

CYCLING IN CLUJ-NAPOCA: AN ACTOR-NETWORK ANALYSIS OF URBAN MOBILITY AND SPATIAL INEQUALITY

Arthur ENE¹, Andrada TOBIAS² 

ABSTRACT. This study explores the dynamics of alternative urban mobility, with a focus on cycling, in the context of Cluj-Napoca. Our analysis, anchored in actor-network theory (ANT) and critical sociological literature, examines bicycle infrastructure not only as a physical support but also as a materialization of power relations and processes of social (de)legitimization. Through semi-structured interviews with users and experts, we investigate how fragmentation, spatial inequality, and compliance with existing car legislation influence the experiences of urban cyclists. We identify how certain interventions, such as green-blue corridors, can contribute to the reconfiguration of urban space and the promotion of more equitable and sustainable mobility. The article contributes to a nuanced understanding of the role of bicycle infrastructure as a terrain for negotiation between human and non-human agents, norms, daily practices, and authority, revealing the complexity of the dynamics between space, power, and identity in contemporary urban societies.

Keywords: Actor-Network Theory, cycling infrastructure, green-blue corridors, spatial inequality, alternative mobility.

Introduction

Urban alternative mobility represents, in the context of contemporary cities, a strategic area of analysis located at the intersection of infrastructure policies, neoliberal urbanization processes, and everyday social practices.

¹ Analiza Datelor Complexe, Faculty of Sociology and Social Work, Babeş-Bolyai University, Cluj-Napoca, Romania; email: arthur.ene@stud.ubbcluj.ro

² Faculty of Sociology and Social Work, Babeş-Bolyai University, Cluj-Napoca, Romania; email: andrada.tobias@ubbcluj.ro



In Romania, intra-urban transport remains dominated by automobile use, a reality that contributes to chronic congestion, high pollution, and an infrastructure regime organized almost exclusively around motorized mobility. This urban organization produces a hierarchy between modes of transportation in which the bicycle, as a non-motorized alternative, is often marginalized both physically and symbolically (Cox, 2020). Moreover, urban planning centered on motorized mobility may reinforce, among others, existing social hierarchies, as the personal car becomes a necessity for fulfilling certain social needs and, at the same time, an essential element for social integration (Arellana et al., 2021). In the Romanian context, most (if not all) of the rapidly expanding urban centers adopt a car-centered vision of mobility.

The present study proposes a critical analysis of alternative mobility in Cluj-Napoca, focusing on everyday cycling as a means of transport. Although official data indicate a slow increase in cycling's modal share (PMUD, 2022), dedicated infrastructure remains fragmented, discontinuous, and often inadequate. This lack is not merely technical but reflects political and economic choices that shape differential access to the city. Accordingly, bicycle infrastructure is analyzed not only as physical support but as a materialization of social relations and as an expression of urban power.

The research is located within a critical sociological tradition that treats infrastructure not as a passive backdrop but as an active agent in the production of spatial and social inequalities (Graham & Marvin, 2001). Mobility is not neutral: it is regulated, distributed and sometimes restricted according to criteria such as economic status, gender, age, or territorial belonging. In the context of the neo-liberalization of cities, infrastructure becomes a form of spatial governance in which the logic of profit and motorized efficiency often prevails over social equity and ecological sustainability (Cresswell, 2010).

To understand how these mechanisms operate in Cluj, the study adopts a relational approach to mobility, emphasizing bicycle infrastructure through an actor-network lens (Actor-Network Theory – ANT). From this perspective, bicycle lanes are treated as networks that go beyond inert physical supports: they are actants whose capacities emerge in interaction with human and non-human agents (Latour, 2005; Law, 2009). Cyclists are not mere passive users but actors who negotiate relations with infrastructure, other traffic participants, institutional norms, and the city's geography. Methodologically, ANT guides the tracing of connections among actors and actants (e.g., lanes, signs, intersections, municipal plans) and the identification of moments when networks are assembled, contested, or reconfigured in practice.

Specifically, the study analyzes the network of bicycle lanes and the institutional framework shaping them, beginning from the Sustainable Urban Mobility Plan of Cluj-Napoca (PMUD 2021–2030). This strategic document reveals the municipal imaginary for alternative mobility but also the persistent hierarchies among mobility forms. Although PMUD mentions objectives for expanding bicycle infrastructure, mobility evaluation is still dominated by motorized traffic indicators (e.g., level of service), while social dimensions such as accessibility, inclusion, and equitable distribution remain secondary (Litman, 2015; Koglin, 2020). Inspired by Lefebvre's (1991) concept of the right to the city and Soja's (2010) spatial justice framework, we argue that the absence of coherent bicycle infrastructure constitutes a form of structural exclusion: cycling becomes an adaptive practice—sometimes invisible, sometimes dangerous—situated at the margins of the dominant mobility system.

To explore these dynamics, the research uses qualitative methods: semi-structured interviews, on-site observation at key routes and document analysis of the municipal planning documents. Finally, the study considers the potential of green-blue corridors as a contextually grounded proposal for more equitable and sustainable urban mobility. Overall, the paper aims to show how bicycle infrastructure in Cluj-Napoca is built, experienced, and contested, and to discuss policy and planning implications for expanding inclusive alternative mobility.

Theoretical Framework

Velo Infrastructure: Facilitation or Segregation?

The development of velo infrastructure in Europe cannot be understood outside the structural transformations that have shaped modern urban mobility. These include, among others: the takeover by the state of the power of decision on urban planning, which brought modifications on the vision of mobility alongside with changes at the level of policies, or the weakening of the voice of cycling organizations that were being thus replaced by the expertise of civil engineers or urban planners (Bonham & Cox, 2010). Initially a symbol of urban elites and recreational activities, the bicycle was not mainly used for mobility, but, with the democratization of production at the beginning of the XX century, it gradually became a means of transport accessible to the large population. Then, in the interwar period, urban cycling began to be perceived as a specific practice of the working class (Oldenziel, 2011), as a fairly wide proportion of the proletariat in Western countries was using the bicycle for commuting.

This happened in a context in which the automobile was gaining the prestige of a marker of modernity and technological progress (Urry, 2004; Cox, 2020). Paradoxically, although cyclists contributed financially to the maintenance of roads (through taxes), as was the case at that time in the bike-friendly Netherlands (Ebert, 2012), urban planning decisions increasingly favored motorized transport. This fact reflects not only a technocratic preference for speed and efficiency in a certain moment when bicycle use was gaining momentum, but also the formation of a symbolic power relationship between forms of mobility (Bourdieu, 1989; Freund & Martin, 1993).

Infrastructure planning has become, in this context, an instrument of segregation for alternative mobility. As Mattioli et al. (2020) argue, the development of infrastructure for cars is not carried out in a simple neutral framework, but represents a politically charged process, which also depends on a series of pro-motorization policies. Also, the reinforcement of certain existing social hierarchies can happen due to the special focus on urban projects intended for automobiles. For example, the car can become a necessity to satisfy certain social needs, in the absence of accessibility or presence of other means of transport (Mattioli et al, 2020). The evolution of the creation of bicycle lanes, far from representing a space of emancipation, has often been conceived as a solution to “discipline” cyclists, considered to be disruptors of car traffic. This vision has been present even in states considered today as being “friendly” to bicycles, such as the Netherlands or Germany, where velo infrastructure was thought of as a compromise imposed to protect motorized traffic flows (Oldenziel, 2011; Mom, 2015).

Sociologically, these processes can be read as part of a fight for urban space, in which non-motorized mobility is often placed in a subordinate position. As Schindler and Kish (2015) note, infrastructure planning reflects political-industrial alliances and normative visions about “legitimate mobility”. Thus, the appearance of bicycle lanes should not be interpreted exclusively as a technical progress, but also as the result of a historical process of reconfiguration of class relations, of symbolic control of space and of redefining the legitimate actors of the city.

At the same time, the remodeling of the organization of space, which has created, among other things, a concise vision of the specific way in which mobility (and especially the alternative) should look like, together with the integration of infrastructure projects in governmental decisions and the change of focus of transport policies have generated a unique framework of interactions for bicycle users to be present. Cyclists’ capacity of action can only be actively rendered in a continuous web of unequal interactions with the mentioned agents.

Symbolic and Political Dimensions of Urban Cycling

Space and time are conventionally perceived as fixed, objective and external dimensions. Although usually seen as immutable dimensions, they can be altered through direct social action (Harvey, 1990). Within the framework of critical sociological theories, these dimensions are understood as socially constructed products maintained through power relations, institutional practices and symbolic mechanisms (Lefebvre, 1991; Massey, 2005). In this regard, the assignment of certain spaces for activities such as urban cycling does not represent a purely technical act, but a profoundly political one, which confers legitimacy to certain social categories and excludes others from the sphere of urban mobility (Tonkiss, 2005; Sheller & Urry, 2000).

Space is also symbolically constructed. Through meaning assignment to different areas and territories, space is also socially delimited, and boundaries are being formed. From the perspective of Bourdieu's theory, space, as symbolically structured, functions like a field of struggle for recognition. The symbolic capital held by social actors varies depending on their position in the social field and, in the case of urban mobility, determines, indirectly, what type of mobility is valued and what forms of circulation are marginalized (Bourdieu, 1989; Crossley, 2001). Thus, velo infrastructure becomes an indicator of urban symbolic order: its absence reflects a peripheral positioning of bicycle users in the hierarchy of mobility. Infrastructure functions not only as a physical device, but also as a system of meanings that institutes and legitimizes a regime of visibility and invisibility (Cox, 2020).

Moreover, urban cycling also carries a variable symbolic weight: it can represent both a counter-hegemonic practice - a form of resistance to the dominance of the automobile and an ecological affirmation of urban identity -, as well as a mark of marginalization of the working class, depending on the local context (Horton et al., 2007; Spinney, 2010; Sarrica et al., 2019). Social representations of cycling integrate cognitive, affective and sensory dimensions that reflect the daily relationship with urban space and the way in which it is experienced bodily and symbolically (Sarrica et al., 2019; Sheller, 2004).

Neoliberal urbanism, despite its comprehensive and ecological discourse, often continues to reinforce structural hierarchies. Urban space planning and the allocation of resources for transport infrastructure reflect power relations, in which the automobile is consolidated as a privileged actor, and the bicycle remains a residual user of public space (Mattioli et al., 2020; Cresswell, 2010). Velo infrastructure is, mainly, built on remainder public space of cities, left after the prioritization of motorized traffic. Such a way of integrating the bicycle reveals not

only technical choices, but also a symbolic order that devalues alternative mobility practices and contributes to the “domestication” of the urban cyclist (Oldenziel, 2011).

In this context, the notion of bikespace, proposed by Peter Cox (2019), is relevant for understanding how the space for cyclists is constituted not only infrastructure-wise, but also symbolically and community-wise. Collective practices such as Critical Mass marches, cycling parades function as forms of reclaiming visibility and offering a new signification to urban space (Cox, 2020; Spinney, 2009). These actions outline a collective identity and express an implicit critique of the motorized hegemony, transforming infrastructure into a symbolic terrain of contestation and affirmation.

Thus, the symbolic dimension of urban cycling cannot be dissociated from infrastructure policies and the regimes of visibility established in urban space. The lack of adequate velo infrastructure is not just a practical obstacle, but a form of symbolic exclusion, which affects the agency, social recognition and the right to the city of bicycle users. Cycling thus becomes a terrain of analysis for understanding the dynamics between space, power and identity in contemporary urban space.

Current Situation of Urban Alternative Mobility in Romania

The absence of a more consistent tradition regarding the use of the bicycle, as well as the lack of a coherent associative structure to represent the interests of cyclists, can be identified as factors that contributed to the low level of social legitimacy of cycling as a means of daily transport on Romanian territory. Urban development, especially in the large centers undergoing continuous expansion, tends to neglect alternative mobility solutions. Thus, the context of urban mobility in the country is characterized by very difficult conditions for alternative means of transport, especially the bicycle. For example, in Bucharest, the capital city of Romania, a metropolis that has reached approximately 2.5 million resident inhabitants (Tempo Online, n.d.), both walking and cycling seem to be administratively placed in inferior positions. The main projects dedicated to alternative mobility appear as unimplemented or partially implemented in the urban plans. For walking, the main impediments are represented by the undersizing of sidewalks or the transformation of pedestrian space into informal parking. This reality, unfortunately, is encountered especially in newly built residential areas, but also in some central areas. The lack of pedestrian connectivity is accompanied, as well, with an extensive fragmentation of the network of bicycle lanes. Inside the municipality, except the small number of km of

marked lanes (60 km), a small percentage of the total is legally homologated (24%) (Planul de mobilitate urbană durabilă pentru regiunea București – Ilfov, 2024)³.

In Timișoara, one of the rapidly expanding western urban centers in the last decade, despite the efforts to increase the practicability of walking in central areas, the same problems as in Bucharest are encountered in residential areas. Furthermore, according to the survey mentioned in the city's Sustainable Mobility Plan for the next 15 years, only 1.1% of journeys in the city are by bicycle (Banca Europeană pentru Reconstrucție și Dezvoltare, n.d)⁴.

In Romania, bicycle and other non-motorized means of transport have a low rate of intra-urban adoption, being considered mostly unconventional means of transportation, although they may be efficient in urban centers. Unlike Western Europe, there is ambivalence in institutional discourses regarding the role of the bicycle, and users are often seen as obstacles in motorized traffic. Limited administrative involvement in urban reorganization to encourage alternative mobility maintains insufficient infrastructure for cycling and pedestrians, with an emphasis on motorized transport, which leads to unsafe interactions between cyclists and motorized traffic.

Cluj-Napoca Urban Mobility Plan and Dimensions of Velo Mobility

This section focuses on the components related to bicycle mobility within the framework of the Sustainable Urban Mobility Plan 2021-2030⁵ of the municipality of Cluj-Napoca. The main purpose is to offer a synthetic perspective on the current status of bicycle use in the city and to identify the strategic directions assumed by local authorities in order to develop infrastructure for alternative mobility. At the same time, certain dimensions of the plan are critically analyzed, from the theoretical standpoint of writings pertaining to the field of sociology and urban planning, in order to highlight any gaps or inconsistencies between the declared objectives and the structural realities.

³ Planul de Mobilitate Urbană Durabilă Regiunea București-Ilfov actualizat PMUD 2.0, https://doc.pmb.ro/servicii/transporturi_drumuri/docs/planul_de_mobilitate_durabila_2016-2030_rev7.pdf

⁴ Banca Europeană pentru Reconstrucție și Dezvoltare, https://sumps-up.eu/fileadmin/templates/sumps-up/lib/sumps-up_registry/_utility/tools/push_resource_file.php?uid=ad4e1e69

⁵ Planul de Mobilitate Urbană Durabilă Cluj-Napoca 2021-2030, https://www.clujmet.ro/wp-content/uploads/2022/01/PMUD_Cluj-Napoca_Draft-final.pdf

PMUD is aligned with the targets of the “European Green Deal”⁶. This aims to modernize transport, reduce carbon emissions and encourage alternative mobility, through objectives such as creating climate-neutral cities, collective transport without emissions and automating mobility. PMUD Cluj-Napoca explicitly points toward reducing dependence on personal motorized vehicles by promoting bicycles, walking and public transport, with an emphasis on improving air quality, public health and protecting resources (PMUD, 2022).

The said analysis of PMUD highlights that, at the time of its elaboration (January 2022), there were 35 km of cycling lanes. However, they were mostly concentrated in the central area, notable fragmentation being the norm. The lack of continuity of the network affects densely populated neighborhoods, some located in the hilly area, and correlates with deficiencies in pedestrian infrastructure, indicating a disproportionate allocation of urban space in favor of motorized transport. The “walk score”⁷ indicator also confirms this trend, reflecting low pedestrian accessibility in neighborhoods such as Gruia (66/100) and Mănăştur (70/100). Also, such areas are almost inaccessible for cyclists as infrastructure is practically non-existent (PMUD, 2022). The distribution of lanes thus reveals not only a lack of spatial fairness, but also a hierarchy of means of transport, where the car dominates. Urban space is thus modeled through symbolic meanings and social practices that naturalize certain behaviors and implicitly consolidate car transport as a norm (Koglin, 2020).

This structural situation perpetuates an accentuated dependence on personal car for daily trips as there is an absence of more prominent pedestrian and bicycle facilities. Data from PMUD 2021-2030 confirm this dependence, only about 8% of trips are made by bicycle (and rather for recreational purposes), and 15% by walking. At the same time, 77% of trips are made by motorized means. (PMUD, 2022, pp. 160-162).

PMUD recognizes the fragmentation of bicycle infrastructure as an obstacle to alternative mobility and proposes a unitary network. Nevertheless, such a way of focusing on increasing the quantitative distances of the lanes might, at the same time, omit qualitative and social aspects of existing and developing infrastructure. This might happen due to the emphasis on numerical indicators, as those present in urban plans (Koglin, 2020). The evaluation of infrastructure

⁶ European Green Deal, https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

⁷ This indicator measures pedestrian accessibility based on nearby facilities and how friendly are the streets with walking on-foot (cove.tool, 2024).

is based on, for example, the “level of service” (LOS)⁸. This approach retains the same car-centric perspective of infrastructure assessment, having origins in the reconfiguration of urban space for car traffic. In addition, the efficiency of bicycle infrastructure in the central area is limited by the lack of connections with the peripheral neighborhoods. Such an analysis model for infrastructure, based on fixed measurements, cannot adequately reflect the social diversity (gender, age, force needed for pedaling, etc.) of the specificity of “soft” means of transport (Ibid., 2020).

This critical analysis suggests that, although PMUD Cluj-Napoca proposes to promote sustainable mobility, its effective implementation requires a reconceptualization of urban space and a more nuanced approach to infrastructure assessment, which goes beyond quantitative indicators and integrates the social, symbolic and experiential dimensions of mobility.

Green-Blue Corridors: An Integrated Solution for Mobility and Environment

The critical analysis of PMUD 2021–2030 of the municipality of Cluj-Napoca reveals, beyond the aspects related to bicycle infrastructure, significant opportunities for integrating nature-based solutions (NbS). Alignment with the European Green Pact implies, in addition to modernizing transport and reducing emissions, specific measures to improve air quality, public health and protect natural resources. These objectives can be achieved through the development of green infrastructure, especially green-blue corridors.

Green-blue corridors, arranged along watercourses, represent a complex urban solution, with multiple implications for climate resilience and environmental quality. These contribute not only to the conservation of ecosystems, but also to reducing the negative impact of urbanization on the physical environment, by reconfiguring urban space in favor of continuous ecological structures, increasing the capacity of cities to cope with climate challenges. At the European level, extreme variations in urban temperature are identified as a major risk, and green-blue corridors can mitigate these effects through natural ventilation and microclimatic regulation (European Environment Agency, 2024).

⁸ The Level of Service of roads is a measure for the quality of some functioning conditions: speed, time of ride, maneuverability, traffic congestion, comfort and convenience. LOS has a hierarchy depending on the operational characteristics mentioned above. It is destined usually for motorized traffic assessment. Safety is not a factor that is measured within this indicator (ISARSOFT, 2024).

Beyond the physical-climatic benefits, green infrastructure plays an important role in reducing urban inequalities, especially those related to accessibility and mobility. Green networks can improve social differences generated by spatial positioning, status, gender or ethnicity, becoming instruments of climate adaptation and vectors of urban equity (Dohotaru et al., 2024).

From the perspective of climate justice, the global agenda for sustainable cities aims at universal access to urban nature, with attention to disadvantaged categories (European Environment Agency, 2024). Densely populated cities, with extensive road infrastructure, generate inequalities in accessibility, and green infrastructure can contribute to the redistribution of symbolic and material access (Dohotaru et al., 2024). By integrating bicycle lanes and pedestrian routes into networks of green spaces, opportunities can be created for alternative mobility for those who do not own cars or live in areas poorly served by public transport.

Studies of urban ecology have highlighted “ecological racism” and “green segregation”, showing that access to nature is not universal, but shaped politically and historically (Liotta et al., 2020, 47–49). Integrating green infrastructure can balance symbolic, functional and material aspects, avoiding gentrification, through democratic policies that protect the right of vulnerable groups to remain in urban space. Alternative mobility becomes a form of democratization of access to the city (Arellana et al., 2021).

In conclusion, green infrastructure is not just an ecological solution, but also a potential instrument for social rebalancing. The essential condition for this to produce democratic effects is that the principles of universality and equity are integrated from the planning and implementation phase. In the absence of such anchoring, the risk that green infrastructure will become a new vector of exclusion, instead of inclusion, remains high.

Research Methodology

The ontology and epistemology of Actor-Network Theory

The type of alternative mobility studied in this paper, observed as a performative act, focuses, in practical terms, on the use of the bicycle as a means of transportation. As detailed in the previous chapter, this phenomenon, from the point of view of its historical evolution, has produced several specific notions about cyclists. These have generated, due to the incorporation of the act of mobility into a set of relations with other agents, a symbolic dimension, loaded with social significance. Due to its existence in a state of relationship with (1) the

infrastructure (that has been in continuous remodeling), (2) the political decisions (that set the tone for expert-based decisions), (3) the social reorganization of urban space and (4) a much higher number of vehicles due to pro-motorization policies, the act of mobility has been affected as such by above mentioned agents.

In order to understand how alternative mobility has been related (although to its detriment) to the rest of the agents involved and in what way its conditions of existence have been shaped - from an ontological and epistemological point of view - this study adopts the assumptions generated by Actor-Network Theory (ANT). One of the main ontological pillars of ANT is based on the idea that materiality is generated by relationship between agents. This principle refers to the fact that it is precisely the links that are actively present between agents that determine their materiality (Law & Singleton, 2014). By weakening the boundary of distinction between what is considered human and non-human, the mentioned theory proposes the extension of the universe of inquiry also to things (objects). Thus, both human and non-human agents, that create a broad web of relationships, being considered active agents, are brought into the scene (Bencherki, 2017; Dolwick, 2009). The relational character of social reality, which also confers its materiality, at the same time, is based on an unceasing performativity (Law & Singleton, 2014). Transposed into the understanding of the reality of alternative mobility through cycling, this ontology would presuppose not only taking into account all the human and non-human agents with whom connections are created, but also how these interactions have generated a specific scenery for the unfolding of the act (Mol, 1999). The reality of mobility today is constituted differently from that of another moment in the past, but it is created through webs of interaction, in the terms of Actor-Network Theory. Also, according to ANT, attention must be paid to the political character of the heterogeneity of interactions (Ibid., 1999). Thus, as stipulated in the previous chapter, the links created with certain agents have a political valence.

Due to the heterogeneous nature of the links, ANT develops its argument that the connections established between agents are not limited only to relations between human entities. Thus, non-human elements can also be brought into the discussion, which can exercise the capacity of action, not necessarily in terms of intention or purpose, but through relating with one another. In this context, the intricacies of these connections become relevant (Dolwick, 2009). Of course, when symmetry between different human and non-human agents is emphasized, it does not refer exclusively to people and objects. Mol (1999) or Law and Singleton (2014) argue that, in accordance with the ontology proposed

by ANT, the connections between agents and politics must also be taken into account, as well as the practices that result from their institutional dimension or from the legislative framework relevant to them.

The vision of the world that the theory proposes may not necessarily be compatible with an interpretive methodology, as this study uses for empirical data collection. But, anyway, Actor-Network Theory's utility is as a toolkit for reality description, rather than as an instrument used for explaining it. The mentioned drawback is due to the fluid nature of the reality proposed by ANT: the links between agents are constantly redefined, and their characteristics vary depending on the new elements in the network and the connections that are established. Moreover, from the perspective of ANT, the lack of a single agent from the network would have meant a completely different historical course for alternative mobility. Therefore, the emphasis is laid upon the formed network, not necessarily on agents' specific actions. Through its epistemology, it thus proposes a new way of describing the reality that is in a continuous state of transformation, and it does not intend to interpret an existing world a priori consolidated (Cordella & Shaikh, 2006). However, the main purpose of this study is to go beyond a descriptive level. The interactions between the different agents mentioned create the framework, the conditions of possibility in which the agents involved in the act of mobility carry out their actions. By using an interpretive methodology, the way in which the collective imagination of urban cyclists is shaped in the context of the complex network of relations in which they are embedded can be understood.

Moreover, ANT can prove to be deficient when it comes to identifying social inequities that are generated by social relations of power. Although, for its followers, the very heterogeneous nature of relations and the capacity of networks to configure themselves between human and non-human agents bring the possibility of exploring the asymmetries that produce inequality or domination, social inequity per se does not represent a central interest. ANT is an important toolkit for describing differences in the capacity of actions (what produces and inequity), but does not propose an ontology that bases its starting point on inequality (Holifield, 2009).

What did we aim for with this research?

Using this perspective that proposes a hybrid environment, this study aims to understand how human agents - cyclists - perceive and integrate into a network. This goal can be achieved by identifying non-human agents with whom

they interact both directly and indirectly (infrastructure, motorized traffic, legislative framework, local policies, etc.) and how these interactions influence and initiate actions.

In addition to understanding the interactions between the two categories of agents, it is important to determine if and how cyclists have the ability to actively negotiate the relationship with non-human elements. Thus, the interpretative methodology is used to offer a subjective perspective on how cyclists perceive and act within this network.

The dimension of symbolic allocation of space must be understood, at the same time, from the perspective of cyclists, being the main creator of inequalities in urban spatial distribution. Possible directions of development of infrastructure through urban nature must be viewed from the perspective of cyclists, following what would be the relations created with other new non-human agents. At the same time, such an interaction would bring new actors on the scene, which would lead to new relations.

The network that is formed between agents and in which they are integrated is constituted outside of them, being in a continuous remodeling due to the interactions and their specificity. Due to ANT and using its assumptions, the study can identify and describe the links between agents. But relying on the comprehension-based goals mentioned above, from an epistemological point of view, the study appeals to a qualitative methodology. The broad web of links, thus, can be described, from the outside, due to the identification of a part of the totality of elements of the heterogeneous ensemble in which the agents are integrated (especially the human ones), but, at the same time, the specificity of the interactions that determine certain characteristics of the actions of cyclists can be understood. Therefore, the study will also focus on understanding the subjective reality of those who use the bicycle as a means of transport, as active agents.

Through semi-structured interviews, several research dimensions are followed: (1) Cyclists and non-human agents with whom they interact, (2) the inequality of interactions considering cyclists and infrastructure, car traffic and other non-human agents, (3) cyclists own self-perception as part of a network, (4) the treatment of transport in numbers (rationalization of transport) and (5) alternative transport through green infrastructure. Other complementary dimensions were introduced in the interview guide later, due to discussions with respondents that generated new adjacent directions of exploration in relation to the central theme of the research. The preference for using the mentioned ontological and epistemological assumptions, as well as the chosen methodological

framework, cannot lead to generalizable results. Thus, those assumptions used to study reality are exclusive to the situation of the study in the case of urban cyclists in the city of Cluj-Napoca.

Discussion: Analysis of processes and dynamics in urban bicycle mobility in Cluj-Napoca

The gathering of qualitative data was carried out through semi-structured interviews with ten respondents: seven regular users of the bicycle as a means of daily transport and three experts in the fields of urban mobility, sustainability and spatial planning. The interviews aimed to follow the dimensions of the interview guide. Certain relevant aspects (from the point of view of the object of the research), which add value to the guide, were explored. They have gradually been unveiled. From the first discussion, the legislative dimension (which, together with the existing infrastructure, and based on it, proposes a specific framework for the unfolding of interactions between agents) represented a direction of research omitted from the dimensions of the interview. It was (only) explored. Very pertinent for relating to infrastructure, traffic and other non-human agents are the personal history of bicycle use, the degree of use and the incidence of certain unpleasant events. Finding out this information set the scene for the later discussion. At the same time, referring to scenarios or concrete locations in the city of Cluj-Napoca represented a more efficient and practical way to obtain the desired results. The differences in reporting to the previously mentioned ones between respondents, but also between respondents and interviewer, could be subjected to comparisons. The results are presented below.

The fragmentation of infrastructure and uneven spatial distribution

All respondents confessed that motorized vehicles can create unpleasant interactions for cyclists, in the absence of a continuous network of infrastructure. Although motorized vehicles are not perceived intrinsically as hostile, the infrastructure dedicated to them dominates the urban landscape and often forces bicycle users to cross dangerous sections of roadway, in the absence of continuous and protected routes. The situations in which the lanes end abruptly, without coherent connections to other important routes, are perceived as expressions of a fragmented planning, which discourages alternative mobility.

Respondents frequently describe situations in which the infrastructure, although apparently existing, does not ensure real protection: lanes placed on already narrow sidewalks, lane markings that intersect with pedestrian routes or unofficially transformed into car parking. Moreover, some certain lanes dedicated to public transport are also intended for cyclist use (for example, one-way bus lane, found on boulevard Memorandumului, in the city center). This type of delimitation dedicated to alternative means of transportation can (although not intended) generate unpleasant interactions. Although it may be just because of a specific organization of the city of Cluj-Napoca. One of the respondents remarks about it:

I was on the bus lane (...), where there is also the sign for bicycles circulation (...) and there was a parked car that opened the door in front of me. The driver told me that this way is only for the bus, it is not for cyclists. (V.S., Secretary of a public institution)

These shortcomings are not just technical dysfunctions, but signal a lack of institutional prioritization of bicycle mobility. The same previous respondent remarked: "(...) you are not seen as in other places where transport by bicycle is considered the same as public transport, which could ease traffic." (Ibid.). Therefore, in the opinion of users, the existing infrastructure functions more as a symbolic compromise than as a practical solution for sustainable mobility.

Redefining the space of certain arteries, which create important connections for the functional context of the city, could play an important role in facilitating mobility. For example, certain roads that are often marked by congestion are also physically very narrow (ex. Clinicilor Street, alternative to the main boulevard on the principal axis of the city). At the same time, those alternatives also become highly congested. The example mentioned above, through a rethinking of spatial organization, could encourage alternative mobility (both by bicycle and on foot). The expert in the field of sustainability remarks, referring to the situation presented: "*(...) a solution here would be to remove the cars parked on Clinicilor Street and cyclists could continue next to the cars (...)*". This remark could only be concretized in this way by eliminating the paid parking on the mentioned street. Along with this, right now there are two auto traffic lanes.

Another respondent (R.G., professor) remarks: "*(...) the design there is clear, to favor auto traffic*", this referring to a lane on the sidewalk, on Moșilor Street. This portion of infrastructure finds its sudden end before the street mentioned above (Clinicilor), thus becoming only a demarcated space, on the sidewalk, on a very short distance for cyclists. Moreover, the lane designated above is

classified as *“parking for cars”* by several interviewees who practice routes on the west-east axis of the city (being also the most used by cyclists, among others also due to the relief).

Possible local causes for the poor development of infrastructure connectivity

Even if bicycle lanes are present in the city, they are characterized by having *“only a symbolic role, but they have no functional role”* (A.D., sustainability expert). It is remarked, especially from the perspective of specialists, a vicious circle in which the political dimension of building bicycle lanes is also involved: *“local authorities do not intervene because they see no cyclists, and cyclists are not on roads because there is no infrastructure”* (T.M., mobility expert). The latter interviewee remarked especially that: *“the local administration should break this vicious circle”* (Ibid.).

In connection with the executive component of the decisions to build lanes, another important aspect, which highlights certain reasons that can prevent or hinder the efficient implementation of urban plans, is related to: *“people from the administration (...) do not ride bicycles. (...) you cannot design a lane well without being a user”* (T.M., mobility expert). Moreover, when the focus is shifted from the local administrative level to the central level, it is remarked that:

At the central level, governmental, a master plan that dictates the entire coordination of infrastructure development is missing, thus, the decisions are taken at the level of public administration, locally. (Ibid.)

Decisions at the local level can be characterized by certain shortcomings in the absence of a central plan, which dictates certain universal design norms, independently of the specific conditions of cities and locations. The planning of urban infrastructure focused on the dominant means of transport, i.e. the automobile, may be due to the lack of expertise of urban planners in developing alternative infrastructure:

Practically we have created road builders, who only made roads for cars, urban planners who only made cities for cars and there have been 40 years of such urban planning. (M.M., expert in urban revitalization/urban planner)

A common pattern in all interviews with experts is the mention of the local decision-making power in the construction of lanes, when the political dimension was brought into discussion.

The development of infrastructure would certainly increase the number of bicycle users, all respondents support this fact. The rehabilitation of roads (which also brings together the development of bicycle lanes), although useful, may perpetuate fragmentation. For example, the rehabilitation of a former industrial platform through the restoration of a park and the construction of a bridge over the river has brought improvements to infrastructure, but only at the micro level. Its connectivity with the central agro-food market (Piața Mihai Viteazu) or the street (from proximity) that connects the train station to the center is non-existent. One of the respondents mentions the rehabilitation of the respective area as a result of real estate developments (and improving the image of the city with this): *"(...) the well-lit bridge, accompanied by bike lanes, was rebuilt near the new tall flat buildings that are being built nearby"* (O. M., teaching staff).

***A higher number of cyclists along with the rest of vehicles,
an option for calming traffic?***

Although the present bicycle lanes of the city are rather characterized by respondents as *"indivisible"*, they have attracted users, especially in recent years. Both one of the experts, and several of the interviewees have remarked the higher presence of bicycle users in the city. Some of them, based on these observations, have mentioned the connection between the increase in the number of users and a (slight) tempering of traffic. Due to some issues that are not necessarily social, such as geography or meteorological factors, in the city of Cluj-Napoca the implementation of a unitary network of lanes could encounter some obstructions. However, the majority of respondents have stated that it is not necessarily lanes delimited by markings, but also portions of roads that highlight in a more serious way the presence of cyclists could be an efficient solution. The respondents have found this solution also as a possibility to encourage the calming of traffic in certain areas of the city. In this sense, cyclists do not exclusively request dedicated spaces, but rather the visible and systematic recognition of their presence in the existing infrastructure, through measures such as reducing auto speed, reconfiguring traffic lanes or integrating clear markings, which can lead to a more equitable cohabitation between different forms of mobility. This perspective highlights a dynamic relationship between human and non-human agents (technical infrastructures), in which bicycle lanes are not just physical spaces, but actors themselves in the networks of

urban mobility (Latour, 2005). Thus, what is often perceived as a simple road delimitation becomes an interface for negotiation between norms, daily practices and institutionalized forms of authority in urban space.

Compliance of cyclists with existing auto legislation

According to the provisions of the current vehicle legislation⁹ in Romania, in the absence of a dedicated infrastructure, cyclists are obliged to circulate on the roadway, thus being integrated, at least theoretically, in the general flow of motorized traffic. However, empirical data indicate that this formal integration does not correspond to the realities experienced by bicycle users. All the respondents interviewed signal the fact that in the so-called “gray areas” – i.e., those portions of the city in which the bicycle infrastructure is completely missing or is fragmented and inconsistent - the circulation of cyclists is significantly hindered. Moreover, these spaces often become places of increased risk, since the legislation does not offer a clear protection for vulnerable road users.

A frequently mentioned example in interviews is that of the segment on Calea Dorobanților - a semi-central artery, with one-way traffic and 4 lanes of car traffic, but with a bicycle lane located on the sidewalk. Following the rehabilitation of the sidewalk and the updating of the markings related to the bike lane, the configuration of the space dedicated to cyclists has changed, determining them to be obliged to give way to vehicles at intersections, including in areas where the continuity of the bicycle route would logically imply cycle and pedestrian prioritization. Paradoxically, even before this administrative intervention, in the absence of explicit signaling, cyclists affirmed that they often felt constrained to give way to motorized traffic. This situation reveals a structural problem: not only does the current legislation create ambiguities, but the infrastructure, in its material form, contributes to the consolidation of asymmetrical power relations between the modes of mobility.

From a sociological perspective, such spaces of juridico-infrastructureal uncertainty can be analyzed as unstable nodes in the network of urban actors, where the cyclist, as a human actant, is placed in a vulnerable position in relation to other traffic participants and to the technical infrastructure itself. In actor-network terms (Law, 2009), road infrastructure and signaling systems do not function as simple physical supports, but act as regulatory agents, mediating

⁹ Codul Rutier Român, <https://www.drpciv-romania.ro/Code/Applications/web/index.cgi?action=codulrutier>

interactions and reconfiguring spatial hierarchies. Infrastructural discontinuities, combined with ambiguous regulation, thus generate a fragmented urban space, in which cyclists are constrained to navigate a network of daily risks, often unnoticed by planning authorities. These microdynamics of mobility indicate the limits of a purely technocratic approach to infrastructure, suggesting the need for a reconceptualization that includes the social, symbolic and relational dimensions of urban mobility (Cox, 2020).

Constraints for Drivers, Accompanied by Alternatives for Mobility

Imposing taxes on the use of personal vehicles inside the city is perceived, by the majority of respondents, as a legitimate and necessary measure for streamlining urban mobility. This appears not only as an economic constraint, but as an instrument for rebalancing the spatial relationship between different modes of transport. The car, say some interviewees, occupies a volume of space much higher than the bicycle, which accentuates mobility inefficiencies in the urban context. However, local policies regarding car parking do not seem to truly discourage their use. For example, in Cluj neighborhoods, the cost of an annual subscription for a parking space for residents (people living in the city for medium to long period of time) is 156 lei¹⁰ in parking lots built by the municipality and 89 lei¹¹ in the rest of the designated spaces. At the same time, parking for bicycles is priced at 71 lei¹² per year. The relatively small difference between these costs, corroborated with the symbolic status and convenience associated with personal vehicles, contributes to maintaining the car as the dominant mode of mobility. Thus, despite declared intentions to reorient towards sustainable mobility, the framework of local public policies continues to favor, at least indirectly, the use of automobiles.

This dynamic also highlights an important limitation of how alternative infrastructure is evaluated and planned: the excessive emphasis on quantitative indicators, such as the *“level of service”*. According to some respondents, such metrics can mask essential aspects regarding the quality, usability or continuity of bicycle infrastructure. An example invoked is that of a lane on a connecting bridge (Bucium), between two very populated neighborhoods (Mănăştur and Grigorescu), built on the north-south axis. This crosses the main artery (Calea

¹⁰ Primăria Cluj-Napoca, Parkinguri, <https://primariaclujnapoca.ro/parcari/parkinguri/>

¹¹ Primăria Cluj-Napoca, Parcări, <https://primariaclujnapoca.ro/parcari/abonamente-locuri-de-parcare/>

¹² Primăria Cluj-Napoca, Parcări, <https://primariaclujnapoca.ro/parcari/biciclete/>

Floreşti) that ensures entry and exit from the city at the western end. The utility for cars of this bridge is significant. Even if the short portion of lane on this segment is classified, from the point of view of the level of service, in a medium category, one of the interviewees expressed doubt about the real degree of use: *"I'm curious how many use it."* (R.G., professor). The question raises the problem of the validity of these quantitative indicators in relation to effective use and with the subjective experiences of users.

Technical Treatment of Infrastructure

Another example, a lane on a main street (Bună Ziua Street), in a modern residential neighborhood, is described as *"rather recreational"* (R.G., professor), since it does not offer a functional continuity to useful daily routes. Also, this portion of lane for bicycles is located at a significant level difference from the city center (approx. 120 m)¹³, which makes its accessibility even more difficult. *"What should I do there? I have to go out on Calea Turzii"* (Ibid.), says the same respondent, suggesting that the lack of connectivity can transform a theoretically functional infrastructure into a marginalized space from a practical point of view.

These observations highlight the importance of a qualitative and contextualized approach in the analysis of mobility infrastructures. The network of bicycle lanes cannot be understood only through the prism of its length or density, but must be analyzed in relation to daily usability, spatial continuity and the subjective perception of those who use it. In this sense, the development of green-alternative infrastructure is not just a technical process, but a profoundly social one, subject to tensions between institutional priorities, user behaviors and the spatial configurations of the city.

Another type of interaction: the green-blue corridor

The green-blue corridor project, which follows the natural route of the Someş River, is perceived by the majority of respondents as a promising urban intervention, capable of creating a safe and equitable alternative in relation to the road infrastructure dominated by automobiles. In this context, the corridor is not only a mobility infrastructure, but also a space with the potential for symbolic transformation of the relationship between city, nature and citizens.

¹³ Calculated using: [freemaptools.com](https://www.freemaptools.com/elevation-finder.htm), <https://www.freemaptools.com/elevation-finder.htm>

By eliminating the direct confrontation between cyclists and drivers, this type of space contributes to diminishing the intermodal tensions that characterize many of the interactions in urban traffic. At the same time, the green-blue corridor is perceived as a more efficient alternative for the development of bicycle infrastructure, especially due to the fact that its route would allow for more fluent mobility and an increased speed of travel for bicycle users. This characteristic is important not only from the perspective of individual comfort, but also in terms of integrating cycling into the functional system of the city. In an urban space in which the distances between residential and economic activity zones are increasingly large, the capacity of infrastructure to support rapid and predictable mobility becomes an essential element of urban equity.

The green-blue corridor is a promising intervention offering a safe and equitable alternative to car-dominated infrastructure, fostering more fluent mobility and faster travel times for cyclists. (M.B., corporate employee)

An important group of potential beneficiaries of this infrastructure is constituted by the inhabitants of the Florești commune, a peri-urban locality located west of the city, which daily provides a consistent flow of commuters to Cluj-Napoca. These represent a vulnerable category from the perspective of mobility: dependent on road infrastructure and directly affected by recurrent traffic jams on the main access road to the city from the west. Similarly, but from the east of the locality, the inhabitants of Apahida face the same type of problems and could benefit from bicycle transport, even in more optimal conditions of travel, the relief being totally flat. The corridor project could, therefore, contribute to the decongestion of these areas, offering a non-motorized, faster and more reliable alternative route.

An important group of potential beneficiaries are the commuters...dependent on road infrastructure and affected by traffic jams. (C. D., civic servant)

Such urban interventions can be interpreted as forms of “ecological reconfiguration” of the city (Amin & Thrift, 2002), through which nature is reintroduced not only as urban decor, but as functional infrastructure. Therefore, the green-blue corridor should not be understood only as a transit space, but as a micro-geography of equity, in which environmental, mobility and social justice policies intersect. In this sense, its symbolic and material importance exceeds immediate usefulness, becoming an indicator of the direction in which the vision of the city is developing: a common space, shared and less segregated according to the means of transport used or the social status of the inhabitants.

Final Considerations

The analysis reveals that urban mobility in Cluj-Napoca is predominantly dependent on personal automobiles, leading to congestion and spatial dysfunctions. This dependence stems from infrastructure that legitimizes certain transport modes and consolidates symbolic relations between agents. Cyclists in the city regard infrastructure as mostly *“invisible”* or as *“predominantly symbolic, with a less functional role.”* Within the framework of social theory, the absence of favorable conditions for alternative mobility undermines the constitution of cyclists as a cohesive social group (Cox, 2020) and limits their agency.

The appearance and development of bicycle lanes (Oldenziel, 2011; Ebert, 2012) constitute important analytical elements for understanding the current configuration of mobility, as they have involved a certain organization of space and a segregation of infrastructure roles. These aspects are manifested predominantly in urban contexts dominated by automobiles, leading to the bicycle being perceived as a relatively unpopular means of transport and with a certain form of social delegitimization. The spatial organization of the city of Cluj-Napoca, although theoretically presenting certain facilities for this mode of alternative transport (delimited and marked lanes), generates remarks such as *“what are you doing here?”*, which reveals not only the social value of cyclists (Cox, 2020), but also their representation in the collective social imaginary. Thus, in the symbolic field, urban cyclists, due to the structural prioritization of motorized traffic, become deprived of visibility.

In accordance with the City’s Sustainable Urban Mobility Plan (PMUD), using the Someș Rover and its tributaries as potential mobility corridors would represent an efficient solution for revitalizing urban transport. Green-blue corridors, in addition to the physical benefits recognized at the urban level (European Environment Agency, 2024), contribute positively to the social dimension of urban accessibility, by reducing the inequities generated by socio-demographic factors (Dohotaru et al., 2024). To fully realize this potential, the PMUD should prioritize the integration of green-blue corridors with existing infrastructure and ensure equitable access for all residents.

The development of alternative infrastructure through urban nature would presuppose both a conducive physical environment and more equitable relations between cyclists and other agents. However, as the connectivity of the bike lane network on the main axis of the city remains precarious and the river bed of the above mentioned Someș remains unadapted, this study considers that despite favorable geographical characteristics, alternative mobility in the city

hovers undeveloped. Addressing this problem requires a holistic approach that considers both physical infrastructure and the symbolic meanings associated with different modes of transport.

Precarious connectivity of the lane network imposes a major impediment for cyclists. Intensifying the presence of symbols specific to alternative mobility could benefit bicycle users, while modifying the symbolic relations between them and automobiles (Koglin, 2020). Looser separation of space between motorized and non-motorized means of transport could contribute to diminishing the hierarchization of the legitimacy of modes of transport.

Cyclists, as active agents in a complex network of human and non-human connections, constantly navigate interactions that are often unfriendly and inequitable. This stems from infrastructure limitations, pro-motorization policies, and urban planning decisions. While a relational ontology helps illuminate these dynamics (Mol, 1999; Law & Singleton, 2014), acknowledging unequal power relations (Holifield, 2009) is crucial for understanding the dominance of automobiles. Future research should explore the lived experiences of cyclists from diverse backgrounds to gain a nuanced understanding of these power dynamics and identify strategies for promoting equitable and sustainable urban mobility.

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