AI beyond Deus ex Machina

Reimagining Intelligence in Future Cities with Urban Experts

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AI beyond Deus ex Machina – Reimagining Intelligence in Future Cities with Urban Experts

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ABSTRACT

The current mechanisms that drive the development of AI technologies are widely criticized for being tech-oriented and market-led instead of stemming from societal challenges. In Human-Centered AI discourses, and more broadly in Human-Computer Interaction research, initiatives have been proposed to engage experts from various domains of social science in determining how AI should reach our societies, predominantly through informing the adoption policies. Our contribution, however, seeks a more essential role for social sciences, namely to introduce discursive standpoints around what we need AI to be. With a focus on the domain of urbanism, the specific goal has been to elicit – from interviews with 16 urban experts – the imaginaries of how AI can and should impact future cities. Drawing on the social science literature, we present how the notion of "*imaginary*" has essentially framed this research and how it could reveal an alternative vision of non-human intelligent actors in future cities.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; *HCI theory, concepts and models*; • **Computing methodologies** → *Philosophical/theoretical foundations of artificial intelligence.*

KEYWORDS

Sociology, Artificial Intelligence, Urban Sciences, Smart City

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1 INTRODUCTION

In a 2019 Nature Review article "Machine behaviour" [66], Rahwan et al. spotlight the discrepancy between the complexity of impacts that AI can have on the human individual and social affairs and the one-dimensional tech-oriented nature of how AI is currently conceptualized and developed. This is followed by seeking an alternative to the present mechanisms of studying machine behaviour: "the scientists who study the behaviours of these virtual and embodied artificial intelligence (AI) agents are predominantly the same scientists who have created the agents themselves".

Motivated by similar broad concerns, the Human-Computer Interaction (HCI) community has offered notable and numerous contributions to interface AI with various domains of social science, mostly as attempts to make compatible automation and efficiency of AI-enabled technologies with human priorities, needs, emotions, and passions (e.g. [1, 32, 39, 51, 64, 70, 74]). The resulting Human-Centered AI campaigns have recognized that in the current forces that shape the evolving world of AI, it is the market-led technology sector that dominantly determines what AI is, how it should be invested in, and in what shape and function will reach the societies [57]. In this model, our cities, our homes, our everyday social interactions, our education system, and many fundamental aspects of our world will be subject to substantial changes that are founded within the technology industry and, at its best, steered by the insights that are confined within the scope of computer and data sciences. We argue that the problem of such a model is beyond the fact that the sociological perspective is missing. One should, more importantly, consider the principles embedded at the core of data science that may be in contradiction with human values and societal priorities. For example, clustering, classification, and profiling when applied to the social realms can engender division, discrimination, and segregation – the problem that has been already seen

in the context of social media and political domain [65], but also the same has begun to manifest itself in the context of urban public spaces [54, 73]. The danger of contaminating the social realm with the inherent desires of data classification is one example. To our observation, across different domains, there is no shortage of critical scholarship that identifies the risks in the currently dominant formulation of AI applications.

In this contribution, we ask whether there can be an alternative formulation of AI: a distinctively sociological conception of non-human intelligence that is not subordinate to or hinged on the technological enablers (machine learning, neural networks, Internet of Things, etc.), but rather is grounded in the societal challenges determining what humans need AI to be. Investigating this question, the eventual objective of our research is to instigate and push forward a discursive campaign that examines how alternative formulations of AI can be constructed. This is essentially different from the proposals that argue for broadening the consideration of knowledge created in social sciences and humanities to inform AI adoption policies and regulations.

We draw on the notion of "imaginary" – as developed by the social constructionist Cornelius Castoriadis – to formulate our research objective as capturing a sociological imaginary of AI and to support the corresponding research method. In general terms, "l'imaginaire" or the "imaginary" is a set of ideas, items, or images, that define what is imaginable for a given individual or collective subject. As a specific notion in Castoriadis' philosophy, it consists of a commonly shared network of concepts, images, stories, and myths that make possible common practices and provide a widely shared sense of legitimacy.

In the interest of clarity and to be able to achieve a concrete outcome, we narrowed down the scope of our investigations to the domain of urbanity. This choice is motivated by the fact that cities are foreseen to be substantially impacted by major AI projects – an evolution that has been discussed under the banner of Smart City. Moreover, a wide span of concerns has been raised questioning the real benefit that cities and their inhabitants gain from some of the highly invested AI projects, for example criticising the push and rush for autonomous vehicles before being able to assess its ramifications [3]. Our aim has been to capture the imaginaries of a specific group: people that shape cities by their actions, or by the theories they transmit through education. We have conducted semi-structured interviews with 16 urban sociologists, city planners, and policymakers who have had a record of influential contributions in the context of European cities. We asked the interviewees about what they recognise as the main concerns of current cities and the priorities of future urban spaces, as well as how they could imagine non-human intelligent actors contributing to possible solutions for current and future cities.

This paper, after describing the process of conducting and coding the interviews in Sections 4 and 5, presents an articulation of collective reflections on possibilities of imagining a sociological conception of AI in future cities in Section 6, and further analyzes it in Sections 7 and 8. Finally, Section 9 offers a broader perspective to discuss our contribution, draw conclusions and outline the future directions for this research.

2 RELATED WORK

This section provides a brief review of research on Urban AI from a sociological standpoint, as well as the previous HCI research interfacing AI with social sciences and particularly steering the vision of smart city agenda. It concludes with an outline of the notion of "imaginary" including its development within the domains of social science and philosophy.

2.1 Sociological approaches to AI and Urban AI

The sociological interest in AI has been continuously developing throughout the past, but often came short by cultivating a reductionist approach towards AI as either a tool for data analysis [15, 25] or the production of theories [13]. A similar trend can be identified within works which focus on the impact of AI on society, such as the social concerns of AI development [12] as well as public perceptions and attitudes towards AI [77]. Such approaches are illustrative of a one-sided inclusion of sociological considerations towards AI, starting from AI as an environmental factor instead of a key actor [47]. On the other hand, there has been a call to acknowledge AI as a key actor within sociological theorising, and the potential of sociology as a key contributor towards AI research. Woolgar [82] has argued that not only does AI provide us with a chance to reconceptualise the basic axiom of the social but conversely how sociology can contribute towards AI development by offering a new perspective towards the artificial. By starting from the social dimension and translating it into the world of artificial agents, the development of AI is shaped within the world and by the necessities of the social dimension. Some researchers go as far as to suggest that true AI cannot be properly achieved without the sociological input [22].

The literature on AI in smart cities has been dominated by themes such as Big-data-driven approaches [6, 10], supported by Internet of Things (IoT) infrastructure and data sharing [7, 11]. A comprehensive literature review of AI research within the smart city landscape has concluded that the central focus is centered around the AI technologies and algorithms themselves, showing a distinct lack of investigation into risks and disruptions of AI in the urban world [83]. Yet the urban-centered approach has also been employed by researchers such as McFarlane and Söderström [54] to change the central axiom of the smart city from an elitist "technology intensive" model towards a more "knowledge intensive" social model. Instead of being driven by the need to employ glamorous new technological expertise, their approach is focused on the knowledge generated from the social challenges of disadvantaged neighborhoods. Such work illustrates the need for a new socially driven approach towards smart technology, by extracting knowledge from the "social" and implementing such newfound perceptions towards AI to overcome previous challenges.

Some researchers have embraced such an approach by focusing on challenges and possibilities in the areas of education [8, 21] and healthcare [56, 61]. Yet, with the exception of the work of Patel [61], these papers have been methodologically focused on literature reviews and theoretical considerations, with a critical lack of gauging conceptualisations of AI from social fields and experts within those fields. Within the domain of smart cities, surveys have been conducted on technological themes [63, 67]. A methodologically similar

approach to our paper can be found in the work of Schechtner [68], who interviewed one academic in the field of geography, yet differing to our approach by focusing on the specific area of adoption gaps in smart cities from the perspective of a single individual.

2.2 AI and Smart Cities in HCI research

Although it may appear that HCI's collaborative entanglement with AI is a relatively recent endeavor, both disciplines have co-developed in a rather competitive manner. Grudin [32] argues that inherent differences in the vision and mission of AI and HCI "led to different priorities, methods, and assessment approaches" and consequentially they contested for – financial and material – resources, with "HCI flourishing in AI winters and moving more slowly when AI was in favor." Despite the inherent formative differences, both these disciplines have found a common ground in numerous research themes at the intersection of technology, intelligence, space, and society. One such theme is that of Smart Cities or Smart Urbanity. Within this particular theme, and in the past several years, we have seen an increased enthusiasm, both in terms of research and technological possibilities as well as funding opportunities from organizations and governments. However, exhaustive scrutiny of the role and impact of HCI and AI within this theme is a relatively recent undertaking, as is evident from the organization of workshops in reputed venues such as ACM CHI [45] and DIS [48]. These workshops have sought to consolidate an interdisciplinary research agenda within HCI around emerging AI issues while critically examining the *a)* responsible and fair embodiment of AI in real-world contexts furnished with knowledge about human values, societal biases, and cultural norms [45], and *b)* viability of varied future possibilities that may emerge as a natural consequence of the mutual engagement of AI and cities by using speculative design approaches [48]. Furthermore, arguments have also been made to re-frame the design principles and methods when considering the design of interactive and intelligent (both built and urban) environments as opposed to the design of intelligent artifacts [4].

Moreover, HCI's relationship with both AI and Cities – or in fact with the conjunction of AI and Cities – is a pivotal one, in that it has led to diverse and rich contributions within the realms of technological and methodological advancements. In relation to urban spaces, Freeman et al. [30] further argue that contributions within HCI have accentuated the practical and technological organization of space as compared to its cultural organization. Such an outlook has in turn resulted in the manifestation of blueprints of "generic world cities" that "sacrifice [their] economic, technological, spatial, and social production" [30]. Furthermore, contributions within HCI, which span across the theme of smart urbanity, can be essentially categorized into *a)* comprehensive envisioning and assessments of diverse future possibilities emerging from the cross-fertilization of HCI's and AI's impact within the urban landscape (e.g., [49, 60]), *b)* empowering citizens to play an active role in urban/civic policy-making, through reduced technological and procedural barriers, which can foster collective development and expression of meaningful participatory narratives about citizens' – physical, perceptual, social and environmental – experiences, opportunities, and concerns (e.g., [24, 30, 36, 50]), and finally *c)* designing novel and nuanced informational services underpinned by the ubiquitous urban technological infrastructure (sensor networks and communication networks) which can support the physical and digital needs, expectations, and experiences of urban dwellers [29], including cohabiting urban fauna [72].

Our contribution is closest in nature to the first category, where we aspire to reimagine an alternative, and more importantly, a bottom-up and sociological conception – i.e. *imaginary* – of AI and its position in smart urbanity. In this way, our study is thematically closest to the *City Yeast* project of Freeman et al. [30], where we seek to elicit specific attributes and functions of AI which are attuned to the needs and experiences of citizens, and simultaneously, address the challenges and concerns of urban planners and designers. Methodologically, our study draws inspiration from the study of Wang et al. [80] who have sought to comprehend the nature of human–AI collaboration in automated AI (and data science) workflows by interviewing expert data scientists.

2.3 The Notion of *Imaginary*

In social sciences and philosophy, *imaginary* is a relatively recent subject of scrutiny. While in French literature "imaginaire" as an adjective – in the sense of what pertains to the faculty of imagination or lacking factual reality – has been recurrent since at least the 16th century. Moreover, the exploration of the concept, as a dimension of the society – as a noun – flourished only over the last few decades [62]. The latter refers to a repertory of items (or images) that define what is imaginable for a given individual or collective subject [19]. In English, however, despite the publications and theoretical reflections on the subject (e.g., [17, 76]), "the imaginary" lacks an entry as a noun in most dictionaries.

The notion of imaginary as such has been discussed also through its collective dimension. Known as *social imaginary*, it has taken up a particular place in social sciences since the works of Cornelius Castoriadis in 1975 on the *Imaginary Institution of Society* [17]. Extending and contributing to the works of philosophers Jean-Paul Sartre, Jacques Lacan, and Gilbert Durand on *l'imaginaire*, Castoriadis explored the nature of the "social imaginary" that, according to him, emerges in precise historic conditions. Castoriadis takes *l'imaginaire* as the anonymous, collective, unmotivated force that nevertheless has strong agency to mold the world we live in.

Collective imaginaries of specific sub-groups or groups of experts have been previously studied through interviews and analysis of discourses, for example looking into the changing imaginaries of European urbanists, their frameworks, and references at the beginning of the turn of the century [18]. Addressing contemporary societies in the context of science and technology studies (STS), Jasanoff and Kim [40] introduced the notion of "sociotechnical imaginaries", which aims to explore the cross-national differences in "exercises of state power, such as the selection of development priorities, the allocation of funds, the investment in material infrastructures, and the acceptance or suppression of political dissent" (p. 123). While their approach addresses the "origins, embedding, resistance, and extension" [41] of the macro-social construction of sociotechnical imaginaries, our focus in this paper is narrower: exploring a particular social group's specific imaginary of AI.

Inspired by the following description, our attempt has been to capture the *network* of ideas and practices that can represent a social

expert imaginary: "The social imaginary gives to the functionality of every system its specific orientation, which overdetermines the choice and the connections of the symbolic networks, creation of every historical epoch, its singular way of living, of seeing and of making its own existence, its world and its relations to it, this original structuring, ... source of what gives itself each time as indisputable and undisputed sense, support of the orientations and of the distinctions of what matters and what does not..." [17]. Thinking of the *imaginaire* as a network also opens connections between Castoriadis' work and other concepts in human science and philosophy such as "monadology" [75], "actor-network" [44] or, perhaps most expressively, the notion of "rhizome" of Deleuze and Guattari [23]. Their rhizome is a network of people, ideas, objects that constitutes reality and transforms it by transforming itself.

3 STUDY OBJECTIVES AND METHOD

The scope of the research presented in this article is confined to a specific domain of urbanism. Moreover, we focus our research on the context of European cities. In this context, the objective is to capture the constituents and structure of a distinctively sociological conception of AI that is not subordinate to or dependent on the technological trends (e.g. deep learning, pervasive sensing), but rather is grounded solely in what experts in a particular discipline need AI to be. Therefore, the specific questions that we strive to answer are as follows: *In the vision of European cities as urban sociologists would describe, what are the promoted ideas that can be associated with a form of non-human intelligence? Consequently, we ask whether a collection of such ideas and their interrelations can create an alternative conception of AI in future cities and how that would be different from the current discourses surrounding smart urbanity?*

Driven by these objectives, we have designed and conducted semi-structured interviews with 16 urban scientists, practitioners, and urban policymakers in Europe. To analyze the interviews we have adopted a mixed-method approach informed by a theoretical framework that draws on the notion of imaginary.

From a broader perspective, the expectation is not that the new conceptions (or imaginaries) of AI lead to the creation of new types of AI devices and tools for smart cities. Rather, by initiating this endeavor to develop such a radically shifted standpoint, our aspiration is to achieve a distant sight for future discourses of smart cities. Such a new perspective should pronounce what AI should bring to societies and shed light on the nature and nuances of tensions between what can be beneficial to future cities and how AI is currently directed. Furthermore, this research seeks to exemplify how the notion of imaginaries can be leveraged to identify the gaps between the current dominant formulation of AI and the domain experts' ideals. We believe that constructing communication mechanisms to bridge these gaps is a timely act and much of the onus falls on the HCI research for its inherent positioning between the realms of digital technologies and social sciences and its legacy "to ensure that human values and human priorities are advanced, and not diminished through new technology" [16].

4 INTERVIEWS

In order to gain insight into urban experts' imaginaries of AI, and its relation to significant societal challenges in cities, we have conducted semi-structured qualitative interviews [14]. The goal is to explore what concerns and expectations are raised by AI in the eyes of the experts within the broad context of spatial sciences, i.e., urbanists, architects, geographers, who are active in both academia and professional practice.

While some potential applications of AI, for instance, appear obvious to researchers in the AI field, they might be absent from the imagination of urban experts. Conversely, our expectation was also that some urban experts expect AI to perform in ways currently absent from the AI research agenda. We have selected our interviewees so as to be able to study gaps between AI and urbanism and if possible, to broaden the very notion of AI.

The ethical application to conduct the interviews has been approved by the data privacy and management committee within the Swiss National Science Foundation that funded the project as part of the evaluation process of the project proposal but also reconfirmed after the completion of the project.

4.1 Selection of Interviewees and Interview Design

We have reached out to urban actors with records of highly impactful projects in academia, professional urban planning, as well as policy-making. Since the orientation of urbanism may have different emphases depending on cultural and economic context, we have decided to limit the geographical extent of our study to central Europe. In the first phase of our research, we have contacted 20 potential interviewees, of whom 16 have agreed to our interview request. All interviews were conducted by video conference and lasted for approximately an hour. An interview outline (described below) served as a general guideline for the subjects to be covered, but we privileged free expression by the interviewees. We have recorded the interviews, transcribed them, and translated them to English when needed (four interviews are conducted in French, two in German, and ten in English). It is worth noting that after our article was accepted for publication, and while preparing the final version, we reached out to the interviewees to know if they would prefer to be identified next to their quotes. Some of the interviewees preferred to be identified by their names, while others preferred to remain anonymous (we use a pseudonym `INTx`, where x refers to a randomly assigned number).

Before conducting the interviews, we prepared an "interview guide" which served as a basic structure of the dialogue, outlining a sequence of questions to be asked and discussed. In compliance with the common practice of qualitative interviewing [33, 81], the interviewers were using the written guide as a memory prompt rather than as a precise script. Instead of reading aloud the questions verbatim, they were to develop a naturally flowing conversation that would gradually cover all relevant subject areas, while also remaining open to the specific concerns and interests of the particular interviewee. According to the outline, each interview started with general introductory questions pertaining to the interviewee's professional orientation and the relation of their work to the urban space, as well as selected aspects of the recent development of their

Table 1: The codebook created from the first phase of interview analysis though discussion and consensus within a multidisciplinary group of researchers. In addition, the number of quotations elicited within each code are also illustrated. For examples of quotations, see the Appendix.

Code	Description	Quotations
The "urban"	Reflections on the role of cities in human societies in relation to urban situations as well as the processes of creation of cities.	206
Governance	Underlying structures of power as well as the interviewee's standpoint on the power struggle between AI and human actors, identified by the central axiom of control over technology and technologies' control over us.	139
Attitude towards AI	Personal, emotional views of AI, culminating in a snapshot of the social responsibility towards AI reflecting the interviewees' standpoint towards the technology and its capabilities.	109
Nature	Reflections on biological components of cities or on global environmental issues.	79
Substance of AI	What AI can and cannot be/do. The interviewees assertion of their view on some of the essential characteristics of AI, and more broadly digital technologies. These assertions may be beyond the specific application domain of urban.	72
Economy	Economic and financial manifestations of cities. The interviewees' perceptions and reflections regarding the economic and market-led aspects of urban environments, and the ways in which it impacts city policies.	71
Ethics	Morally grounded issues or potential troubles with regard to technology and Urban AI in particular.	57
Data	The interviewees' concerns and reflections about the data collection and processing workflows and their ethics, privacy, anonymity, security, and ownership.	55
Equality	Covering topics related to the inequalities in cities and the notion of justice, including social and spatial justice, social diversity, minorities' rights, and accessibility.	48
AI vs. Human	Discourses that position human values and inherent capabilities in relation to the current and possible conceptions of non-human intelligence, as well as thoughts on how these two can collaborate or may contradict.	45
Education	Reflections on education as a social subsystem and institution, and any kind of organised and intentional knowledge transmission.	20
Space-time	Highlighting spatio-temporal discussions, such as the value of time, speeds, and accelerations, how these relate to technologies.	15

field of expertise. The next questions focused on the identification of the major issues of contemporary cities and the provocative notion of an "ideal city". At this point, the subject of "non-human (intelligent) actors" was usually introduced by the interviewer, formulated as a possible general solution to some of the urban problems mentioned earlier. The final part of the interview was dedicated to an explicit discussion of the notion of AI and its possible roles within the urban environment.

5 ANALYSIS – EXTRACTING THE INTERRELATION OF THEMES

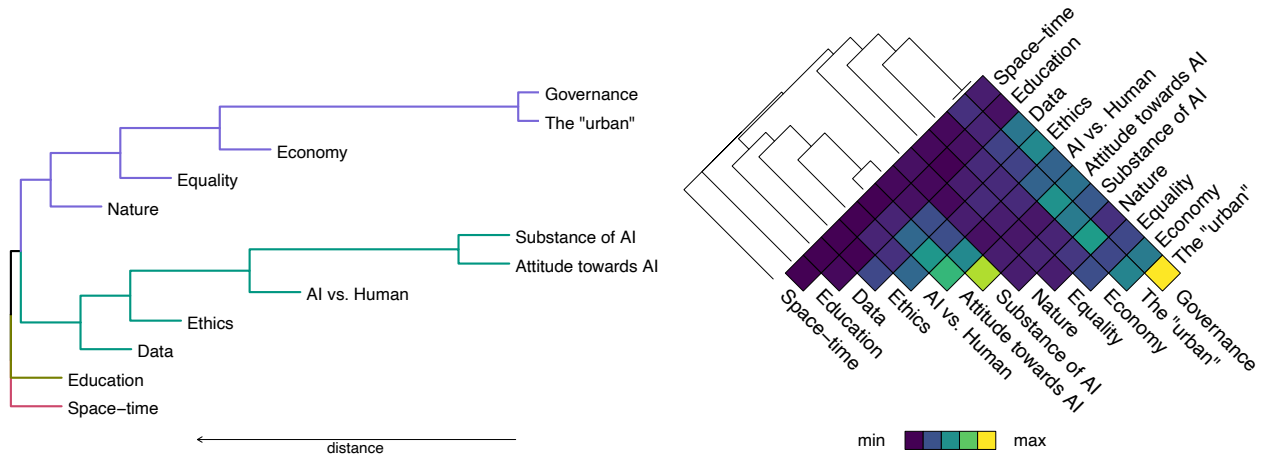
In this section, we briefly describe the first round of analysis of the interviews, including the creation of a codebook, the coding process, as well as the analysis of theme inter-dependencies through identifying their co-occurrences in different parts of the interviews.

5.1 Coding

The 16 interview transcripts were manually coded by six researchers. In qualitative research, the term *coding* refers to a process of annotating a text with labels ("codes") that enables subsequent comparison of individual interview segments referring to particular topics, sort them into categories, and establish a basis for analysing their texture: such as similarities or differences, distance or proximity, and tensions or affiliations (cf. [20]).

Each member of our team assembled a list of ten codes, which inherently reflected her or his disciplinary standpoint. Not being computer scientists professionally engaged with developing AI systems, our approach bears a resemblance to Gaver's "cultural commentators" method that uses insights from individuals who "work outside [a] usual community of discourse, and are often accustomed to reflecting issues ... that are difficult to address from traditional HCI perspectives" [31]. As a next step, we discussed possible ways of consolidating our individual codes into a single codebook, maintaining the multiplicity of perspectives and interpretive approach. Our final codebook consisted of 12 codes, described in Table 1, which were formulated inductively on the basis of our repeated immersive perception of the interview recordings. Thus the codebook reflected our own interdisciplinary interests as well as the concerns and ideas of the interviewees.

The methodological procedure of coding consisted of re-reading the transcripts and focusing on identification and marking of portions of the text that are relevant to one of the codes. Each tagged



(a) Cluster dendogram **(b) Pineplot heatmap**

Figure 1: Cluster dendrogram and pineplot heatmap derived from the *co-occurrence count* matrix. Clustering algorithm used: "complete linkage".

portion of the text is referred to as a quotation. A group of six researchers coded the interviews, each responsible for two codes. The coding procedures elicited 916 quotations with a distribution displayed in Table 1.

5.2 Analyzing Code Co-occurrences – Towards Capturing the Imaginaries

Beyond the mere elaboration of the individual codes, we investigated how the codes co-occurred in the interviews to further gain insight into the associations of ideas and eventually capturing the imaginaries of the experts (as we will elaborate in the next section). This was accomplished on the basis of *thematic overlap*, i.e., when two quotations attributed to two different codes overlap in an interview.

In quantitative terms, the value of C_{ij} – where C is the co-occurrence matrix – indicates the number of times where topics i and j co-occurred in all of the interviews. To analyze the conceptual proximity of the codes, C is converted to a distance matrix (D) and a distance-based clustering algorithm (*complete-linkage*) is applied to identify code groups. Formally, $D := max(C) - C$. The clustering dendrogram and a pineplot giving a visual of the co-occurrence matrix are presented in Figure 1.

In addition to co-occurrence count, we have also tested a second co-occurrence metric, called the *c-coefficient* defined as follows:

$$c := \frac{n_{ij}}{(n_i + n_j) - n_{ij}}$$

Where n_{ij} is the co-occurrence frequency of two codes i and j, whereby n_i and n_j are their individual occurrence frequencies. The *c-coefficient* varies between 0 (these two codes do not co-occur), and 1 (these two codes co-occur wherever they are used). When taking the *c-coefficient*, instead of co-occurrence count, as a proximity metric, the two main groups remain identical. We observe a closer relationship between "Data" and "Ethics", which now constitute a level three grouping. Similarly, "Governance" and "Economy" appear closer too. Also, the nearest two themes appear to be "Attitude towards AI" and "AI vs. Human", before the ("Attitude towards AI", "Substance of AI")-pair identified by the co-occurrence count metric.

As we can see from such slight – yet significant – differences, interpretations can shift along with the parameters of quantitative analysis. Already at the level of attribution of codes to text sections, if themes are associated in an interviewee's discourse without directly overlapping, they become invisible from the point of view of a co-occurrence matrix. Although statistical and quantitative analysis of qualitative interviews is already an established practice [28], its role in our analytic procedure was to provide insights and a general structure for a more fine-grained qualitative interpretation, whose results are presented in the following section in an analytical process to extract an expert imaginary of urban AI.

6 APPLYING THE NOTION OF *IMAGINARY* TO THEMATIC ASSOCIATIONS IN EXPERT INTERVIEWS

To make the notion of imaginary operational in our context, we take up the *network* metaphor as described by Castoriadis (see Section 2.3). The assumption is that an individual's imaginary can be considered as a *network of topics*, i.e., a double unconscious selection: a selection of topics (i.e. codes) and a selection of links between those topics (i.e. co-occurrence of codes) [59]. The collective imaginary of the experts then can be achieved by a superimposition of the individual network of ideas highlighting the most recurrent topics and links.

6.1 Visual Representation of Imaginary as a Network

The analysis of the codes and their co-occurrences brought forward two dominant themes: one around various notions and concerns

related to technology in general, and the other, ideas, issues, and challenges concerning the city. This is much expected as it partly reflects the design of the interviews, seeking to answer how the urban experts imagine reconciling values and concepts associated with urban (i.e., urban conditions) with the current vision of AI (i.e., attitude towards AI) into a new form of intelligence. What is rather unexpected is how these two poles are connected, and how the interviewees conceptually connect the ideas around intelligence with the urban issues. The characteristics of the networks that make pathways between these two poles, we believe, can shed light on what we mean by the alternative imaginaries of AI in cities.

In an attempt to understand, visualize, and make sense of the links between the two poles, we went through a transformed re-iteration of analysis and interpretation. We have applied a layout algorithm[1] to a network whose nodes represent our topics and whose link-weights correspond to the values of the co-occurrence count matrix. To reduce the visual complexity of the illustration, we regrouped the codes that have similar properties in terms of their co-occurrences with other codes. For example, "Governance" and "Data" were often discussed in relation to each other but also had very similar links to the other codes; the same goes for "Economy" and "Equality". The resulting schema is shown in Figure 2, in which the similar codes are grouped within dotted circles, the positions of the nodes are adjusted to make the connections visually clear, and the size of the nodes are changed to reflect the occurrences of the themes. In the remainder of this section, we explain why this figure serves the purpose of making visible the imaginaries of the interviewees. *The main argument is that the blue line (pathway) carries the characteristics of a new imaginary, alternative to the mainstream tech-oriented and market-led conception of AI, which is exhibited in the red line (pathway).* In the next section, we try to gain insight into the nature and attributes of the new imaginary by offering a descriptive analysis on the bases of the interviews themselves as well as the relevant literature particularly in the domain of urban science.

6.2 The two pathways connecting AI and the Urban

By regrouping some of the codes against the background of a network of interconnections of themes in Figure 2, we attained a simpler set of relations, where we can recognise pathways of connection between AI and the City. One of the links (the red line) starts from the recurrent question of "Ethics" in AI, passes through "Governance" (and "Data"), underlining the importance of political power and processes of regulation and legitimization in the adoption of AI, and connects to the persisting challenges of cities like inequalities, firmly related to the dominant economic processes of growth and development. Re-reading the portions of the interviews related to the elements of this red pathway, we recognize two types of discourses: *1)* the statements (re-)articulating the concerns around the current state of AI (ethical issues, transparency, economical division, etc.), and *2)* the proposals for an alternative perspective to the position of "data". As expected, this pathway, which appears to represent the existing conception of AI in cities, covers many of the intertwined concerns that have been widely recognized and discussed in various domains of social sciences, particularly in the domain of urbanism (e.g. [3, 73]). Interestingly, within the current standpoint, when the interviewees seemed to be accepting the market-led and tech-oriented conception of urban AI (in times for the sake of argumentation and in times as an irrefutable reality) the solutions that they discursively construct were focused upon adoption policies that can govern *data*, and not possible alternatives such as adoption policies for AI-enabled applications or machines. We will further analyze this focus on "data" in the next section, showing how a new paradigm surrounding data ownership complements the new imaginary of AI and defines its relation with the current conceptions.

The second pathway (the blue line in Figure 2), nevertheless, seems to be uncovering a sociological standpoint, distanced from the broad questions surrounding AI, and rather focused on issues of the human collective life. It passes through a group of two codes: "Substance of AI" and "AI vs. Human", both of which repeatedly discuss, contrast, and compare AI with humans. After re-reading the related quotations, we realized that these codes, interestingly, contain rather bold assertions in contrast to some of the underpinning principles of AI and conceive novel relations between non-human and human intelligence. Except for a few cases they overlap rarely with the codes associated to the first pathway, while sharing many ideas within the same set of codes across interviews. Owing to the above mentioned features, we argue that what has been visualized as the blue pathway in Figure 2 can help trace the ultimate objective of this research: a novel conception of urban intelligence based on the values and priorities of the cities, and the concerns and visions of the urban experts. In the next section, we investigate this new imaginary, which we refer to as "non-artificial urban intelligence" – the term borrowed from one of the interviews, and alluded to in some of the other interviews with different nomenclatures.

7 THE IMAGINARIES OF URBAN INTELLIGENCE – A NEW DISCURSIVE STANDPOINT

In this section, we focus on the new imaginary of urban intelligence, which we have introduced in the previous section. We provide a descriptive analysis of this standpoint structured in *three* parts: *first* we discuss its composing ideas – the four characteristics of a non-artificial urban intelligence, according to our interviewees – and try to trace them in the relevant literature and legacy of urban design. *Secondly*, we investigate the relation between this new imaginary and the current conception of urban AI through the lens of "data". *Finally*, these will be complemented in the next section (Section 8), by a discussion of what we believe is, insightfully, absent in the presented imaginary.

7.1 "Non-artificial Intelligence" – a sociological imaginary of urban intelligence

In another round of qualitative analysis (re-reading and extracting discursive patterns), we sought to capture the common concepts that appeared in the interviews related to the "human" and the "social", and connecting the urban prioritized concerns with solutions that are characterized as a form of intelligence. We have found four recurring notions that, we suggest, together can cast light on

[1] Edge-weighted spring-embedded, provided by the *Cytoscape* software [69].

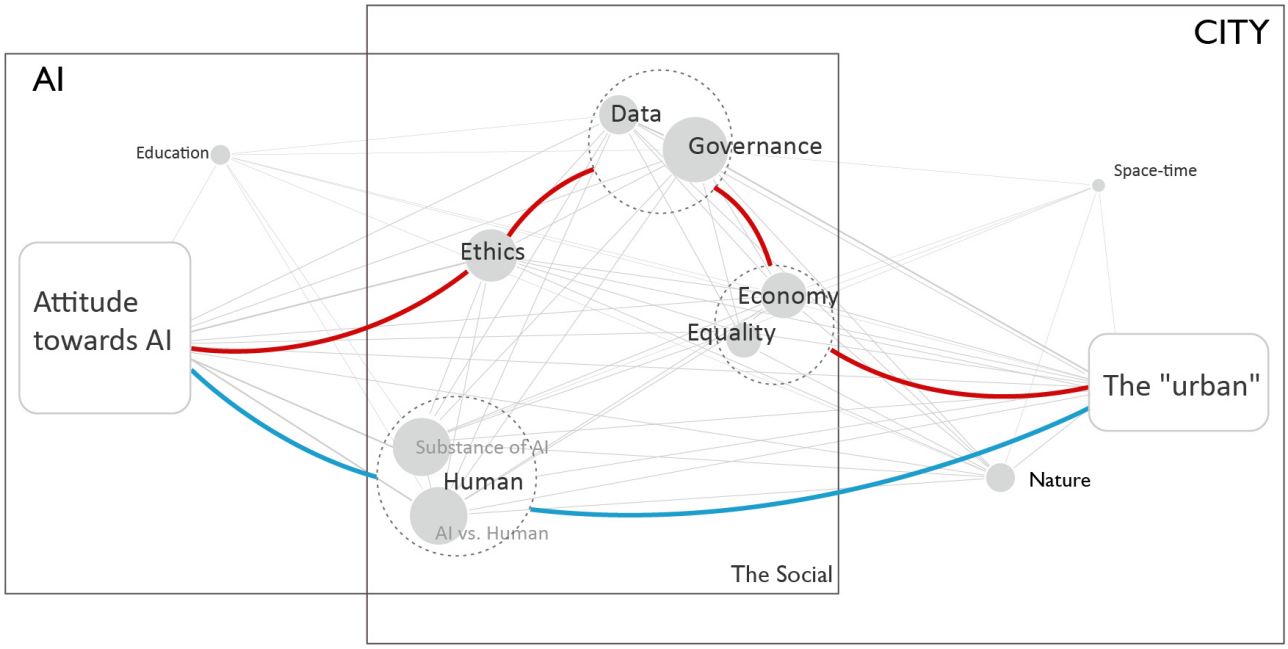


Figure 2: A topology of imaginaries: topics and links between the topics pertaining to the urban and AI, as synthesised from the interviews.

what non-artificial intelligence represents. Interestingly, the elicited discourses around these notions appear to be in limited interdependence (co-occurrence) with the discussion of "data" and "market", suggesting a sociological imaginary of intelligence that can develop independently from the current underpinning principles that define the evolution of AI.

7.1.1 Contextual – the local "wisdom". Most of the interviewees highlighted that any type of non-human intelligence needs human beings and their knowledge of the local context – it can provide answers, but people must be there to ask meaningful questions. Furthermore, "wisdom isn't about choosing an answer. Usually, wisdom is about knowing that there is an infinite number of answers, of which a few are plausible." (INT1). At least three interviewees contrasted "smartness" of cities with what they refer to as *wisdom* or collective knowledge (INT1, INT8, Rob Kitchin). The idea of civic participation channelling the local collective knowledge can also be traced in the urban science literature, where the theoretical works on urban learning and knowledge production [46, 53] have informed the recent discourses around knowledge-intensive urbanity [54]. The recurrent question of "who provides knowledge for urban development strategies?", in these discourses, contrasts with the dominant corporate-driven logics, and often lead to the significance of citizen engagement – the topic that has been addressed in notable HCI research works (e.g. [9]).

From this point of view, the real challenge of non-human intelligence in cities is to be embedded in a *reflexive system* extending beyond techno-fix approaches of optimisation through data and automation, but rather bringing citizens and their knowledge in engaging processes through which the non-artificial urban intelligence is conceived. A failure of an AI system to reach beyond its "data-horizon" yields sectorial solutions to broader problems.

> "And so if you're using it to expand people's minds and to be creative, then that is a great step forward on the road to wisdom, and I guess you need to have the technology where your phone or your laptop or whatever it is, is powerful enough and fast enough and able to do all those things. Of course, that becomes where the technology comes in, simply the tool." (INT1)

7.1.2 Collaborative – augmenting the human intelligence. Many of the interviewees envision a formulation of intelligence that is by nature "collaborative", i.e., functioning as a connected set of confluences between instruments and information. It is collaborative also in the sense of its relation with humans, emphasizing the necessity of human collective participation in the production and dissemination of the intelligence through a democratic process.

> "But it's all about 'how can you also better connect the creative potential of individuals and thus arrive at new designs that you hadn't even thought of before'." (INT14)

> 'So that's also one of the things, I think, about re-imagining this technology, is that you have to imagine how this technology is used within a suite of lots of other instruments." (Rob Kitchin)

The scope of these ideas are often broader than the urban context. When calling for collaborative intelligent instruments, our interviewees rarely link their arguments with the needs of the cities

and their inhabitants, but rather link it to their general impression of where technology should be positioned in the realities of human life.

Some interviewees sketched an image akin to the Hegelian *master–slave* dialectic, including the discussions of humans being "on-the-loop" and "off-the-loop" (Rob Kitchin). Finally, the connection between human and technology can be grounded in a *master–apprentice* relationship, which then leads to the issue of AI "overcoming" its creators, by being "more creative than the person who's written the algorithm" (INT11). AI would therefore possibly give rise to truly innovative ideas, lack of which has been a perpetual point of its critique (e.g., [26, 27]).

7.1.3 Controlled – Human Agency and Interaction. We have often encountered the notion of *control* described as the human agency through various means of individual or collective interaction with the urban intelligence. This overlaps with the previous points surrounding participation and collaboration, but with a distinct emphasis on the human agency and power to overrule non-human intelligence. On the one hand, the interviewees advocate a public control of urban technologies; on the other hand, they warn against intelligence utilized for controlling the public. This points to the conception of technology as inherently ideological, i.e., produced by human beings with interests and political intentions.

> "If we stop talking about Artificial intelligence we can begin to make sense of what it could be made to do, I think. OK, so because it opens up the idea that there are politics to algorithms, there are values, imaginaries to algorithms. And the only way I think one can make sense of Artificial Intelligence in cities is to have that perspective." (INT8)

The interviewees' standpoint around citizens' agency fall within the broader re-emerging discourses in the scholarly domain of urbanism that advocate democratic legitimacy and accountability for urban intelligence: "smart cities are anchored in principles of democratic representation" [55]. An interviewee proposed:

> "I think there should be an ethical codex that ... that we should all start to employ and actually engage in how we deal with those tools, because right now it's totally out of control. I mean, some governments use it for themselves. But at the same time, we know that it's ... It has a life of its own, and I think we as ethical communities, not only as humans, we have to regain a saying in that, if I may say." (INT5)

The complexity of human psychology of *control* over the environment was recognized by our interviewees to be intertwined with the complexity of human interactive experiences with various forms of intelligence embodied by that environment. This view implies numerous questions and manifests many challenges for the growing branch of HCI research and design that seeks to study and steer the evolution of human experiences with and within smart built environments of the future [5]. Some of the interviewees alluded to such intertwinements, for example:

> "I believe that we should use Artificial Intelligence and technology to actually facilitate things. But then where do you put the cursor? And I think that the human interaction should be how to set the cursor." (Jan Bega)

7.1.4 Conscious – an intelligence based on "non-artificial reality". Part of the language used around the ideas of non-artificial intelligence questions the reliance on the instrumental utilisation of *data* as the sole representation of reality and its relevance.

> "... it's a layer that allows you to work. But in the end, the corpus on which we work is the physical city, it's nature, it's the air. It is not the addition of equations or contacts. The corpus still consists of real-life things. Of course we can have the digital, of course we can use all that. But in the end, we like to go and have a beer with colleagues. " (Michael Schuppisser)

This echoes with concerns from other disciplines that "scientists working in a 'data-driven world' are recognising the strong risk of concentrating on data gathering and analysis alone" [61]. In the analyzed interviews we have seen suggestions for a "conscious" intelligence grounded in the evolving public knowledge that is progressive, creative, and generative, instead of relying on information whose validity may not transfer from the past to the future.

> "I would be more interested in a creative, shared intelligence, something like that. " (INT14)

> "So AI is something like a differential equation, it's just a state of things. So it doesn't make any big difference whether it is like this or that, it's just always the same. So it's always the same. So therefore it's dead." (INT4)

Each of the four attributes that describe the new imaginary, as it has become clear above, cross through the scope of the other ones, but also connect with concepts associated with "data". In the following section, we elaborate on these connections, which define the relations between the new imaginary and the current dominant formulation of urban AI.

7.2 Data as a public good

The specific constellation of themes on the upper part of Figure 2 can take us a step forward in the discussion of governance and data ethics in a democratic society, as it links this topic to "Equality". The code addresses the problem of increasing inequalities globally and covers discussions related to racial, economic, and spatial justice in cities, like social diversity and access to nature and healthy urban environments for everyone.

The problem of inequalities has been mentioned in interviews as one of the most pressing challenges of cities, rooted in the economic models based on which the global cities have been developed in the last few decades. Meanwhile, AI, according to the interviews, is suspected to "learn" and reproduce the existing patterns of segregation and exclusion and hence is likely to increase the gaps by further concentrating the power, including the power of data. At the same time, there are hopes about the potential of the use of data. The data produced from the patterns of everyday lives of citizens can inform and guide cities to organise and adapt better to everyone's specific needs. Raising these issues in relation to each other brings forward a very simple question: how can data generated by everybody (that is, through the conduct of our everyday lives) be

used at the service of and for the benefit of everybody? This basic assumption about the use of data — *produced* by all and *consumed* by all — immediately brings forward the notion of "public good" in economics.

A "public good" in economic terms is a collective good that benefits the public: like *knowledge*, it is produced through the same processes as it is consumed. In other words, its production is also its consumption. A "public good" is non-rivalrous: its use by one individual does not cause a shortage of that good for the others. A common example of a public good in the urban domain is public space. Public space is co-produced by its consumers; the consumption of public space contributes to its production. The pedestrian contributes to the existence of the public space by participating in it, by being present or walking through it [2]. In the same fashion, can data or knowledge (or "local wisdom") behind the urban intelligence be regarded as a public good? This question, we believe, summarizes the link between the new imaginary captured from the interviews and the dominant formulation of urban AI.

8 THE ABSENT ASSOCIATIONS

The "imaginary" cannot be reduced to stated topics and links. To imagine is also *not to see*, to be blind to other topics and links of a universe of topics where everything co-exists, and where everything is linked in some way. In Castoriadis' work on the imaginary, there is the notion of the *impensé*, the "unthought-of". In our network metaphor, the *impensé* translates into absent links, i.e., to associations that could have been made, but whereupon our interviewees remained silent – for whatever reasons. As another step to analyze the new imaginary, i.e. the non-artificial urban intelligence, in this section we leverage the concept of *impensé* and describe what we believe are insightful absent associations in the interviews.

Ethical issues occurred overwhelmingly in relation to AI. In other words: while AI raises ethical concerns, the city does not. Whether AI should exist or not – in any shape and form –, and whether it should be deployed in cities – in any kind of way –, remains a question in the imaginary of our experts; a question that could be well answered in the negative on ethical grounds. No such ethical concerns were raised about the fact that human societies organise into cities, although this type of organisation could have been seen as an ethical problem, due, for instance, to relations of domination between centers and peripheries it can induce. The more rarely mentioned topic of "Education" also strikes by its greater proximity to the AI-related topics. Fewer interviewees speak about *urban literacy*, i.e., express the idea that the city is, also, a code or a competence mastered by some and endured by others. The idea that cities, too, are artificial constructs reflecting a specific understanding – i.e., a specific intelligence – of the social functions and processes was rarely discussed.

The *impensé* is also incarnated by a set of topics and associations that one considers so obvious that they are not worth mentioning. In the imaginary of our expert group, the urban seems to encompass the human by default: so much that "human" does not even appear as a distinct topic when discussing the urban, whereas it does occur in the opposition to the artificiality of AI. Our coding process, based on the interviews, has even led us to introduce a joint code "AI vs. Human". This can be contrasted to the close association that some philosophers establish between the human and the artificial: for them – whom we may consider as another expert group – the artificial and the artefact do not oppose the human; on the contrary, being human-made is the very definition of the artificial, which is rather opposed to nature and the natural [79, chapter 9.1]. Contrarily, in the imaginary of our interviewees, nature rather appears in association to the urban, with which it is frequently compared and opposed to. An opposition between nature and AI was never mentioned, although some interviewees pointed towards ideas similar to, e.g., Haraway, who suggested that we should imagine "rich multispecies assemblages that include people" [34]. For instance, Luc Schuiten proposed "finding how to integrate living things, nature, plants in a space that is for the most part excessively poor in this respect," pointing out that "our cities are almost exclusively mineral..." Later in the interview, he adds:

> "The fact that we ... cut ourselves off from this closeness that is essential for me made us bitterer, sadder, less sensitive to things. Seeing a frog in a pond is a little touching and people might start to take care of it a little bit, to go and look. There must be something there that could come back to life and that can make the quality of the dwellings that could calm social relations." (Luc Schuiten)

All of these "absent associations" are of course due, to some extent, to the framing of our interviews. Speaking in the context of a discussion about the urban and AI, most members of our expert group have probably set aside many of their concerns about cities *per se*, focusing on the extra challenges posed by the introduction of the "non-human autonomous intelligent agents". Nevertheless, the "absent associations" also reveal how the introduction of this topic into a discussion can alter an expert's imaginary pertaining not only to AI but also to his or her own field of expertise.

9 DISCUSSION

With regard to the original objective of our study, our expectation has not been that the new imaginaries of intelligence lead to the creation of new types of AI devices and tools for smart cities. Rather, by initiating this endeavor to develop such a radically shifted standpoint and analyzing it, our aspiration has been to achieve a distant, yet engaged, position for future discourses of smart cities. Such a new perspective should pronounce what AI should bring to societies and shed light on the nature and nuances of tensions between what can be beneficial to future cities and how AI is currently directed. This is accomplished through studying alternative topologies of the imaginary where AI and society connect in unexpected ways, and explore new paths for AI development, outside of the brambles of a techno-ideological complex.

9.1 "*Imaginaries*" in HCI

In our work, we draw on the notion of "*imaginary*" (or l'imaginaire in French) [17] to not just *elicit* deeper, founded, and yet shared constructs of urban experts about the entanglement of society, space, and intelligence, but also to *assess* the future position, function, and impact of AI in the urban context. In this way, our contribution is two-fold: *1)* to provoke the existing and established conception of designing AI and pave the way for an alternate conception that

is grounded in societal challenges, and *2)* using our study as an example, exhibit how the notion of imaginaries itself can be used as a conceptual lens to reveal the distinctly sociological themes which would otherwise not be possible with other similar methods prevalent in HCI. With the latter dimension, it is also our aspiration to establish the methodological legitimacy of imaginary within the realm of HCI by contrasting the methodology and its outcomes against similar or overlapping notions within HCI.

Mental Models [42, 43, 58] encapsulate the means through which humans represent and make sense of their social reality, and navigate through it on a daily basis anchored in one's knowledge. Context Mapping [71, 78] (an approach grounded in the design discipline and considered as the key ingredient of participatory design methods) frames the user – the *human* – as an *expert* of her experiences with their specific mental models. Although overlapping with the aforementioned notions, our study and methodology transcend the boundaries of mental models and context mapping because it does not merely capture the knowledge (or a gap thereof) and experience of our participants. It rather draws out deeper constructs ("assumptions", "myths", "experiences"), which can unveil alternative visions and perspectives.

In terms of envisioned outcomes, our approach may appear thematically closest to the notion of Future Studies [35, 37, 38, 52]. Still, there are fundamental differences. For instance, it is not our intention to generate several alternative futures – with their varying temporalities – about AI's role and impact in future cities, but instead a single, coherent, consolidated, and uniquely sociological conception of AI which is different from the existing and dominant ideology. Another point of divergence is our deliberate attempt to not differentiate between possible, probable and preferable futures [38]. Although some of our interviewees expressed their preferred images of a value-centric, ethical, and well-regulated co-existence with AI, these visions were not interpreted by us as diverse possible realities whose realization is conditional to a different set of variables.

Finally, extending the scope of imaginary beyond our immediate study, we believe that this notion is a valid and valuable methodological framework that can be applied to other socio-technical contexts within HCI. For example, to assess and rethink the role of technology in public health, education, culture, etc. Unlike our context where the interviewees had a relatively higher thematic similarity in expertise, this notion can also be employed with multidisciplinary stakeholders to capture the collective, yet complementary network of themes grounded in social and cultural values, biases, and assumptions.

9.2 Research method and its limitations

Regarding our interviewing and coding processes, the acquired experience makes us able to refine them. Unavoidable bias will remain in the dependency of views between interviewers and interviewees – a specific interviewer might reinforce some considerations by deepening specific subjects while leaving others closed – and in the development of the practical skills of the interviewers acquired in each new interview. Therefore, while obtained "independently", the interviews are discursively interlinked by the person of the interviewer. During the coding process, the list of codes can be elaborated by new interview inputs, and frequently recurring topics such as the "definition of the urban condition" can be subdivided to offer a more refined analysis of topics and their links. Finally, we also wish to explore means of improving the metrics of co-occurrence, for instance by taking into account not only overlapping coded sections of our transcript, but all of them, weighting their co-occurrence by relative distance within the transcribed interview. Co-occurrence of codes observed in multiple interviews could also be weighted more strongly.

In research where quantitative procedures are applied to qualitative interviews, the calculations are "not used as a replacement of the qualitative analysis but as a complementary method" [28]. This was also the case with our present work. In particular, the quantitative analysis of codes provided us with novel insights and interpretive frameworks, leading to the discovery of two distinct pathways between urban matters and the interviewees' attitudes towards AI. In combination with a more fine-grained qualitative analysis, we have thus outlined a perspective that reflects upon the risks and challenges of incorporating AI in urban spaces.

9.3 Future Direction

It is still necessary to gain a clearer understanding in further research on how the imaginary of our expert group differs from the imaginaries of other groups. Understanding the specificity of our expert group in the imaginary of a "whole society" is certainly at least as difficult to circumscribe as that "society" itself. A broader view, extending beyond a set of specific research fields, could be offered by conducting survey research. Designing the questionnaire of such a survey requires a finite set of predefined topics that survey participants could identify as either related or unrelated to each other, to AI, and to urbanism. Our research has already contributed to the constitution of this finite set.

10 CONCLUSION

At this point, when AI has become common in everyday life and public discourse – both implicitly and explicitly, often praised and often criticized – our aspiration in this paper has been to radically reimagine non-human intelligence, and to question the "*Deus ex Machina*" perception of AI (in Aristotelian sense, a machine to resolve the plot of tragedies and bring grand effects). Our case study reported here focused on the role of AI in urban environments. Aiming to elicit expert perspectives, we have conducted semi-structured interviews with 16 highly influential urban researchers and practicing professionals. The results of our analysis revealed the characteristics of a sociological conception of intelligence, namely, "contextual", "collaborative", "controlled", and "conscious". We call this expert imaginary of urban intelligence "non-artificial" intelligence, inspired by the use of the terms by our interviewees. In addition, we have found that the urban experts that we interviewed perceive AI, and more broadly technologies enabled by citizens' data, as a carrier of many threats to the relations of power and governance between the social actors of cities, and propose treating data as a "public good". Ultimately, our analysis affirms the argument that AI-based technologies should be thoroughly encompassed by conscious regard to the human condition, encouraging further empirical research in the social implications and meanings of AI. In other words – those

of one of our interviewees – "the relation of human behavior to AI is more important than the development of AI itself" (INT3).

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