this sequence is that maps are highly artificial. They are constructed objects with a strong influencing power on planners and this is mainly due to *"the tendency to view maps in terms of what they represent rather than what they do."* [Corner, J. 1999] Urban planning often uses mapping without properly tackling possible downside of this artificial aspect of maps, as they do with the data used to build those maps.
The artifice behind maps is not evil per se, on the con-

trary: maps have to be artificial, although they would be not useful or representative for the user. Thus maps are synthesis, schematisations where certain elements are prioritized, ignored, indexed and framed in specific ways: maps are already projects in the making [Arnheim, R.] and so are data. Not acknowledging the possible distortions inherited from maps may be hindering the map reader in properly obtain knowledge of a city and its phenomena.
This opens a serious controversy on the use of data visualization and mapping practices in the field of urbanism and urban studies.
Mapping operations that give this medium neutrality as granted are failing their mission of creating useful and empowering tools for readers (from citizens to policy makers and planners). Showing data on screen or print surface is not sufficient: balanced analysis, context reflections and careful visual encoding are needed to produce a fair picture of urban phenomena or any other dimension that the mapmaker want to make visible.

Thus the question is, is revealing patterns and plotting data on maps an efficient way of uncovering new aspects and producing meaningful insights for dealing with urban complex phenomena or its artificial nature and reductive effects on individuals and environments need to be improved and enriched with other information to be effective?

The answer to this question is stratified and complex, however declaring mapping as purely reductive would be as superficial as not questioning the practice itself. In fact, maps can lead to profound or superficial insi-

ghts based on the mapmaker technique of building the map itself.
In the following pages, I will frame on a methodology to deal with data and visualization practices in the urban environment, while taking into consideration and making transparent the underlying complexities and potential discrepancies between reality and data.
Starting from data feminism, grounded theory in data visualization and creative mapping operations I will try to escape the 'tracing' natures of maps (as Corner define it: delineating patterns but revealing nothing new), to produce agency: uncovering new realities previously unseen and challenging the pretence of objectivity.
As Deleuze and Guattari [1988] say:

"Make a map not a tracing!".

MAPPING OPERATIONS: FIELD, EXTRACTS, PLOTTING

4.2

Mapmaking is a set of practices that go from collecting data to abstracting physical space and selecting pertinent features.
Corner broke down mapping operations into three steps: *"field"* definition, *"extracts"* observation and *"plotting"*.
The field is both the surface itself and the graphic system within data will be extracted and later observed. "The system include the frame, orientation, scale, coordinates, scale, units of measure and graphic projection" (Corner). The field is naturally setting conditions for the representation itself, those conditions can be restrictive and limited or more open to new experimentation.

The extracts “are the things that are then observed within a given milieu and drawn into the graphic field”. Extracts are data, detached and de-territorialised. Extracts are never neutral, they are always generated, manipulated, filtered, selected and so on. Based on the field, extracts will reveal new patterns and possibilities.

“Plotting entails the ‘drawing out’ of new and latent relationships that can be seen amongst the various extracts within the field.” [Corner, J. 1999] Possible plotting are infinite, as relationships between extracts and field are multiple. Based on the analysis and the observation angles different plotting will be preferred upon others. Finding relations and traces can be seen also as a re-territorialisation of the extracts.

By using Corner’s categorization of mapping operations the artificial nature of mapmaking becomes clear. In each step, choices are made by the designer, defining the type of representation that will result in the end.

However, the data extraction or ‘de-territorialisation’ and the plotting or ‘re-territorialisation’ phases are the most influenced by the mapmaker’s ability in comprehending and revealing context.

Building context is a fundamental ability in the mapmaking process, it differentiates between a ‘tracing’ and a ‘map’. Context enables the mapmaker to move from observing extracts to plotting relationships without losing meaningful information, as data will always be intertwined with their origin. This is fundamental for the reader as well: contextual information can foster a more responsible reading of a map and, in some cases, stimulate new observations on the plotted extracts by establishing clear links

between extracts and field.
While for the mapmaker should be almost trivial the necessity to use contextual information to analyze data, this may be new to the reader. In fact, apart from geographic and generic temporal information, maps are seldom displaying specific contextual elements on plotted phenomena.
At this point, it is important to define the meaning of context, both for the mapmaker and the reader. Defining context for those two actors will help understanding how to use it efficiently in mapping urban phenomena. On one hand I will define a valid strategy to support the mapmaker in using context as a magnifier to inspect data, on the other hand, I will propose visual techniques to encode contextual information to foster the reader's knowledge.

CONTEXT IN DATA: THERE IS NO VIEW FROM NOWHERE

4.3

In the past few years the nature of big data has been analyzed deeply. Moving from the positivist view that large datasets are speaking for themselves and therefore they can be displayed to the reader as some sort of objective ground truth, the discourse now involves the skepticism and dissatisfaction in the self explanatory nature of big data.
Donna Haraway's "view from nowhere" critique is at the centre of the discourse around big data accountability:

"Haraway refers to how data is often presented as though it inhabits an omniscient, godlike perspective. But the "trick" is that the

bodies who helped to create the visualization – whether through providing the underlying data, collecting it, processing it, or designing the image that you see–have themselves been rendered invisible. There are no bodies in the image anymore."

[D'IGNAZIO, C. AND KLEIN, L. 2019]

The view from nowhere is always a view from somewhere, therefore data can't be considered as neutral elements ready to be used without any further consideration.
Johanna Drucker exemplifies it very well by stating that all data are capta, in the sense there is no such thing as given datasets or already formed ensambles of data [Drucker, J. 2010].
Moreover all data are local, meaning that even the most extensive dataset in the world is not a monolithic and homogeneous resource, but a heterogeneous assemblage of local conditions originating from other local entities [Loukissas, Y. A. 2016], therefore no data is neutral and without a physical source.
Urban data are both deliberately collected (i.e., capta) and bound up with the local situation, therefore there are supplementary levels of knowledge that should be taken into account before, during and after the analysis.
The observation of those two layers is, in fact, context. Ignoring contextual information of data with the claim of being neutral is a serious threat that could endanger the map efficacy in displaying one phenomenon.

Mapmakers should be particularly aware of context while building a map, not just geographic context, but as previously discussed also the wider social context about data and the observed locality.

Maps always contain some degree of context, in the classic definition of Corner “field” could be considered context, for example. In general, the terrain level representing the geographic boundaries of our map is always referring to context, as a representation of the physical space in which the phenomena are happening.
However context, just like data in Drucker’s definition, is never given to the mapmaker as something monolithic and unchangeable. Scale, graphic appearance, included details and so on make the field layer as constructed as the rest of the map.
In the same way as the mapmaker construct this first layer of context, the same operation can be done with other information to strengthen the broad picture displayed.
Collecting data about context - both for local context or context on data - could be considered as an uncovering operation: phenomena always carry with them information about context.

To uncover context in urban data various steps are possible. I identified possible steps that could be used for a more general methodology. The passages sketches below are outlined through critical takes on data from various scholars, grounded methods for qualitative data gathering and my modest personal experience with urban analysis. Not all steps presented are necessary, each one is a form of local

reading that can be reiterated once or many times, both in a linear or recursive way. Based on [either names of fields or academics], I aim to explore the viability of the following procedure to produce and present context for urban data:

1

Explore and (create) Background [D'Ignazio, C. 2019]

The first step involves breaking down the datasets to observe how they are composed. This is not limited to preliminary visualizations practices (plotting data to observe possible patterns), but it includes the observation of the table itself.
Number of rows and columns, column titles and entries encoding are rich information that could help uncover how the data structure. Observing how the data are arranged spots a light on possible problems: unclear naming of fields, missing entries, time or geographic discontinuity, etc.
Checking data composition means also understanding where the data are coming from and for which purpose they were harvested in the first place. Backgrounds operations are necessary to uncover the nature of data: data provider, usage policy, meta-description and harvesting method are informations that should always checked before starting proper analysis actions.
In this phase, some datasets could be excluded (if possible) when non reliable, impossible to check or non relevant with the investigated topic.

2

Know the phenomena

We experience the city daily, therefore we can obtain experiential knowledge about the phenomena we aim to observe. At least we have an idea on how things should be. This baggage of common knowledge should not be underestimated even if it is personal and linked to a specific perspective. This information can help in understanding data, but also in challenging them when discrepancies and curious behaviours emerge.

3

Enlist discrepancies

Preparing a list of discrepancies is somehow creating a small dataset of problems related to data. Unclear entries, missing data, unexpected patterns, unchecked sources, etc. should be ordered to be further analyzed and eventually solved. Keeping track of them will be useful later in the process to determine which contextual information store.
Creating a list of the encountered conflicts will also spot a light on the different natures of problems: some of them can be solved by doing further analysis on data and sources, while the other can be checked only by physically move to the location that is being observed.

Walk the area

Walking the place that is being analyzed is a very

4

useful practice, social sciences and human geography often adopt it when inspecting specific spatio-temporal phenomena in the urban context. Knigge and Cope define an iterative and reflexive method to collect and visualize contextual data of an urban exploration. Grounded visualization is the resulting practice: using visualization to constantly challenge and correct their assumption based on large datasets.
Inspecting the area after gaining knowledge about it through the data could help in solving parts of the previously analyzed problems or prompting new interesting angles for the viewer.
Unfortunately, this practice is not always possible, due to geographic proximity, safety, time scarcity, size of the analyzed area and other obstacles.

5

Visualize and Ask

When walking the area is possible, taking the data with you is recommended. Plotting some of the data (especially the problematic or incomplete ones) could enable quick corrections, highlights and explanations. Printing and taking the data around during area explorations is a valuable technique to start a conversation with people living or working at the place.
Asking questions is key in generating meaningful contextual data. Two main actors will be involved: domain experts (people that know the data or the phenomenon structure and could be actively involved in harvesting and cleaning the datasets) and area users (people that permanently, occasionally, or recursively spend time in the area).
Three techniques fit the needs: semi-structured inter-

views, data driven questions and visualization driven exercises. They can be combined or isolated based on the designer's need, preferences of participants and other variables that occur during this phase.
Domain experts can be asked for specific opinions: such as they know that data are harvested on their activity, if they had an active role in gathering them, if there are recurring events that can be linked to data and if the data are effectively representing the phenomenon as they know it information on data, while area users can be interviewed to gain further local knowledge about one phenomenon, such as how do they experience it, what emotional traces and memories have left, if they recursively noticed elements in the space they are using.
Domain experts and area users will provide answers that can be confronted with gathered data and used to eventually correct and solve discrepancies.
Using visualizations to start conversations with interviewees in both scenarios will facilitate the exchange of knowledges and could be the foundation for practical drawing activities on graph. Asking users for a direct intervention is the first step to visually encode and store data about local context.

6 Record contextual data

Collecting supplementary data about context will require a further step for classification and storage. Creating an index of what kind of information users and domain experts provided is an important step for carrying out a better analysis,to formalize highly colloquial and subjective pieces of text and incorpo-

rate the perspectives of involved actors (both domain experts and area users) that later will be shared with the reader.

Storing contextual data calls for a classification of entries. Producing knowledge through open questions and interviews means creating a various range of casual observations. This variety is not problematic per se, the mapmaker should be able to intuitively use this knowledge during the mapping project. However, storing may be problematic, therefore categorisation and schematisation of interviews is required.
While taxonomies are always problematic, it is necessary to break down the information in reusable pieces. Contextual information can be categorized in three main groups:

1. *Completions*
2. *Contestations*
3. *Comments*
4. *Confirmations*

Completions are observations about specific elements in the data or generic patterns and structures. They can be obtained by formulating open questions about one topic or using visualizations that clearly depict one pattern or a small assemblages of data points. Completions can be formulated both about data structure (if the interviewee is a domain expert) or about the location itself (if the interviewee is an area user). Completions aim at solving unclear situations:

unexpected trends, unclear fields in the dataset and so on.
The more efficient way to store it is reporting the specific comment extracted from the interview creating a new field in the data table and adding one label to differentiate about data and location completions.

Contestations are directly bound to data points. The more efficient way to obtain those information is providing the interviewee with a printed visualization they can work on. This design intervention should be done carefully, the mapmaker should guide the interviewee by explaining how to read and what kind of interventions can be done on paper.
Contestations are useful to correct data or improve them when they are not descriptive enough. They unveil subjective perspectives of the surrounding spatio-temporal location and specific events that digitally collected data alone are not sufficiently granular to capture.
An efficient way of storing those information is by creating a twin field to one already existing in the data, based on the type of original data the information can be encoded in different ways: numbers, strings, booleans and so on.

Comments are additional observations about data or location. They do not aim to solve problematic patterns or evaluate the quality of data, but they are casual insights that can be deduced during the interviews. Comments encoding can be done in various ways by looking at single interviews or by comparing them.

Confirmations are general observations on data. Both the interviewee and the designer can confirm the data, the former by looking at them and expressing their degree of compatibility with the phenomenon, the latter by studying the location and the involved phenomena. Confirmations are not specifically data points or values, but they serve as a positive reinforcement on the correct nature of collected data. If data are not confirmed, then further investigations and reflections should be done.

The rise of ICT dominated cities and the speed at which our society is evolving, connecting localities to the world [Corner, J. 1999] is increasingly making the relations between space and time relevant.
The situated nature of space is evident, citing Corner [1999]: “the experience of space cannot be separated from the events that happen in it”. This is a call for urban planners and scholars: dealing with urban data means emphasise the space-time relational systems and their highly dynamic nature. Social, political and cultural processes flow through space, constantly shaping it.
When classifying the qualitative criteria of urbanism Kevin Lynch [1961] includes among others also context. Without context it would be impossible for the urban planner to understand how the past is embedded in the present and how urban elements interact with each other. “A preliminary condition for forming recognisable urban spaces is to take the entire context of an area into consideration.” [Pompe, A. Temeljotov Salaj, A. 2014].

Context is more than ever a fundamental dimension that has to be embedded in urban analysis. This is not limited to the data collection and preparation, but could be extended also to reading operations. Representing this information is useful because it makes the complex nature of the space - to some degree - knowable, not just through words, but also through visualizations. Multiple versions of reality and 'truth' are made visible and the pretended objective nature of data is challenged.
Challenging does not mean disrupting, but rather enabling different perspectives and experiences to be part of one representation.

In the previous section a strategy to use context to carry out a granular and effective observation on data has been depicted. It is clear at this point, that by solving problems related to data context during the analysis, a great amount of data - about space, history, emotions, culture and rituals - is harvested.
I will now proceed in explaining how to prepare a compelling story for the readers by using both spatio-temporal and contextual data. The aim is to convey specific information about one place without losing the context of it.

CONTEXT IN READING: A GUIDE FOR EXPLORERS

4.4

The visual representation of contextual data in urban cartography is not a unique and monolithic intervention. While mapping and analysis operations have a somewhat fixed paths ora at least a general package of practices, representation itself can be intended as

more free and creative. Design actions such as choosing a narrative structure, selecting specific features, adapting existing models and using some UI strategies come together to model a visual environment where the reader can be made aware of them as smoothly as possible.
There are five main steps that I followed while designing:

1. *Define a form*
2. *Choose a reading scale*
3. *Select compelling features*
4. *Create a taxonomy for context*
5. *Create visual anchors for context*

Those steps are part of classic design strategies, adapted and expanded to cover the project's specific goals.

1

Define a form

The very outcome of the work change based on the way the data are presented.
The first challenge is choosing a form to convey information.
Narrative forms, such as interactive storytelling and data journalism oriented articles, enable the reader to focus on content while going through a specific path designed to make them understand some aspects of the data or general concepts. They can be really helpful, especially if readers do not have a previous knowledge about the topic or if they are not used to

looking at complex visualizations. On the other hand they lack of flexibility and readers are most likely not able to explore data in a serendipitous way by moving from one dimensions to another, combining and filtering them.
Explorative interfaces, in fact, leave a higher degree of freedom, providing small constructed knowledge and opening data to the reader.
There is no right path to choose, but since my works have been thought to be a divulgative piece on cities time patterns I chose a strictly narrative form.
Having in mind a broad and non specialized audience I decided to deliver one story with clear intentions and paths to let the reader learn without getting lost with data.
This structure is commonly known as 'Interactive Slideshow' [Segel, E and Heer, J. 2010] where the reader perspective is balanced with the author intentions, allowing small explorations of salient points.
This choice turned out to be helpful also for contextual data embedding: putting readers on a clear path allows the existence of a distinct level of data for context that will not be merged with other visual element in a complex interface for exploration, but will be developed carefully while users are reading. Moreover, the progressive and linear disclosing of knowledge helps in gradually build the intellectual context of the reader.

However, I am well aware that using a linear narrative form can be prone to problems: explorative interfaces can convey a larger amount of data layers, while linear narratives will always require an intensive work of selection that may lead to some erasure. Moreover

narratives can be frustrating for the reader when too long or too complex.
Still, if designed carefully, data stories can be a powerful tool to convey knowledge and context about urban phenomena to the reader. Moreover, interaction and exploration are maintained to some degree, by providing interaction loops both circular and linear. Users will be able to move freely and break the linear narrative when looking at data.

Choose reading scales

2

One project could require multiple scales to make context fully understandable for the reader. This seems almost a trivial operation: by definition maps should contain a “field” of observation, which is the first mapping operation according to Corner method.
However establishing a point of start and arrival in the narrative will require establishing scale changes as well, influencing the whole structure of interface and visualizations.
By defining how the scale is going to change over the narrative arc by zooming in or zooming out specific geographical area we are creating a bridge between distant and close reading operations, merging distant and general views on the city with site dependant and detailed scenes of the phenomenon.
If we look at the Rosenthaler Platz design challenge from the previous chapter there is one moment in the narrative where the scale is switched and from the entire city of Berlin to a local and narrowed point of view. This is a key moment for the reader that is able

to trace back the identity of the analyzed place without having previous knowledge of it.
From a distant reading of a general complex entity, readers transition to a close reading of one single element that contributes in generating the whole.
Scale selection does not mean that - as a rule - the field layer won't have to be visually displayed. In my case, for example, I decided to remove the geographical layer as quick as possible in the narrative to create space for other kinds of contextual information potentially beneficial for the reader. As discussed above, historically maps are not strictly geographic representations [Buisseret, D. 1998], but they are more generally a representation of a locality.
Removing space as a visual dimension allowed me to focus on the local nature of time, subjective comments on data and more flexible models where scales and granularity are not dependent on geographic scales.

3

Select compelling contextual features

Defining scales for every step of the narrative opens up for the third step of this journey to context.
Selecting compelling contextual extracts means deciding what is actually going to be displayed or not, apart from the actual data.
This step requires a careful filtering operation from the designer, not every subjective information harvested may be in the scope.
As a general rule, follow the main visualization purpose is a good way to select contextual information. It

is worth asking questions such as: what is the underlying structure of the data I am showing? Are humans playing a key role? What are the problematic elements in my visualization that can be explained or completed by subjective data?

The operation of deciding which kinds of information should be added to the basis layer of our visualization could lead to further data gathering, especially if we decide to expand one aspect of the topic that has not been covered yet. It could be worth taking other interviews or explorations of the area in order to reinforce the contextual datasets and collect some more annotations and material, therefore this step should not be performed too late in the design process, since gathering data can be a really long and time demanding task.
Once that a selection has been done then extracts can be categorized according to their content and source before being plotted.

4 Categories for context: how to provide a taxonomy

When dealing with the Rosenthaler project, I reduced the overall complexity of the data collected by providing an internal taxonomy.
I divided contextual entries according to the information they were carrying and who produced it, ending with 10 distinct categories. As the humanities scholars analyze the grammar of one paragraph, I designed a grammar for context which in my case was strongly

linked to time.
While specific categories can be considered highly dependent on the project outline, some operations to create a proper taxonomy could be considered universal.

Map the sources of contextual data
Where are the data coming from?

By listing all the sources it becomes easier to take in consideration who actually produced the data.

Map the carried information
Is it a direct quote from someone? A citation of some other work or project? Is it a number or a photography?

By defining in how many ways the information is carried it will be possible to create specific categories if required.

Map the knowledge
What insights are fostered? What knowledge is carried by this piece of information?

Preparing a taxonomy for contents is a very important step in the design process, because it allows to handle part of the complexity.
Taxonomies are, in fact, fundamental to handle complexity. They allow us to create “boxes” to structure unorganized information. However, this practice - as previously written - is highly problematic. First of all, it is highly arbitrary to decide which elements belong together in a class. While working at City Bits this became evident for commercial activities: in order

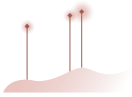
to produce few meaningful classes, some venues, especially the mixed ones, such as grocery stores or restaurants that also serve as pubs, had to be “forced” into general and mono dimensional categories. Secondly, it may happen that high number of entries in a certain group could bias the designer into giving more importance to one category over another. However, it is not possible to completely solve the problematic nature of categories, what is feasible is trying to be as representative as possible and declare the composition of our categories to the reader. Transparency is an important element to gain the trust from the reader and to properly convey the gathered material.

5

Create visual anchors for context

Visual anchors are highly depending on the underlying visualization and the kind of data that are shown. Therefore I will provide only generic strategies to achieve this task, since each visual model should have its proper labels and element to convey context.
Each strategy presented here could be adopted for visualizing every kind of contextual data, they are independent from the content, only the visual form will be discussed.
The main ways to visually encode context are: Annotating, Redrawing, Highlighting and Guiding.

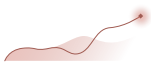
Annotating
Visual annotations can be dots, lines, glyphs or other



ANNOTATING

Close and Distant

small elements that are positioned near or on top of the visualized data. Annotations are meant to explain or complete a piece of information. Their presence on the visual landscape can be considered as a dimension of the data on its own, as they could draw an independent pattern from the one initially visualized through data.
When annotating, it is important to save a percentage of space in the interface to display the content of the annotations. This area, left blank when no annotation is selected, will be filled with the content of the annotation, such as text, pictures etc.
Tooltips are one possible solution as well, if there is no area left on the screen. However tooltips are partially hiding the visualization from the reader, making a direct confrontation between the annotation and the rest of the content difficult or even impossible.
Annotating is an efficient way of expanding the contextual landscape both for large and small scales.

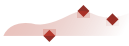


REDRAWING

Close

Redrawing
While annotations are small elements designed to not interfere visually with the underlying visualization, redrawing is the complete opposite.
When redrawing a visualization some parts of it are hacked with the contextual data and the shape of the main element is changed. Context is therefore actively modifying displayed data.
This is particularly useful for contestations, as the contradictory dimension of data is clearly depicted.
While visually impacting and appealing, redrawing can become difficult on large scales, due to the high level at which data are presented. Moreover scale perception might be a problem. Since the most efficient way

to store this information is by asking the interviewee to directly redrawn the peaks on printed visualizations, it should be noted that the scales might be profoundly affected from emotional and personal biases. However, if treated fairly, by declaring to readers their subjective nature, redrawns can be a powerful tool to convey the perception of the user.



HIGHLIGHTING

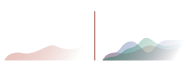
Close and Distant

Highlighting

Another way of dealing with context, especially when a large amount of data is displayed consists in highlighting some elements of the visualization to signal the presence of further content. This technique is slightly different from annotating and could be considered as a hybrid with redrawing.

To highlight an element or an entire visualization color hue, borders or size can be used to alter its aspect. By interacting with it, the reader can perform a zooming operation to reveal a more granular level of data or other parts of the visualization would be highlighted and commented to give importance to underlying patterns.

As shown in the Rosenthaler case study, when dealing with big and small scales it could be a good idea to transition between the two states even in single visualizations and not only on a general levels (i.e. with scales).



GUIDING

Distant

Guiding

Dividing the screen in multiple views is a well known and adopted technique in Interface Design, especially when an analytical goal has to be achieved. Creating a space for a side view can help in many situations by displaying the main phenomenon while conveying

contextual information that do not match up with the form or scale of the main visualization.
Even if to some degree it could be distracting for the reader to constantly have other views to check, implementing side panels that can be hidden could make room to display general context on space, time or even data structure.

[See the appendix 3 in the next page for detailed descriptions on visual strategies]

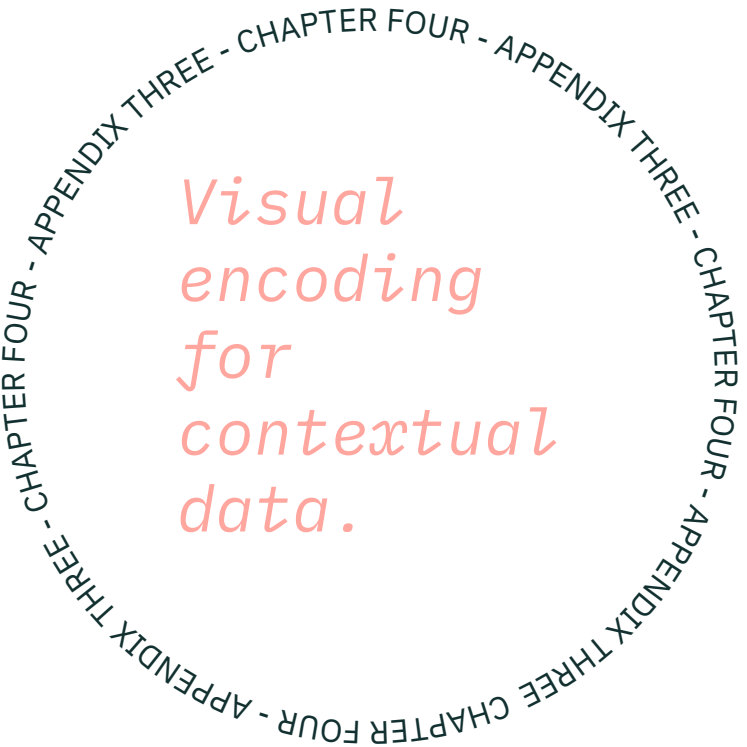
There might be several other ways to represent contextual data, some of them are certainly influenced by the project structure. The techniques presented above have been developed for the Rosenthaler storytelling, following its narrative structure.
During the design process I tried to carefully pick visual elements that can be more or less adapted independently from the interface, however some re-design operations could be needed.

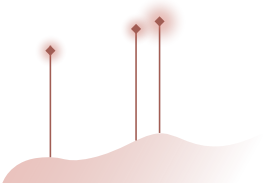
A GUIDE, NOT A SET OF STRICT RULES

4.5

The presented procedures should be read as a guide to embed contextual elements in a data based narrative story. Just as the explorers follow their guides in the wild but are always free to experiment and design new paths, the designers should feel free to use the presented ideas as a trace for their work. Obviously there are many more ways to represent contextual data as interface elements. It should always be kept in mind how map constructed nature will always force us as designers to operate choices and therefore political

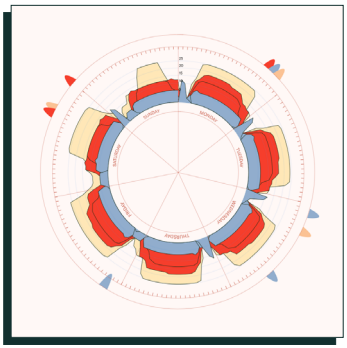
stances (Ricci). This is why we need to acknowledge our arbitrary choices in the narration, to be fair to our readers or users, to interviewees and to the city as well.
It is intuitively clear that we can't represent all the contextual information and the designer skills should be focused on finding the right amount of context without generating too much "noise" for the reader. However, this guide tries to be a step in the direction of formalizing context representation - with a special eye to time related urban issues - to create an easier path for the designer that decides to embed it in their project.

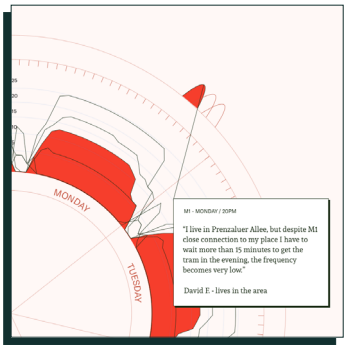

CHAPTER FOUR - APPENDIX THREE - CHAPTER FOUR - APPENDIX THREE - CHAPTER FOUR - APPENDIX THREE - CHAPTER FOUR - APPENDIX THREE
Visual encoding for contextual data.

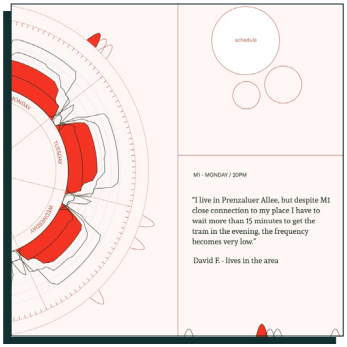


ANNOTATING

Close and Distant

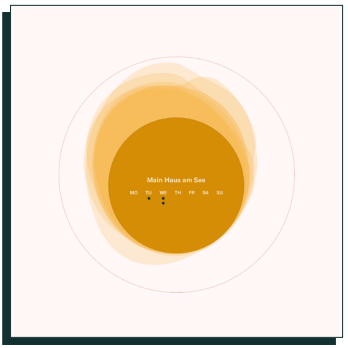


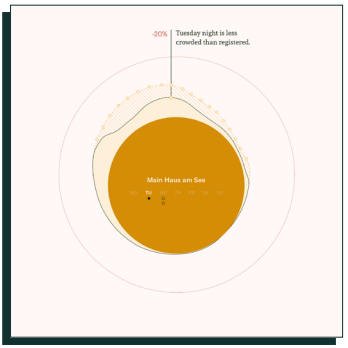


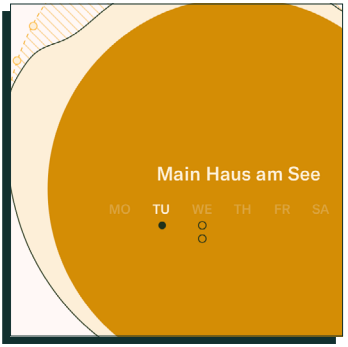


REDRAWING

Close

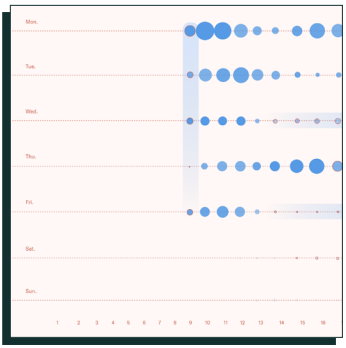


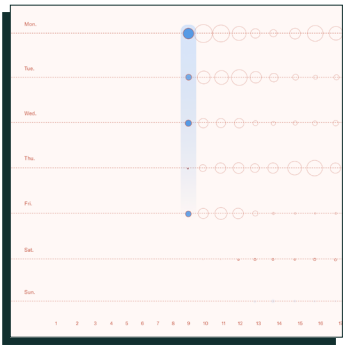


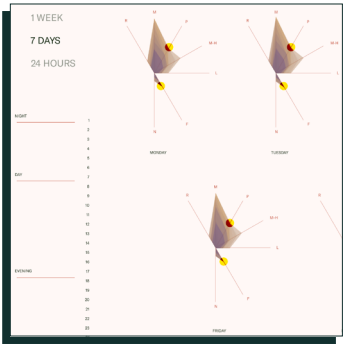


HIGHLIGHTING

Close and Distant

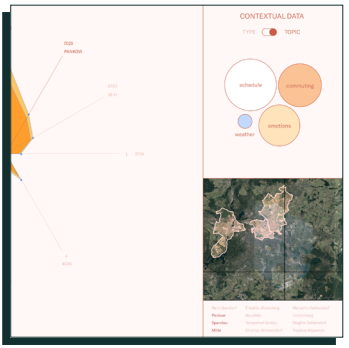






GUIDING

Distant



Cities, People, Time and Data

THERE IS MUCH MORE TO BE DONE!

5.1

Studying the city has always been a challenge. Cities are complex systems that constantly reshape themselves, combining an almost infinite variety of objects and phenomena. Challenges on urban representation has been evolving throughout history, adapting ways the city is observed and the very purposes of observation.

The challenges that, as cartographers and urban mapmakers, we are facing today focus on how to critically handle urban data in representations and how to pay the right attention to humans and their existence in the city as active actors.
Finding new ways to represent complex urban phenomena without losing the granular and perspective dependent nature of the city is crucial, as it will foster critical discussions on urban cartography and its role in urban planning.

This thesis tries to move in this direction by presenting existing literature and approaches that consider the city as a prism, with multiple angles and elements that constantly recombine themselves. Moving from this theoretical approaches, I presented a specific design challenge: how to represent temporal patterns and personal perspectives to analyze the city of Berlin.
The design actions required to tackle this challenge led me to build a small toolbox to practically handle perspectives on urban phenomena.
Mine is obviously not the only method or attempt in mapping rigorously contextual information and abstract urban patterns, many scholars have questioned urban representation and many designers worked on projects that highlight and pay justice to urban per-

spectives as well.

Going back to the first pages of my work I asked: how can spatio-temporal data be examined critically to visualize meaningful and contextualized temporal patterns of the urban environment?
The short answer to my research question could be synthetized: by acknowledging, in every step of the work, the importance of perspectives and context.
Context is key in urban exploration, because data that appear to be meaningless and obvious can gain a new meaning through different angles of observation, but also because provides internal coherence to the urban space representation by displaying its heterogeneous nature.
When dealing with time complexity the use of contextual data can be even more powerful because it helps orchestrate different elements in a more cohesive landscape of events.
Therefore, context may be seen as a tool by the cartographer, both critical and functional to handle complexity.

However dealing with context is a complex task per se. During my work encountered various problems and crossroads, both in terms of topic framing and representation. Not every piece of information can be represented after all.
This is the first problematic challenge that I encountered during my journey: how do I critically select the information that will be displayed to the reader?
Following the traces of data feminists and scholars that tried to define a rigorous frame to deal with con-

text and metadata, I tried to replicate their method in practice by embedding as much information as possible in my final visualizations. However some omissions were still made, fostering some critical questions: is there a such thing as “enough context” gathered? At which point the researcher can stop the gathering operations and consider herself satisfied?

Other critical considerations can be made on the method I draw: how representative of the urban identity and rhythm is the picture of a smaller and contained area? The main concept I based my analysis on is the possibility of using a small urban area as a proxy for its broader “parent”. In my specific case, I used Rosenthaler Platz - a single location in the heart of Berlin - to explore the internal temporal dynamics of the Mitte district. The produced findings are observations on temporal patterns and local characteristics; observations based on how different elements interact with each other in the urban landscape. Such findings were consistent with the area official description provided by the city urban planning office. Starting from completely different data I was able to reconstruct part of the findings produced for the official reports. This may be an indication of the approach goodness, however it could be further tested by analysing different areas of the city and even directly confronting them. The design case I choose was deliberately conveying a broad picture of one urban area, I did not pick a specific place interested by controversies or problematic temporal phenomena. The reason why I did not presented other - more specific - design cases was to prove to focus on methodological elements and not on findings.

However, by applying this method in different circumstances and by asking new - and maybe more specific - questions, its solidity could be improved or challenged.
One improvement that could certainly be done is further exploring the visual representation of geographic scales switches to create a better connection between large scale phenomena and specific considerations on small pieces of the urban landscape.
Generally, exploring deeply the idea of close and distant readings on the city might be an important step to strengthen and systematize this approach.

The third important critique regards the reader reaction and capability to comprehend the content of the analysis. Is the project explicative enough to foster the readers comprehension and generate an intellectual landscape of the analysed area?
User testing should be performed in order to gather information about the readers thoughts and feelings. One specific element that should be tested is the perception of embedded contextual information in the visualizations. Is it sufficient to foster a more broad comprehension? Does it help in following the narrative and structuring insights and findings? Is it distracting the reader by creating intellectual and visual noise?
User testing may lead to explore new forms of representation and narrative structures: the proposed linear storyline might not be working in combination with exploratory views.

However, even if some problems should be tackled and some challenges are still to be explored, recogni-

sing the existence of concrete way to operationalise the qualitative and quantitative mapping processes in urban cartography is an important step to build a solid bridge between theory and practice, using other fields, approaches and ideas as cornerstones.
This thesis does not claim the creation of a new, groundbreaking mapping practice, instead tries to collect inputs from other fields and urban cartography itself to explore new narrative and visual possibilities.

THE FUTURE OF URBAN CARTOGRAPHY

5.2

Kitchin [2015], as already profusely discussed, was really precise in identifying the historical moment where from data scarcity we switched to a data deluge in the field of urban studies.
The advent of ICT technologies and big data was a foundational earthquake for this research field, opening new possibilities and perspectives never imagined before.
From that moment on it was possible to obtain an unprecedented amount of information in a relatively short and fast way. Today technologies are even more advanced and data collection has been going on for almost twenty years, while new sources of data are continually created and injected in our world. We are at a stage where urban data are commonly produced by all of us, almost continuously and in diverse, capillary ways.
When I approached this topic and decided to study urban time and its multiplicity, I had to confront myself with a long tradition of speculations and projects in the field of urban analysis and visualisation. By looking

at how this subject has been treated, only inside the institutions I belong, it is possible to witness some fundamental changes in the way urban controversies, or more generally, the city has been addressed. Changes that reflect the more broader and general evolution in urban studies and information design: a generalised tendency to prioritise big data over qualitative information while designing for the urban exploration has emerged and kept growing over the years, changing the ways in which the city is studied.
It is really interesting how, starting almost 15 years ago the discussion around urban cartography and visualisation has been evolving, influenced by other scintific fields, technology developments and critical perspectives.

The previously cited works from Noland [2009] and Ricci [2007] are early examples of how the interest in harvesting large quantities of data to analyze the city was already really attractive in the early era of big data. Both the scholars worked profusely to gather big data and intertwine them with qualitative and emotional information. Their works are already providing good and reliable methods and ideas to deal with contextual information in the urban environment. The necessity to compensate the scarcity of large datasets (that needed to be independently harvested by scholars) asked for interviews and perspective dependent data to be gathered instead.
With the ICT progress, it is possible to observe how big data started to have a more central and important role in visualisation. Matteo Azzi [2011] Dust, Lupi [2014] *UrbanSensing project and the mobility explorer Iso-

scope [Gortana F., Kaim S. et von Lupin M., 2015] are using rich flows of data to visualise the city. Their aims are different - Dust uses official urban data produced by institutions to help decision making on a specific topic, in Lupi *UrbanSensing we are invited to discover the user generated city through social media data, while Isoscope uses mobility data to visualise possible movements in the city - but the synthetic views of the urban environment are similar, prediliging a distant and comprehensive look to a situated one. The space for qualitative instances on data and the subjective perspectives is limited, as big data and simplified interfaces are the only tools made available to the user. The interest over subjective perspective, however, is not completely gone and it is through big data (such as social media feeds and use generated contents) that researchers try to display cities, designing interfaces that offer large views and real time dashboards to trace the activity of people in the city. Smartphones become active tools in monitoring how inhabitants and city users are moving and using the city projects like Shifted Maps [Dörk M., Müller B., Nagel T., 2014], for example, is interestingly combining personal data with annotations to build mobility maps that could trace the movements and the life quality of users inside the city.

It is by following this idea of personal traces networks that the concept of a subjective built city is addressed again.

By reflecting on the rich traditions of projects cited above, it is clear how changes are still happening and will keep happening in the field of urban visualisations. Gaining easy access to big data sources had fostered a series of projects dedicated to synthetically visualise

the entire city, now the critical debate on data accuracy and trustability is creating a new shift that will most likely prioritise situated and specific views of the city and its parts.
Having easy access to large datasets is slowly acquiring a different meaning: it won't be about visualising the largest possible amount of data anymore, more sources would mean more possibility of choice and more time to be spent on qualitative and critical analysis, since harvesting data won't be a problem anymore. Since various open sources of data are already available online and they will be more and more accessible over time, we will be able to focus on more aspects of the same phenomenon and on how to critically make use of these data and the different instances that generated them.
Finally, there is space for context, not only in terms of visual elements and strategies that we can use to directly encode it while designing interfaces, but also in terms of attention that can be dedicated to discuss the data we are using in our work and in terms of time if we, as designers, decide to gather further knowledge on a topic.

This is where my work aims to position itself: by offering a method to create situated views of the city multiple entities - in this case on temporal, abstract phenomena - I am following this path that has started a long time ago - and will further evolve - to create trustful, diverse and innovative views of these polyrhythmic - and sometimes not smart at all - organisms that are our modern cities.

Biblio-graphy

B

Bernhardt, C., Credico, G., Pietsch, C., Dörk, M. (2014). Duetsche Digitale Bibliothek Visualisiert: How does a cultural collection of over 7 million objects look like?. FH Potsdam - University of Applied Sciences Potsdam. Available at https://uclab.fh-potsdam.de/ddb/

Boyd, D., & Crawford, K. (2012). Critical questions for big data: Provocations for a cultural, technological, and scholarly phenomenon. *Information, communication & society*, 15(5), 662-679.

Bludau, M. J., Dörk, M., Heidmann, F. (2018). Perspective Dependent Data Visualizations of an Art Collection. FH Potsdam - University of Applied Sciences Potsdam.

Buisseret, D. (Ed.). (1998). Envisioning the City: Six Studies in Urban Cartography. University of Chicago Press.

Buja, A., McDonald, J. A., Michalak, J., & Stuetzle, W. (1991, October). Interactive data visualization using focusing and linking. In Proceeding Visualization'91 (pp. 156-163). IEEE.

C

Ciuccarelli, P., Lupi, G., & Simeone, L. (2014). *Visualizing the data city: social media as a source of knowledge for urban planning and management.* Springer Science & Business Media.

Corner, J. (1999). The agency of mapping: speculation, critique and invention (pp. 213-252). *Mappings* (ed. Cosgrove, D.). Reaktion Books.

D

District Department of Transportation Washington DC. (2019). District Mobility. Available at https://www.districtmobility.org/

D'Ignazio, C. & Klein L. (2018 draft). Data Feminism. MIT Press.

Doleisch, H., Gasser, M., & Hauser, H. (2003, May). Interactive feature specification for focus + context visualization of complex simulation data. *VisSym* (Vol. 3, pp. 239-248).

Dörk, M., Carpendale, S., & Williamson, C. (2011, May). The information flaneur: A fresh look at information seeking. *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 1215-1224). ACM.

Dörk, M., Bludau, M. J., Brüggemann V. (2019) Reading Traces: Visualizing Fontane's reference library. Available at https://uclab.fh-potsdam.de/projects/reading-traces/

Drucker, J. (2011). Humanities approaches to graphical display. Digital Humanities Quarterly, 5(1), 1-21.

Idem (2014). Graphesis: Visual forms of knowledge production. Harvard University Press.

E

Ellegård, K. (2018). Thinking time geography: Concepts, methods and applications. Routledge.

G

Gaye, L., Mazé, R., & Holmquist, L. E. (2003, May). Sonic city: the urban environment as a musical interface. *Proceedings of the 2003 conference on New interfaces for musical expression* (pp. 109-115). National University of Singapore.

Gortana F., Kaim S., von Lupin M. (2014). Isoscope: Exploring Mobility. Available at http://isoscope.martinvonlupin.de/

H

Halder S., Michel B. (2018). Editorial - This Is Not an Atlas (pp.13-21). *This is Not an Atlas* (ed. Kollektiv Orangotango+). Transcript Verlag.

Henckel, D., Thomaier, S., Könecke, B., Zedda, R., & Stabilini, S. (Eds.). (2013). Space-time design of the public city. Springer Netherlands.

J

Jänicke, S., Franzini, G., Cheema, M. F., & Scheuermann, G. (2015, May). On Close and Distant Reading. *Digital Humanities: A Survey and Future Challenges. In EuroVis (STARs)* (pp. 83-103).

K

Kirschenbaum, M. G. (2007, October). The remaking of reading: Data mining and the digital humanities. *The National Science Foundation Symposium on Next Generation of Data Mining and Cyber-Enabled Discovery for Innovation*, Baltimore, MD.

Kitchin, R. (2014). The real-time city? Big data and smart urbanism. *GeoJournal, 79*(1), 1-14.

Idem (2015). Data-driven, networked urbanism.

Knigge, L., & Cope, M. (2006). Grounded visualization: integrating the analysis of qualitative and quantitative data through grounded theory and visualization. *Environment and Planning A*, 38(11), 2021-2037.

L

Latour, B., Jensen, P., Venturini, T., Grauwin, S., & Boullier, D. (2012). 'The whole is always smaller than its parts'–a digital test of Gabriel Tardes' monads. *The British journal of sociology*, 63(4), 590-615.

Loukissas, Y. A. (2017). Taking Big Data apart: local readings of composite media collections. *Information, Communication & Society,* 20(5), 651-664.

Lupi, G. (2014). Visualizing the user generated city: exploring the potentiality of emergent geo-social media applications as a novel source of urban knowledge. (Doctoral Thesis, Politecnico di Milano, Milano, Italy). Available at https://www.politesi.polimi.it/handle/10589/89629

M

Maharawal, M. M., & McElroy, E. (2018). The anti-eviction mapping project: Counter mapping and oral history toward bay area housing justice. *Annals of the American Association of Geographers*, 108(2), 380-389.

Mareggi, M. (2012). Pratiche e tempi d'uso nella città contemporanea. Politecnico di Milano.

Mattern, S. (2015). Deep Mapping the Media City. U of Minnesota Press.

Monmonier, M. (1990). Strategies for the visualization of geographic time-series data. *Cartographica: The International Journal for Geographic Information and Geovisualization*, 27(1), 30-45.

Moretti, F. (2013). Distant reading. Verso Books.

N

Nold, C. (2009). Emotional Cartography - Technologies of the self. Available at http://www.emotionalcartography.net/

O

Otten, H., Hildebrand, L., Nagel T., Dörk, M., Müller, B. (2018). Shifted Maps: Revealing spatio-temporal topologies in movement data. FH Potsdam - University of Applied Sciences Potsdam.

P

Pompe, A., & Salaj, A. T. (2014). Qualitative criteria of urbanism and brands: A comparative analysis. Urbani izziv, 25(1), 74.

Pucci, P., & Colleoni, M. (Eds.). (2016). Understanding Mobilities for Designing Contemporary Cities. Springer.

R

Ratti, C., Vanky, A., Santi, P., Duarte, F., Song H., Ma, R., So, W. (2017). City Ways: Unveiling Recreational Movements in Urban Areas. Senseable City Lab. MIT. Available at http://senseable.mit.edu/cityways/app/

Ricci, D. Ciuccarelli, P. (Eds.). (2009). Complexity Maps. In Designing Connected Places (pp. 58 - 71). Torino World Design Capital & Editrice Compositori. Extract available at https://issuu.com/densitydesign/docs/donato_ricci_design_and_visualization

Ricci, D. (2009). Design and Visualization. Diagrammatic Tools for Complexity. *Designing Connected Places.* Torino World Design Capital & Editrice Compositori. Extract available at https://issuu.com/densitydesign/docs/donato_ricci_design_and_visualization

S

Segel, E., & Heer, J. (2010). Narrative visualization: Telling stories with data. *IEEE transactions on visualization and computer graphics*, 16(6), 1139-1148.

Serlen, R. (2010). The distant future? Reading Franco Moretti. *Literature Compass*, 7(3), 214-225.

Serlen, R. (2010). The distant future? Reading Franco Moretti. *Literature Compass*, 7(3), 214-225.

V

Vitrano, C. (2017). Mobilità e disuguaglianze temporali: uno studio empirico sull'accessibilità e il lavoro notturno a Milano. (Doctoral Thesis, Gran Sasso Science Institute, L'Aquila, Italy).

W

Wolfram, M. (2012). Deconstructing smart cities: an intertextual reading of concepts and practices for integrated urban and ICT development (pp. 171-181). Na.

Acknowle-dgements

My gratitude goes first to my advisor Paolo Ciuccarelli from Politecnico di Milano and my investigator Marian Dörk from Fachhochschule Potsdam. Without them I would not be able to dive this deep into this topic. Thank you for the opportunities, inspirations, challenges and feedbacks.
I would also like to thank Nathalie Wachotsch, colleague and friend, for helping me explore Rosenthaler Platz and its secrets.

One big thank to Chiara Vitrano, that introduced me to urban temporal issues. Your contagious passion for this topic was inspiring.

Thanks to my colleagues from Urban Complexity Lab, your warm welcome made me feel home.

Thanks to my family - Benedetta, Fabrizio, Paola - and to my friends - Sonia, Ginevra, Chiara, Marta, Silvia - for always supporting and cheering me up.

Last, but most important: I would like to thanks Francesca. Thank you for never leaving my side in this journey even when things get difficult.