A systemic investigation and strategic design response to barriers to ***cycling*** in the car centric city of ***Turin***

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"The city is a means to a way of life. It can be a reflection of all our best selves. It can be whatever we want it to be. It can change, and change dramatically."
(Montgomery, 2013, p. 12)

Preface

Urban mobility is one of the fundamental components of how cities are experienced. It shapes how people move around, but also how they perceive, inhabit and relate to each other as well as to the urban space. Among all the various modes of transport, cycling is often presented as one of the most promising alternatives to current car-oriented mobility systems, offering a great variety of environmental, social and individual benefits. Yet, despite this widely acknowledged potential, its everyday adoption remains limited in many urban contexts.

This research originates from a personal experience of this contradiction. Growing up in Turin, cycling was never part of my daily mobility. In my memory, the bicycle was associated with specific moments rather than everyday life: occasional attempts to use it for practical purposes, sunny spring afternoons that made it feel appealing, and few childhood memories of family Sundays spent cycling in parks. It was rarely perceived as a real alternative to other modes of transport. But of course this changed significantly after moving to the Netherlands, where cycling is not only widespread but deeply embedded in everyday life and urban systems. Experiencing this shift first-hand showed me how profoundly mobility practices can influence both individual well-being and the quality of urban environments.

Rather than assuming that such models can or even should be simply and directly replicated, this experience raised a more fundamental question: why does cycling remain marginal in cities where many of the apparent conditions for its adoption seem to be present?

In this sense, Turin was chosen because it represents a particularly relevant case, beyond it simply being my hometown. The city is predominantly flat and relatively compact, with almost every neighbourhood located within a 7 km radius of the city centre; these are conditions that would in theory make cycling a feasible option for a large share of daily trips (La Torre, 2020; Rosso et al., 2025). At the same time, Turin is well known for its historical role as a “one-company town” and the headquarters of FIAT, and it records one of the highest motorisation rates in Europe, reaching approximately 757 cars per 1,000 inhabitants (Isfort, 2025), while cycling still accounts for only a limited share of urban mobility, estimated at 3% of total trips (EMTA, 2021). This coexistence of favourable spatial conditions and low levels of cycling adoption highlights a structural tension that cannot be explained by single factors alone.

This thesis builds on this tension. It aims to understand how barriers to cycling adoption emerge and interact within a specific urban context, and to translate this understanding into a design perspective. The research focuses on the early and strategic phases of the design process, where analysis and contextual insight support the definition of directions for intervention.

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Executive summary

Cycling is widely recognised as one of the most effective levers for making urban mobility more sustainable, healthy and liveable, yet its everyday adoption remains marginal in most Western cities. This thesis investigates that contradiction through the case of Turin, Italy, a city that is morphologically well suited to cycling, predominantly flat and compact, with almost every neighbourhood within a 7 km radius of the centre, but that records one of the highest motorisation rates in Europe (approximately 757 cars per 1,000 inhabitants) and a cycling modal share of only around 3% of daily trips. Turin therefore offers an emblematic example of a "Starter" city, where favourable spatial conditions coexist with a deeply rooted car-centric culture inherited from its industrial past.

The research addresses a gap in the existing literature, which has tended to analyse barriers to cycling in isolation and to draw on cities with long-established cycling cultures whose solutions cannot be directly transferred to car-dependent contexts. Against this background, the study asks how local decision-makers can be supported in prioritising and addressing the most critical barriers to cycling adoption in Turin.

The investigation follows a qualitative, design-oriented process structured around the Double Diamond model. It combines a structured literature review based on the PRISMA framework, which organises the barriers to cycling into five macro-categories; a contextual analysis of Turin's spatial, cultural and institutional conditions; and an empirical phase based on eighteen semi-structured interviews, fifteen with everyday mobility users (distinguished between cyclists and non-cyclists) and three with field experts in cycling mobility. The findings are then translated into design priorities through a multi-criteria prioritisation framework that combines three dimensions drawn from the empirical data: perceived relevance for users, and perceived impact and difficulty of intervention for experts.

The analysis confirms that barriers to cycling in Turin operate as an interdependent system spanning infrastructural, behavioural, cultural and institutional dimensions, rather than as isolated obstacles. Three findings prove particularly significant. First, a consistent gap emerges between user perception and expert evaluation: users anchor their assessments in what they directly experience, such as network discontinuity and unsafe intersections, while experts identify latent and systemic conditions, such as car-culture dominance and institutional lock-in, that operate beneath the threshold of everyday awareness. This asymmetry has direct design implications, since the barriers most visible to potential cyclists are not necessarily those most resistant to change, and effective strategies must address both registers at once. Second, the institutional framing of cycling as a sustainability measure is misaligned with how cyclists actually experience it, namely as a source of

personal autonomy, well-being and enjoyment. Third, the formation of cycling habits in childhood emerges as one of the most durable and underexploited levers for long-term change.

These insights inform a two-layer design response. The first layer is a strategic roadmap that translates the prioritisation framework into a shared, evidence-based reference tool for local decision-makers, sequencing interventions across time horizons, thematic domains and levels of institutional responsibility. The second is Turin Bike Kids Club, a web-based platform that collects, structures and circulates initiatives supporting cycling normalisation among children and in school contexts. Beyond its outputs for Turin, the thesis contributes a replicable methodological process for translating locally grounded barrier research into strategic design intervention, one applicable not only to other cities with low cycling maturity but also to other domains of active mobility, and more broadly to any context where a widely recognised practice fails to achieve actual adoption.

Chapter 1

Introduction

1.1. Why cycling and why it matters

Urban mobility is well known as to represent one of the central domains in the fight to the current climate crisis (Lanzini & Khan, 2017; Rosso et al., 2025). The transport sector is responsible for approximately 14% of global greenhouse gas emissions and, unlike other industrial sectors, has shown limited progress in reducing its environmental impact over recent decades (Lanzini & Khan, 2017). Within this context cities play a critical role, because they concentrate most of everyday mobility demand and represent the most effective scale for implementing transition policies (Lanzini & Khan, 2017; Rosso et al., 2025).

Among the strategies that are aimed at reducing the environmental and social costs of the transport systems, cycling is widely recognised as a particularly effective lever (Abdolrazaghi & Mirbaha, 2024; Rosso et al., 2025). As a mode of transport, it simultaneously addresses multiple dimensions of the urban mobility problem. From an environmental perspective it contributes to lowering greenhouse gas emissions, air pollution and energy consumption (Bhandal & Noonan, 2022; Mela & Girardi, 2024; Rosso et al., 2025). At the same time it comes together with significant public and individual health benefits, because it integrates some physical activity into daily routines and so decreases the risks associated with sedentary lifestyles (Fernández-Heredia et al., 2014; Götschi et al., 2016; Mela & Girardi, 2024).

"Faced with immense problems such as widespread obesity, traffic congestion, climate change, class inequity, social isolation, and budgetary constraints, decision makers have brought this nimble machine back from near-extinction to confront these daunting challenges head-on." (Bruntlett & Bruntlett, 2018, p. 14)

Beyond these aspects, cycling also produces broader urban and socio-economic effects. It requires significantly less space than motorised transport, contributing to a more efficient use of public space and reducing traffic congestion (McLeod et al., 2020; Dufour, 2010; Rosso et al., 2025). It improves accessibility and represents an affordable mobility option for a wide range of users (den Hoed, 2025; Dufour, 2010), while also generating economic benefits through lower individual transport costs and reduced pressure on public health systems (Mela & Girardi, 2024; Piras et al., 2023). In addition, cyclists refer very positive experiential dimensions, including greater autonomy, perceived efficiency in urban travel and a more direct engagement with the urban environment (den Hoed, 2025; Passafaro et al., 2014).

For these reasons the bicycle should not be interpreted as a mere alternative or recreational mode of transport (den Hoed, 2025; Fernández-Heredia et al., 2014). Rather, it should be understood as to be representing a practical and scalable component in the reconfiguration of urban mobility systems, with the potential to address multiple structural challenges simultaneously and to contribute to more liveable, healthy and accessible cities (den Hoed, 2025; Rosso et al., 2025). And in cities such as Turin, where the potential conditions

for cycling adoption coexist with a still dominant car-oriented mobility system, this tension becomes particularly evident.

1.2. Research gap and limitations

Despite the extensive evidence documenting the multiple benefits of cycling, its actual adoption remains limited in most urban contexts (Handy et al., 2014; Pucher & Buehler, 2008). In many Western cities the modal share of cycling rarely exceeds a few percentage points of daily trips, often as low as 1% to 2%, revealing a persistent gap between the recognised potential of this mode of transport and its real-world uptake (Doğru et al., 2021; Goel et al., 2022).

A large body of research has attempted to explain this gap by investigating the barriers that discourage individuals from choosing the bicycle for everyday mobility (Heinen et al., 2010; Pucher et al., 2010). But existing studies often analyse these obstacles in isolation, focusing on specific variables such as infrastructure availability, perceived safety or individual attitudes (Davies et al., 1997; Pooley et al., 2011). While these approaches have generated valuable insights, they frequently produce a fragmented understanding of the mechanisms that shape cycling behaviour, failing to capture the complex interplay between observable factors (e.g. infrastructure quality) and latent factors (e.g. social identity, perceived security) (Fernández-Heredia et al., 2014; Silvestri et al., 2024; Sottile et al., 2019).

The possibility to transfer findings across contexts is another relevant limitation. Many of the most cited success stories in cycling policy come from cities with long-established cycling cultures, such as Amsterdam or Copenhagen (Pucher & Buehler, 2008), but interventions that turn out to be effective in these "Champion" contexts cannot be directly replicated in "Starter Cities", where auto-mobility is deeply embedded in infrastructure as much as it is within institutions and everyday practices (Félix et al., 2019; Dufour, 2010).

"As countries look to the Netherlands for inspiration, they'll find one takeaway more important than any other: every location is different, and it's never as simple as copying-and-pasting their methods."
(Bruntlett & Bruntlett, 2018, pp. 18-19)

For this reason, the literature increasingly emphasises the importance of context-sensitive investigation (Panter et al., 2019; Rosso et al., 2025). Barriers to cycling do not operate as universal constants, rather their relative weight and interaction vary according to the socio-cultural, spatial and institutional characteristics of each city (den Hoed, 2025; Heinen et al., 2010). Understanding these locally specific configurations therefore becomes a prerequisite for designing effective and context-appropriate interventions that can successfully put the transition in motion (Félix et al., 2019; Silvestri et al., 2024). Within this perspective, the city of Turin is selected as a relevant case study to investigate how these dynamics unfold in a context where favourable spatial conditions coexist with a strong car-centric culture and low levels of cycling adoption.

1.3. Research aim and objectives

Building on the limitations identified in the existing literature this research aims to investigate the barriers that limit the adoption of cycling as a mode of everyday mobility in the city of Turin, Italy. Rather than treating these barriers as isolated obstacles the study approaches them as interconnected elements within a broader urban mobility system, where infrastructural, social, cultural and institutional factors interact in shaping mobility choices.

The objective of the research is twofold. First, it seeks to understand which barriers currently hinder the adoption of cycling in Turin, assessing their relative relevance within the local context. Second, it aims to translate this understanding into a strategic perspective, identifying the leverage points that could support the wider integration of cycling and developing concrete design outputs that make these priorities actionable for local stakeholders.

To achieve these objectives the study combines insights from the existing literature with qualitative empirical research conducted in the local context. In particular conversations with experts and urban mobility stakeholders are integrated with interviews with everyday users, so to capture both professional and institutional perspectives and lived experiences of urban mobility. This approach allows the research to explore how structural conditions, perceptions and practices interact in shaping cycling behaviour.

By focusing on a context where cycling is still marginal, this study seeks to contribute to the broader discussion on how transitions towards cycling mobility can be put into motion in cities where car-oriented systems are still dominant. In doing so, this research aims to give support to the development of strategies that are context-sensitive and capable of stimulating the gradual shift towards more sustainable, healthier and more liveable urban mobility systems.

1.4. Research questions

Building on the research gap identified in the previous section, this study can be described as guided by a main research question supported by a set of hierarchically structured sub-questions that address different levels of inquiry.

RQ (main): “How can local decision-makers be supported in prioritising and addressing the most critical barriers to cycling adoption in Turin?”

To answer this question, the research is structured around three sub-questions:

RQ1 (theoretical level): “Which barriers limit the adoption of cycling in urban mobility systems and how do different structural and perceptual factors interact in shaping cycling behaviour?”

RQ2 (contextual level): “How do these barriers manifest and interact within the specific urban context of Turin?”

RQ3 (strategic level): “Which barriers represent the most relevant leverage points within the context of Turin and how can they be addressed through strategic design interventions aimed at promoting cycling adoption?”

Together, these sub-questions define the research pathway, in which theoretical understanding (RQ1) informs contextual interpretation (RQ2), which in turn supports the identification of strategic priorities (RQ3), ultimately contributing to answering the main research question.

1.5. Research design, methodology and thesis structure

This thesis adopts a qualitative, exploratory and case-study-based research

design, aimed at investigating how barriers to cycling adoption emerge, interact and persist within a specific urban context, and how this understanding can support strategic design interventions. The study focuses on the city of Turin as a context-sensitive case, where favourable spatial conditions coexist with low levels of cycling adoption and a strong car-oriented mobility culture.

From a methodological perspective, the research combines multiple complementary methods across different phases. These include a structured literature review based on the PRISMA framework, conducted to identify and synthesise existing knowledge on barriers to cycling; a contextual analysis combining desk research with direct observation and photographic documentation of the urban environment, aimed at understanding the spatial, infrastructural and institutional characteristics of the case study; and a qualitative empirical investigation based on eighteen semi-structured interviews with both everyday mobility users and field experts. This multi-method approach was selected to integrate theoretical insights, contextual conditions and lived experiences, supporting a systemic understanding of the factors that shape cycling behaviour.

The overall research process is informed by a design-oriented logic inspired by the Double Diamond model (Design Council, 2019), which structures the progression from problem exploration to solution development through alternating phases of divergence and convergence. This logic is reflected in the architecture of the thesis. The first diamond corresponds to the problem space: a divergent phase of exploration, spanning the literature review and the contextual and empirical investigation (Chapters 2 to 4), followed by a convergent phase in which the findings are synthesised and the most relevant barriers are framed as strategic priorities (Chapter 5). The second diamond corresponds to the solution space, moving from the divergent ideation of possible directions to the convergent development of the final design outputs (Chapters 5 and 6). Rather than a rigid procedure, the model functioned as an internalised orientation that informed how the research moved between opening up and narrowing down at each stage.

Accordingly, the thesis is organised as follows. Chapter 1 introduces the research topic, defines the research gap and presents the research questions, design and methodology. Chapter 2 develops and describes what is considered to be the theoretical foundation of the study through a structured review of the literature on barriers to cycling adoption. Chapter 3 provides a contextual analysis of the city of Turin, consisting in an attempt to examine its spatial, cultural and institutional characteristics in relation to urban mobility. Chapter 4 presents the empirical part of the research, based on qualitative data collected through semi-structured interviews with users and experts, and analyses how barriers are perceived and experienced in practice. Chapter 5 translates these findings into a strategic perspective, identifying key leverage points and defining directions for intervention also through the development of a more precise design brief. Chapter 6 develops these directions into two concrete and complementary design outputs (a strategic roadmap and an initiative platform) aimed at supporting local stakeholders and responding to the main research question. Finally, Chapter 7 discusses the main findings of the research, reflects on its limitations and outlines potential directions for future work.

Chapter 2

Literature review

2.1. Literature review methodology

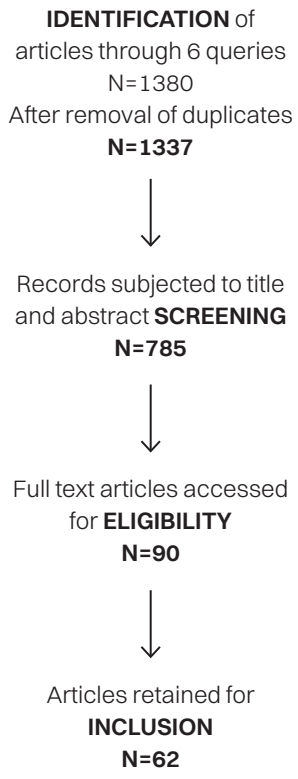
The literature review was structured in accordance with the flow logic proposed by the PRISMA framework, in order to ensure transparency and procedural clarity. The process followed the four core phases of Identification, Screening, Eligibility and Inclusion, adapted to the scale and objectives of the present master's research.

The bibliographic search was conducted through Scopus, which was selected because of its broad multidisciplinary coverage and its strong representation of peer-reviewed research in transport studies and social sciences. An initial exploratory consultation of leading journals in the field, including Travel Behaviour and Society and Transport Reviews, supported the refinement of keywords and the definition of the conceptual perimeter of the study.

Six queries were developed and applied through the Advanced Search function using the TITLE-ABS-KEY field. The search strings combined the following terms: ("cycling behaviour" OR "cycling behaviour") AND ("barriers" OR "determinants"); ("urban cycling" OR "bike mobility"); ("cycling" AND "Italy"); ("cycling" AND "Turin"); ("active mobility" AND "Italy"); ("active mobility" AND "Turin"). The inclusion of "active mobility" was theoretically motivated by its relevance within the broader framework of sustainable urban mobility, within which cycling represents a specific modality. No temporal restrictions were imposed, in order to include both recent review articles and empirical studies, as well as earlier theoretical contributions relevant to the definition of key concepts. Filters were subsequently applied for document type (peer-reviewed articles and reviews) and language (English and Italian).

Across the six queries, 1,380 records were identified. After export to reference management software and removal of duplicates, 1,337 unique records remained. During the Screening phase, and in order to balance comprehensiveness with analytical feasibility, a threshold of 250 records was applied to queries generating larger result sets; in these cases, the first 250 entries sorted by relevance were considered. Queries returning fewer than 250 results were screened in full. This procedure resulted in 785 records subjected to title and abstract screening. Although the use of relevance-based ranking entails reliance on the database's algorithmic ordering, this decision was taken consciously to preserve thematic salience while maintaining a manageable corpus.

Of the 785 screened records, 692 were excluded on the basis of predefined relevance criteria. Exclusion at this stage concerned studies not focused on urban contexts; contributions primarily addressing technical, physiological



or biomechanical aspects unrelated to mobility behaviour; works centred on e-bikes, cycling tourism or other niche sub-domains not aligned with everyday urban mobility; and studies with limited conceptual relevance to the Italian or European context. A total of 93 records were retained for full-text assessment, which became 90 after the removal of residual duplicates.

During the Eligibility phase, full texts were examined in depth by a single reviewer, with decisions guided by the previously defined research objectives and relevance criteria. At this stage articles were excluded whenever they provided limited analytical contribution in relation to the research questions, were too descriptive without sufficient conceptual or empirical depth, or presented substantial thematic redundancy with more comprehensive or methodologically robust studies already selected. Following this assessment, 62 peer-reviewed articles were retained for inclusion and constitute the final body of literature underpinning the thesis.

In addition to the database search, backward and forward citation tracking was conducted on selected key publications to further consolidate coverage of the academic debate. Complementary sources, including a limited number of relevant master's theses identified through open-access university repositories, as well as selected books and practitioner-oriented publications, were also consulted to support the conceptual framing of the study. These sources were not included in the systematic screening process but informed the broader theoretical background. The resulting corpus provides a foundation for the subsequent analytical and design phases of the research that is considered to be conceptually coherent and methodologically transparent.

2.2. The adoption gap in cycling mobility: how the literature frames the problem

The starting point of contemporary literature on active mobility is the recognition of a fundamental paradox, already introduced in Chapter 1: the evident discrepancy between the objective benefits of cycling and its actual levels of adoption (Aldred, 2019; Cabral et al., 2018). If on the one hand it is scientifically well established that a shift towards cycling produces significant advantages in terms of public health, reduction of greenhouse gas emissions and urban quality of life (Bhandal & Noonan, 2022; Cabral et al., 2018; McLeod et al., 2020), on the other hand, empirical data show that, in most Western cities, the modal share of cycling remains markedly low, often between 1% and 4% (Bélanger-Gravel & Janezic, 2021; Bhandal & Noonan, 2022; Daley et al., 2007; Félix et al., 2017; Sottile et al., 2021).

An analysis of the collected academic contributions reveals that the literature tends to follow a recurring narrative structure in framing this problem (Doğru et al., 2021; Passafaro et al., 2014). The examined papers almost invariably begin by defining cycling as one of the main responses to the global challenges generated by road transport systems and pollutant emissions (Echeverría et al., 2022; Fernández-Heredia et al., 2014; Passafaro et al., 2014). Shortly thereafter, however, the authors emphasise that such awareness does not translate into large-scale behavioural change, describing the phenomenon as an "intention–behaviour gap" or "green gap" (Cabral et al., 2018; Passafaro et al., 2014). The academic narrative therefore shifts rapidly from the acknowledgement of

benefits to the recognition that infrastructure alone is not sufficient to trigger substantial change (Doğru et al., 2021; Sottile et al., 2020; Sottile et al., 2021).

It is precisely in response to this gap between theory and practice that a distinct strand of research on barriers has developed (Davies et al., 1997; Félix et al., 2017; McLeod et al., 2020; Timmons et al., 2024). The analysed studies clarify that examining obstacles (whether physical, social or psychological) emerges from the need to understand the factors that prevent cycling adoption despite a generally favourable perception of the mode (Biassoni et al., 2023; Davies et al., 1997; Félix et al., 2017; Prati et al., 2017). In this way, the literature no longer positions the reader before the question "why is cycling beneficial?", but rather before the crucial technical issue of identifying the deterrents that make cycling behaviour still a difficult choice for the majority of the population (Bhandal & Noonan, 2022; Daley et al., 2007; Davies et al., 1997; Félix et al., 2017; Timmons et al., 2024).

2.3. Cycling as a socio-technical and behavioural practice

"Travel time was seen as a wasteful disutility, to be minimised at all costs. Speed was to be increased and friction at street level decreased, and every other human being — whether on foot, on a bicycle, or in a car — became a competitor; an obstacle to the pace and progress of the homo economicus." (Bruntlett & Bruntlett, 2023, pp. 51-53)

For the comprehension of the gap of cycling adoption, the literature suggests moving beyond a view of modal choice as a rational decision purely based on costs and travel time (Fernández-Heredia et al., 2014; Sottile et al., 2020). Instead, mobility behaviour is being interpreted more and more as a complex socio-technical practice that emerges from a delicate interaction between individuals, the built environment and the broader socio-cultural context (Bhandal & Noonan, 2022; Félix et al., 2017; Timmons et al., 2024). From this perspective, cycling can be analytically framed through four interrelated dimensions that help explain the plurality of barriers examined in the following paragraphs.

First, modal choice is deeply routinised and habitual. A substantial body of research shows that everyday travel is rarely the outcome of continuous deliberation, but rather of automatic responses triggered by contextual cues (Passafaro et al., 2014; Semenescu & Coca, 2022; White et al., 2019). Habit functions as a relatively independent determinant that can "override" deliberate intentions: individuals accustomed to car use tend to overlook available alternatives, making behavioural change a challenge that extends beyond the mere provision of infrastructure (Aldred & Jungnickel, 2014; Gutiérrez et al., 2020; Lanzini & Khan, 2017).

Second, the cycling practice is socially mediated. According to the Theory of Planned Behaviour (TPB), "subjective norms", meaning the perceived expectations and behaviours of significant others, play a central role in shaping the intention to cycle (Lanzini & Khan, 2017; Passafaro et al., 2014). So, social influence operates through peer pressure, family support and through the perception of cycling as a "normal" or desirable behaviour within one's community (Aldred & Jungnickel, 2014; Davies et al., 1997; Giubergia et al., 2024; Prati et al., 2017; Passafaro et al., 2014). In the absence of a critical mass of cyclists, the bicycle may struggle to be perceived as a legitimate transport option (Aldred & Jungnickel, 2014).

Third, cycling possesses cultural meaning. Mobility is not merely functional displacement but also an expression of identity and social positioning (Fruhen

et al., 2019). In many Western contexts, the bicycle carries symbolic meanings that range from the environmentally "cool" to the social stigma of those who can not afford car ownership (Prati et al., 2017). The literature describes how often cyclists are shaped as an "out-group" or as members of a minority, facing a form of "double stigma" that alternately portrays them as reckless road users or as incompetent and vulnerable subjects (Aldred, 2013; Aldred & Jungnickel, 2014; Prati et al., 2017; Timmons et al., 2024). These cultural meanings, further mediated by gender and social class, can significantly influence individual dispositions to either adopt or reject cycling (Aldred & Jungnickel, 2014).

Finally, cycling practice is embedded within an institutional system historically shaped by the paradigm of auto-mobility (den Hoed, 2025; McLeod et al., 2020). For decades, urban planning has largely prioritised motor vehicles, structuring public space predominantly around their needs (Aldred, 2019; McLeod et al., 2020; Prati et al., 2017; Timmons et al., 2024). This institutional imbalance generates not only material constraints but also asymmetries in the distribution and perception of risk, contributing to the marginal position of cycling within dominant mobility regimes (McLeod et al., 2020; Rosso et al., 2025).

"The car is not the problem, but it's the best symbol of the underlying problems; the bicycle is not the solution, but it's the best symbol of the types of solutions that we're looking for."
(Bruntlett & Bruntlett, 2023, p. 57)

Adopting this multidimensional perspective makes it possible to link categories of obstacles that might otherwise appear disconnected. The lack of cycling infrastructure (an infrastructural barrier), fear of traffic (a psychological barrier), and social stigma (a cultural barrier), among the others that are discussed below, do not belong to separate domains, but rather represent different manifestations of a single practice embedded in the social and technical fabric of contemporary cities (Bhandal & Noonan, 2022; Bishop et al., 2024; den Hoed, 2025; Félix et al., 2017; Winters et al., 2017).

2.4. From isolated obstacles to systemic barriers

The multidimensional nature of cycling is recognised by the literature, yet much of the existing research has tended to analyse obstacles in a fragmented manner, focusing on specific barriers isolated from their systemic context (Bhandal & Noonan, 2022; Davies et al., 1997; Vallejo-Borda et al., 2020). This "atomistic" approach, which for example examines variables such as the lack of cycling infrastructure or the individual fear of traffic separately, may lead to the risk of producing a partial and sometimes contradictory view of the phenomenon (Aldred & Jungnickel, 2014; Doğru et al., 2021). By contrast, a critical analysis of the reviewed papers reveals a strong interdependence among factors: barriers do not operate in isolation, but overlap and reinforce one another, collectively shaping the cycling experience and the city's actual accessibility (den Hoed, 2025; Silvestri et al., 2024).

"Where light traffic knits a community together, heavy traffic rips it apart."
(Bruntlett & Bruntlett, 2023, p. 35)

To overcome the limits of this analytical fragmentation it becomes necessary to recognise that barriers to cycling operate at different and interconnected levels, often framed within socio-ecological models of mobility (Bhandal & Noonan, 2022; Bishop et al., 2024; Winters et al., 2017):

- Individual level: includes psychological and physiological factors, such as personal attitudes, confidence in one's own abilities (self-efficacy), and risk perception (Bishop et al., 2024; Passafaro et al., 2014; Timmons et al., 2024).
- Relational level: concerns the influence of social norms, peer or family

support, and the pressure of reference groups that may legitimise or stigmatise bicycle use (Bhandal & Noonan, 2022; Bishop et al., 2024; Prati et al., 2017).

- Urban and environmental level: encompasses not only physical infrastructure and network connectivity, but also urban morphology and climatic conditions (Cabral et al., 2018; den Hoed, 2025; Timmons et al., 2024; Titze et al., 2008).
- Institutional level: refers to the planning system, investment policies, and the dominant cultural paradigm (auto-mobility) that systematically prioritises or marginalises active users (McLeod et al., 2020).

The literature suggests that any predictive model or intervention strategy that ignores the complexity of these interactions is likely to also underestimate the actual weight of deterrents (Semenescu & Coca, 2022). For example, the subjective perception of safety (individual level) is not merely a reflection of street design (urban level), but is mediated by local road culture and the behaviour of other users (relational and institutional levels) (Abdolrazaghi & Mirbaha, 2024; den Hoed, 2025; Piras et al., 2023).

In this thesis, the distinction between these dimensions is assumed to be purely analytical in nature. Of course in the socio-technical practice of cycling these factors are fused into a single lived experience, but still their decomposition represents an essential methodological tool for the reading of a system that would otherwise be too complex to manage analytically (Doğru et al., 2021; McLeod et al., 2020; Xiao et al., 2022). So, the decision to construct the macro-categories of barriers that are presented in the following section does not aim to deny their ontological intertwinements, but rather to provide a systematic framework that is capable of guiding decision-makers towards integrated interventions acting simultaneously across multiple levels (Davies et al., 1997; Gutiérrez et al., 2020; Sottile et al., 2021).

2.5. Categorisation of barriers to cycling adoption

The literature on active mobility identifies a wide range of factors influencing the adoption of cycling, spanning infrastructural, psychological, social and institutional dimensions (Biassoni et al., 2023; Semenescu & Coca, 2022; Sottile et al., 2021). But as discussed in the previous sections, these obstacles are often analysed in isolation, producing a fragmented understanding of the mechanisms that discourage cycling behaviour (Bhandal & Noonan, 2022; Semenescu & Coca, 2022).

To address this limitation, the barriers identified across the reviewed studies have been reorganised into a synthetic analytical framework. The objective of this synthesis is not merely descriptive; rather, it aims to isolate the underlying deterrence mechanisms that shape individuals' mobility decisions, moving beyond the enumeration of isolated variables.

Drawing on socio-ecological perspectives and on studies that group determinants according to their functional role, the obstacles identified in the analysed papers are reorganised here into five macro-categories. Each category captures a specific dimension through which cycling is evaluated as

a mobility option, allowing different deterrence mechanisms to be examined within a coherent analytical structure.

Although analytically distinct, these categories should not be interpreted as independent domains: they represent interconnected components of the same system and their effects, all combined, contribute to the sustainment of the gap between the generally favourable attitudes towards cycling and its relatively low levels of adoption (Lanzini & Khan, 2017; Semenescu & Coca, 2022).

2.5.1. Risk and safety constraints

Barriers related to the perception or experience of physical vulnerability and risk. The main driver is the anticipation of harm or accident. The bicycle is not perceived as a protected environment, and the risk arising from interaction with traffic or other factors is considered unacceptable.

Table 1. *Risk and safety constraints*

Barrier	Description	Supporting literature
1A: Excessive motorised traffic and intrinsic vulnerability	High traffic volumes, speed and vehicle mass create a structural asymmetry between cyclists and motorists.	Abdolrazaghi & Mirbaha, 2024; Prati et al., 2017; Rosso et al., 2025
1B: Aggressive motorist behaviour	The perception of hostility and the lack of respect for cyclists generate a hostile environment, characterised by an increase in both stress and perceived danger.	Bélanger-Gravel & Janezic, 2021; Bhandal & Noonan, 2022; Bishop et al., 2024; Daley et al., 2007; Davies et al., 1997; Fruhen et al., 2019; Félix et al., 2019; Passafaro et al., 2014; Prati et al., 2017; Rosso et al., 2025; Silvestri et al., 2024; Sottile et al., 2021
1C: Lack of physical protection	The absence of segregated cycling infrastructure or effective traffic-calming measures leaves cyclists directly exposed within traffic.	Abdolrazaghi & Mirbaha, 2024; Bhandal & Noonan, 2022; Cabral et al., 2018; den Hoed, 2025; Gutiérrez et al., 2020; McLeod et al., 2020; Panter et al., 2019; Rosso et al., 2025; Vallejo-Borda et al., 2020; Timmons et al., 2024
1D: Complex intersections	These concentrate conflict points and require manoeuvres such as crossing traffic streams or turning across lanes that may be perceived as high-risk situations.	Abdolrazaghi & Mirbaha, 2024; Aldred & Jungnickel, 2014; Davies et al., 1997; O'Hern et al., 2020; Rosso et al., 2025; Vallejo-Borda et al., 2020; Timmons et al., 2024
1E: Accident statistics as psychological deterrent	Awareness of cycling-related injuries and fatalities amplifies the perception of danger regardless of personal lived experience.	Abdolrazaghi & Mirbaha, 2024; Mela & Girardi, 2024; Passafaro et al., 2014
1F: Personal insecurity in isolated areas	Fear of assault, robberies or harassment along poorly monitored routes.	Davies et al., 1997; Félix et al., 2019; Gutiérrez et al., 2020; Panter et al., 2019; Rosso et al., 2025; Vallejo-Borda et al., 2020

1G: Theft and vandalism	The perceived likelihood of bicycle theft or damage reduces confidence in using the bicycle for daily mobility.	Bhandal & Noonan, 2022; Davies et al., 1997; Félix et al., 2019; Fernández-Heredia et al., 2014; Gutiérrez et al., 2020; Sottile et al., 2021; Vallejo-Borda et al., 2020
1H: Additional environmental risk factors	Poor lighting, limited visibility, stray animals and unexpected obstacles reinforce overall insecurity.	Abdolrazaghi & Mirbaha, 2024; Bhandal & Noonan, 2022; den Hoed, 2025; O'Hern et al., 2020; Rosso et al., 2025; Vallejo-Borda et al., 2020

2.5.2. Material and spatial feasibility constraints

Barriers that affect the objective feasibility of the trip, limiting the practical possibility of using the bicycle due to physical, spatial or environmental conditions. The primary drivers are technical impracticability, excessive physical demand or structural inefficiency of the context.

Table 2. *Material and spatial feasibility constraints*

Barrier	Description	Supporting literature
2A: Unfavourable topography and hilliness	The presence of steep climbs requires physical effort that may render cycling impractical.	Abdolrazaghi & Mirbaha, 2024; Baeli et al., 2022; Bhandal & Noonan, 2022; Cabral et al., 2018; den Hoed, 2025; Félix et al., 2019; Fernández-Heredia et al., 2014; Giubergia et al., 2024; Mela & Girardi, 2024; Rosso et al., 2025; Semenescu & Coca, 2022; Sottile et al., 2021; Timmons et al., 2024; Vallejo-Borda et al., 2020
2B: Adverse weather conditions	Persistent heat, heavy rainfall, strong winds, or cold temperatures reduce the physical comfort and viability of cycling.	Abdolrazaghi & Mirbaha, 2024; Bélanger-Gravel & Janezic, 2021; Bhandal & Noonan, 2022; Bishop et al., 2024; Cabral et al., 2018; den Hoed, 2025; Félix et al., 2019; Fernández-Heredia et al., 2014; Semenescu & Coca, 2022; Sottile et al., 2020; Sottile et al., 2021; Timmons et al., 2024
2C: Excessive distances and urban sprawl	Low-density urban forms and long travel distances increase travel time and energy expenditure beyond what is considered acceptable for everyday cycling.	Bhandal & Noonan, 2022; Biassoni et al., 2023; Bishop et al., 2024; Cabral et al., 2018; den Hoed, 2025; Félix et al., 2019; Fernández-Heredia et al., 2014; Gutiérrez et al., 2020; Jussila et al., 2026; Passafaro et al., 2014; Rosso et al., 2025; Semenescu & Coca, 2022; Sottile et al., 2021
2D: Perceived excessive physical demand	Cycling is avoided when the required effort is perceived as exceeding one's physical capacity.	Bhandal & Noonan, 2022; Biassoni et al., 2023; Bishop et al., 2024; Davies et al., 1997; den Hoed, 2025; Doğru et al., 2021; Félix et al., 2019; Fernández-Heredia et al., 2014; Gutiérrez et al., 2020; Jussila et al., 2026; Timmons et al., 2024

2E: Limited intermodal integration	Poor coordination between cycling infrastructure and public transport.	den Hoed, 2025; Echeverría et al., 2022; Félix et al., 2019; Panter et al., 2019; Sottile et al., 2021
2F: Cycling network discontinuity	Fragmented or interrupted cycling infrastructure.	Félix et al., 2019; McLeod et al., 2020; Panter et al., 2019; Rosso et al., 2025; Sottile et al., 2021; Timmons et al., 2024
2G: Lack of end-of-trip facilities	Absence of secure parking, showers, changing rooms or storage at destinations.	Bhandal & Noonan, 2022; Davies et al., 1997; den Hoed, 2025; Doğru et al., 2021; Félix et al., 2019; Fernández-Heredia et al., 2014; Gutiérrez et al., 2020; Piras et al., 2023; Sottile et al., 2021
2H: Poor road surface quality	Uneven pavement, potholes, debris or inadequate maintenance.	Abdolrazaghi & Mirbaha, 2024; Aldred, 2013; Bhandal & Noonan, 2022; Bishop et al., 2024; den Hoed, 2025; Panter et al., 2019; Passafaro et al., 2014; Pooley et al., 2011; Rosso et al., 2025; Vallejo-Borda et al., 2020
2I: Path obstructions and spatial conflicts	Invasions by pedestrians, parked vehicles, street vendors or other obstacles along cycling routes.	Abdolrazaghi & Mirbaha, 2024; Bellizzi et al., 2021; Caulfield et al., 2012; den Hoed, 2025; Silvestri et al., 2024; Vallejo-Borda et al., 2020

2.5.3. Comparative utility and convenience constraints

Barriers that emerge from a comparative evaluation between cycling and available alternatives. The deterrent mechanism is perceived efficiency: the bicycle is rejected when it is considered less convenient in terms of time, flexibility, comfort or overall utility.

Table 3. *Comparative utility and convenience constraints*

Barrier	Description	Supporting literature
3A: Habitual mode lock-in	Established travel routines reduce the likelihood that cycling is actively considered, even when it may be functionally viable.	Aldred, 2019; Baeli et al., 2022; Bhandal & Noonan, 2022; Cabral et al., 2018; Davies et al., 1997; Doğru et al., 2021; Gutiérrez et al., 2020; Lanzini & Khan, 2017; Mela & Girardi, 2024; Passafaro et al., 2014; Pooley et al., 2011; Semenescu & Coca, 2022; Sottile et al., 2021
3B: Trip-chaining complexity and dependent mobility	The need to combine multiple stops within one trip or to accompany children, elderly relatives, or other dependants.	Aldred & Jungnickel, 2014; Badland et al., 2013; Bhandal & Noonan, 2022; Daley et al., 2007; Félix et al., 2019; Giubergia et al., 2024; Gutiérrez et al., 2020; Pooley et al., 2011; Sarkheyli & Sarkheyli, 2026; Semenescu & Coca, 2022; Sottile et al., 2020; Sottile et al., 2021; Timmons et al., 2024

3C: Opportunity costs of car ownership	When a household already owns a car, its marginal cost of use is perceived as low, reducing the incentive to shift to cycling.	Aldred, 2019; Bhandal & Noonan, 2022; Davies et al., 1997; Echeverría et al., 2022; Giubergia et al., 2024; Semenescu & Coca, 2022; Sottile et al., 2021; Vallejo-Borda et al., 2020
3D: Automobile comfort and technological amenities	Climate control, seating comfort, entertainment systems and protection from weather enhance the perceived convenience of the car.	Aldred, 2019; Daley et al., 2007; Davies et al., 1997; Fernández-Heredia et al., 2014; Semenescu & Coca, 2022; Sottile et al., 2021
3E: Perceived long travel times	Cycling is avoided when journey duration is considered excessive compared to motorised modes.	Bhandal & Noonan, 2022; Cabral et al., 2018; Félix et al., 2019; Fernández-Heredia et al., 2014; Hunt & Abraham, 2007; Jussila et al., 2026; Sottile et al., 2021
3F: Direct individual costs of cycling	Perceived expenses related to bicycle purchase, maintenance or equipment.	Baeli et al., 2022; Bhandal & Noonan, 2022; Bishop et al., 2024; Daley et al., 2007; Davies et al., 1997; den Hoed, 2025; Félix et al., 2019; Hunt & Abraham, 2007
3G: Preparation and organisational time	The need to change clothing, manage appearance, carry equipment or plan around weather and unknown routes adds perceived inconvenience compared to door-to-door motorised travel.	Daley et al., 2007; Davies et al., 1997; den Hoed, 2025; Félix et al., 2019; Pooley et al., 2011; Rosso et al., 2025; Sottile et al., 2021

2.5.4. Normative and identity constraints

Barriers rooted in social norms, cultural meanings and identity processes that shape how cycling is interpreted and valued. The bicycle is rejected when it is perceived as socially illegitimate, inconsistent with one's identity or associated with a stigmatised group.

Table 4. *Normative and identity constraints*

Barrier	Description	Supporting literature
4A: Dominance of car culture	Dependence on the automobile as the default and socially validated mode of transport frames driving as normal, desirable and aspirational.	Aldred, 2019; Bellizzi et al., 2021; Davies et al., 1997; Echeverría et al., 2022; Passafaro et al., 2014; Prati et al., 2017; Semenescu & Coca, 2022; Silvestri et al., 2024
4B: Lack of a widespread cycling culture	Cycling is not normalised, nor perceived as an ordinary, everyday practice.	Aldred & Jungnickel, 2014; Bhandal & Noonan, 2022; Piras et al., 2023; Pooley et al., 2011; Silvestri et al., 2024
4C: Absence of visible role models	The propensity to cycle is strongly influenced by the presence of family members, friends or colleagues who already cycle (descriptive norms). The informal support and direct example of "ambassadors" act as catalysts.	Aldred & Jungnickel, 2014; Bishop et al., 2024; Passafaro et al., 2014; Prati et al., 2017; Timmons et al., 2024

4D: Politicisation of cycling identity	Cycling may be associated with strong political meanings, such as environmental activism or radical ideological positioning, discouraging individuals who, while recognising the benefits of the vehicle, reject an identity that is perceived as overly polarised.	Aldred, 2013; Aldred & Jungnickel, 2014; Félix et al., 2019; Passafaro et al., 2014; Rosso et al., 2025; Semenescu & Coca, 2022.
4E: Association of cycling with poverty	The bicycle may be perceived as a sign of economic necessity rather than choice, signalling low status or inability to afford a car.	Daley et al., 2007; Davies et al., 1997; den Hoed, 2025; Pooley et al., 2011; Prati et al., 2017
4F: Cyclists as a stigmatised out-group	Cyclists may be constructed as a distinct and negatively evaluated social category, perceived as deviant, irresponsible or disruptive road users.	Aldred, 2013, 2019; Basford et al., 2002; Fruhen et al., 2019; Prati et al., 2017; Timmons et al., 2024
4G: Gender norms and care roles	Social expectations related to gender and care-giving responsibilities may frame cycling as impractical or inappropriate.	Aldred et al., 2016; Rosso et al., 2025; Timmons et al., 2024
4H: Aesthetic stigma and decorum norms	Concerns about appearance may be in conflict with expectations of elegance or respectability in social and professional contexts.	Daley et al., 2007; Davies et al., 1997; den Hoed, 2025; Rosso et al., 2025; Sottile et al., 2021

2.5.5. Governance and political constraints

Meta-structural barriers generated by institutional decisions and political priorities. These do not describe direct individual experience, but create the systemic framework that allows all other barriers to persist, making physical and social deterrents difficult to remove.

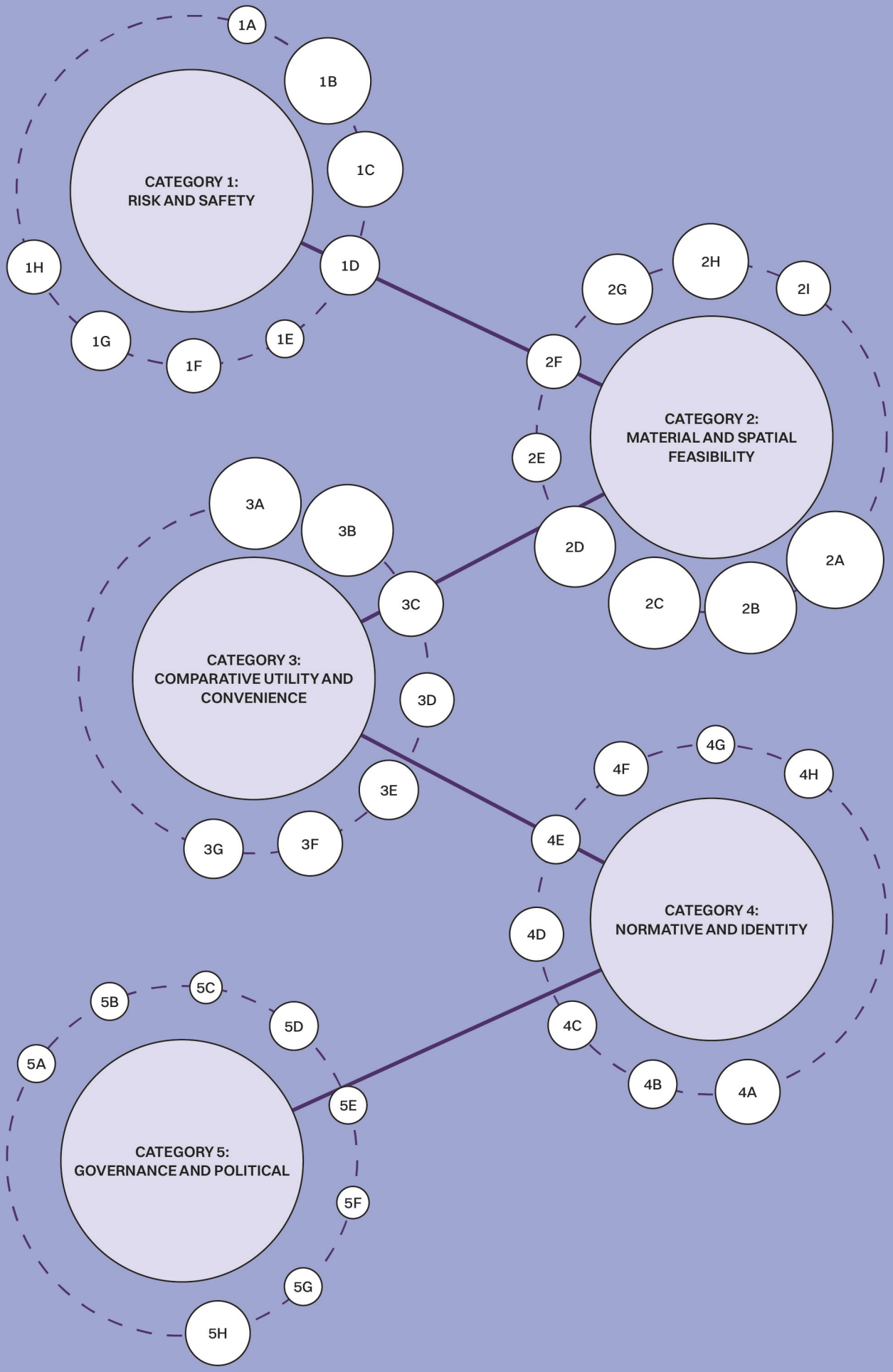
Table 5. *Governance and political constraints*

Barrier	Description	Supporting literature
5A: Chronic underfunding of cycling infrastructure	Allocation of public resources continues to prioritise road investments for motor vehicles, marginalising funding for active mobility which prevents the development of comprehensive networks and shifts the financial burden to isolated and often ineffective projects.	Bhandal & Noonan, 2022; Lawlor et al., 2023; McLeod et al., 2020
5B: Fragmented planning and institutional silos	The lack of coordination between different departments (e.g. transport, urban planning, public health) and between different levels of government (local, regional, national) leads to discontinuous planning; this "compartmentalised" approach hinders the creation of a systemic vision and produces inconsistent infrastructure.	Lawlor et al., 2023; Marqués et al., 2014; McLeod et al., 2020

5C: Institutionalised car-centric paradigm	Urban planning has historically been dominated by "rationalist" models that prioritise motor vehicle flow as a symbol of progress; therefore, cyclists' needs are only considered marginally or too late in road design processes.	den Hoed, 2025; McLeod et al., 2020
5D: Political resistance and "bikelash"	Initiatives promoting cycling often face strong political opposition linked to perceptions of public opinion; the fear of losing electoral support due to restrictive measures for cars (such as the removal of parking spaces) leads to the downsizing or abandonment of projects.	Aldred, 2019; Gase et al., 2015; Lambert et al., 2026; Lawlor et al., 2023; Timmons et al., 2024
5E: Lack of data and cycling expertise	Many administrations have limited in-house technical expertise and lack advanced data collection systems on cycling; this "statistical invisibility" of cycling further weakens its position in evidence-based decision-making processes.	Lawlor et al., 2023; McLeod et al., 2020; Silvestri et al., 2024
5F: Inconsistent regulations and complex bureaucracy	Rigid bureaucratic procedures and inconsistent regulatory frameworks make the implementation of active infrastructure slow and costly; often, technical guidelines are difficult to apply or are not applied at all, favouring the maintenance of the status quo.	Lawlor et al., 2023; Semenescu & Coca, 2022
5G: Scarcity and discontinuity of incentives	The absence of stable support policies (e.g. subsidies for the purchase of e-bikes or corporate mobility plans) limits the effectiveness of physical interventions. Without ongoing incentives, it is difficult to trigger mass behavioural change that goes beyond the niche of committed cyclists.	Baeli et al., 2022; Doğru et al., 2021; Passafaro et al., 2014
5H: Policy-structured competition with other modes	Urban policies often maintain structural advantages for cars, such as free parking or tax breaks, which make cycling less competitive in terms of comparative utility.	Bhandal & Noonan, 2022; Davies et al., 1997; Fernández-Heredia et al., 2014; Passafaro et al., 2014; Piras et al., 2023; Pooley et al., 2011; Silvestri et al., 2024; Sottile et al., 2021

2.6. Contextual variability and the need for localised investigation

As demonstrated with the categorisation of the previous section, the barriers identified in the literature tend to recur systematically across different studies; however their interdependence produces specific deterrent configurations that depend on the dominant mobility regime (den Hoed, 2025; Félix et al., 2019). Research shows that the impact of a barrier is not static but varies significantly depending on a city's cycling maturity: according to the European PRESTO



Each small circle corresponds to an individual barrier; sizes reflect the number of studies citing that barrier, indicating its prominence in the literature. Connections between categories highlight that they do not operate in isolation but form an interconnected system.

framework, cities can be classified as Starter, Climber or Champion depending on their evolutionary trajectory (Dufour, 2010). In Starter cities or cities with low cycling maturity (LCM), barriers do not act as simple addenda, but form a complex interplay in which cultural and psychological factors can amplify or attenuate the effectiveness of material interventions (Félix et al., 2019).

In contexts dominated by cars, motorisation norms and structural dependence on private vehicles create systemic resistance that goes beyond the simple lack of cycle pathways (Timmons et al., 2024). In these realities, symbolic meanings, such as social stigma or the perception of cyclists as "out of place" users, act as multipliers of perceived risk, making modal choice an act of constant negotiation with a hostile environment (Prati et al., 2017). Consequently, the literature suggests that a "standardised" view of barriers is insufficient: a situated investigation is needed to decode how the historical and socio-technical trajectory of a territory conditions the relative weight of each deterrent (Bruntlett & Bruntlett, 2018; den Hoed, 2025; Panter et al., 2019).

This need for localised analysis justifies the focus on a city such as Turin. Characterised by some of the highest motorisation rates in Europe and a deep industrial heritage linked to the automotive sector, Turin is an emblematic case of a Starter city in which the car-centric paradigm specifically shapes the experience of vulnerability, the social legitimacy of the practice and the material feasibility of travel (Rosso et al., 2025). Understanding these dynamics in the context of Turin, examined in the next chapter, therefore provides the basis for moving from a theoretical taxonomy to the definition of an effective intervention strategy

Chapter 3

The Turin case study

3.1. Why Turin? Case study rationale

Turin represents a relevant case study for analysing the dynamics of cycling mobility adoption within an established urban context (Rosso et al., 2025; Staricco et al., 2024). From the perspective of urban morphology, the city is predominantly flat and characterised by a compact spatial structure, factors that significantly reduce the physical effort required for cycling and support the feasibility of short-distance trips (La Torre, 2020; Rosso et al., 2025).

"The Dutch don't cycle because their country is flat [...]. They cycle because they've built a dense network of fully separated infrastructure and tamed the motor vehicle."
(Bruntlett & Bruntlett, 2018, p. 15)

This configuration creates a favourable condition for cycling, placing Turin in a position of morphological advantage (La Torre, 2020). But of course this comes together with a deep-rooted legacy linked to auto-mobility that derives from Turin's historical role as a "one-company town" and the headquarters of FIAT (Staricco et al., 2024; Vitale Brovarone et al., 2023). The pervasive presence of the automotive industry has not only shaped the city's urban structure, inspired by the Fordist model of large avenues (La Torre, 2020), but has also contributed to the definition of a car-centric culture in which the private automobile is often perceived as a status symbol (Vitale Brovarone et al., 2023). This legacy is reflected in one of the highest motorisation rates of Europe: while historical data recorded over 650 cars per 1,000 inhabitants (EMTA, 2021; ISTAT, 2021), recent estimates from the Isfort (2025) report indicate a peak of approximately 757 cars per 1,000 inhabitants, marking one of the most critical trends among major Italian cities.

A tension that is central for this research therefore emerges, as Turin is morphologically ready for cycling but still remains culturally and infrastructurally anchored to the car-centric mobility regime (La Torre, 2020; Vitale Brovarone et al., 2023). This contradiction is also mirrored by the city's cycling adoption gap. Despite the ambitious objectives set by the Biciplan, which aimed for a cycling modal share of 15% by 2023 (Città di Torino, 2013), the actual use of bicycles continues to play a minor role. Estimates generally range from 3% of total trips (EMTA, 2021) to approximately 7% according to more recent observations by local advocacy groups (FIAB Torino, 2025). These figures highlight how the transition towards sustainable mobility in Turin is still an incomplete process, constrained by barriers that go beyond the simple physical configuration of the territory (La Torre, 2020).

3.2. Urban and mobility profile

Turin is the fourth most populated city in Italy, with approximately 848,000 residents and a relatively high urban density of 6,526 inhabitants per square

Figure 1. *Turin's cycling network map displayed in public space.* Photograph by the author. Field observation, Turin, March 2026.

Figure 2. *Dedicated on-road cycle path.* Photograph by the author. Field observation, Turin, March 2026.

Figure 3. *Shared-use route within traffic-calmed zone 30 area.* Photograph by the author. Field observation, Turin, March 2026.

Figure 4. *Controviale along one of main boulevards.* Photograph by the author. Field observation, Turin, March 2026.

kilometre (Istat, 2024). However, the city also functions as the core of a much larger metropolitan system: its Functional Urban Area (FUA) reaches approximately 1.8 million inhabitants, generating substantial daily commuting flows from surrounding municipalities into the urban core (Staricco et al., 2024; Vitale Brovarone et al., 2023). The city's administrative area covers 130 km² and lies predominantly on a flat plain, characterised by a regular grid-like street network that originated from its Roman and Baroque urban development (Istat, 2021; La Torre, 2020). This spatial structure is also remarkably compact, since almost every neighbourhood is located within a 7 km radius of the city centre, a distance that makes active mobility feasible (La Torre, 2020).

Despite this spatial configuration mobility practices remain strongly oriented toward private motorised transport (Staricco et al., 2024; Vitale Brovarone et al., 2023). The modal split data also confirm this: private cars account for 39% of total trips, followed by walking (34%), public transport (24%) and cycling (3%) (EMTA, 2021). This cycling share is historically low, although more recent observations by local associations suggest a potential increase towards 7% following behavioural shifts after the COVID-19 pandemic (FIAB Torino, 2025). This car-centric mobility pattern is consistent with Turin's motorisation rate, among the highest in Italy and Europe, discussed in Section 3.1 (EMTA, 2021; Isfort, 2025). Studies also highlight a socio-spatial dimension of mobility inequality and transport poverty, as lower-income households often remain dependent on private cars due to residential patterns in peripheral areas with weaker public transport connections, which in turn limits the uptake of alternative modes (Isfort, 2025).

In terms of cycling infrastructure estimates of the municipal network's extent range from approximately 230 to 300 km across different sources (Città di Torino, 2026; Mondo, 2022; D'Arcangelo, 2025), the variation reflecting different criteria for what is counted as cycling infrastructure. The network is conceptually structured around a system of radial corridors and circular routes designed to connect the city centre with peripheral areas, and it includes dedicated cycle paths (about 143 km), both segregated and on-road, as well as shared-use routes within traffic-calmed "Zone 30" areas (Città di Torino, 2026; Mondo, 2022). A distinctive feature of Turin's urban layout is the presence of "controviali", secondary side lanes along large boulevards that cover about 80 km and have moderated traffic speeds, therefore serving the opportunity of prioritising cyclists (Rosso et al., 2025; Staricco et al., 2024). But despite the quantitative extension the network often fails to operate as a continuous system, because it is still fragmented and poorly interconnected, particularly at major intersections and along the city's main radial corridors (Mondo, 2022; Staricco et al., 2024).

In 2019 the municipality also introduced a system of stations that automatically count passages to monitor cycling flows, with a total of 33 active sensors distributed across the urban area (Città di Torino, 2026). This enables the collection of information on cycling volumes and temporal patterns and at the same time reflects a growing reliance on data-driven approaches to mobility planning. Available dashboards report an average of 613 daily bicycle passages, although it is not specified whether this figure refers to individual sensors or to the network as a whole; this lack of clarity regarding the spatial and methodological scope of the indicator significantly limits its interpretability.

Moreover the availability of such data does not necessarily translate into coherent infrastructural improvements, highlighting a gap between monitoring capacity and effective implementation.

The urban mobility landscape also includes several shared mobility services, such as car sharing, car pooling and scooter sharing (Mondo, 2022). Until recently this system also included the station-based bike-sharing system TOBike, which debuted in 2010 as one of the first services of its kind in Italy. It was well known as an affordable option, especially for short urban trips, with annual subscriptions priced at 25 Euros and free use granted for trips under 30 minutes. Still, the system continuously faced issues related to both vandalism and operational sustainability; after an attempted relaunch in 2019, it was officially discontinued in 2023, leaving the city without a public bike-sharing system (Paolini, 2023). As a result, shared mobility is currently mainly provided via free-floating services run by various companies (e.g. Lime, RideMovi), which expand the range of available mobility options within the city (Mondo, 2022; PUMS Città Metropolitana di Torino, 2021). At the same time these services often involve higher usage costs compared to the former public system, an aspect that potentially limits their accessibility for everyday mobility (Paolini, 2023).

Figure 5. *Free-floating shared bikes outside Torino Porta Susa railway station* Photograph by the author. Field observation, Turin, March 2026.

These services operate alongside a public transport network composed of 8 tram lines, 92 bus lines and a single automated metro line (Line 1), which currently extends over 15.1 km and serves 23 stations (Mondo, 2022; PUMS Città Metropolitana di Torino, 2021). Still, technical and regulatory constraints continue to limit opportunities for full intermodal integration; most notably, the transport of bicycles is currently prohibited on the city's metro carriages due to the reduced size of the trains and related safety concerns (La Torre, 2020; Mondo, 2022).

3.3. Cycling policies and planning framework

The understanding of existing cycling policies in the city of Turin must first be put into perspective within the broader Italian context, historically characterised by one of the highest motorisation rates in Europe and a relatively slow transition toward sustainable mobility. At the national level private car ownership exceeds the 700 cars per 1,000 inhabitants, while cycling modal share has only recently reached 5.2% (Isfort, 2025), after having for a long time stagnated around 3.6% (Legambiente, 2018). A regulatory shift of particular interest occurred with the Law 2/2018, which established the General Plan for Cycling Mobility and required each region to develop their own dedicated cycling plans (La Torre, 2020). Then the following year, in 2019, the preparation of a Sustainable Urban Mobility Plan (PUMS) was made mandatory for all cities possessing more than 100,000 inhabitants; this is also linking local mobility planning with national funding mechanisms (D'Amico, 2024). Despite these policy developments, which came together with temporary incentives such as the 2020 mobility bonus for bicycle purchases, cycling still plays a relatively minor role as a daily transport mode in Italy (Baeli et al., 2022).

Within this national framework Turin's own trajectory reflects a gradual transition from a primarily recreational conception of cycling toward a more integrated mobility strategy, although this transition has yet to fully

materialise (La Torre, 2020). The first institutional impulse dates back to the mid-1970s with the creation of the Assessorato all'Ecologia (Department of Ecology), which promoted early pedestrianisation initiatives and the city's first cycle path, inaugurated in 1979 between Parco Ruffini and Parco della Pellerina (Benedetto, 1979). Throughout the 1980s and 1990s the network expanded slowly, reaching approximately 30 kilometres but still remaining largely concentrated in green areas (Città di Torino, 1986). During the same period of time the municipality introduced more and more pedestrian zones within the historic centre, including major public spaces such as Via Garibaldi and Piazza Castello, projects that contributed to a gradual reconfiguration of central urban space in favour of pedestrians (La Torre, 2020).

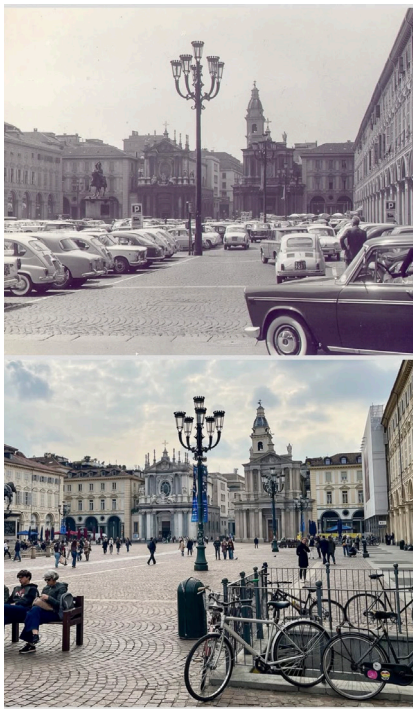


Figure 6. *Piazza San Carlo before and after the removal of car parking (2004).* Adapted from a post by @modacitylife on Instagram, October 15, 2025. Copyright by modacitylife.

A more structured policy perspective emerged only afterwards, in the early 1990s, when the Urban Traffic Plans (PUT) was adopted; this for the first time explicitly identified the lack of safe and continuous cycling infrastructure as the main barrier to cycling adoption rather than a lack of public interest (Ufficio Tecnico di Torino, 1992). The current strategic framework is primarily defined by the city's Sustainable Urban Mobility Plan (PUMS), which introduced a longer-term and more integrated approach to mobility governance (Città Metropolitana di Torino, 2021; Staricco et al., 2024). Within this same framework the Biciplan, officially approved in 2013, established the ambitious target of increasing cycling modal share from 3% to 15% by 2023 (Città di Torino, 2013). The plan aimed on one hand to systematise the cycling network targeting an overall extension of more than 300 kilometres, on the other to introduce complementary measures such as secure bicycle parking, improvements to bike-sharing services and anti-theft initiatives (Città di Torino, 2013). But still it is safe to say that this objective has not been achieved, with recent estimates still placing the cycling share between 3% and 7% of total trips (EMTA, 2021; FIAB Torino, 2025). The Biciplan is currently under a revision process that aims to address gaps in network continuity and update infrastructure standards (FIAB Torino, 2025; Mondo, 2022).

The gap between the planning ambitions and then the concrete outcomes becomes even clearer when comparing Turin with other Italian cities that have recently accelerated their cycling policies and have been, it is possible to say, fairly successful. First of all, Bologna has gained international recognition thanks to the introduction of its "Città 30" policy and the development of the Bicipolitana cycling network; also Milan has progressively expanded its cycling infrastructure through tactical urbanism initiatives and temporary bike lanes introduced during the COVID-19 pandemic (Copenhagenize, 2025; Isfort, 2025). By contrast Turin remains completely absent from international rankings of bicycle-friendly cities, reflecting the persistent issues that are related to infrastructure fragmentation and slower policy implementation compared to its peers (Copenhagenize, 2025; Mondo, 2022).

The Consulta in practice

Until 2017 the Municipality maintained a dedicated internal office (Ufficio Biciclette) responsible for technical monitoring, infrastructure planning and the coordination of cycling

The governance of cycling mobility in Turin involves a complex network of institutional and civic actors. If on the one hand the Municipality remains the primary decision-maker, still participatory mechanisms have expanded through the **Consulta della Mobilità Ciclistica**, which was established in 2017 as a formal advisory body (La Torre, 2020). This board allows local advocacy groups, such as FIAB Torino, to submit technical amendments that the administration is formally required to address (FIAB Torino, 2025; La Torre, 2020). These

organisations have played a significant role in promoting cycling culture, also through large-scale events such as the Bike Pride, which has attracted up to 35,000 participants (La Torre, 2020). While such initiatives increase the visibility of cycling, they also tend to frame mobility as a politically charged issue, a dynamic that can at the same time contribute to public engagement but also to local polarisation.

Research furthermore highlights specific institutional constraints that hinder systemic change. First, the municipality operates with a remarkably small dedicated staff which consists of only two officials responsible for all cycling planning and sharing services (La Torre, 2020). But implementation is also constrained by the rigid financial context, as Turin's budget is under the supervision of the Court of Auditors (Corte dei Conti) because of significant municipal debt; this of course prevents the city from financing large-scale investments through credit (La Torre, 2020). Consequently, the implementation of cycling policies often remains fragmented and incremental: this is evident both in the limited outcomes of European initiatives such as CIVITAS Handshake and in the difficulties encountered by locally-driven experimental projects such as the Torino Mobility Lab, where interventions struggled to transition into permanent structural transformations over a period of several years (Staricco et al., 2024; Vitale Brovarone et al., 2023).

3.4. Current barriers and local debates

Despite an increasing attention devoted to cycling mobility in Turin over the past decade the number of studies specifically examining barriers to everyday cycling in the city is still relatively limited (Rosso et al., 2025). Nevertheless, technical reports, policy documents and a small body of academic literature consistently highlight a set of recurring issues that limit the diffusion of cycling as a daily mode of transport (Consulta della Mobilità Ciclistica, 2025; La Torre, 2020; Rosso et al., 2025). These discussions converge on a set of interconnected challenges including infrastructural limitations, safety concerns, cultural attitudes, as well as practical and institutional constraints affecting the implementation of cycling policies (Consulta della Mobilità Ciclistica, 2025; La Torre, 2020; Rosso et al., 2025; Staricco et al., 2024; Vitale Brovarone et al., 2023). Although these issues are addressed from different disciplinary perspectives and with varying levels of empirical depth, collectively they provide an initial picture of the obstacles currently shaping Turin's cycling landscape.

3.4.1. Infrastructure fragmentation and safety issues

One of the most frequently discussed limitations concerns the fragmentation of the cycling network (FIAB Torino, 2025; Mondo, 2022). Although the overall length of cycling infrastructure in Turin has progressively increased over time, several studies and technical reports emphasise that the existing routes often fail to form a continuous and well-connected system (FIAB Torino, 2025; Mondo, 2022; D'Arcangelo, 2025). Discontinuities are particularly evident along major radial corridors and at large road intersections, where cycling paths frequently end abruptly and cyclists are forced to merge with motorised traffic (Mondo, 2022; D'Arcangelo, 2025).

initiatives. When the Consulta was established as a formal civic advisory body, the office was dissolved. The two structures serve fundamentally different functions: while the Consulta acts as a representative voice for cyclists and holds the power to submit advisory opinions on infrastructure projects, it lacks the technical and executive capacity of the former office. Under the 2017 deliberation the Municipality is required to seek the Consulta's opinion on all cycling projects before implementation; in practice, the frequency of these consultations has varied across administrations, and the Consulta has on several occasions noted the absence of projects it expected to review (Consulta della Mobilità Ciclistica, personal communication, April 2026).

Figure 7. *Abrupt end of a cycle path at road intersection.* Photograph by the author. Field observation, Turin, March 2026.

Figure 8. *Cyclist navigating a road intersection without dedicated infrastructure.* Photograph by the author. Field observation, Turin, March 2026.

Figure 9. *Vehicle parked in a cycle lane (malasosta).* Photograph by the author. Field observation, Turin, March 2026.

Figure 10. *Cyclist riding in close proximity to parked and moving vehicles.* Photograph by the author. Field observation, Turin, March 2026.

Figure 11. *Poorly maintained path (faded markings, uneven surface).* Photograph by the author. Field observation, Turin, March 2026.

Safety concerns are particularly strong when it comes to intersections, which are repeatedly identified as critical points within the network (Consulta della Mobilità Ciclistica, 2025; Mondo, 2022). Local mobility reports suggest that the situation is further aggravated by the widespread phenomenon of "malasosta" (illegal parking), which reduces visibility and increases conflicts between cyclists, pedestrians and motor vehicles (Consulta della Mobilità Ciclistica, 2025; FIAB Torino, 2025).

Several studies also indicate that Turin presents critical safety conditions for cyclists in comparison with many European cities. According to data from the International Transport Forum (2019), the city falls within a high-risk category in terms of cyclist mortality rates per billion kilometres travelled, with values significantly higher (exceeding 150-200 fatalities) than those recorded in cities with well-established cycling systems such as Copenhagen or Berlin, where rates are close to zero (Mela & Girardi, 2024). More broadly, national statistics confirm the vulnerability of active mobility users: around 17,000 road crashes involving bicycles were recorded in Italy in 2024, causing 185 fatalities and over 16,000 injuries; also, pedestrians and cyclists together account for nearly 80% of road fatalities in urban areas (Isfort, 2025).

Recent studies further highlight what has been described as a "safety paradox" in several Italian cities, including Turin, where the high risk of traffic injuries can partially offset the expected health benefits associated with physical activity (Mela & Girardi, 2024). In this context both the objective safety conditions and what are the only perceived risks become significant barriers to cycling adoption (Rosso et al., 2025). Local surveys indicate that concerns about safety at intersections, high vehicle speeds and insufficient physical separation from motorised traffic represent the main deterrents to everyday cycling, particularly among women and less experienced riders (FIAB Torino, 2025; Rosso et al., 2025).

Additional technical issues also emerge in local reports, including the uneven maintenance of road surfaces and the condition of the controviali (Rosso et al., 2025; Staricco et al., 2024). Although these lanes can offer relatively calmer traffic conditions, inconsistencies in their design and maintenance (such as faded horizontal markings or dangerous road gaps) may reduce their effectiveness as safe cycling environments (Consulta della Mobilità Ciclistica, 2025; Rosso et al., 2025; D'Arcangelo, 2025).

3.4.2. Cultural dominance of auto-mobility

Beyond the infrastructural factors several authors emphasise how the car-centric culture rooted in Turin's industrial legacy, already described in Section 3.1, continues to shape contemporary mobility (Staricco et al., 2024; Vitale Brovarone et al., 2023). This heritage manifests today in the perception of the private car not merely as a tool, but as a fundamental status symbol and a "right to the street" (La Torre, 2020; Vitale Brovarone et al., 2023).

This is reflected in the contemporary debates surrounding the redistribution of urban space. Measures thought of to expand pedestrian areas, introduce cycling infrastructure or reduce on-street parking often generate resistance from residents and local businesses (Staricco et al., 2024; Vitale Brovarone et

al., 2023). These groups frequently perceive such interventions as a threat to urban accessibility or economic vitality, often citing the loss of parking spaces as a primary concern (La Torre, 2020; Vitale Brovarone et al., 2023). As a result, the reallocation of road space between different transport modes frequently becomes a contested issue, characterised by a polarisation between the "right to auto-mobility" and the need for more liveable public spaces (Vitale Brovarone et al., 2023).

Within this context, cycling is still sometimes perceived as a secondary transport option or a recreational activity rather than a legitimate mode of utilitarian transport (La Torre, 2020). Although recent policy initiatives and advocacy campaigns such as the Bike Pride have increased the visibility of cycling, several studies suggest that the transition toward a more balanced mobility culture has yet to fully materialise (FIAB Torino, 2025; La Torre, 2020; Staricco et al., 2024).

3.4.3. Everyday deterrents and practical constraints

Alongside the infrastructural and the cultural factors, some practical considerations related to the everyday concrete use of bicycles also influence mobility choices. The fear of bicycle theft, for instance, is frequently mentioned as a significant deterrent to cycling in Turin (Isfort, 2025; Mondo, 2022). National reports describe that the average age of the Italian bicycle fleet is approximately 8 years, with 30% of bicycles being over 10 years old (Isfort, 2025). This relative antiquity is largely attributed to a defensive strategy by residents who rely on lower-value bicycles to minimise potential losses from theft, which indirectly reduces the comfort, reliability and perceived attractiveness of cycling for daily trips (Isfort, 2025).

Figure 12-13. *Damaged bikes on the street (top) and in a bicycle parking at Lingotto railway station (bottom).* Photograph by the author. Field observation, Turin, March 2026.

Another practical issue is that of the incomplete intermodal integration. Several reports point to the limited availability of secure bicycle parking at major public transport nodes, such as railway stations and metro stops (Mondo, 2022). Also, there are technical and regulatory constraints, most notably the prohibition to transport bicycles on the Metro carriages mentioned above, that are significantly restricting the opportunity of integrated travel (La Torre, 2020). These everyday deterrents are less visible than large-scale infrastructural gaps, yet they can still play a significant role in shaping how feasible cycling is perceived to be (Piras et al., 2023; Sottile et al., 2021).

3.4.4. Institutional and governance challenges

Finally, a number of studies point to institutional and governance-related factors that constrain policy implementation. The municipality of Turin operates within a rigid financial context, with its budget under the supervision of the Court of Auditors due to significant public debt (La Torre, 2020). This financial burden limits the capacity to invest in large-scale infrastructure and forces a reliance on external funding programmes (e.g. ministerial grants) or temporary experimental initiatives (e.g. CIVITAS Handshake) (La Torre, 2020; Vitale Brovarone et al., 2023).

Administrative and organisational dynamics also have an influence on policy implementation. Analyses of initiatives like the **Torino Mobility Lab** project

The Torino Mobility Lab
Launched in 2016 following a ministerial call for funding, the Torino Mobility Lab (TML) was an experimental project concentrated in the San Salvario neighbourhood, combining cycling infrastructure, pedestrianisations and school street closures with the aim of testing an approach replicable across the city. With a total budget of approximately €3.9 million, co-funded by the Ministry of the Environment and the Municipality, it introduced temporary interventions intended to transition into permanent structural redesign after a monitoring phase. In practice, this transition proved protracted: announced in late 2020, the permanent phase was still approaching completion in late 2023 — seven years after the initial funding was secured (Vitale Brovarone et al., 2023; Staricco et al., 2024).

point to challenges related to lack of clear leadership, poor departmental coordination and bureaucratic rigidity (Staricco et al., 2024; Vitale Brovarone et al., 2023). In some cases, the relationship between political decision-making and technical expertise appears overly direct, with a lack of intermediate professional figures (e.g. mobility sociologists or economists) that are capable of mediating conflicts and providing multidisciplinary analyses (La Torre, 2020). Consequently, the planning process is sometimes perceived as fragmented and incremental rather than fully systemic, leading to a state of "permanently temporary" experimentation that fails to trigger long-term behavioural shifts (Staricco et al., 2024; Vitale Brovarone et al., 2023).

3.5. Knowledge gaps and research opportunity

The analysis of Turin's mobility landscape reveals a central contradiction: although the city presents morphological conditions and policy frameworks that are theoretically favourable to active mobility, a significant cycling adoption gap persists, with modal share remaining far below the targets established in local planning strategies (La Torre, 2020; Rosso et al., 2025). Existing studies and technical reports have provided valuable insights into the structural dimensions of this issue, documenting the expansion of cycling infrastructure and analysing mobility patterns through quantitative modelling approaches (Mondo, 2022; Staricco et al., 2024). In addition, recent research has examined governance dynamics, highlighting institutional and procedural tensions that can hinder the transition from temporary street experiments to more permanent infrastructural transformations (La Torre, 2020; Staricco et al., 2024; Vitale Brovarone et al., 2023).

Despite these contributions an important knowledge gap remains with regards to the qualitative and experiential dimensions of cycling barriers in Turin. Within the Italian context more broadly, academic research has frequently prioritised infrastructural provision and quantitative mobility modelling, paying comparatively less attention to how perceptions, social norms and everyday practices influence individual mobility choices (Giubergia et al., 2024; Piras et al., 2023). As for Turin, technical reports often identify issues such as network discontinuities, maintenance deficiencies or safety concerns (Consulta della Mobilità Ciclistica, 2025; Mondo, 2022), but there is actually limited empirical evidence that explores how these material constraints interact with cultural imaginaries that continue to frame the bicycle as a recreational tool rather than a legitimate mode of utilitarian transport (La Torre, 2020).

Existing research also suggests that the objective provision of infrastructure alone is a necessary but insufficient condition to produce substantial increases in cycling uptake (Sottile et al., 2021). Factors such as perceived safety, latent attitudes and everyday practical constraints are recognised in their ability to play a decisive role in shaping mobility decisions (Baeli et al., 2022; Isfort, 2025; La Torre, 2020; Silvestri et al., 2024). However in the specific context of Turin very few studies have attempted a systemic reading of how these different barriers manifest simultaneously and interact within the broader urban mobility system, linking structural conditions (such as the institutional and financial constraints) with the everyday experiences of diverse groups of mobility users (La Torre, 2020; Rosso et al., 2025).

Addressing this gap represents a clear research opportunity and directly responds to the second research question (RQ2) of this thesis: how these barriers manifest and interact within the specific urban context of Turin. By shifting the analytical focus from predominantly descriptive or quantitative assessments toward a qualitative and interpretative perspective, this research aims to investigate not only what barriers to cycling exist in Turin, but also how they are experienced and negotiated by urban mobility users and local stakeholders. Through an in-depth qualitative investigation involving urban mobility users and field experts, the study seeks to capture how infrastructural, cultural and institutional factors converge in shaping everyday mobility choices within a predominantly car-centric mobility regime (Staricco et al., 2024; Vitale Brovarone et al., 2023).

Chapter 4

Empirical research: interview design and findings

4.1. Research approach and methodological positioning

Consistently with the knowledge gap identified in Section 3.5 this chapter adopts a qualitative and exploratory research approach. While existing studies on cycling in Turin have mostly focused on quantitative mobility patterns and infrastructural conditions, little attention has been given to how different actors experience and interpret barriers within everyday mobility practices.

To address RQ2, which investigates how barriers to cycling manifest and interact within the specific urban context of Turin, a qualitative approach has been chosen. Semi-structured interviews allow it to explore barriers not as isolated variables to be measured, but as interconnected elements that emerge from lived experiences, perceptions and situated practices. With this perspective, barriers are seen as relational and context-dependent phenomena, whose effects are shaped both by structural conditions and by subjective interpretation.

The empirical investigation therefore focuses on eliciting experiential and interpretative accounts from urban mobility users and field experts. This approach supports a context-sensitive understanding of how the different barriers converge, reinforce or contradict each other, while also allowing an initial assessment of their relative relevance within the local mobility system.

4.2. Interview design

This phase was structured to generate a multi-perspective understanding of cycling barriers in the urban context of Turin, combining experiential insights described by users with professional evaluations explained by field experts. While the overall approach remains qualitative and exploratory, the design of the interviews was guided by the dual objective of capturing on one hand the perceived relevance from users, and assessing on the other the impact and the difficulty of intervention from experts. The comparison between these perspectives was conducted a posteriori, as part of the analytical phase, to enrich and triangulate the findings.

4.2.1. Participant selection strategy

A total of 18 semi-structured interviews were conducted, including 15 users and 3 experts.

Users were selected with the intention of engaging individuals who could realistically adopt cycling as a mode of urban transport in the near term. This orientation was informed by a loose interpretation of diffusion dynamics (Rogers, 2003), focusing on participants that are ideally positioned between early adoption and early majority stages, without applying a formal theoretical framework.

To operationalise this, specific inclusion and exclusion criteria were defined. Participants were required to be over 18 years old and in possession of a valid driving license, so to ensure a baseline level of autonomy in mobility choices. Individuals living outside the municipality of Turin, in highly peripheral areas or in the hilly parts of the city were excluded, as these conditions introduce structural constraints that could disproportionately shape mobility behaviours. Similarly, individuals with children under the age of ten were excluded, as care-giving responsibilities often come together with additional logistical constraints that were not central to the scope of this study. These delimitations were purposefully introduced so to focus the field research on participants with a relatively high degree of agency in their mobility choices. The aim was not that to exclude groups that face strong constraints, but to avoid an over-representation of highly specific barriers and instead explore a broader range of factors influencing potential cycling adoption within a more comparable population.

Based on previously encountered literature (Daley et al., 2007; Piras et al., 2023; Sottile et al., 2020; Sottile et al., 2021), participants were initially thought as belonging to three categories: frequent cyclists, infrequent cyclists and non-cyclists. However, following data collection, the distribution did not support this segmentation, as only two participants fell into the “infrequent” category with heterogeneous profiles. Consequently, participants were grouped into two categories: cyclists (n=8) and non-cyclists (n=7).

The classification was based on frequency of utilitarian cycling (e.g. commuting, daily errands), rather than recreational or sport use. Participants using the bicycle at least once or twice per week for utilitarian purposes were classified as cyclists, reflecting a stable integration of cycling into everyday mobility practices. All others, characterised by absent or occasional use (equal to or less than once or twice per month) were classified as non-cyclists. Recreational or sport use was recorded as a descriptive variable but not considered sufficient, in isolation, to define adoption.

Recruitment was conducted through the researcher’s personal network and extended via snowball sampling. Participation was voluntary. While the risk that this approach may introduce potential biases was taken into account, it was still considered acceptable given the exploratory nature of the study and the non-sensitive framing of the topic. Care was taken to ensure diversity in terms of age, gender, occupation and residential area within the city.

Experts (n=3) were selected because of their professional involvement in the field of cycling mobility. All three are currently working in the Netherlands in roles related to cycling consultancy, advocacy and policy advisory. They were identified through prior interactions, events and direct outreach (e.g. email, LinkedIn), and were invited to contribute on a voluntary basis. Their inclusion aimed to provide an informed, practice-based perspective on both the impact

of identified barriers and the difficulty in addressing them, complementing the insights collected with the users.

4.2.2. Sampling rationale and limitations

The sampling strategy reflects the aim to balance methodological rigour and project feasibility, considered the most logic for this research.

The focus on participants with relatively low structural constraints, as described above, was consciously chosen to isolate and better understand those barriers that are more widely shared and therefore actionable within the urban population, rather than those tied to specific life conditions (e.g. families with young children) or geographical factors (e.g. residents of hillier areas of the city). However it is important to state that this choice inherently limits the representativeness of the sample, because certain user groups, such as residents in peripheral or hilly areas, or individuals with care-giving responsibilities, are not captured in this study despite potentially facing significant barriers to cycling adoption. As so, the findings should not be interpreted as exhaustive, but rather as indicative of a specific segment of the population.

Similarly, the use of personal networks and snowball sampling introduces the risk of homogeneity for the sample, despite efforts to ensure diversity. This approach privileges accessibility and depth of engagement over statistical representativeness, which is thought to align with the qualitative nature of the research, but must still be cleared.

As for the experts, the small sample size (n=3) and the shared geographical context (the Netherlands) may limit the diversity of perspectives and introduce some convergence in viewpoints. Still, their advanced expertise in cycling mobility is considered as a strength, particularly in relation to the evaluation of intervention difficulty and systemic impact. Their insights are not thought as a tool that is directly generalisable to the Turin context, but rather intended to inform this through comparison and extrapolation.

4.2.3. Development of the interview protocol

The interview protocols for users and experts were developed starting from the categorisation of barriers defined in Chapter 2. Each barrier was translated into a corresponding discussion point within the interviews, defining a fil rouge between the conceptual framework derived from the literature review and the empirical data collection. Both protocols are characterised by a semi-structured format, combining a consistent structure with flexibility for probing and follow-up questions. Full interview protocols, including the complete set of questions for both users and experts, are provided in the Appendix.

For users the interview began with a short survey-like section collecting demographic and contextual information (e.g. gender, age, occupation, household composition, cycling frequency). This was soon followed by the main discussion, where participants were asked to evaluate the relevance of each barrier based on their personal experience. For each barrier, participants were asked to give an evaluation using a 5-point scale (1–5), where higher values indicate a higher perceived relevance. The focus was explicitly experiential,

as participants were encouraged to reflect on how and to what extent each barrier affects their mobility practices, regardless of whether their input was based on direct experience or perception.

For experts the structure was aligned but adapted to their role. While grounded in the same categorisation of barriers developed in Chapter 2, the protocol included different evaluative dimensions, as experts were asked to assess each barrier in terms of perceived impact and difficulty of intervention. Both dimensions were evaluated using the same 5-point scale (1–5), where higher values indicate greater impact and higher difficulty respectively. This dual assessment was introduced to support the prioritisation of design interventions, distinguishing between short-term opportunities and more complex, long-term challenges.

Differences between user and expert interviews were defined a priori. In particular, Category 5 (Governance and political constraints) was excluded from user interviews, as it was not aligned with the experiential and perception-based focus of their contribution, but was included in expert interviews due to its more technical nature. Conversely, in expert interviews, the first three barriers of Category 2 (Material and spatial feasibility constraints), namely topography, weather and urban sprawl, were excluded, as these aspects are highly context-specific and were already addressed through desk research and user input.

No formal pilot interview was conducted, but an initial verification after the first interview confirmed the clarity, timing and overall effectiveness of the protocol. The structure was therefore maintained consistent across all subsequent interviews, ensuring comparability between participants while preserving flexibility in follow-up questions.

Overall the protocol design is considered to have reached a good balance between consistency across interviews and adaptability to different participant profiles, ensuring both comparability and depth.

4.2.4. Data collection and time management

Data collection was conducted over the course of March 2026. Among experts one interview was conducted in person and two via video call. Among users 12 interviews took place in person and 3 via phone call. This mixed-mode approach was adopted to accommodate participants' availability while maintaining a consistent level of engagement.

Interviews lasted on average 45 minutes for users and 60 minutes for experts. All sessions were audio-recorded with participants' consent and complemented by handwritten notes taken during the conversation.

Interviews with users were conducted in Italian, while those with experts were conducted in English. Prior to each session, participants were informed about the objectives of the research, the expected duration, and the use of collected data. Written consent was obtained in all cases, including permission for audio recording and data anonymisation.

From a time management perspective, particular attention was given to

balancing the structured evaluation of barriers with the opportunity for open-ended discussion. While the interview guide provided a clear sequence, the depth of exploration was always adjusted in real time based on the participants' engagement and the perceived relevance of specific topics. This flexible pacing allowed it to get deeper insights where appropriate, without exceeding the overall time constraints. No substantial differences were observed in the quality or depth of responses between in-person and remote interviews.

The choice to combine structured evaluation with adaptive probing is thought to be reflecting the broader methodological positioning of the study: maintaining coherence and comparability across interviews, while preserving the richness and variability of qualitative data.

4.2.5. Data analysis approach

The analysis of the empirical material was structured as a combined qualitative and quantitative process, aimed at integrating perceptual evaluations with in-depth interpretative insights. This approach was selected in order to capture both the relative weight assigned to different barriers and the ways in which these are experienced and articulated by participants.

On the quantitative side, all numerical responses collected through the interview scales were systematically organised in a spreadsheet and analysed using descriptive statistics. In particular mean values were calculated for each barrier and for each category, so to allow for a structured comparison of perceived relevance across the dataset. Standard deviation was also considered as a complementary indicator to capture the degree of variability in responses, so to provide insights into levels of agreement or divergence among participants.

For user interviews the analysis was conducted both on the full aggregated dataset and by distinguishing between cyclists and non-cyclists. This enabled the identification of differences in perception across mobility profiles, as well as the observation of relative gaps in how specific barriers are experienced; comparative measures were used to explore these same variations, supporting a more nuanced reading of the data beyond simple overall averages.

In the case of expert interviews, the quantitative analysis considered two distinct evaluative dimensions: the perceived impact of each barrier and the perceived difficulty of intervention. These dimensions were analysed both independently and in relation to each other, allowing for an initial exploration of how barriers differ not only in terms of relevance, but also in terms of perceived feasibility of action. Additional descriptive comparisons were used to highlight patterns across barriers and categories, with the goal to support the interpretative phase.

Across both datasets, the quantitative analysis is not treated as statistically representative, but rather as a set of indicative patterns that inform and support the qualitative interpretation. The role of these measures is therefore complementary, it aims to contribute to the structure and comparability without substituting the depth of qualitative insight.

The qualitative analysis was conducted on the basis of full verbatim

transcriptions of the interviews. These were imported into Atlas.ti and analysed through a structured coding process. The coding framework was primarily deductive and derived from the five macro-categories of barriers identified in the literature and previously operationalised in the interview design. Each barrier was associated with a specific code (e.g. 1A, 1B), so to allow it for a systematic classification of the data according to the analytical structure developed in Chapter 2.

At the same time, in order to avoid forcing all empirical observations into predefined categories, an additional "EXTRA" code was introduced to capture relevant insights that did not fully align with the existing framework. This allowed the analysis to still keep some degree of openness to the more unexpected or context-specific elements emerging from the data.

Coding was primarily applied at the level of individual excerpts, with most segments associated with a single dominant barrier. However, in cases where participants' accounts reflected overlapping or interrelated constraints, multiple codes were assigned to the same excerpt. This reflects the interconnected nature of the barriers, which of course can often manifest in practice as combined rather than isolated deterrents.

The analytical process was conducted individually by the researcher. While this excludes the possibility of inter-coder validation, particular attention was given to maintaining consistency in code application and transparency in the analytical procedure, ensuring the traceability of the interpretation from raw data to final synthesis.

The analysis of the two participant groups (users and experts) was initially conducted separately, both in the quantitative processing of scale responses and in the qualitative coding phase. This separation allowed each perspective to be examined on its own terms. A comparative reading between the two groups was then developed in the subsequent phase of interpretation, where convergences, divergences and complementary insights were identified.

Overall, the analytical process can be understood as iterative and progressive, moving from data structuring (organisation of numerical data and coding of transcripts) to interpretative synthesis. The findings presented in the following sections are therefore the result of a combined reading of quantitative patterns and qualitatively coded narratives, aimed at providing a context-sensitive understanding of how barriers to cycling are perceived and experienced in the case of Turin.

4.3. Findings

4.3.1. Overview of the dataset and first insights

As outlined in the previous section, the user sample was grouped into cyclists (n=8) and non-cyclists (n=7) based on the frequency of utilitarian bicycle use, allowing for a differentiated reading of perceptions across mobility profiles.

From a demographic perspective the user sample presents a balanced gender distribution (8 women and 7 men) and a heterogeneous age range,

with participants spanning from 18 to over 67 years old. Most participants are employed (9), with a smaller portion of students (3) and retired (3); the level of education is overall relatively high, with the majority holding at least a secondary school diploma and more than half having completed tertiary education.

Household characteristics indicate moderate levels of motorisation, with an average of 1.73 cars per household, alongside a relatively high availability of bicycles (average of 3.6 per household). Together with this, only a limited number of participants report using bike-sharing services, suggesting a preference for privately owned bicycles or a limited integration of shared mobility options into daily practices.

In terms of mobility behaviour the dataset reflects a diversified modal distribution. While the bicycle emerges as the primary mode of transport for a notable portion of participants (6), others rely primarily on walking (3) or on car use, either as drivers (3) or passengers (1), with single participants reporting public transport (1) and a micro electric vehicle (1) as their main mode. Public transport, in particular, appears more often as a secondary or tertiary option than as a dominant one, being the primary mode for only one participant. This distribution supports the relevance of the cyclists vs non-cyclists distinction made, highlighting the coexistence of different mobility patterns within the sample.

Initial quantitative analysis provides a first indication of how barriers are distributed across categories. Overall differences between categories appear relatively contained, suggesting that the strongest barriers to cycling are not concentrated within a single dimension but rather distributed across multiple domains, so confirming the value of the categorisation presented within this study. Some variations emerge when distinguishing between user groups. In particular while cyclists tend to assign slightly higher relevance to risk and feasibility constraints (Categories 1 and 2), non-cyclists attribute comparatively greater weight to aspects related to convenience and comparative utility (Category 3). Although these differences are not pronounced in absolute terms, they indicate an interesting shift in perspective between those who already cycle and those who do not.

At the level of individual barriers, several recurring patterns can be observed. Across the full user sample, elements related to the quality of cycling infrastructure (e.g. cycling network discontinuity, poor road surface quality) consistently receive high evaluations, and this seems to indicate a widespread perception of infrastructural inadequacy. Among non-cyclists, additional barriers linked to preparation and organisational efforts and aesthetic worries also emerge more prominently, suggesting that the decision not to cycle is influenced not only by physical conditions but also by perceived inconvenience and symbolic factors.

The expert evaluations provide a complementary perspective. Barriers that are associated with infrastructural complexity (e.g. complex intersections, cycling network discontinuity) are evaluated as being of high impact, while cultural and institutional factors (e.g. dominance of car-culture, underfunding of cycling infrastructure) are perceived as particularly difficult to address. This distinction is interesting as it introduces an additional layer of interpretation,

Legend

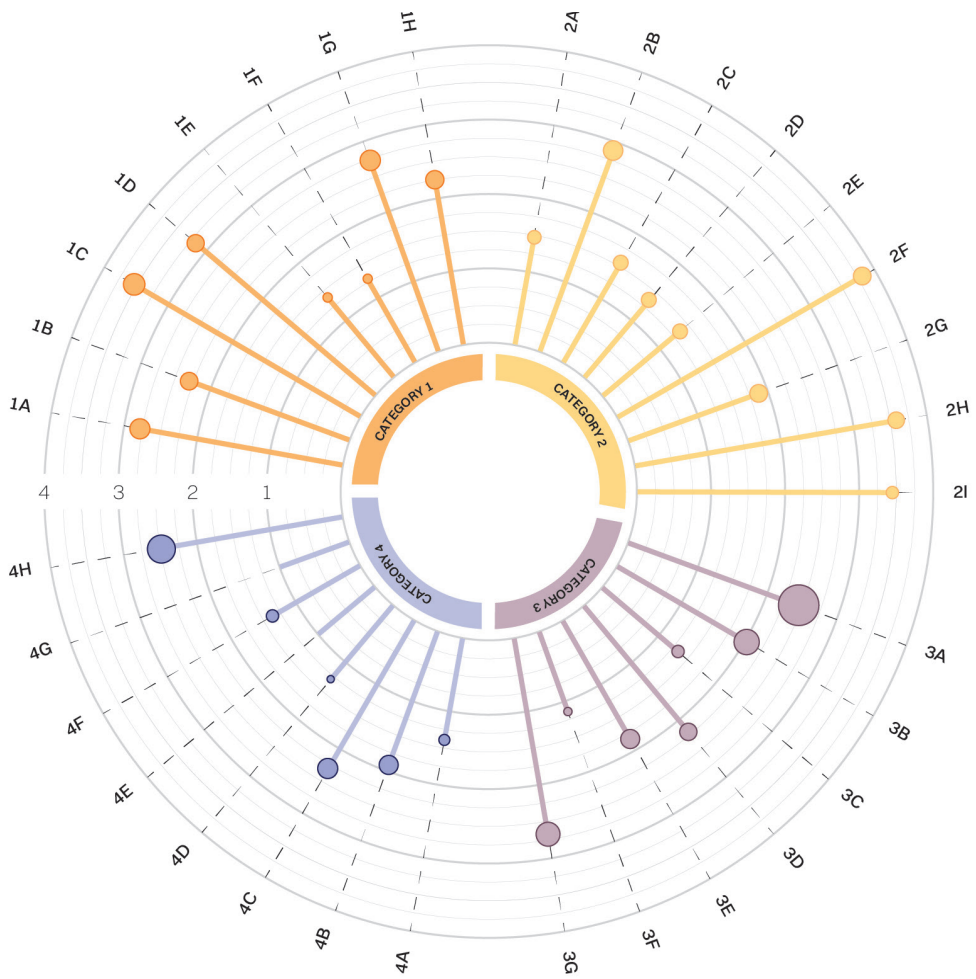
1A: Excessive traffic and intrinsic vulnerability
1B: Aggressive motorist behaviour
1C: Lack of physical protection
1D: Complex intersections
1E: Accident statistics
1F: Personal insecurity in isolated areas
1G: Theft and vandalism
1H: Additional environmental risk factors

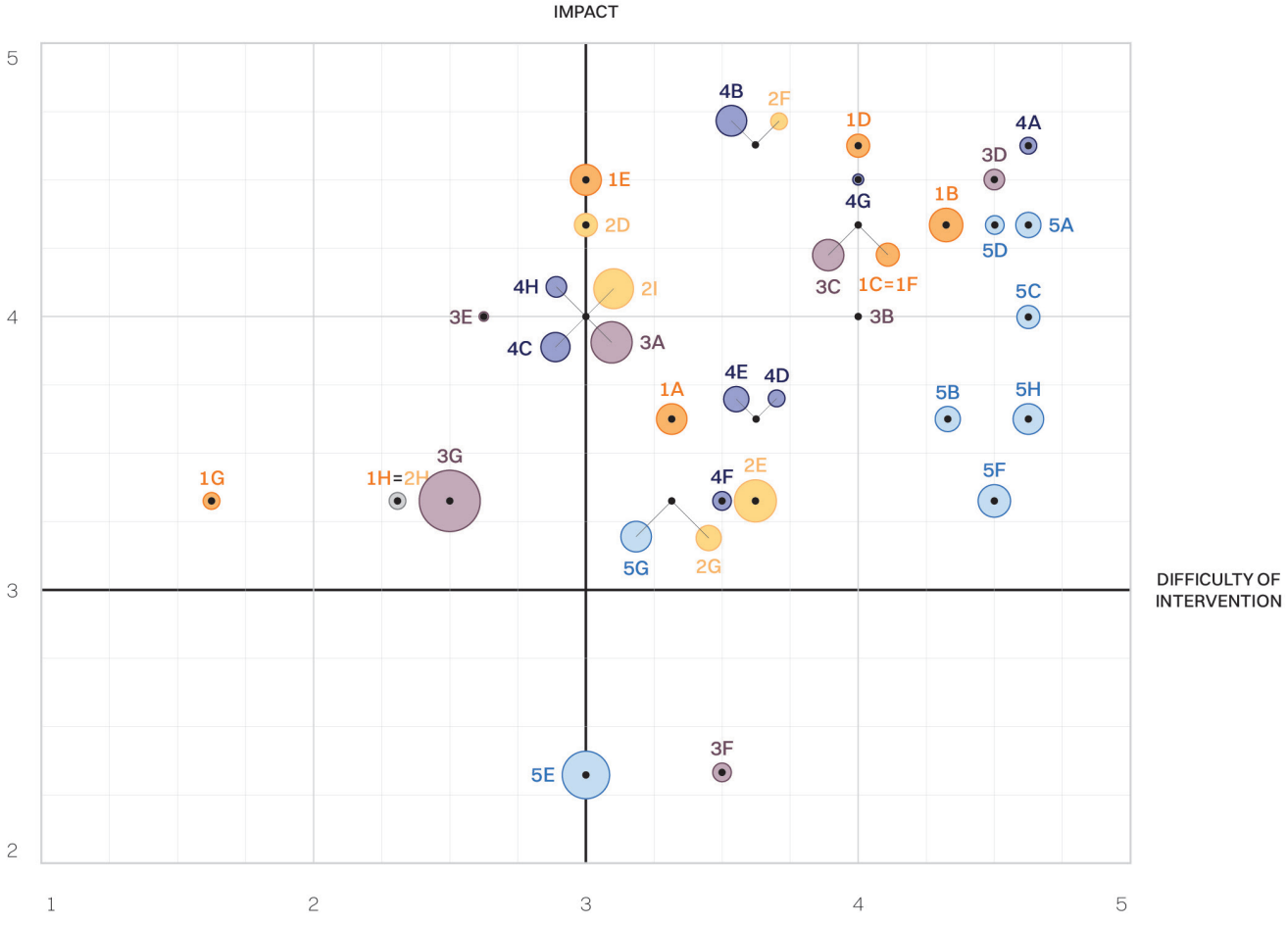
2A: Unfavourable topography
2B: Adverse weather conditions
2C: Excessive distances/urban sprawl
2D: Excessive physical demand
2E: Limited intermodal integration
2F: Cycling network discontinuity
2G: Lack of end-of-trip facilities
2H: Poor road surface quality
2I: Path obstructions/spatial conflicts

3A: Habitual mode lock-in
3B: Trip-chaining and dependant mobility
3C: Opportunity costs of car ownership
3D: Automobile comfort and tech amenities
3E: Perceived long travel times
3F: Direct individual costs of cycling
3G: Preparation and organisational time

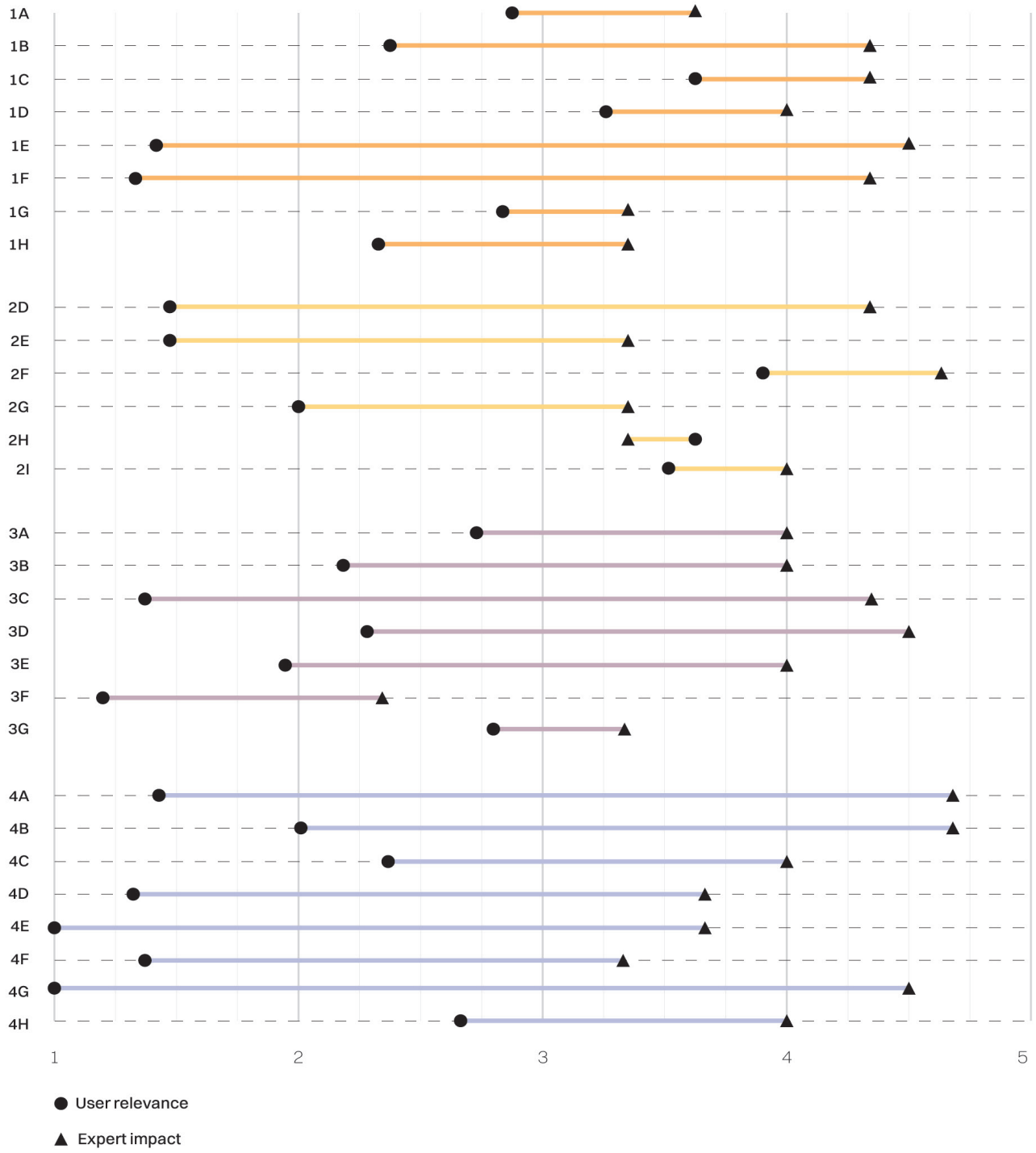
4A: Dominance of car culture
4B: Lack of widespread cycling culture
4C: Absence of visible role models
4D: Politicisation of cycling identity
4E: Association of cycling with poverty
4F: Cyclists as stigmatised out-group
4G: Gender norms and care roles
4H: Aesthetic stigma and decorum

5A: Underfunding of cycling infrastructure
5B: Fragmented planning and institutional silos
5C: Institutionalised car-centric paradigm
5D: Political resistance and “bikelash”
5E: Lack of data and cycling expertise
5F: Inconsistent regulations and bureaucracy
5G: Scarcity/discontinuity of incentives
5H: Policy-driven competition with other modes





Top: average user ratings of each barrier (scale 1-5), with marker size indicating standard deviation. Bottom: average expert ratings of each barrier, plotted by impact (y-axis) and difficulty of intervention (x-axis), with marker size indicating standard deviation.



Comparison between user relevance and expert impact ratings (scale 1-5) for each barrier, highlighting areas of agreement and divergence between the two groups. The distance between the two points indicates the degree of disagreement.

highlighting the potential gap between what is most problematic and what is most actionable within the system.

Taken together these initial observations confirm that the barriers to cycling adoption in the context of Turin do operate across multiple, interrelated dimensions. Rather than being attributable to a single dominant factor, they emerge as a combination of physical, behavioural and systemic constraints. The following sections develop this perspective in greater detail, analysing each category of barriers through an integrated reading of quantitative patterns and qualitative accounts, and examining how these are perceived and articulated by both users and experts.

Figure 14. *Cyclist riding on sidewalk to avoid the street.* Photograph by the author. Field observation, Turin, March 2026.

4.3.2. Risk and safety constraints

Risk and safety constraints emerge as a central yet internally differentiated category. While the overall average assigned by users remains moderate (M=2.51 at category level), the distribution across specific barriers reveals a clear distinction between structurally embedded risks and more contingent or situational concerns.

Among users, the most relevant barriers within this category are lack of physical protection (1C; M=3.67) and complex intersections (1D; M=3.27), followed by excessive traffic and intrinsic vulnerability (1A; M=2.87) and theft and vandalism (1G; M=2.80). In contrast accident statistics (1E; M=1.40) and personal insecurity in isolated areas (1F; M=1.33) are consistently rated as low-impact. This suggests that the perceived risk is primarily shaped by direct experience of the urban environment rather than by abstract knowledge or indirect forms of insecurity.

This interpretation is further supported by the qualitative material. Several participants describe cycling in Turin as a condition of constant exposure, often normalised through habituation. As one user states: "every time I come back home I think 'thank God nothing happened' ". At the same time, this perception does not necessarily translate into avoidance, but rather into adaptive behaviours such as riding on sidewalks, slowing down at crossings or strategically choosing routes.

The prominence of lack of physical protection reflects a widespread demand for clear spatial separation between cyclists and motorised traffic. Users consistently refer to physically segregated cycling infrastructure, often drawing comparisons with Dutch examples, as the only configuration capable of generating a sense of safety. The issue is not only the absence of infrastructure, but its fragmentation and inconsistency, which undermines trust in the system as a whole.

A similar dynamic applies to complex intersections, which are repeatedly described as critical breakdown points within the network. While some linear segments are perceived as relatively manageable, the intersections are experienced as moments where cyclists are left to "figure it out on their own". This aligns closely with the perspectives of experts, that identify the intersections as systemic safety hotspots. Interestingly experts also highlight a gap between actual and perceived risk, suggesting that users may underestimate the objective danger of these same nodes, experiencing them mostly as points of uncertainty.

"I commit so many traffic violations — I have to!"
(User interview)

"I stop and check that the cars have actually seen me. This obviously ruins the flow a bit."
(User interview)

"Build cycle lanes, sure — not necessarily many, but intelligent ones. Right now they're scattered, full of interruptions, and it's not even clear where you're supposed to go."
(User interview)

"I have to cross [...] and there you think: what do I do, how do I behave? I close my eyes and hope I make it to the other side."
(User interview)

"Intersections are the safety hotspots. But it seems that, politically or for the stakeholders, it's harder to intervene there than to build the straight lane."
(Expert interview)

"Projects happen on the streets, but the intersections are left out of the project entirely."
(Expert interview)

Differences between cyclists and non-cyclists are relatively contained across most barriers, but still some variations are noteworthy. Cyclists tend to assign slightly higher relevance to traffic-related risks (1A, 1B, 1D), reflecting their direct exposure, while non-cyclists report higher concern for environmental and contextual factors such as personal insecurity (1F) and visibility conditions (1H). Still, the most relevant barrier overall (1C) is evaluated almost equally by both groups and this indicates a shared perception of infrastructural inadequacy.

"After my bike was stolen I didn't cycle for a month and a half. It completely killed my motivation."
(User interview)

In contrast, accident statistics (1E) appear largely irrelevant in shaping behaviour. Multiple participants explicitly downplay their influence, pretty often relativising them by comparing cycling risks to those associated with driving. This suggests that statistical information does not significantly contribute to perceived risk, which appears to remain grounded in immediate and experiential factors.

"I see it all the time — bikes worth nothing with €150 locks."
(User interview)

Theft and vandalism (1G) occupy an intermediate position. Even if not among the highest-rated barriers overall, they do generate strong qualitative responses and reveal a pattern of behavioural adaptation. Users describe a range of different mitigation strategies, including the use of low-value bicycles, high-security locks or very selective parking practices. In some cases, previous theft experiences lead to temporary disengagement from cycling, indicating that this barrier can have a disproportionate impact despite moderate average scores.

"If theft weren't a problem — if everyone could have a decent bike, maybe an assisted one — you'd solve the sweating issue too. It's all connected. One problem feeds another."
(User interview)

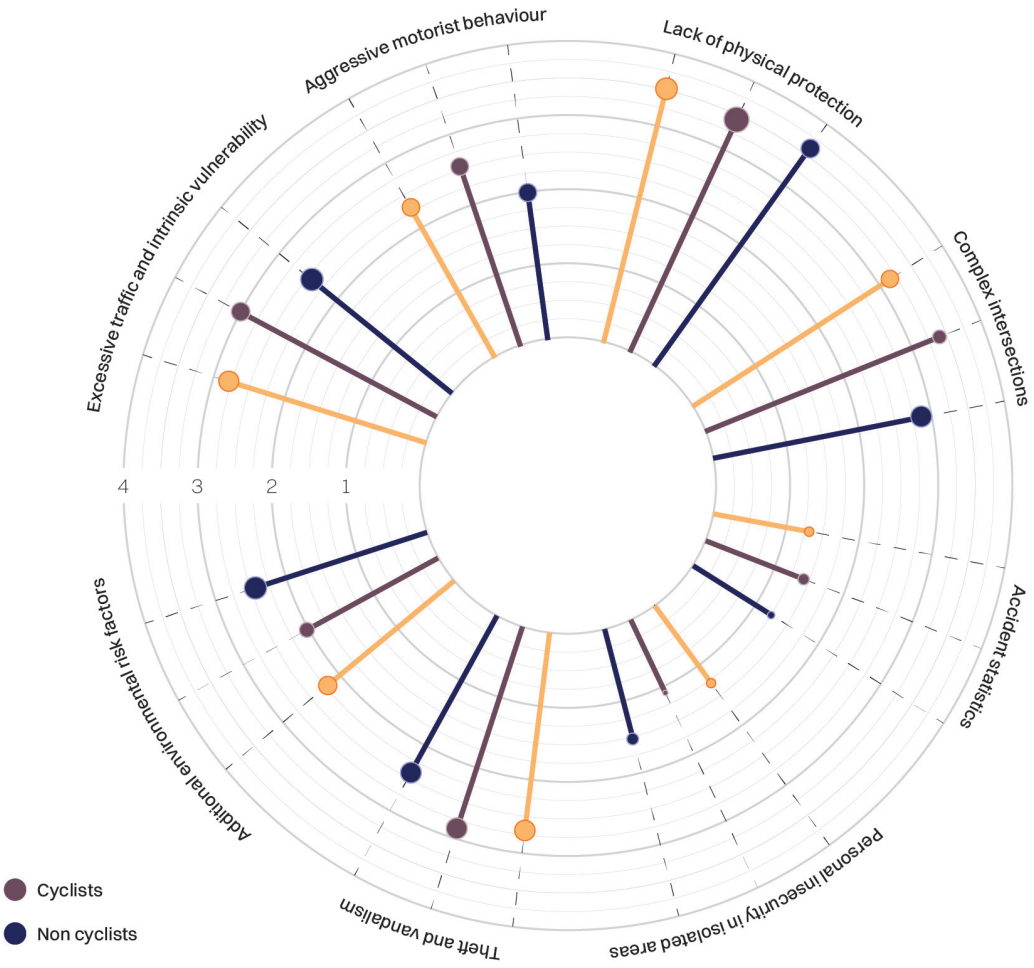
From the expert perspective, risk and safety constraints are consistently evaluated as high-impact across almost all sub-categories. In particular, aggressive motorist behaviour (1B), lack of physical protection (1C), complex intersections (1D), and accident-related risks (1E) all receive high impact scores ($M \geq 4.00$). However, their perceived difficulty of intervention varies significantly. While infrastructural issues such as physical protection and complex intersections are considered solvable technically but also very complex to implement, behavioural and systemic factors such as motorist behaviour are perceived as equally impactful but more difficult to address.

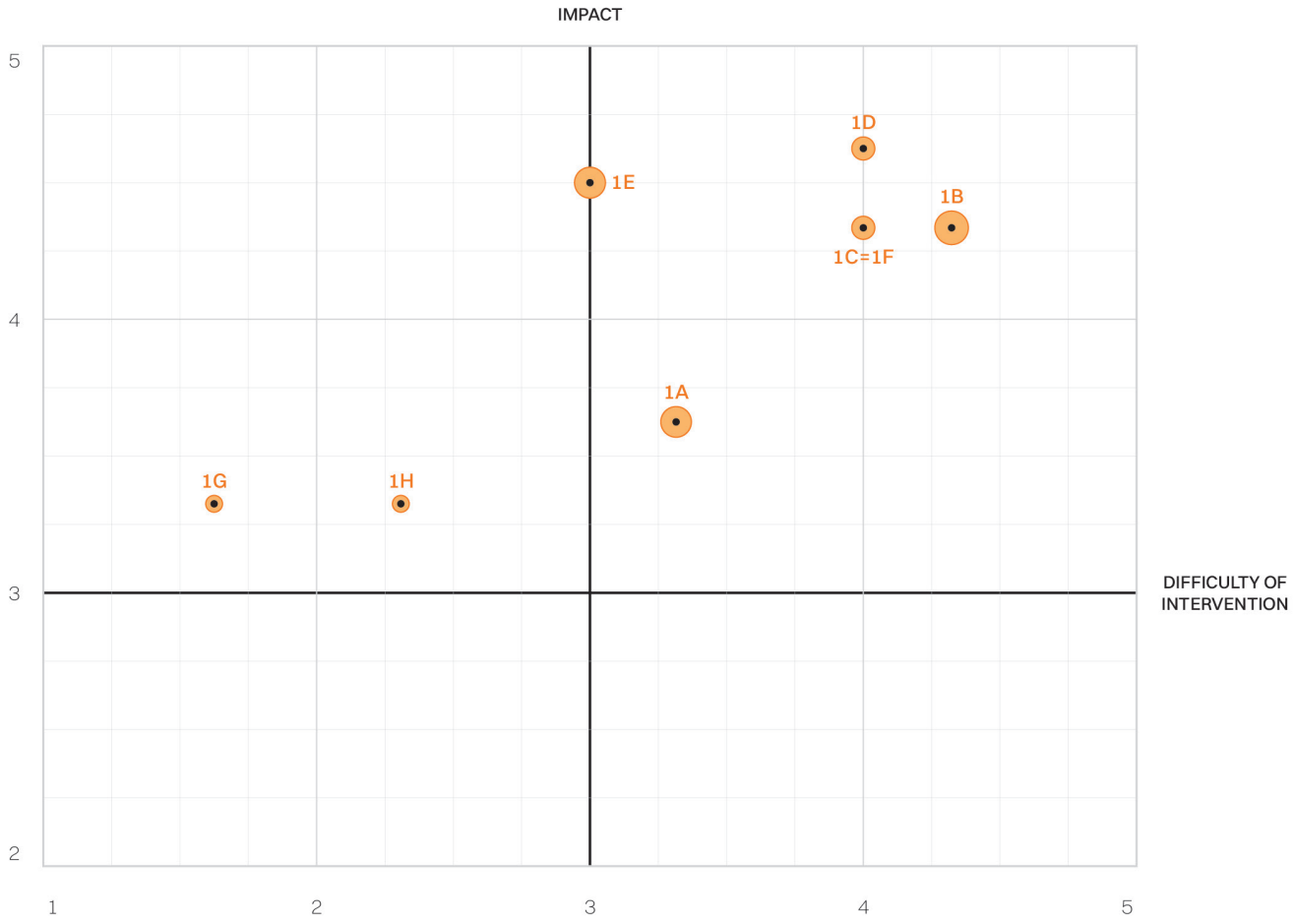
A notable divergence emerges in relation to accident statistics (1E) and personal insecurity (1F). Both are rated as highly impactful by experts but receive low relevance from users. This gap suggests somewhat of a misalignment between professional assessments of risk and the ways in which risk is perceived and internalised in everyday mobility practices.

"Sometimes it's the small flagship moments — opening a new bike parking even if with just five spots. Not enough, but politically and financially an easier win than redesigning a junction."
(Expert interview)

Finally, theft and vandalism (1G) stand out as a relatively high-impact but low-difficulty barrier from the expert perspective, indicating the presence of actionable interventions. But experts also emphasise that the phenomenon is partly rooted in broader societal dynamics, limiting the extent to which it can be fully addressed through mobility-specific measures.

Overall this category highlights a key structural pattern: the barriers that seem to be the most influential for users are those directly embedded in the physical configuration of the urban environment, particularly where infrastructure is absent, discontinuous or ambiguous. At the same time a gap persists between experiential perception and systemic evaluation, pointing to the importance of addressing both the material and interpretative dimensions of safety in cycling mobility.





Top: average ratings (scale 1-5) for Category 1, shown as overall user average plus separate averages for cyclists and non-cyclists, with marker size indicating standard deviation. Bottom: average expert ratings for the same barriers, plotted by impact (y-axis) and difficulty of intervention (x-axis), with marker size indicating standard deviation.

4.3.3. Material and spatial feasibility constraints

Within this category, the interpretation of results requires a preliminary clarification regarding the composition of the sample. As already outlined above, within the participant selection strategy section, individuals living in highly peripheral or hilly areas, as well as those subject to strong structural constraints (e.g. care-giving responsibilities), were deliberately excluded. This choice was intended to focus the analysis on a population with a relatively high degree of agency in mobility decisions, avoiding an over-representation of context-specific limitations. As a consequence certain barriers, particularly those related to topography (2A) and to intermodal integration (2E), may appear less relevant in this dataset than they would for other specific population groups. Therefore, this does not imply that these barriers are negligible in absolute terms but rather that their weight is contingent on specific territorial and socio-demographic conditions.

Among users the overall relevance of this category is relatively heterogeneous, with a clear distinction between low-impact structural conditions and more salient infrastructural deficiencies. The most significant barriers emerge as cycling network discontinuity (2F; M=3.87), poor road surface quality (2H; M=3.67), and path obstructions and spatial conflicts (2I; M=3.53). In contrast, factors such as unfavourable topography (2A; M=1.53), excessive distances (2C; M=1.60), perceived physical demand (2D; M=1.47), and limited intermodal integration (2E; M=1.47) receive consistently low evaluations.

Unfavourable topography (2A) is among the least relevant barriers in the dataset, with a total mean of 1.53 characterised by some difference between cyclists (M=2.00) and non-cyclists (M=1.00). Qualitative data confirms that Turin is generally perceived as a relatively flat city, with the exception of hilly areas that fall outside the scope of most participants' daily routines. While some users do mention specific infrastructural elements such as overpasses as physically very demanding, these are described as isolated inconveniences rather than systemic deterrents. The availability of electric bicycles also mitigates this issue further.

"Rain is the one thing that stops me. When it's like that, I just don't go."
(User interview)

Adverse weather conditions (2B) present a more complex and internally differentiated pattern (M=3.00; SD=1.31). Non-cyclists assign a higher relevance (M=3.57) compared to cyclists (M=2.50), but the qualitative material suggests that this difference should not be interpreted as a simple dichotomy. Both groups include individuals who avoid cycling in specific conditions, most notably rain, as well as users who report no behavioural change. Rather than reflecting a clear segmentation, weather sensitivity appears to be highly subjective and dependent on individual thresholds, habits and levels of adaptation. While increased cycling frequency may contribute to its normalisation, the data still seems to indicate that weather does remain a situational and personally mediated barrier rather than a structurally determinant one.

"There's no bad weather, only bad equipment. If you have the right gear you go out when it's pouring, when it's snowing."
(User interview)

Excessive distances and urban sprawl (2C) are consistently rated as low-impact (M=1.60) with slightly higher values among cyclists (M=1.87) compared to non-cyclists (M=1.28). Participants describe Turin as a city where most daily destinations are reachable within short travel times, at times quantifying typical cycling trips within a range of 15–20 minutes. This perception does align and even reinforce the findings presented in Chapter 3, which describe Turin

as a city with a relatively compact spatial structure.

Perceived excessive physical demand (2D) is among the least relevant barriers (M=1.47) with minimal variation between cyclists and non-cyclists. Qualitative insights reveal an almost absent concern regarding physical effort, which is often reframed as irrelevant or even as desirable. From the expert perspective however this barrier is attributed a higher impact (M=4.33), despite a moderate perceived difficulty of intervention (M=3.00). This suggests that while users do not currently perceive physical effort as a limiting factor, the same barrier may still represent a limit for broader adoption, in particular among less active populations. Experts also talk about behavioural and cultural interventions such as awareness campaigns or role-modelling strategies as potential levers, although their effectiveness is still considered uncertain.

"If I use it to get to work — with a heavy bag, the laptop — I arrive completely drained."
(User interview)

"The whole point is that we enjoy the physical effort. I'm going to sit at a desk all day — at least let me move a little on the way there."
(User interview)

Limited intermodal integration (2E) is also rated as low-impact by users (M=1.47), with only marginal differences between cyclists (M=1.62) and non-cyclists (M=1.28). For most participants cycling is not combined with other transport modes in daily routines, and this results in a general perception of this barrier as being irrelevant. This is reflected in the qualitative material, where intermodality is rarely discussed and even when mentioned is not framed as a constraint. Experts assign a moderate impact (M=3.33) but show a high variability in perceived difficulty of intervention (SD=2.31), indicating a lack of consensus on both its priority and feasibility.

"When I end up on streets I don't know, it's stressful — you look for the lane, you can't see it, then you spot it on the other side of the road, then it changes again..."
(User interview)

In contrast cycling network discontinuity (2F) emerges as the most critical barrier within the whole dataset (M=3.87), having high evaluations from both cyclists (M=3.62) and non-cyclists (M=4.14). Users consistently describe the cycling network as being fragmented, inconsistent with itself and difficult to navigate particularly in unfamiliar areas. This fragmentation is experienced not only as a physical interruption but also as a cognitive burden, requiring continuous adaptation and route interpretation. Experts reinforce this interpretation assigning the highest impact score within the category (M=4.67) and emphasising the structural nature of the issue. Infrastructural investment is identified as the primary solution, but experts also point to incremental strategies such as traffic calming and network optimisation as feasible intermediate interventions.

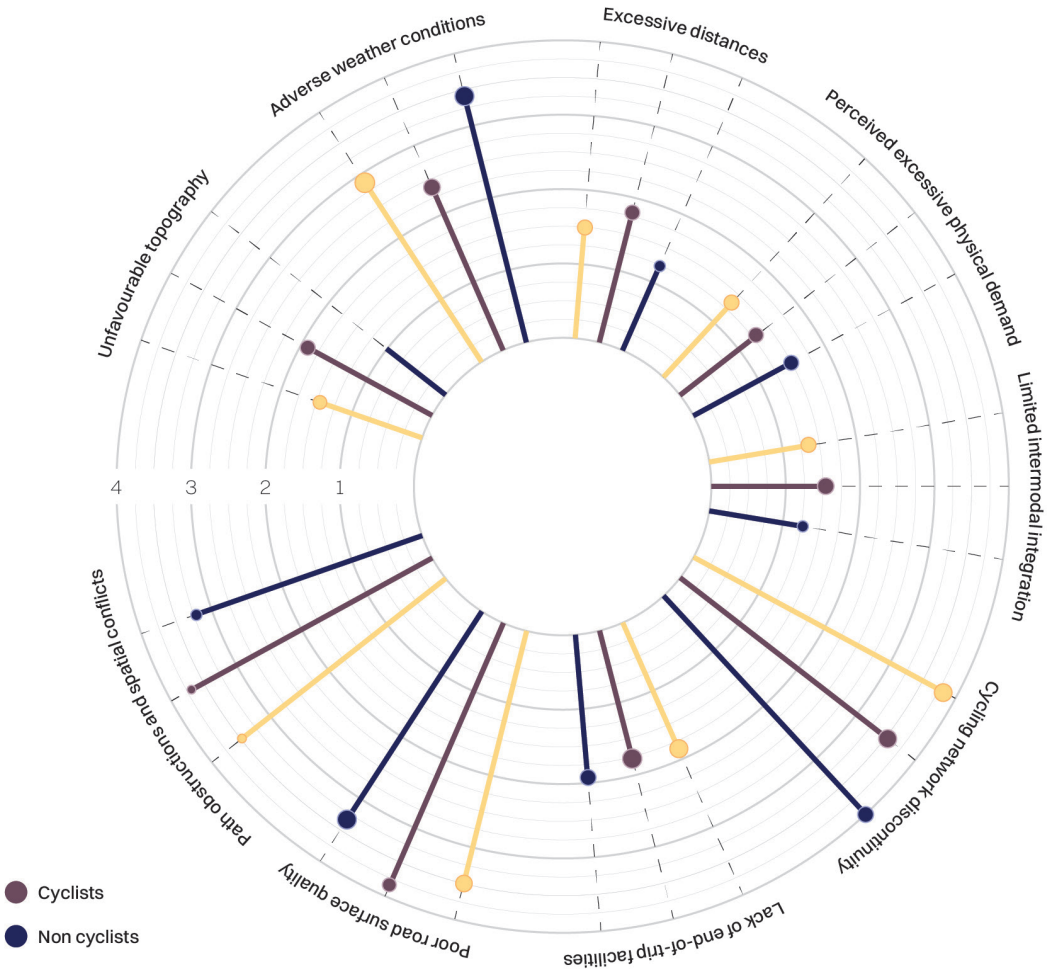
"I'd rather there were no cycle lanes at all than these ones that confuse you and make the routes even stranger."
(User interview)

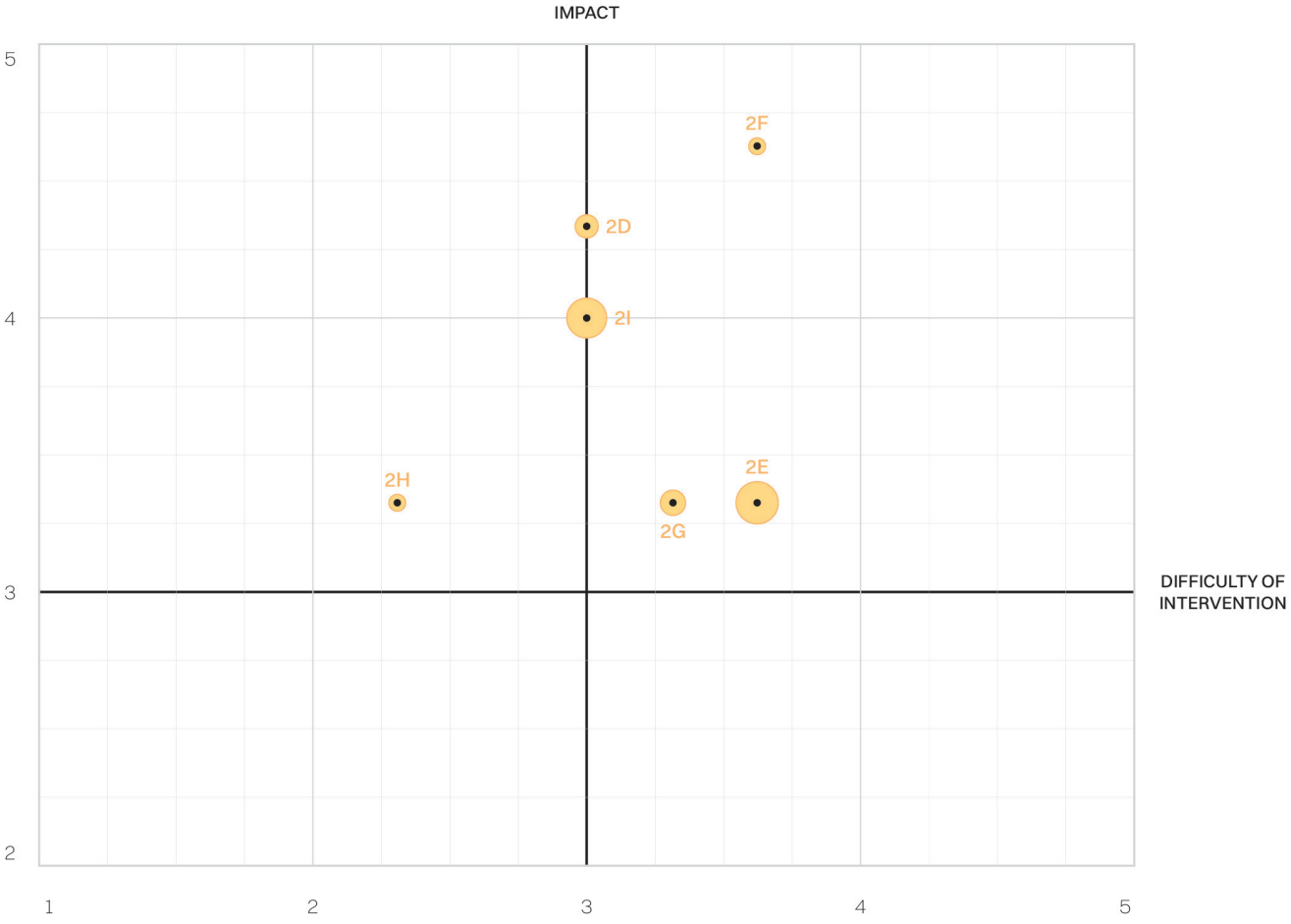
"Having a consistent visual identity for cycle lanes absolutely matters — for cyclists, for drivers, for everyone. You start to know what to expect and how to behave."
(Expert interview)

Poor road surface quality (2H) is another highly rated barrier (M=3.67), with slightly higher concern among cyclists (M=3.87) than non-cyclists (M=3.43). Participants frequently refer to uneven surfaces, cobblestones and tram tracks as sources of discomfort and even of potential risk. Although rarely described as a factor that completely prevents cycling, it is consistently framed as a significant source of both physical and psychological friction. Experts assign a moderate impact (M=3.33) and relatively low difficulty of intervention (M=2.33), and they identify maintenance and budget allocation as the primary constraints.

Path obstructions and spatial conflicts (2I) also go among the most relevant barriers (M=3.53), with higher evaluations from cyclists (M=3.75) compared to non-cyclists (M=3.28). The qualitative data highlights some recurring conflicts with parked vehicles, delivery activities and pedestrian behaviours, all of these contributing to a perception of cycling space as contested and unreliable. Unlike network discontinuity, which is primarily infrastructural, this barrier is strongly linked to behavioural patterns and enforcement gaps.

"In the morning I leave at 7 to avoid the worst traffic and have a bit more safety. But even then, there are always vans parked on the bike lane, unloading."
(User interview)





Top: average ratings (scale 1-5) for Category 2, shown as overall user average plus separate averages for cyclists and non-cyclists, with marker size indicating standard deviation. Bottom: average expert ratings for the same barriers, plotted by impact (y-axis) and difficulty of intervention (x-axis), with marker size indicating standard deviation.

Experts recognise its high impact (M=4.00) assigning a moderate difficulty of intervention (M=3.00) and suggesting that regulatory and cultural measures could play a significant role.

Lack of end-of-trip facilities (2G) has an intermediate position (M=2.00), with limited differentiation between cyclists and non-cyclists. While aspects such as secure parking are occasionally mentioned as being minor inconveniences, facilities such as showers or changing rooms are generally seen as unnecessary. Experts similarly attribute moderate importance to this barrier (M=3.33), and suggest that its influence on modal choice may be overestimated in relation with other structural constraints.

"Maybe in summer it would be nice... but we do have a shower at the office. And yet it would never actually cross my mind to use it."
(User interview)

Overall, this category reveals a clear pattern: the most influential barriers are those embedded in the everyday material configuration of the cycling environment, particularly where infrastructure is incomplete, poorly maintained or contested by other street users. In contrast factors related to physical effort, distance or intermodality appear to play a secondary role within this specific context. As in the previous category a partial misalignment emerges between user perception and expert evaluation, particularly in relation to latent or systemic barriers such as physical demand. However both perspectives converge in identifying infrastructural continuity and spatial legibility as key conditions for enabling broader cycling adoption.

4.3.4. Comparative utility and convenience constraints

Compared to the previous categories, this dimension presents a higher degree of internal variability, with several barriers showing strong divergences between cyclists and non-cyclists, as well as less consistent patterns in expert evaluations.

Among users the most relevant barriers within this category are preparation and organisational time (3G; M=2.80) and habitual mode lock-in (3A; M=2.73), followed by automobile comfort and technological amenities (3D; M=2.27) and trip chaining and dependent mobility (3B; M=2.20). In contrast perceived travel times (3E; M=1.93), opportunity costs of car ownership (3C; M=1.40) and direct individual costs of cycling (3F; M=1.20) are consistently rated as low-impact.

Habitual mode lock-in (3A) reveals one of the most pronounced differences between cyclists and non-cyclists, with a mean of 1.62 among cyclists and 4.00 among non-cyclists (Δ = - 2.38). This divergence reflects the nature of the barrier itself: for individuals who already cycle, the habit is either established or has already been successfully disrupted, whereas for non-cyclists routine still does emerge as a significant constraint. Qualitative material supports this interpretation with both users and experts describing mobility practices as deeply embedded in everyday routines. One expert notes that "if cycling is not part of someone's routine, it's difficult to break through it", highlighting how habits function as cognitive shortcuts that stabilise behaviour over time. At the same time both datasets point to specific moments of potential disruption, such as relocation or changes in life circumstances, as opportunities for behavioural shift. Users also already emphasise here the role of social influence and prior exposure, suggesting that habit formation is not only individual but also relational and contextual.

"Cycling offers perfect chain-tripping possibilities — it's a solution, not a problem. People who don't cycle think it's harder, but actually it's easier."
(Expert interview)

Trip chaining and dependent mobility (3B) present a relatively moderate relevance (M=2.20) with minimal differences between cyclists (M=2.12) and non-cyclists (M=2.28). However, this result should be interpreted in relation to the sampling criteria which excluded participants with young children and therefore reduced the presence of complex dependency-related travel patterns. Qualitative data reveals a high degree of variability as some participants perceive cycling being highly efficient for multi-stop trips even saying that "the more things I have to do, the more likely I will take the bike", while others highlight clear limitations in particular when transporting goods or accompanying others. Experts adopt a similarly ambivalent position describing cycling as potentially well-suited for trip chaining but only when supported by adequate infrastructure and spatial conditions.

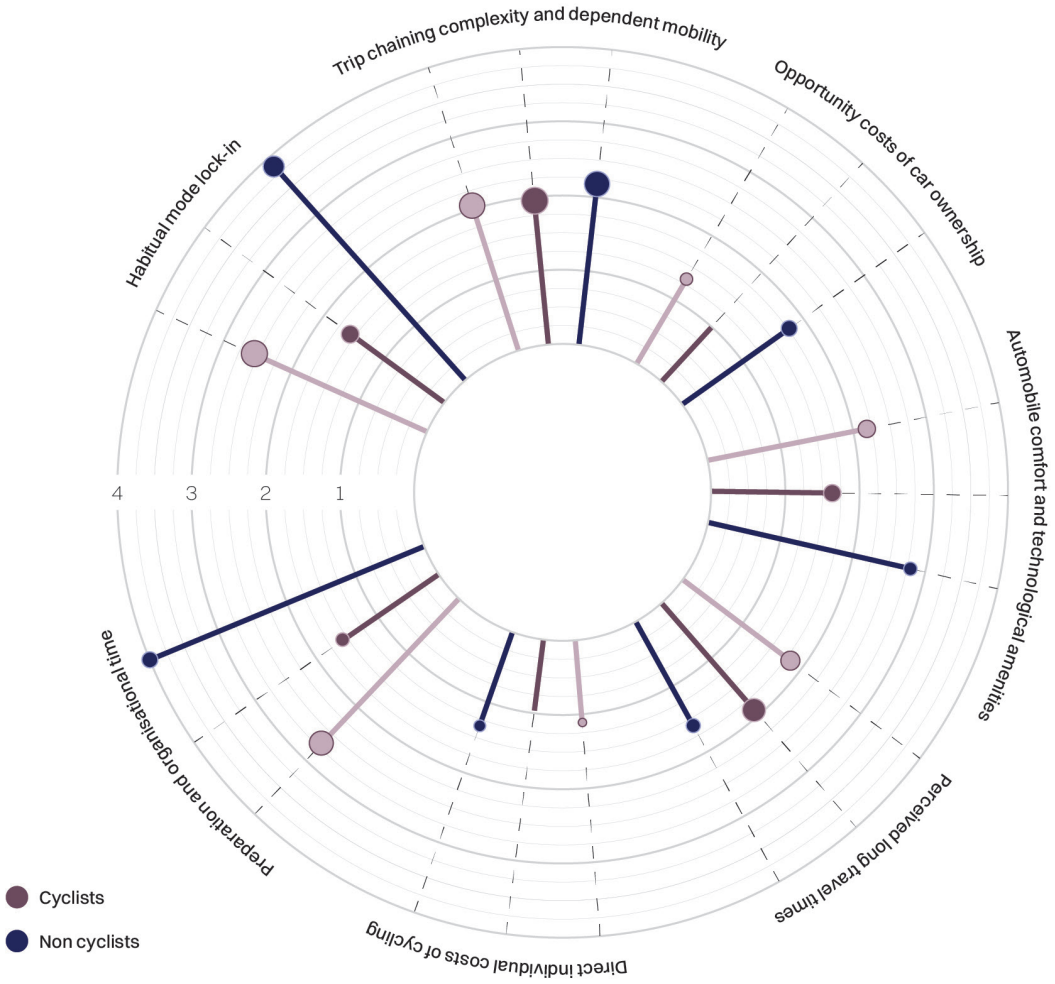
Opportunity costs of car ownership (3C) are consistently rated as low (M=1.40), with cyclists assigning a value of 1 and non-cyclists 1.86. Users do not generally perceive car ownership as a factor that really discourages cycling, often they frame the two modes as complementary rather than mutually exclusive. In contrast experts attribute to this barrier a relatively high impact (M=4.30) and also a high difficulty of intervention (M=4.00). This suggests that, although not explicitly perceived by users, the structural and economic lock-in associated with car ownership may still play a significant role at a systemic level particularly in shaping long-term mobility habits.

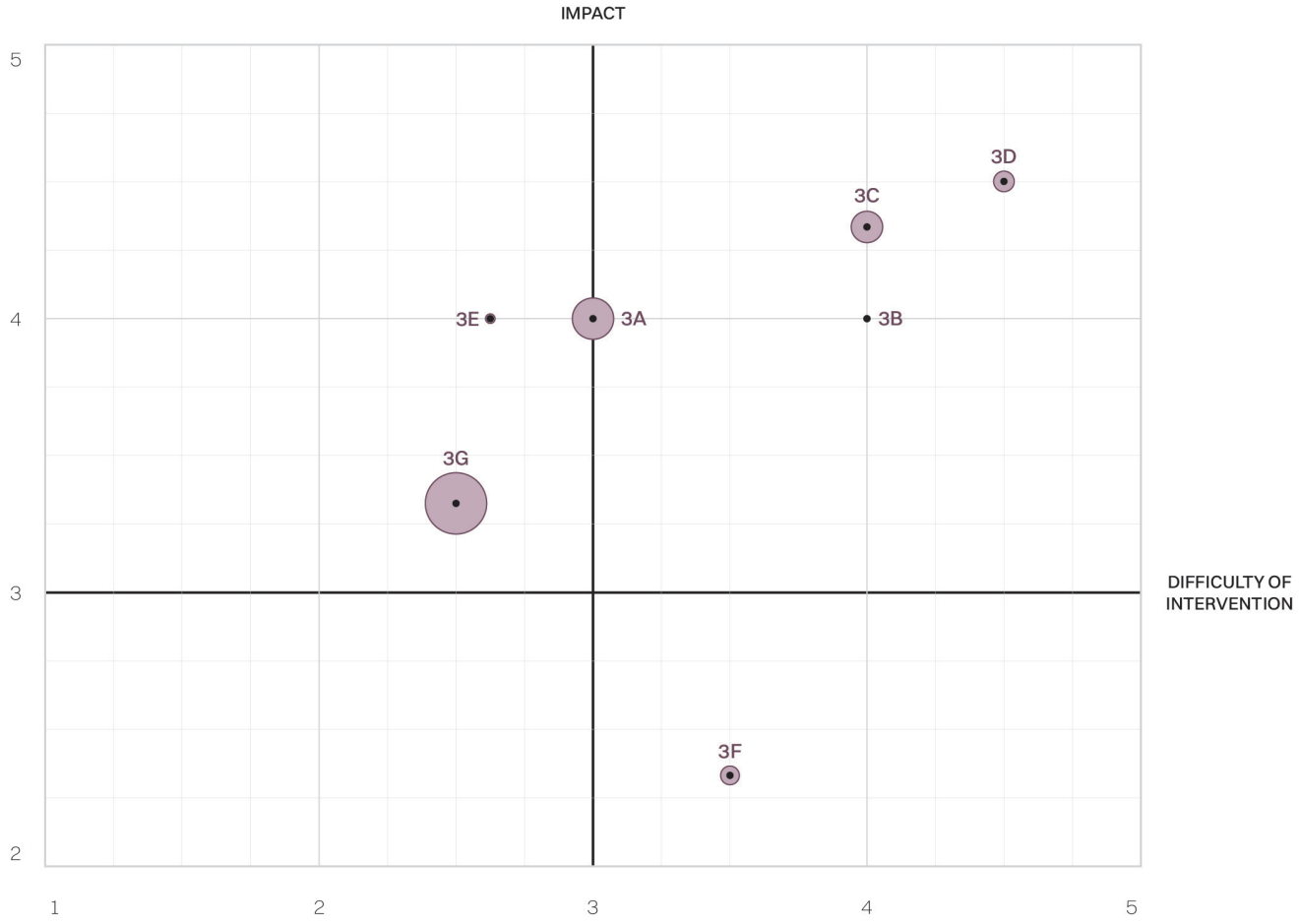
Automobile comfort and technological amenities (3D) show a moderate relevance among users (M=2.27), with higher values for non-cyclists (M=2.86) compared to cyclists (M=1.75). This indicates that comfort-related factors such as protection from weather and embedded technologies are even more salient for those who do not currently cycle. Experts further reinforce the importance of this barrier as they assign both high impact (M=4.50) and high difficulty of intervention (M=4.50) and so suggest that the appeal of the automobile is deeply embedded in both material conditions and cultural expectations. At the same time qualitative insights indicate that these preferences are context-dependent and can be partially mitigated through alternative solutions such as e-bikes or environmental adaptations.

"Yes, it takes more time — but the time you save with the car you generally lose looking for parking. So the time factor is actually in the bike's favour."
(User interview)

Perceived long travel times (3E) are evaluated as low-impact by users (M=1.93), with slightly higher values among cyclists (M=2.12) than non-cyclists (M=1.71). This is consistent with qualitative evidence where multiple participants explicitly challenge the assumption that cycling is slower often emphasising the time lost in traffic or parking when using a car. Experts however assign a high impact to this barrier (M=4.00) while indicating a relatively low difficulty of intervention (M=2.70). This gap seems to suggest that travel time is primarily a perceptual barrier, one that potentially can be addressed through communication, experiential learning or direct comparison between modes.

Direct individual costs of cycling (3F) result to be the least relevant barrier in the category (M=1.20), with minimal variation between cyclists (M=1.00) and non-cyclists (M=1.43). Most users describe cycling as economically accessible, particularly when compared to car-related expenses. Some more nuance emerges in relation to the initial investment, especially if it comes to higher-quality or electric bicycles. Experts similarly attribute low impact to this barrier (M=2.30), while recognising a moderate difficulty of intervention (M=3.50)





Top: average ratings (scale 1-5) for Category 3, shown as overall user average plus separate averages for cyclists and non-cyclists, with marker size indicating standard deviation. Bottom: average expert ratings for the same barriers, plotted by impact (y-axis) and difficulty of intervention (x-axis), with marker size indicating standard deviation.

"Preparation time — five as a perceived barrier, but a one to address it. It's literally just trying it. A lot of marketing is heavily focused on all the gear you supposedly need. All you really need is a bicycle. And maybe a lock."
(Expert interview)

primarily linked to the need for financial incentives or subsidy schemes.

Preparation and organisational time (3G) represents one of the most polarising barriers in the dataset with a total mean of 2.80 but a substantial divergence between cyclists (M=1.62) and non-cyclists (M=4.14; Δ= -2.52). For the second group, cycling is often perceived as if it requires additional effort in terms of planning, equipment and personal management, whereas cyclists tend to normalise or minimise these aspects. This perception is echoed in expert interviews where preparation is described as a "perceived barrier" rather than an objective constraint, often reinforced by cultural narratives around cycling as a complex or gear-intensive activity. This barrier also presents the highest level of disagreement among the experts (combined SD=4.00).

Overall this category highlights a key distinction between perceived and experienced barriers. Factors such as habits, preparation and comfort appear to play a significant role in shaping non-cyclists' attitudes, while being largely neutralised through practice among cyclists. At the same time several barriers identified by experts, particularly those related to systemic lock-in or perceptual biases, are not directly recognised by users, pointing to a layered structure of behavioural constraints that operates differently across levels of experience and awareness.

4.3.5. Normative and identity constraints

Normative and identity constraints emerge as a low-impact category from the user perspective, with all average scores remaining below the mid-scale. However this apparent marginality comes together with both strong internal variation and a consistent misalignment with expert evaluations, which instead assign high systemic relevance to most of these same dimensions. Overall while users tend to downplay the influence of normative and identity-related factors on their own behaviour, the combined quantitative and qualitative data suggest a more complex and uneven landscape.

"Well to change car culture, that's the ultimate challenge isn't it?"
(Expert interview)

The dominance of car culture (4A; M=1.50, SD=0.74) is among the clearest cases of divergence between user perception and expert assessment. Both cyclists (M=1.40) and non-cyclists (M=1.60) assign very low relevance to this barrier, indicating that it is largely invisible at the level of individual decision-making. Qualitative accounts acknowledge its existence primarily as a background condition saying things like "it's a city built for cars, so people use cars", yet this rarely translates into a perceived constraint on personal behaviour. In contrast, experts identify this dimension as one of the most impactful within the entire dataset (M=4.67), pointing to it being a structural factor that shapes mobility practices without being consciously recognised by users. The data therefore indicate a systemic condition that is normalised to the point of becoming perceptually neutral at the individual level.

A similar but less extreme pattern characterises the lack of a widespread cycling culture (4B; M=2.10, SD=1.30), where a clearer distinction emerges between cyclists (M=1.50) and non-cyclists (M=2.70). For non-cyclists in particular the limited visibility and normalisation of cycling appears to constitute a more tangible barrier. Qualitative evidence suggests that this operates primarily through positive reinforcement: increased exposure to other cyclists is

perceived as enabling, with statements like "if I saw more people cycling, I would feel more encouraged", while the absence of such visibility is not explicitly framed as a real deterrent. Experts again attribute very high impact to this dimension (M=4.70), but consider it comparatively more tractable (difficulty M=3.70), highlighting its relevance as a lever for behavioural change despite its limited explicit recognition among users.

"Cycling in the evening with friends, everyone on bikes, no one waiting for a bus or worrying about parking or deciding not to drink — there's a freedom to it that's hard to explain."
(User interview)

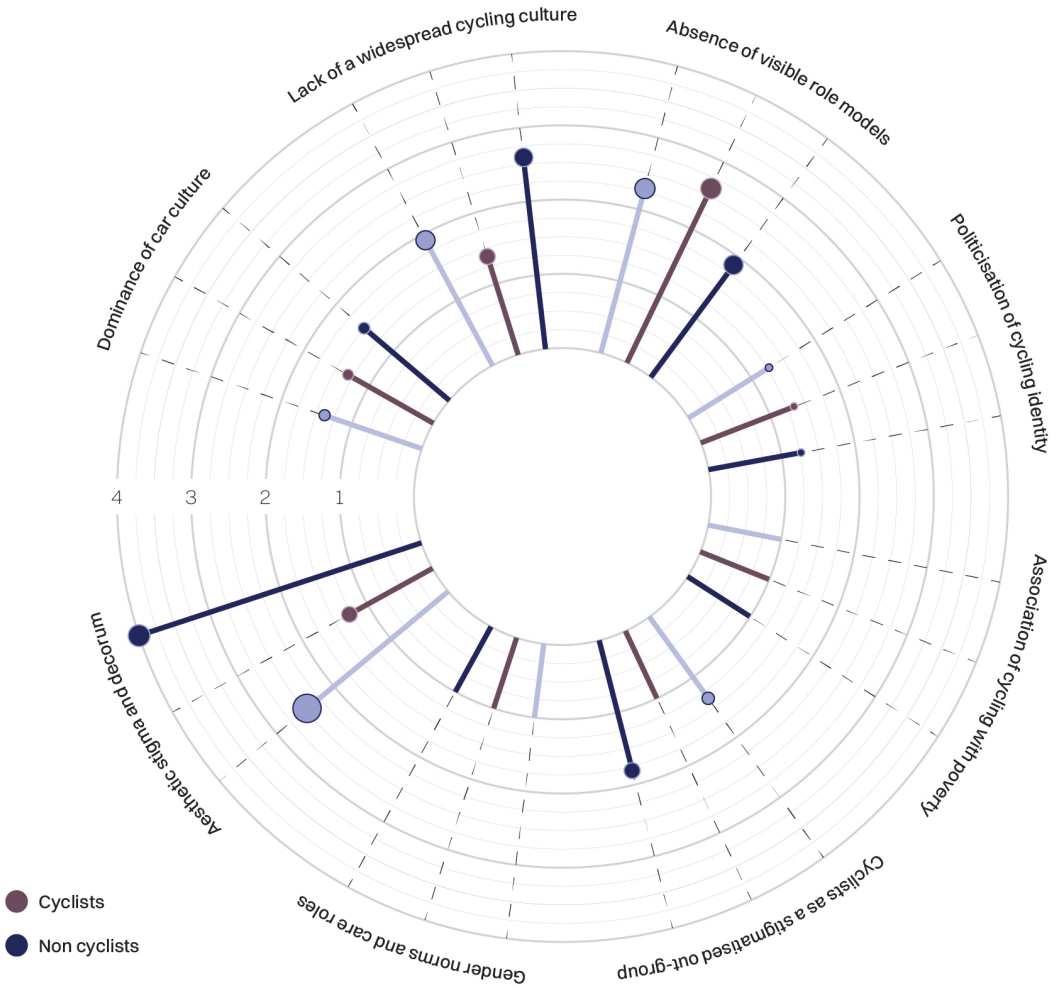
The absence of visible role models (4C; M=2.40, SD=1.35) presents a more ambivalent profile, with cyclists (M=2.75) reporting slightly higher sensitivity than non-cyclists (M=2.00). Qualitative data reveal a consistent pattern in which participants tend to deny direct influence while simultaneously acknowledging its possible effects. As one user notes "denying the influence of others is difficult". This suggests that social influence operates in a partially implicit manner, as it is not necessarily recognised as a real determinant of behaviour, but it is still present in shaping perceptions and practices. Expert perspectives align with this reading as they emphasise the role of visibility and identification processes, while also noting the limits of formalised advocacy or ambassador-based strategies.

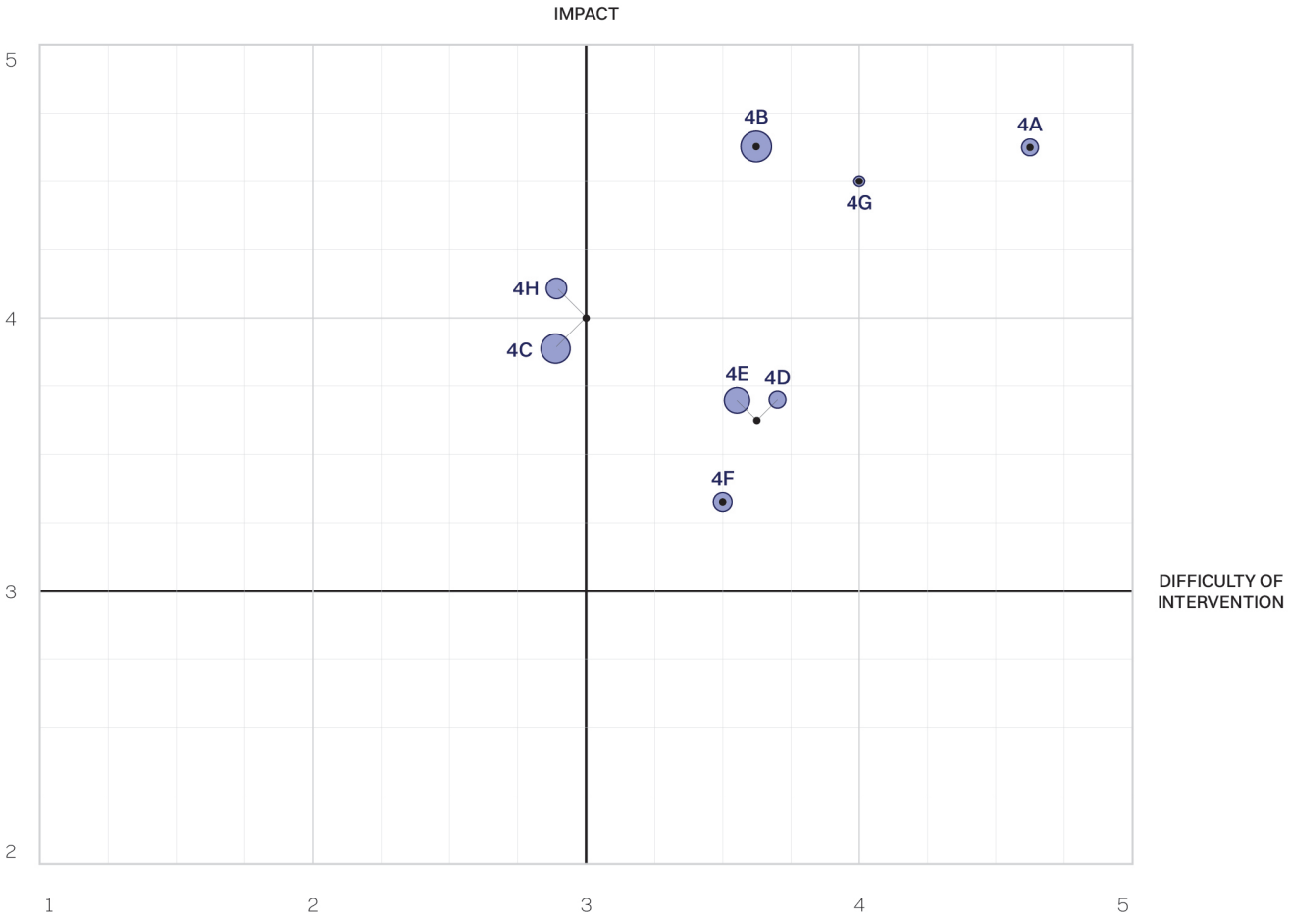
The politicisation of cycling identity (4D; M=1.33, SD=0.49) is consistently rated as negligible across both groups (cyclists M=1.37; non-cyclists M=1.28), indicating that it does not constitute a meaningful barrier in the observed context. Qualitative accounts frame this dimension as either weakly present or largely irrelevant: "maybe it exists, but it's not so widespread", and even where acknowledged it is rarely perceived as behaviourally consequential. Experts assign moderate impact (M=3.67), suggesting that politicisation may operate more strongly at institutional or discursive levels than in everyday mobility choices.

Two barriers, association of cycling with poverty (4E) and gender norms and care roles (4G), are unanimously rated at the minimum level (M=1.00; SD=0), indicating complete convergence across all participants. In both cases the data suggests that these constraints are currently not perceived as relevant within the whole sample. In particular the association between cycling and economic disadvantage appears to be largely outdated, as reflected in statements such as "that may have been true in the past, but not anymore" or "now cycling is actually seen as something cool". Similarly gender-related constraints are not recognised as influential in the present context, with no one across the users having past experiences to be related with this, although some qualitative accounts do acknowledge that these dynamics may still exist in specific situations or life stages. At the same time experts attribute moderate to high impact to both dimensions (4E impact M=3.67; 4G impact M=4.50), pointing again to a discrepancy between individual-level perception and broader structural or cultural dynamics.

The perception of cyclists as a stigmatised out-group (4F; M=1.40, SD=0.83) remains relatively limited overall, with some difference between cyclists (M=1.00; SD=0) and non-cyclists (M=1.86; SD=1.07). While most participants do not report feeling directly affected by this, qualitative accounts do highlight the presence of latent tensions often described in terms of mutual polarisation between cyclists and motorists. One user refers to a "kind of war" with both groups reinforcing oppositional identities. At the same time these dynamics

"It's a vicious circle: on a bike I hate drivers, in a car I hate cyclists, on foot I hate everyone. It's genuinely terrible."
(User interview)





Top: average ratings (scale 1-5) for Category 4, shown as overall user average plus separate averages for cyclists and non-cyclists, with marker size indicating standard deviation. Bottom: average expert ratings for the same barriers, plotted by impact (y-axis) and difficulty of intervention (x-axis), with marker size indicating standard deviation.

are frequently framed as manageable or situational and in some cases implicitly linked to the lack of adequate infrastructural conditions, which shape behaviours on both sides. As such, while it is present, this barrier does not appear to consistently translate into explicit behavioural inhibition.

A notable exception within the category is aesthetic stigma and decorum (4H), which shows a higher overall relevance (M=2.67; SD=1.88) and most importantly the largest gap in the entire dataset between cyclists (M=1.37) and non-cyclists (M=4.14; Δ= - 2.77). This indicates a strong divergence in how this barrier is perceived across groups. While cyclists largely dismiss this dimension, for non-cyclists concerns related to appearance, physical discomfort and situational appropriateness constitute a concrete and relatively high barrier. Crucially qualitative data indicate that this barrier is often framed not in terms of external judgement but as internal misalignment: "It's not that I feel judged, I just don't feel like myself when I'm not put together. It's not about looking unprofessional, it's a personal discomfort.". This shifts the issue from social stigma and explicit external judgement to self-perception and identity coherence. Experts assign high impact to this dimension (M=4.00) while indicating comparatively lower difficulty of intervention (M=3.00), suggesting that processes of normalisation and exposure may play a significant role in mitigating its effects.

Overall, this category reveals a consistent structural pattern. Normative and identity-related barriers tend to be weakly recognised at the individual level, yet are simultaneously assessed by experts as highly influential within the broader mobility system. This is particularly evident for structural-cultural dimensions such as car dominance and cycling normalisation, which appear to operate in the background of everyday decision-making. At the same time, specific barriers, and most notably the aesthetic stigma, show strong differentiation across user groups indicating that identity-related constraints may become highly salient under particular conditions even when they remain largely unacknowledged in general terms.

"Some things could be tested with almost no infrastructure investment — just signage, markings, small experiments. See what works before committing to anything permanent."
(User interview)

4.3.6. Governance and political constraints

As outlined above this category was assessed exclusively through expert interviews given its technical nature and its distance from the experiential focus of users. Overall governance and political constraints are consistently evaluated as high-impact barriers, with difficulty scores that are systematically equal or higher than impact scores, an aspect that indicates that these barriers are not only structurally significant but also particularly resistant to change.

Underfunding of cycling infrastructure (5A) is identified as a major systemic constraint (impact M=4.33; difficulty M=4.67). Experts highlight how funding allocation mechanisms tend to disproportionately favour motorised transport and often in ways that remain invisible to users. While effects of underinvestment such as discontinuous or inadequate infrastructure are directly experienced the underlying financial structures are not necessarily recognised as causal factors. As one expert notes "users experience that the bike path disappears, but they don't necessarily connect it to how funding is allocated".

"Not every street needs a cycle lane. 80% of Dutch streets have no cycling infrastructure. They just have slow traffic. It's uncomfortable to drive — so cars go elsewhere."
(Expert interview)

Fragmented planning and institutional silos (5B) are also described as deeply embedded barriers with the qualitative material that emphasises how

organisational structures themselves hinder integrated mobility planning with limited coordination across departments and policy domains. This fragmentation is not framed as a temporary inefficiency but as a structural condition: "it's really embedded in how institutions are built". Accordingly both impact and difficulty are rated high (impact M=3.67; difficulty M=4.33), reflecting the complexity of intervening in entrenched governance systems.

The institutionalised car-centric paradigm (5C; impact M=4.00; difficulty M=4.67) is positioned by experts as an overarching explanatory factor underpinning multiple other barriers. It is described as a foundational condition that is actively shaping the planning priorities, but also resource allocation and regulatory frameworks. This systemic nature is also reflected in the very high difficulty of intervention which indicates that addressing this barrier would require structural transformations and not simple isolated policy measures.

"Politicians only hear the loudest voices. But the loudest voices are always a minority — the silent majority don't show up to public meetings. So politicians end up only hearing the bad."
(Expert interview)

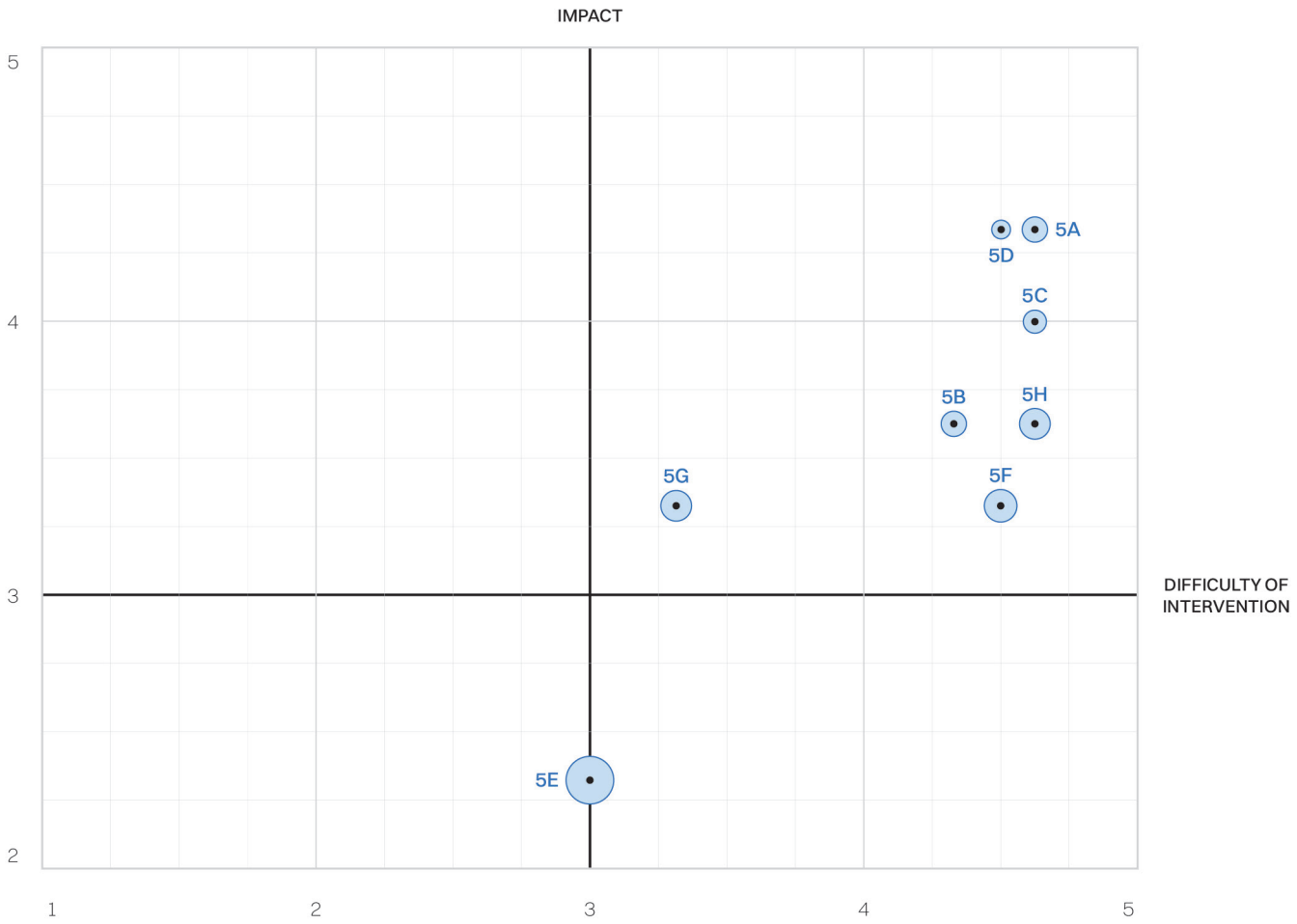
Political resistance and "bikelash" (5D; impact M=4.33; difficulty M=4.50) further complicate the governance landscape. In particular experts point to the role of political incentives and electoral dynamics in shaping the mobility policies, and they say that while some decision-makers do pursue cycling-related interventions as part of long-term sustainability agendas, others are constrained by short-term political considerations and potential backlash. As one expert observes some politicians act "because they know it's the right thing to do", while others prioritise maintaining consensus and electoral support. This results in uneven implementation and contributes to the perceived difficulty of advancing cycling policies.

"We already know what needs to be done. In the seventies the Netherlands didn't have the data either and they still changed. Lack of data is an excuse, not a reason."
(Expert interview)

In contrast the lack of data and cycling-specific expertise (5E) is evaluated more ambivalently, as it receives the lowest impact score within the category (M=2.33), alongside the highest variability among experts (combined SD=3.26). Some experts explicitly downplay its relevance saying that "it is not so important, it is an excuse" and arguing that sufficient knowledge already exists and that historical precedents demonstrate that transformative change can occur even in the absence of extensive data. Others however do recognise its importance but emphasise its relative ease of resolution, pointing to the availability of external expertise and the possibility of institutional learning. This results in a barrier that is perceived as secondary and comparatively more tractable than others in the category.

Inconsistent regulations and bureaucratic complexity (5F) represent another significant constraint, particularly when we go to talk about the implementation. While impact assessments are pretty moderate (M=3.33), the high difficulty score (M=4.50) does reflect the high challenges associated with navigating and trying to reform regulatory frameworks. The variability in impact evaluations (SD=1.53) suggests that this barrier may manifest unevenly across contexts but, when it is present, it is perceived as a substantial obstacle to effective intervention.

The scarcity and discontinuity of incentives (5G) occupy an intermediate position. Experts generally agree on their potential relevance in supporting behavioural change (impact M=3.33) while also emphasising that such measures are relatively feasible to implement (difficulty M=3.33). Qualitative accounts highlight that incentives can be effective without requiring substantial financial resources and therefore represent a potentially actionable lever within the



Average expert ratings for Category 5 barriers, plotted by impact (y-axis) and difficulty of intervention (x-axis), with marker size indicating standard deviation. This category was assessed by experts only.

broader governance framework.

Finally policy-driven competition with other modes (5H) reflects the broader allocation of priorities within the mobility systems. Experts describe a context in which cycling must compete with established transport modes, and in particular with private cars, for space but also for funding and political attention. While the impact is considered moderate to high (M=3.67), the very high difficulty of intervention (M=4.67) indicates that shifting these priorities involves complex trade-offs and long-term strategic change.

Overall governance and political constraints are characterised by a consistent pattern of high perceived impact combined with even higher perceived difficulty of intervention. Many of these barriers are described as structurally embedded within institutional, political and economic systems, making them resistant to incremental change. At the same time dimensions such as incentives or specific expertise are identified as comparatively more actionable, and this seems to suggest the presence of partial entry points within an otherwise constrained governance landscape.

4.4. Interim reflections

The findings presented in this chapter offer a multi-layered picture of cycling barriers in Turin, one that resists reduction to any single dominant factor. Across all five categories, constraints emerge as distributed, interdependent and unevenly perceived depending on the level of analysis: individual experience, professional assessment, or systemic structure. This section draws together the main cross-cutting patterns emerging from the analysis, integrating the qualitative insights coded under the "EXTRA" category in Atlas.ti alongside the barrier-specific findings discussed above. These additional observations, which did not fully align with the predefined analytical framework, proved analytically relevant precisely because of their transversal character.

A first structural observation concerns the consistent gap between user perception and expert evaluation, which recurs across all five categories rather than appearing as an isolated artefact. This gap is particularly pronounced in relation to structural conditions such as the opportunity cost of car ownership (3C) and the dominance of car culture (4A), both of which receive high impact scores from experts while remaining largely invisible to users. The asymmetry is analytically significant: the barriers most legible to potential cyclists are not necessarily those most resistant to change. Any design intervention must therefore navigate this double register, addressing both the material conditions that users directly encounter and the structural conditions that shape what can realistically be built and sustained.

A second, related pattern concerns the relationship between infrastructure and culture. The data do not support a simple causal hierarchy between the two, and several participants, both users and experts, explicitly resist it. One expert frames the dynamic as "a chicken and an egg", noting that while raising cultural awareness may not change modal share directly, it can generate recognition of the need for infrastructure investment. This recursive logic has practical implications as the interventions targeting cultural normalisation and those targeting physical infrastructure are not alternatives but complements, and

their sequencing matters. The Dutch historical precedent, which is referenced by multiple experts, is instructive here: bottom-up advocacy was transformative but only once it became institutionalised and acquired the capacity to influence resource allocation and spatial policy. Local associations and civic groups are described as essential allies, yet their power remains structurally limited unless connected to the institutional actors who control public space, funding and planning decisions. The implication for Turin is that effective change requires both registers to be active simultaneously, and that facilitating productive dialogue between advocacy and institutional actors represents a concrete and underexplored lever.

"Local groups have a huge role to play. But I don't know of a single example where structural, lasting change happened through them alone."
(Expert interview)

A third cross-cutting finding concerns the discursive framing of cycling. Both expert accounts and user reflections converge on a shared critique: in Turin, as in many Italian cities, cycling tends to be institutionally positioned as a sustainability measure, nested within environmental policy agendas and competing with other green priorities for limited funding and political attention. One expert observes that linking cycling exclusively to sustainability means addressing only the population segment that can drive, so excluding children, older adults, people with disabilities and anyone for whom independent mobility is not a given. Crucially the data also reveal that this framing does not reflect how cyclists themselves experience the practice. Among users who cycle regularly, the motivations most frequently cited are personal autonomy, physical well-being and enjoyment, not environmental concern. Cycling is described as something discovered to be intrinsically rewarding, with sustainability emerging, if at all, as a secondary rationalisation rather than a primary driver. This disconnect suggests that the fact that the institutional communication is currently built around environmental arguments may be addressing the wrong motivational register entirely, and that cycling's potential to attract new users could be better unlocked through the lived experience of its personal benefits than through abstract appeals to the collective responsibility. Reframing cycling as an accessibility and well-being issue rather than primarily an environmental one therefore emerges as a substantive strategic recommendation with implications for how design and communication interventions are positioned.

"People working in cities are focused on priorities, budgets and milestones. The advocacy people say: fix it now. They speak two different languages." (Expert interview)

"The bicycle has become synonymous with green and only gets framed that way — but it's so much more, also on a personal level."
(User interview)

"If we only talk about cycling in terms of sustainability, we forget that a huge part of the population simply cannot drive — children, elderly people, people with disabilities. This isn't about going green. It's about access."
(Expert interview)

A fourth theme that emerged transversally, and with notable consistency across unrelated participants, concerns the role of childhood habit formation. Multiple users, without being prompted, converge on the observation that cycling adoption is most durable when established early, and that the absence of cycling as a normalised childhood practice in Turin constitutes a long-term structural deficit. This connects to the broader argument about cultural lock-in: the difficulty of disrupting established mobility habits among adults is in part a consequence of those habits having been formed without cycling as a viable or visible option. Participants point to the potential of school-based programmes, family cycling infrastructure, and reduced exposure to risk in residential environments as upstream interventions capable of shifting the cultural baseline over time.

"I took it up as something I enjoy. I put on headphones with music and I experience the city in a different way."
(User interview)

"If they got used to cycling as children, half the work would already be done."
(User interview)

Finally, the data suggest that normalisation through direct experience represents a potentially underutilised entry point. Expert accounts highlight the demonstrated effectiveness of cycling events, bike-to-work programmes and experiential campaigns in converting uncertain or occasional users, not

"If as a child they put you on a bike and teach you that's how you go to school, I don't think it weighs on you as an adult."
(User interview)

"90% of people end up enjoying it, once they try it. The woman who now runs Vancouver's bike share started exactly like that: someone said 'why don't you try it for a week?' — and now she's a great advocate for urban cycling."
(Expert interview)

"It can't be only for the hardcore cyclists in their cycling gear. You have to think beyond those people."
(Expert interview)

through persuasion but through the removal of unfamiliarity. This connects directly to the motivational pattern described above: if what makes cycling attractive is the experience of it rather than the idea of it, then creating low-threshold opportunities to try it, and ideally to try it early in life, becomes a strategically significant intervention in its own right. At the same time experts do caution that such initiatives risk preaching to the converted if they remain embedded within cycling subculture rather than being designed to reach new audiences through familiar and low-threshold contexts.

Taken together these reflections point toward a design challenge that is simultaneously material, cultural and institutional. The following chapter translates these understandings into a design brief that will identify the strategic priorities, target conditions and intervention logics that will orient the subsequent design phase.

Chapter 5

From research findings to design direction

5.1. Synthesis of findings and starting point for design

As anticipated by the design-oriented logic described in Section 1.5, the analytical process underlying this thesis was iterative rather than strictly linear. Interpretive patterns began to emerge during data collection, and design directions started to take shape before the formal analysis was complete. Far from being a methodological weakness, this non-linearity reflects the alternation between divergence and convergence that characterises the Double Diamond logic, and it underlines that the findings presented in Chapter 4 were never simply descriptive endpoints but active inputs to a process of progressive reframing.

The cross-cutting patterns identified in Section 4.4. (the gap between user perception and expert evaluation, the recursive relationship between infrastructure and culture, the motivational mismatch in how cycling is institutionally framed, and the structural significance of childhood habit formation) collectively define the starting point for the design phase. Rather than restating them here, this chapter takes them as given and asks what they imply for intervention: which conditions are most actionable, which require long-term structural change and where design can most effectively contribute.

This shift from understanding to action is not automatic. It requires moving beyond the description of what barriers exist, which has been the focus of the research so far as to respond to RQ1 and RQ2, toward an explicit interpretive and decision-making process that identifies the most relevant leverage points and translates them into strategic design directions, thereby addressing RQ3 and ultimately contributing to an answer to the main research question. This chapter develops that process in three steps: a focused conversation with the Consulta della Mobilità Ciclistica, which served as a funnel between the breadth of the research findings and the concrete reality of local decision-makers (Section 5.2.); a structured ideation phase in which design directions and intervention ideas that had emerged organically throughout the research process were collected, mapped and reflected upon (Section 5.3.); and a multi-criteria prioritisation framework through which the identified barriers were structured in terms of the evaluations collected on impact (experts), difficulty of intervention (experts) and perceived relevance (users), so as to determine which ones represent the most meaningful leverage points to act upon and with what urgency (Sections 5.4., 5.5.), culminating in the declaration of the final design brief (Section 5.6.).

5.2. Stakeholder in conversation: the Consulta della Mobilità Ciclistica

The Consulta della Mobilità Ciclistica is the formal advisory body established by the Municipality of Turin in 2017 to represent the interests of cyclists within local governance processes (La Torre, 2020). It brings together the main cycling advocacy associations active in the city and acts as an institutional intermediary between civil society and the municipal administration (FIAB Torino, 2025; La Torre, 2020). As described in Chapter 3, the Consulta holds a formally recognised role: it is consulted on cycling infrastructure projects and retains the power to submit independent proposals to the municipality (Consulta della Mobilità Ciclistica, 2025; La Torre, 2020). This position, simultaneously embedded in civic advocacy and in institutional decision-making, makes it a particularly relevant actor at the intersection of the two registers that this research has consistently identified as central to any meaningful intervention in Turin's cycling landscape. Engaging with the Consulta therefore allowed this research to access a perspective that sits between the everyday experiences of users and the technical-professional evaluations of the experts interviewed in Chapter 4, completing a picture of the local cycling system that spans all three levels of analysis.

Engagement with the Consulta was not limited to a single moment but extended across the duration of the research. From the early stages of the project, the Consulta was part of a broader network of field actors who were informed of the research objectives and invited to provide periodic feedback. With the Consulta this initial contact was followed by participation in some of their working sessions and ongoing exchanges throughout the research process. Their early response was notably positive with members explicitly recognising the relevance of the research questions to their own operational needs, a signal that the directions being explored were not only academically motivated but practically grounded.

At the transition between the empirical and design phases, a dedicated conversation was conducted with the president of the Consulta. Unlike the semi-structured interviews described in Chapter 4, this session was deliberately open and conversational in format. Rather than following a fixed protocol, it was guided by a set of broad thematic questions that served as starting points for a largely spontaneous exchange. The objective was not to collect additional data on barriers, as that phase had been completed, but to use the Consulta's perspective as a funnel, as a way of bringing the breadth of the research findings into contact with the concrete priorities, constraints and needs of a key local actor, and of allowing that contact to inform the design decisions that would follow.

Several insights from this conversation proved directly relevant to the design phase. First the president confirmed the structural fragmentation of the local governance landscape, describing how the relationship between the Consulta and the municipality has become less fluid under the current administration, with fewer formal consultations and persistent ambiguity around the Consulta's mandate. This reinforced the research finding on institutional silos and political resistance, while also pointing to the concrete need for tools or formats that could support more structured and anticipatory dialogue between advocacy actors and technical decision-makers, rather than reactive feedback on near-

finalised projects.

Second the conversation highlighted the gap between the quantitative expansion of cycling infrastructure and its qualitative performance. The president explicitly called for a rebalancing of investment priorities toward maintenance and coherence rather than new construction alone, an observation that resonates with the empirical findings where network discontinuity and poor road surface quality featured among the most salient barriers for users.

Third, and most generative for the design phase, the discussion touched on the theme of cycling normalisation and the role of upstream interventions. The conversation covered school-based programmes, family-oriented events and educational initiatives as underutilised levers, and pointed to the existence of a fragmented landscape of local initiatives such as events, courses or advocacy campaigns that currently lack a shared point of reference, which is limiting their visibility and cumulative impact. When the idea of a platform capable of collecting and connecting these dispersed efforts was raised during the conversation, the president responded that such a tool would be genuinely needed. He recalled the existence of a previous municipal resource of this kind, in particular a webpage managed by the then-active Ufficio Biciclette that aggregated cycling events and initiatives across the city; this however had fallen into disuse not by deliberate choice but as a collateral consequence of the office's closure when the Consulta was established in 2017, leaving no institutional actor responsible for maintaining it.

Taken together, these insights served a dual function. They validated the analytical directions emerging from the research confirming that the barriers and leverage points identified empirically were recognised as real and pressing by a key institutional actor, and they oriented the subsequent design decisions toward outputs that could be genuinely useful within Turin's specific governance and cultural context. The following section documents the ideation process through which these directions were further developed.

5.3. Ideation process and emerging directions

Throughout the research process, design directions did not emerge only at the end of the analytical phase but developed in parallel with it. A broad and heterogeneous field of possible interventions began to take shape through four main sources: personal notes and reflections accumulated across the various stages of the work; conversations with the expert network that accompanied the research from its early stages; the responses to the open-ended question posed at the end of each user interview, in which participants were invited to suggest concrete interventions they would like to see implemented; and the stakeholder conversation with the Consulta della Mobilità Ciclistica described in Section 5.2. This section makes that material visible as a structured brainstorming: not a set of ready-made solutions, but a broad and deliberately inclusive mapping of the possibilities that had emerged, intended to support reflection and inspire the subsequent interpretive steps.

The full set of ideas that emerged across these different sources is collected in the visual on the following page. It includes proposals of very different kinds and scales, spanning between infrastructural interventions, communication

Continuous cycling lanes / Physically separated cycling lanes **/ Uniform design of cycling infrastructure to make it recognisable across the network** / Priority to maintaining existing infrastructure before building new routes / Better spatial distribution of the network: less concentration on certain axes, more coverage where missing **/ Communication campaign reframing cycling around personal benefits** / Improved management of intersections / Traffic calming on secondary streets to connect the network even without separated infrastructure **/ Institutional communication for existing infrastructure: many residents are unaware of what already exists** / More secure bicycle parking throughout the city / Better lighting along cycling routes **/ Facilitation tools and workshops to improve dialogue between the Consulta and the Municipality** / Reduction of on-street car parking to free up space for cycling infrastructure / Making car parking more expensive or difficult in the city **/ Car free Sundays: events and car free days where people can experience the city without traffic** / Bicycle registration and marking schemes to reduce theft / Incentives for the purchase of e-bikes / Corporate cycling mobility programmes **/ Guided city discovery rides (accessible and non-competitive format) / Direct comparisons of travel times by bike vs car** / Stronger enforcement against illegal parking on cycling lanes **/ Marketing showing ordinary people cycling, not just sport cyclists** / Reintroduction of an accessible public bike sharing system **/ Bike to Work Week: a week of cycling to work with prizes and checkpoints / Bike to Shop: discounts in partner shops for customers arriving by bike / School-based cycling education programmes / Bike to School: organised group cycling to school** / Car free zones around schools **/ Cycling courses for adults who never learned or lost the habit / A single online platform collecting all local cycling initiatives and events** / Extended and better enforced ZTL (limited traffic zone) **/ A repository of best practices and case studies from other cities to inspire local decision-makers** / Increase in dedicated technical staff for cycling planning at the Municipality / Maintenance as a structural budget line, not an afterthought **/ A shared roadmap and vision for local decision-makers** / Politically bold traffic restriction decisions

campaigns, governance tools, educational programmes, events, digital platforms and policy measures. Some of these fall outside the scope of what a design intervention at this scale can realistically address. Others belong primarily to the domains of urbanism, engineering or institutional reform. Many however do point toward recurring and connectable directions where design could contribute meaningfully.

Collecting and mapping this material was itself an analytical act. Laying out the full breadth of what had emerged across sources, scales and degrees of feasibility made it possible to step back from individual ideas and begin to see patterns of which themes recurred most consistently, which proposals addressed symptoms rather than underlying conditions, and where different strands of the research seemed to converge. This reflection, combined with the prioritisation framework developed in the following section, forms the interpretive bridge between the open field of possibilities gathered here and the specific design directions that will be declared in the design brief.

5.4. Prioritisation framework: a multi-criteria interpretation

Translating empirical findings into design priorities requires an explicit decision-making logic. The breadth of the dataset, spanning five categories and over thirty individual barriers, makes it necessary to move beyond simple relevance rankings and adopt an interpretive framework capable of distinguishing between different types of barriers and different types of actionability.

Three evaluative dimensions were used, drawn directly from the data collected in Chapter 4: perceived relevance from user interviews, perceived impact and difficulty of intervention from expert interviews. These three dimensions were selected because they capture the two analytical registers that have proven structurally important throughout this research, the experiential perspective of users and the systemic perspective of experts, and because combining them allows the framework to distinguish not only what is most problematic but also what is most actionable.

For the barriers in Category 5 (governance and political constraints), which were assessed only through expert interviews given their technical nature and distance from everyday experience, user relevance is by definition absent. These barriers are therefore positioned on the basis of expert impact and difficulty alone, which places most of them among the systemic and latent conditions of the framework, with the few assessed as more tractable falling among the moderate or lower priorities.

Rather than applying a mathematical formula, the three dimensions are combined through an interpretive logic that assigns each barrier to one of nine strategic categories, each carrying different implications for design intervention:

- Top priorities are barriers scoring high on both user relevance and expert impact regardless of difficulty: the combination of maximum salience and structural significance justifies investment even when complex.
- Actionable priorities combine at least two high scores with non-maximum

difficulty, making them both necessary and relatively feasible to address.

- Strategic priorities show medium user relevance but high impact and high difficulty, and for this reason are considered as structurally significant conditions that require long-term commitment.
- Quick wins present low difficulty alongside at least medium relevance and impact, making them intervenable rapidly with good return.
- Moderate priorities show no exceptional scores but no negligible ones either.
- Systemic or latent barriers are largely invisible to users yet assessed as highly impactful and highly difficult by experts. This pattern can be interpreted in two ways: either these conditions operate beneath the threshold of individual awareness, shaping behaviour without being consciously recognised, or they are genuinely less salient in the specific context of Turin, where local users may have a more accurate reading of the situation than external evaluators. The data collected in this study do not allow these two interpretations to be fully distinguished and this ambivalence is acknowledged as a limitation.
- Communication and framing opportunities reveal a gap between low user perception and high expert impact at medium difficulty: the most effective intervention here is informational/experiential rather than infrastructural.
- Low priorities combine low to medium impact with low user relevance and/or high difficulty, making prioritised investment difficult to justify.
- Contextual barriers were intentionally excluded from the expert interview protocol, as their evaluation did not require professional assessment: in the specific case of Turin, factors such as topography, distances and weather conditions present a self-evidently low to medium impact given the city's flat terrain, compact spatial structure and relatively mild climate, while their difficulty of intervention is by definition extreme. Their relevance is therefore acknowledged but treated as a fixed contextual condition rather than an actionable leverage point.

One pattern deserves explicit mention. The barriers of habitual mode lock-in (3A), preparation and organisational time (3G) and aesthetic stigma (4H), show a pronounced divergence between cyclists and non-cyclists, with the latter rating them as highly salient while the former consider them largely irrelevant. This suggests that these barriers tend to dissolve through the experience of cycling itself, making them particularly interesting from a design perspective: rather than requiring structural change, they may be addressable through low-threshold interventions that create opportunities for direct experience.

The resulting mapping of barriers into strategic categories is presented in the table below.

Table 6. *Strategic categorisation*

Category	Barriers
Top priority	Lack of physical protection (1C); Complex intersections (1D); Cycling network discontinuity (2F); Path obstructions and spatial conflicts (2I)

Actionable priority	Excessive traffic and intrinsic vulnerability (1A); Poor road surface quality (2H); Habitual mode lock-in (3A)*; Absence of visible role models (4C); Aesthetic stigma and decorum (4H)*
Strategic priority	Aggresive motorist behaviour (1B); Trip chaining and dependent mobility (3B); Automobile comfort and tech amenities (3D); Lack of widespread cycling culture (4B)
Quick win	Theft and vandalism (1G)
Moderate priority	Additional environmental risk factors (1H); Preparation and organisational time (3G)*; Lack of data and cycling expertise (5E); Scarcity and discontinuity of incentives (5G)
Systemic/latent	Personal insecurity in isolated areas (1F); Opportunity costs of car ownership (3C); Dominance of car culture (4A); Politicisation of cycling identity (4D); Association with poverty (4E); Gender norms and care roles (4G); Underfunding of cycling infrastructure (5A); Fragmented planning and institutional silos (5B); Institutionalised car-centric paradigm (5C); Political resistance and "bikelash" (5D); Policy-driven competition with other modes (5H)
Communication/framing	Accident statistics (1E); Perceived excessive physical demand (2D); Perceived long travel times (3E)
Low priority	Limited intermodal integration (2E); Direct costs of cycling (3F); Lack of end-of-trip facilities (2G); Cyclists as stigmatised out-group (4F); Inconsistent regulations and bureaucracy (5F)
Contextual	Unfavourable topography (2A); Excessive distances (2C); Adverse weather conditions (2B)

* Strong divergence between cyclists and non-cyclists: barrier tends to dissolve through direct cycling experience

5.5. Identification of leverage points and design opportunities

Reading the prioritisation table as a system rather than a ranking reveals several barriers that stand out not only for their individual scores but for their capacity to generate cascading effects across multiple dimensions simultaneously.

Lack of physical protection (1C), complex intersections (1D), cycling network discontinuity (2F) and path obstructions and spatial conflicts (2I) emerge as the most structurally critical conditions, being top priorities on all three axes. Addressing them would simultaneously reduce perceived risk, improve spatial legibility and lower the threshold for potential cyclists. Theft and vandalism (1G), considered a quick win also in terms of intervention difficulty, carries disproportionate systemic weight as the data show that fear of theft discourages investment in quality bicycles, which in turn amplifies physical effort, reduces comfort and reinforces the perception that cycling is impractical for everyday use. A relatively contained intervention here could unlock a chain of positive effects across multiple barrier categories.

Among the actionable priorities, habitual mode lock-in (3A) and aesthetic stigma (4H) are particularly significant because of the strong divergence between cyclists and non-cyclists; both barriers seem to dissolve through direct experience, suggesting that low-threshold experiential interventions may be sufficient to address them. The absence of visible role models (4C)

> ***"Copenhagen's safe bike routes produced new cyclists. As the separated lane network grew, cyclists filled them, and as they did, they demanded more space. The more people bike, the safer the streets get for cyclists, partly because drivers adopt more cautious habits when they expect cyclists on the road. There is safety in numbers."***
> **(Montgomery, 2013, p. 248)**

operates through a similar mechanism, reinforcing the case for interventions that increase the visibility and normalisation of everyday cycling.

These patterns often converge on a broader strategic direction: the need to work not only on physical conditions but on the cultural and behavioural layer that sustains the adoption gap. Normalising cycling as an everyday practice could be pursued through multiple complementary angles such as increasing the visibility of ordinary cyclists, creating experiential opportunities that lower the entry threshold, reframing the institutional discourse around cycling or targeting upstream habit formation through interventions directed at children and schools, among others. None of these directions is self-evidently superior to the others and the prioritisation framework does not produce a single inevitable conclusion.

It is important to acknowledge here that the analysis developed across this chapter has opened a wide field of potentially valid design directions, many of which could independently justify a dedicated output. The choice of which direction to pursue is therefore shaped not only by the analytical logic developed in this chapter, but also by the practical constraints of this research in terms of its scope, timeline and scale of intervention. The following section makes that choice explicit.

5.6. Design brief: declaration of output and rationale

The analysis developed across this chapter has produced a structured understanding of how barriers to cycling adoption operate in Turin, which conditions are most actionable and where design can contribute most meaningfully. This section translates that understanding into a formal design brief, declaring the outputs to be developed in Chapter 6 and grounding each in the research logic that motivated it.

5.6.1. The problem this design addresses

Two structural gaps emerge from the research. The first is a gap in strategic prioritisation: the barriers to cycling adoption in Turin have not previously been mapped, weighted and translated into operative priorities in a way that is accessible and usable by local decision-makers. Technical reports and policy documents address individual dimensions of the problem, but no integrated tool currently exists that connects empirical evidence on barriers with a coherent framework for intervention sequencing. The second is a gap in knowledge circulation: a fragmented landscape of local initiatives exists but these remain largely invisible beyond their immediate context, difficult to replicate and disconnected from one another. The result is that both strategic intent and practical action are weakened by the absence of the infrastructure needed to make them cumulative and systemic.

These two gaps are not independent. The absence of a shared strategic vision makes it difficult to evaluate which initiatives are worth supporting and scaling. Conversely the invisibility of existing initiatives deprives decision-makers of the evidence base needed to inform strategic choices. Addressing one without the other would produce an incomplete intervention.

5.6.2. The design response: a two-layer system

The proposed output is a two-layer system that connects strategic prioritisation with actionable and replicable initiatives, operating simultaneously at the institutional and civic levels.

The first layer is a strategic roadmap that translates the research findings, and specifically the multi-criteria prioritisation developed in Section 5.4, into a structured and visually accessible reference tool for local decision-makers, primarily the Municipality of Turin to share with the Consulta della Mobilità Ciclistica. The roadmap does not prescribe specific solutions nor does it function as a decision-making tool in the technical sense; rather, it serves as a strategic reference framework: a shared and evidence-based vision of which conditions require immediate attention, which demand long-term structural commitment and which can be addressed through communication and cultural interventions. Its value lies not in its technical precision but in its capacity to make complexity legible, to support dialogue between institutional actors and to provide a common language for discussing intervention priorities. The roadmap is conceived as a poster-format artefact that is visually rich, designed to be shared, displayed and discussed rather than archived.

The second layer is a web-based platform dedicated to collecting, structuring and circulating initiatives that support cycling normalisation among children and in school contexts. Among the multiple directions that the prioritisation framework identified as viable, this focus was selected for three converging reasons. First it addresses a leverage point that is simultaneously cultural, behavioural and upstream: the data consistently show that adults who cycle regularly tend to have cycled as children, suggesting that habit formation in early life produces effects that no adult-targeted intervention can easily replicate. Second it targets a territory that is currently underserved: while infrastructural and policy interventions receive institutional attention, school-based and family-oriented cycling initiatives remain fragmented, poorly visible and difficult to replicate without a dedicated resource. Third it is a direction where design can make a specific and bounded contribution not by replacing institutional action but by creating the informational infrastructure that makes civic activation possible. These three reasons are further supported by the spontaneous and consistent mention of childhood cycling habits across unrelated user interviews, the confirmation of this theme by the Consulta, and the broader analytical finding that normalisation rather than infrastructure alone is one of the most underaddressed dimensions of the adoption gap in Turin.

The platform serves three main functions. First, actionability: each initiative is described concretely (what was done, by whom, in what context, with what resources) so that it can be understood and evaluated by potential adopters. Second, replicability: initiatives are framed not only as case studies but as transferable practices, structured to support adaptation across different schools, associations or neighbourhoods. Third, knowledge circulation: the platform makes existing local practices visible and reusable, addressing the invisibility that currently prevents promising initiatives from scaling beyond their original context. Content includes existing initiatives in Turin, replicable practices from other cities, and proposals derived directly from this research.

The platform is designed to be useful to a range of local actors who may want to activate or support cycling initiatives in educational contexts; this range includes parents, teachers and school mobility managers, the last being a legally required figure in Italian schools who in practice often lacks the tools and knowledge needed to fulfil the role effectively as confirmed through direct exchanges with the Consulta della Mobilità Ciclistica during this research.

Crucially, the two layers are conceived not as independent outputs but as a single system: the roadmap legitimises the platform's focus at the institutional level, while the platform translates that strategic intent into tangible and replicable action. How this connection works in practice is developed in Section 6.5.

5.6.3. Scope and limitations of this brief

It is important to acknowledge that this brief represents a deliberate scoping choice among multiple valid directions that the research could have supported. The prioritisation framework identified a wide range of leverage points, many of which could independently justify a design output. The decision to focus on these two specific layers reflects both the analytical logic developed in this chapter and the practical constraints of this research in terms of scope and timeline. Other directions, including governance facilitation tools, communication campaigns or infrastructural design proposals, remain consistent with the research findings and are not excluded as future developments. What this brief commits to is a specific and bounded contribution: making strategic knowledge accessible and making existing civic energy replicable, at a scale and within a timeframe that this research can credibly support.

Chapter 6

Design development and outcomes

6.1. Design principles and approach

The design phase of this research builds directly on the strategic directions established in Chapter 5, translating the findings of the empirical investigation into two concrete and complementary outputs. Rather than approaching these outputs as isolated artefacts, the development process was guided by a set of shared principles that orient both layers of the system and reflect the specific nature of the problem this design aims to address.

These principles were not adopted as generic design guidelines but follow directly from the way the problem and the intended response were framed in Chapter 5. The design brief of Section 5.6 defined the problem as two structural gaps, and each of them carries an implicit requirement for how the outputs must be designed: the gap in strategic prioritisation calls for knowledge that is accessible and legible to non-technical actors, while the gap in knowledge circulation calls for outputs that are actionable rather than merely informative. The brief's decision to address both gaps through a single two-layer system introduces a third requirement, systemic coherence, and the research logic underpinning the brief, grounded throughout in locally collected evidence and in the context-specificity that has guided the thesis from the outset, accounts for the remaining two, evidence-based grounding and the specificity to Turin. The principles set out below therefore make explicit the design requirements already implied by the strategic directions of Chapter 5, rather than introducing new criteria at this stage.

The first principle is evidence-based grounding. Both outputs are anchored to the empirical findings of this research: the prioritisation framework developed in Section 5.4 constitutes the direct foundation of the roadmap's content, while the platform's thematic focus on children and schools derives from one of the most consistent and cross-cutting patterns to emerge from the interviews. This grounding is not merely methodological but also strategic, as it ensures that the outputs respond to locally identified conditions rather than to generic assumptions about what cycling interventions should look like.

The second principle is accessibility and legibility. It follows directly from the first gap identified in Section 5.6.1, the absence of a tool able to make strategic knowledge accessible and usable by local decision-makers: an output that its intended audience cannot readily understand cannot close that gap. Both outputs are therefore designed to be used by actors who are not necessarily technical experts in mobility planning: local administrators, civic advocates,

school mobility managers, teachers and parents. This requires that complexity be made navigable without being oversimplified, and that the visual and structural choices actively support comprehension and use rather than merely conveying information.

The third principle is actionability. It follows from the second gap identified in Section 5.6.1, the invisibility and limited replicability of existing initiatives: closing that gap requires outputs that move their users toward action rather than merely informing them. Accordingly, the outputs are not conceived as analytical documents but as tools that enable action: the roadmap by providing a shared and structured language for discussing intervention priorities, the platform by making existing initiatives visible, concrete and replicable. In both cases the design choices prioritise practical usability over exhaustiveness.

The fourth principle is systemic coherence. It follows directly from the decision taken in the design brief (Section 5.6.2) to conceive the two outputs not as independent artefacts but as a single two-layer system. Although the two layers address different scales and audiences, they are designed to operate as a connected system rather than as independent outputs. The logic connecting them, and the conditions under which this connection can be productive, is developed further in Section 6.5.

Finally, both outputs are explicitly designed for the specific context of Turin. The barriers they address, the actors they target and the institutional dynamics they navigate are all rooted in the local conditions documented across Chapters 3 and 4. This contextual specificity is considered a strength rather than a limitation because, as argued throughout this research, effective interventions in cycling mobility cannot be generic and the value of these outputs lies precisely in their capacity to respond to a particular configuration of constraints and opportunities.

6.2. Evaluation approach: iterative feedback and stakeholder validation

The evaluation of the design outputs developed in this research was not structured as a single formal validation step conducted at the end of the process, but rather as an iterative and ongoing practice of feedback collection that accompanied the design phase from its early stages. This approach reflects the broader methodological orientation of the study, in which understanding and design developed in parallel rather than sequentially, and is consistent with the design-oriented logic described in Section 1.5.

Feedback was gathered from three sources. The first is the network of field experts who had already contributed to the empirical phase of the research as described in Chapter 4. All three responded positively to the overall direction of the work, confirming the relevance of both outputs within the broader landscape of cycling mobility interventions. Their individual contributions were primarily focused on the platform. Two experts suggested the inclusion of additional international reference cases and organisations, expanding the platform's repository of replicable practices beyond what the desk research alone had identified. One expert raised the question of contextual sensitivity when presenting practices from cycling-mature contexts: while the inclusion of international examples is considered valuable and necessary, it is important

to explicitly acknowledge within the platform that initiatives developed in settings where cycling is already deeply normalised may require adaptation before being transposed to a different urban and cultural context such as Turin. A further expert highlighted two structural considerations: the long-term sustainability of the platform, emphasising that maintaining it over time requires institutional commitment and a clearly identified responsible actor; and the importance of a clear and accessible entry point for users who do not yet identify with the cause, suggesting that the platform's purpose and relevance should be immediately legible to first-time visitors. These observations were integrated into the design decisions described in the following sections.

The second source of feedback is the Consulta della Mobilità Ciclistica, whose role in orienting the design phase has already been described in Section 5.2. Beyond the dedicated conversation with its president, members of the Consulta representing local cycling associations provided observations specifically focused on the platform's content. Their contributions operated on two levels. On one hand, they identified existing local initiatives not yet captured in the platform despite the desk research conducted for this study. This finding is itself significant: the fact that relevant activities were taking place in Turin without having surfaced through a systematic search confirms the limited visibility and circulation of local cycling initiatives, and reinforces both the relevance of the platform as a tool and the importance of developing it in direct collaboration with local actors rather than through desk research alone. On the other hand, members of the Consulta proposed a range of actions that do not yet exist but could be developed and supported through the platform, including school cycling trips, the use of bicycles for urban educational visits, and tools to help schools and families advocate for safer cycling connections in their neighbourhood. Taken together, these observations reinforced the diagnosis that a fragmented but active local ecosystem of initiatives exists, one that lacks a shared infrastructure to make its efforts visible, connectable and replicable.

A third source of feedback was sought specifically in relation to the platform. An international NGO working to accelerate cycling uptake and build more human-centred cities was approached because part of its recent work involves developing digital platforms with aims closely related to those of Turin Bike Kids Club, such as stakeholder engagement, knowledge sharing and community building. This made it a particularly relevant interlocutor for assessing the platform not only in terms of its content but as a digital tool. The organisation broadly endorsed the concept on three counts: the focus on children, families and schools as a leverage point for long-term cultural change; the decision to connect and amplify existing initiatives rather than launch a new standalone one, on the grounds that the fragmentation of information and actors, rather than a lack of good initiatives, is frequently the core obstacle; and the Discover-Learn-Act structure, seen as effectively guiding users through what is relevant to them, what they can learn from others and what they can do next. This endorsement carries particular weight, as it draws on the organisation's own experience with programmes that similarly support local actors in running initiatives rather than delivering them centrally. Alongside this validation, the organisation offered several forward-looking reflections drawn from its platform-development experience: the importance of addressing long-term ownership and maintenance from the outset, possibly through a distributed model in which featured organisations update their own content rather

than relying on a single actor; the observation that adoption is often more difficult than development, so that sustained visibility depends on trusted intermediaries actively directing users to the platform; the potential of even simple usage analytics to reveal over time where users need support and where gaps remain; and the distinction between development and operational funding, the latter being harder to secure yet essential to keeping the platform relevant. The reflections on visibility through trusted intermediaries and on the importance of addressing maintenance from the outset align with and reinforce the dissemination and sustainability strategy set out in Section 6.4.4; the remaining considerations (the distributed maintenance model, usage analytics and the development–operational funding distinction) lie beyond the scope of this research and are recorded here as valuable input.

Complementing this iterative feedback, a more focused evaluation of the platform was carried out toward the end of the design process with a small panel of representative end users: two parents and two teachers based in Turin, anonymised here as Parent A, Parent B, Teacher A and Teacher B. Before reviewing the prototype, participants were asked to bracket two contextual factors and to assess the work in spite of them, namely that the site is an early-stage research prototype rather than a finished product, and that its English-language interface reflects its academic origin and would be localised into Italian for any public release. With these factors set aside, the evaluation concentrated on the strength of the underlying concept and on how it is currently realised, gathering first impressions, specific concerns and suggestions for development. This step was deliberately exploratory rather than a full usability study: with only four participants it cannot claim representativeness, but it was sufficient to test the concept against the perspective of the very users the platform is designed to serve, an audience that the earlier rounds of feedback, drawn entirely from experts and organised stakeholders, had not yet reached.

The overall response was clearly positive: all four participants independently confirmed that a resource of this kind is needed and that nothing comparable currently brings Turin's scattered initiatives together in one place, with the strongest validation directed at the core proposition of collecting what already exists and pairing it with concrete, step-by-step actions. Beyond this shared endorsement, several themes pointed toward future development. The most recurrent was a demand for a local, place-specific dimension: both parents framed their central question not as what exists in the city but as whether cycling is safe on their own route and in their own neighbourhood, a street-level question that the platform, strong at the city level, does not yet answer. A related theme was a gap between inspiration and local application, with the international best practices seen as motivating but hard to translate into the under-resourced reality of an Italian school. A third was a desire to move from catalogue toward community, connecting people rather than only listing resources. Finally, and consistently with the empirical findings of Chapter 4, perceived traffic danger emerged as the decisive barrier rather than any dislike of cycling: foregrounding how cycling is made safe, through organised, accompanied group travel and traffic-free streets, was what shifted the most sceptical participant from dismissal to interest.

These observations translate into concrete directions for a future iteration, several of them within the platform's control. The highest-impact is a local

geographic layer: a map or a grouping of initiatives by neighbourhood or Circoscrizione, surfacing route-level and school-street information, which would speak directly to the question of whether cycling is safe nearby. Others include ready-to-use, downloadable materials such as printable kits and a one-page handout for staff meetings, which would lower the effort for time- and budget-constrained teachers; deepening the existing relevance note on each international best practice into a more concrete account of how it would translate into the Italian school system, including the administrative steps involved; an evolution from catalogue toward a living network that builds on the participatory layer already in place, allowing active schools, parents and teachers to become visible and contactable to one another; a single, minimal entry-level action within Act to lower the activation barrier for time-poor users; and a stronger foregrounding of the safety framing across the experience. One of these directions also bears on the current prototype directly: the community stories presently shown are illustrative place-holders, and in any future version they should either carry credible attribution or be explicitly labelled as such.

Two boundary conditions of this evaluation process should nonetheless be acknowledged. The first concerns the user evaluation just described: with only four participants, and with the prototype's unfinished and English-language nature deliberately bracketed, it provides an indicative reading of how end users receive the concept rather than a representative or fully ecological test of a finished product. The second concerns the roadmap, which, unlike the platform, has not yet been evaluated with its intended end users, namely the municipal administrators and decision-makers it is designed to support; gathering their assessment remains a necessary next step. It is also worth noting that several of the concerns raised during the evaluation, in particular the physical safety of the road environment, the entrenched car-dependent culture, the limited time and budget of schools and the administrative complexity of the Italian system, reflect structural conditions that the platform can inform, motivate and help users navigate but cannot itself resolve. These are acknowledged as the context within which the outputs operate rather than as shortcomings of the design, consistent with the argument developed in Section 6.5.

6.3. Layer 1: Strategic roadmap

6.3.1. Concept and design rationale

The strategic roadmap responds to the first of the two structural gaps identified in the design brief of Section 5.6: the absence of an integrated tool that connects empirical evidence on barriers to cycling adoption with a coherent framework for intervention sequencing, accessible and usable by local decision-makers. While technical reports and policy documents addressing individual dimensions of the problem do exist in Turin, no resource currently brings these together into a shared and prioritised vision of what needs to happen, in what order and at what institutional level.

The roadmap is not conceived as a decision-making tool in the technical sense, nor as a prescriptive plan that determines specific solutions. Rather, it functions as a strategic reference framework: a structured and evidence-based synthesis of intervention priorities that can support dialogue between

institutional actors, help align agendas across different governance levels and provide a common language for discussing what cycling mobility transition in Turin could concretely look like. Its value lies in translating the multi-criteria prioritisation framework developed in Section 5.4 into a format that is readable, shareable and discussable by actors who may not share the same technical background.

This communicative ambition directly shapes the choice of format. The roadmap is designed as a poster-format artefact rather than a report or policy document. This decision reflects a deliberate positioning: a poster is inherently public-facing, designed to be displayed, handed over and referred to in conversation rather than archived. It invites a different kind of engagement than a written document, one that is more immediate, more visual and more conducive to shared interpretation. In a governance context characterised by fragmented institutional dialogue and limited shared reference points, as documented in Chapters 3 and 4, the ability to place a single artefact on a table and discuss it together carries its own strategic value.

The primary intended audience is the local decision-making ecosystem surrounding cycling mobility in Turin, and in particular the Municipality and the Consulta della Mobilità Ciclistica. The roadmap is designed to be useful both as an internal reference for the Consulta in its interactions with the municipal administration, and as a starting point for more structured and anticipatory dialogue between the two actors, a need that was explicitly identified during the stakeholder conversation described in Section 5.2.

6.3.2. Architecture and content

The roadmap is structured around three interconnected organisational dimensions: a temporal axis, a thematic clustering of intervention areas, and a set of cross-cutting layers that reflect the different nature of the actions involved.

"It is only when everyone can choose biking as an entirely normal way to get around that other nations will have succeeded in building their own remarkably unremarkable cycling cities. When everyone — young, old, rich, or poor — is simply cycling, what a wonderful, bike-friendly world it will be."
(Bruntlett & Bruntlett, 2018, p. 269)

The temporal axis organises interventions across three sequential horizons: Initiate (2026), Consolidate (2031) and Transform (2041). These reference years are not prescriptive deadlines but orientative markers that convey a sense of realistic pacing for a transition of this complexity. The sequencing derives directly from the prioritisation framework developed in Section 5.4, where barriers were assessed along the combined dimensions of user relevance, expert impact and difficulty of intervention. Actions positioned in the Initiate horizon correspond to top priorities and actionable priorities, where the combination of high salience and relative feasibility justifies immediate investment. The Consolidate horizon addresses conditions that require sustained effort and institutional commitment over time, including strategic priorities and systemic barriers that cannot be resolved through short-term interventions alone. The Transform horizon describes the long-term cultural and structural conditions that the cumulative effect of earlier interventions is intended to generate, framing the overall direction of change rather than prescribing specific actions. The roadmap's overarching direction is captured in a **Future Vision** statement positioned prominently on the poster, which describes a Turin where cycling is within reach for everyone who wants it: not as an act of courage or commitment, but as a simple, spontaneous, supported

and socially normal part of everyday urban life.

"The car is twentieth-century stuff. We have to create a new Turin, a new identity."
(User interview)

The thematic content is organised into six clusters, each translating a specific set of empirically identified barriers into a coherent area of intervention, and each assigned a lead actor that reflects the most appropriate institutional driver for that domain. Cluster A addresses the continuity and safety of the cycling network, translating the top-priority infrastructural barriers of physical protection, network discontinuity and intersection design into a sequenced set of actions from urgent maintenance to full network completion; its lead is the Municipality. Cluster B tackles the reduction of vulnerability in shared street space, combining immediately actionable measures such as theft prevention with the longer-term cultural shift towards safer coexistence between cyclists and motorists; its lead is also the Municipality. Cluster C operationalises the strategy of lowering the entry threshold for potential cyclists, developing a programme of experiential interventions, from pilot events such as Bike to Work Week, guided city rides, travel time comparisons between bike and car and everyday cycling marketing, to a stable and recurring programme replicable across neighbourhoods, designed to make cycling a visible and accessible practice for new audiences; its lead is the Consulta della Mobilità Ciclistica. Cluster D translates the upstream intervention logic into concrete actions targeting children and schools, and is directly supported by the initiative platform described in Section 6.4; it is jointly led by the Municipality and the Consulta. Cluster E gives form to the reframing of cycling's institutional narrative, developing a coherent set of communication actions oriented toward repositioning cycling around personal well-being, urban liveability and social benefits rather than exclusively environmental sustainability; it is jointly led. Cluster F addresses governance strengthening, converting the systemic and political barriers identified as the most structurally resistant into a set of institutional actions oriented toward building more resilient and integrated cycling governance; it is also jointly led.

Each cluster is further differentiated across three action layers that reflect the physical, behavioural and institutional dimensions of the intervention system. This three-way distinction is not a rigid classification but a reading aid, intended to make visible the different types of change that effective cycling transition requires and to signal that no single layer is sufficient on its own.

Two milestones function as go/no-go conditions before moving to the next horizon. The first, at 2031, requires that the network has been systematically mapped and priority discontinuities identified, that a first cycle of experiential events has been completed and outcomes documented, that the web platform has been launched and pilot programmes in schools are active, and that an anticipatory dialogue format between the Consulta and the Municipality is operational. The second milestone, at 2041, describes the conditions marking the transition to the Transform horizon: a cycling network that is continuous and legible across all radial corridors, a cycling modal share showing consistent and documented growth, maintenance embedded as a structural budget line across at least two administrative cycles, and a generation of children having received cycling education in schools. These milestones are not targets in the planning sense but threshold conditions: signals of systemic readiness to move to the next phase of intervention.

Finally, the roadmap includes a set of reinforcing loops that make visible the interdependencies between clusters, highlighting how progress in one area creates enabling conditions for others. A dedicated legend explains the visual grammar of the poster, distinguishing between actions that continue across horizons, actions that evolve into a more developed form in the next phase, reinforcing loops between clusters, go/no-go milestone conditions, and the initiative platform developed within this research as a concrete and immediately actionable output. These elements are intended to convey the systemic nature of the intervention logic, countering the risk that individual clusters might be read as independent priorities to be addressed in isolation.

6.3.3. The roadmap poster

The roadmap is materialised as a large-format poster, designed to function simultaneously as an analytical reference and a communication artefact. The visual and compositional decisions that shape the final output follow directly from the communicative purpose established in Section 6.3.1.

The overall layout is organised along the temporal axis, which runs horizontally across the poster and provides the primary reading direction. The three time horizons (Initiate, Consolidate and Transform) are visually distinct but continuous, conveying the sense of a progressive and cumulative process rather than a set of disconnected phases. The six thematic clusters are arranged vertically within this temporal structure, allowing the reader to follow the evolution of each intervention area across time while also reading the system as a whole at any given moment. The three action layers (physical, behavioural and institutional) are differentiated through colour coding, making the cross-cutting nature of each dimension immediately visible without requiring a separate explanatory structure.

A Future Vision statement is positioned prominently on the left side of the poster, providing an immediate orientation to the reader before they engage with the detail of the clusters. Its function is not analytical but motivational: it frames the purpose of the entire roadmap in accessible and concrete terms, describing not only the direct goal of making cycling a normal and supported part of everyday life in Turin, but also the broader systemic effects that such a shift would generate, including less congestion, cleaner air, more liveable streets and a more equitable and healthy city for cyclists and non-cyclists alike. A dedicated legend accompanies the content, explaining the visual grammar of the poster and allowing the reader to interpret the different types of action, transition and connection represented across the surface.

Priority levels were incorporated in earlier iterations of the roadmap through explicit labels derived from the prioritisation framework of Section 5.4. In the final version, this information is absorbed into the sequencing logic itself: the positioning of actions within the temporal horizons and the go/no-go milestone conditions together convey the relative urgency and feasibility of each intervention without requiring separate labelling. Each cluster also identifies its lead actor, making explicit which institutional figure carries primary responsibility for driving that area of intervention and providing a clear point of reference for accountability.

The two milestones are visually marked as go/no-go threshold conditions at the boundary between temporal horizons, distinguishing them clearly from the action content within each phase. The reinforcing loops between clusters are represented as visual connections, making the interdependencies between intervention areas legible without overloading the overall composition.

The typographic and visual register of the poster is intentionally designed to balance analytical rigour with accessibility. The tone is professional but not technical as it is aimed at an audience of decision-makers and civic actors more than at transport engineers or academic researchers. A clear visual hierarchy ensures that the poster can be read at multiple levels of depth: a first reading that captures the overall structure and direction, and a more detailed engagement that allows individual clusters and actions to be examined and discussed.

The poster is conceived as a living reference rather than a finished product. While the version developed in this research constitutes a complete and self-contained output, it is explicitly designed to be updated as the local context evolves, new evidence becomes available or implementation progresses. This openness to revision is consistent with the roadmap's function as a shared strategic framework rather than a fixed prescription.

6.3.4. Promotion and dissemination strategy

The value of the roadmap as a strategic reference tool depends not only on the quality of its content but on its capacity to reach and engage the actors for whom it is intended. The dissemination strategy is therefore considered an integral part of the design, rather than an afterthought to be addressed once the artefact is complete.

The primary dissemination channel is direct engagement with the Consulta della Mobilità Ciclistica, which represents both the most immediate audience and the most strategically positioned actor for ensuring that the roadmap enters the local governance conversation. Given the relationship established throughout this research, the roadmap can be introduced directly within the Consulta's working sessions, where it can function as a shared reference point in discussions with the municipal administration. This mode of introduction is considered more effective than a passive distribution, as it allows the artefact to be contextualised, discussed and appropriated by the actors who will use it rather than simply received.

A second dissemination pathway involves the broader network of cycling advocacy organisations and civic actors active in Turin. Local associations such as those represented within the Consulta could distribute the poster through their own communication channels, increasing its visibility among an audience already engaged with cycling mobility issues.

A third pathway concerns the academic and professional community. The roadmap, as an output grounded in a rigorous research process and connected to a published thesis, can circulate within networks of mobility researchers, urban planners and policy practitioners beyond the Turin context. While this audience is not the primary target, broader circulation can contribute to the visibility of the research and, over time, to the potential adaptation of the

Strategic roadmap

Towards a cycling Turin

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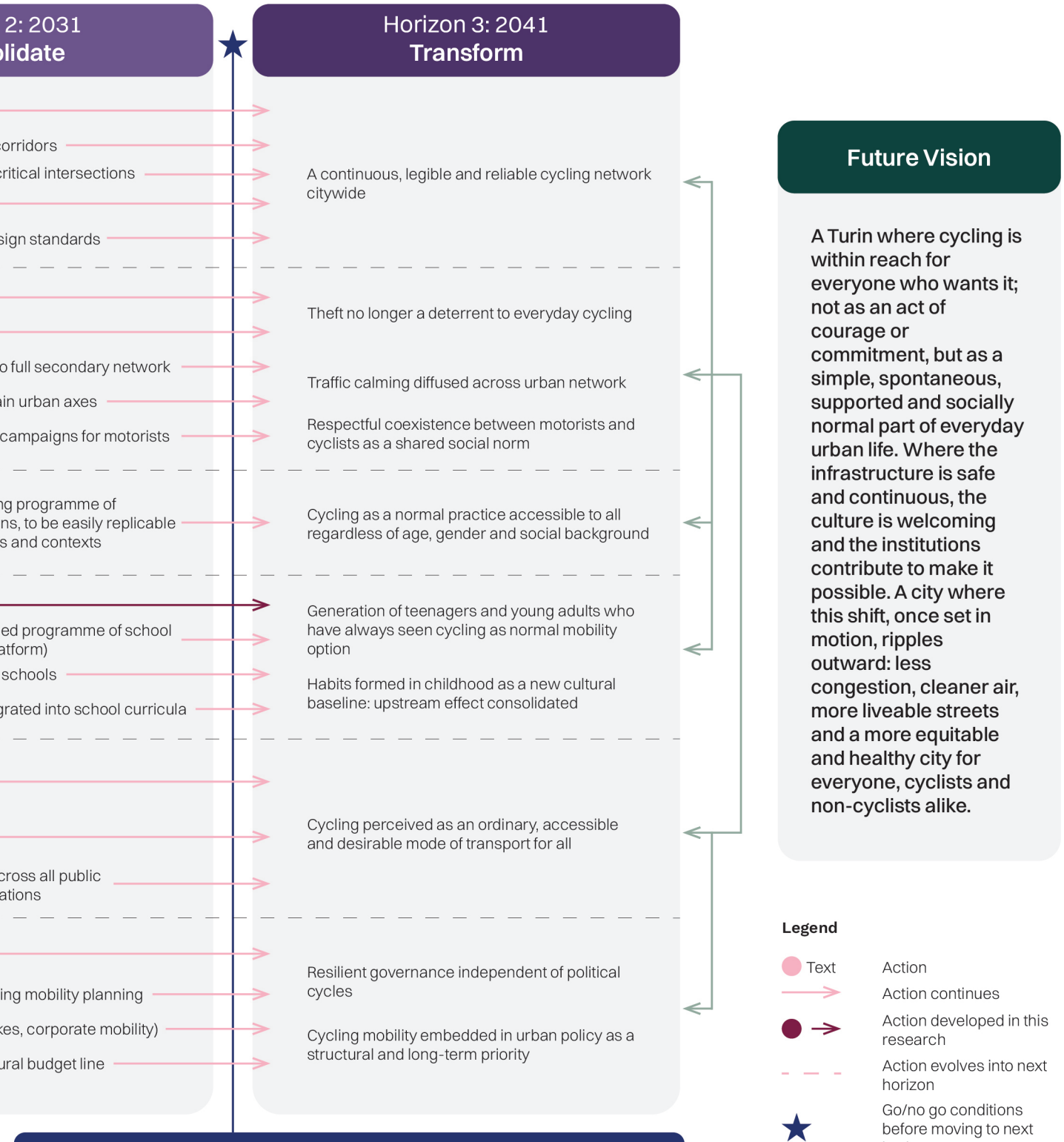

Future Vision

A Turin where cycling is within reach for everyone who wants it; not as an act of courage or commitment, but as a simple, spontaneous, supported and socially normal part of everyday urban life. Where the infrastructure is safe and continuous, the culture is welcoming and the institutions contribute to make it possible. A city where this shift, once set in motion, ripples outward: less congestion, cleaner air, more liveable streets and a more equitable and healthy city for everyone, cyclists and non-cyclists alike.

Legend

- Text
- Action
- Action continues
- Action developed in this research
- Action evolves into next horizon
- Go/no go conditions before moving to next horizon
- Reinforcing loops

Milestone 2

- [ ] Cycling network continuous and legible across all radial corridors
- [ ] Cycling modal share shows consistent and documented growth
- [ ] Maintenance as structural budget line across at least two administrative cycles
- [ ] A generation of children has received cycling education in schools

roadmap framework to other cities facing comparable challenges.

As with any strategic tool, the roadmap's long-term impact ultimately depends on conditions of institutional uptake that lie beyond the design itself, discussed further in Section 6.5.

6.4. Layer 2: Initiative platform

6.4.1. Concept and design rationale

"One of the largest barriers is often not the lack of good initiatives, but the fragmentation of information, knowledge and actors."
(Expert feedback on the platform)

The initiative platform responds to the second structural gap identified in the design brief of Section 5.6: the invisibility and fragmentation of existing local initiatives that support cycling normalisation, and the absence of a shared infrastructure to make them connectable and replicable. While the roadmap operates at the institutional level, the platform operates at the civic level, giving local actors the concrete resources needed to act within a specific and under-addressed intervention territory: cycling among children and in school contexts.

The choice to focus the platform on this territory was motivated in Section 5.6.2 by three converging reasons: childhood habit formation as an upstream lever that adult-targeted interventions cannot replicate, the current invisibility and fragmentation of school- and family-oriented initiatives, and the bounded contribution design can make by building the informational infrastructure that enables civic activation. The design phase further confirmed this direction: the evaluation process described in Section 6.2 surfaced local initiatives that had not emerged through desk research, reinforcing both the underserved nature of this territory and the value of a dedicated resource to make such efforts visible and replicable.

The platform is named Turin Bike Kids Club. The name was chosen to make its purpose and scope immediately legible. Naming the city explicitly anchors the platform in its local context, signalling that it is a situated resource grounded in the specific conditions of Turin rather than a generic collection of cycling content, a positioning consistent with the emphasis on context-specificity that runs throughout this research. The reference to bikes and kids foregrounds the focus on children and cycling, which the research identifies as the most upstream and durable lever for long-term adoption. The word club, finally, conveys a sense of community and collective practice, framing cycling in schools as a shared and welcoming endeavour rather than a specialised or ideologically charged activity. Taken together, the name signals that the platform is addressed to parents, teachers and school mobility managers rather than to cycling advocates, and that taking part is meant to feel accessible and worth doing.

"Finding a realistic and relaxed environment in between the classroom and the real world can be a significant challenge, but is absolutely essential for getting people who are hesitant about cycling to give it a try."
(Bruntlett & Bruntlett, 2018, pp. 252–253)

The platform serves four interconnected functions. The first is aggregation: bringing together in a single place initiatives, practices and resources that currently exist in dispersed and often invisible forms across Turin and beyond. The second is replicability: presenting each initiative not merely as a case study but as a transferable practice, structured to support adaptation across different schools, associations and neighbourhoods. The third is inspiration: offering users who are not yet active a clear entry point into the topic, making

the relevance and accessibility of cycling in schools immediately legible to first-time visitors regardless of their prior familiarity with the cause. This third function responds directly to the feedback received during the evaluation process, which highlighted the importance of designing for users who do not yet identify with cycling advocacy and need a reason to keep reading. The fourth is participation: enabling users not only to consume the platform's content but to contribute to it, by signalling initiatives, proposing practices and sharing their own experiences. This function reframes users as active contributors to a shared resource rather than passive recipients of information, and is developed in detail in Section 6.4.2.

6.4.2. Platform architecture and content strategy

Turin Bike Kids Club is organised around a home page and three main sections, each addressing a distinct phase of user engagement, from discovery to inspiration to action. The platform can be navigated freely across all three sections, or through two dedicated pathways designed for specific user profiles: one for parents and one for teachers and school mobility managers. These pathways do not introduce separate content but offer a curated and sequenced entry point into the existing sections, filtering and ordering the available resources according to the most likely needs and starting points of each user group.

Alongside the three content sections, the platform includes an About page that makes its authorship and provenance explicit. It presents the research project behind the platform, situates it within its academic context and provides direct contact details, framing Turin Bike Kids Club as an independent, research-grounded initiative rather than a commercial or institutional product. This transparency contributes to the credibility and trust that a first-time visitor needs in order to engage with and act on the content, and it is honest about the platform's current status as the output of a single researcher, a condition that the dissemination and sustainability strategy in Section 6.4.4 explicitly seeks to move beyond by identifying a long-term institutional home.

The first section, Discover, constitutes the most locally grounded layer of the platform. It collects and presents initiatives already active in Turin that address cycling among children and in school contexts, making visible a set of practices that, despite being already in place, remain largely unknown beyond the immediate circles of those who organise them. The existence of this gap was confirmed during the evaluation process: a small number of local initiatives did not surface through desk research and only became visible through direct engagement with members of the Consulta della Mobilità Ciclistica, which is itself a telling indicator of how limited the circulation of such efforts currently is. Each initiative is presented through a structured card that describes what the initiative involves, who organises it, which user group it is most relevant for, and practical details on timing, location and how to replicate or join it.

The second section, Learn, broadens the horizon beyond Turin through two complementary types of content. The first consists of best practice case studies from Italian and international cities that have developed particularly effective or transferable approaches to school cycling. The rationale for including these examples is not merely comparative but strategic: in a context where the

"Some of the best ideas on New York's streets were inspired, imported, borrowed, or flat out stolen from other cities — London, Montreal, Copenhagen. Cities are inspiring one another and choosing from the menu of options that other cities provide."
(Sadik-Khan, 2016, p. 108)

landscape of existing local initiatives may appear limited, exposure to what has been achieved elsewhere can expand the imagination of what is possible, raise the expectations of local actors and create informed demand for more ambitious interventions. Each case study is accompanied by a note on its relevance for Turin and the conditions under which adaptation would be required, a framing introduced in response to feedback about contextualisation received during the evaluation process. The second type of content within Learn consists of resource cards covering legal frameworks, curriculum tools and international organisations, addressing users who need informational grounding alongside inspiration. Together these two content types position Learn as both an inspirational and an informational layer, serving users at different stages of engagement with the topic.

The third section, Act, is oriented towards users who are ready to move from awareness to implementation. Rather than presenting isolated resources, it offers structured sequences of concrete steps organised by objective and ordered from the most immediately accessible to the most ambitious. The section presents nine action pathways in total, four addressed to parents and five to teachers and school mobility managers, each identifying a specific goal, listing the steps required to achieve it, and pointing to relevant resources within the platform that support each step. This format was designed to serve users who may have limited time or prior knowledge making the path from intention to action as direct and navigable as possible. The section is further differentiated by user profile within the dedicated pathways, so that each group encounters action sequences calibrated to their specific role and sphere of influence.

Cutting across all three sections is a participatory layer that allows the platform to grow through the contributions of its users rather than remaining a fixed, single-authored repository. Each section includes a dedicated entry point for submissions calibrated to its content: in Discover, users can flag local initiatives that the platform has not yet captured; in Learn, they can propose best practices or resources from other contexts that they consider relevant; and in Act, they can share their own experiences of putting cycling into practice. The Act section additionally surfaces community stories, short first-person testimonies from parents, teachers and advocates who have taken action (illustrative in the current prototype), which serve both to inspire new users and to frame the platform as a shared and active community rather than a static archive. Submissions are reviewed before inclusion and contributors are credited, preserving editorial coherence while allowing the content to be continuously enriched by those closest to it. This participatory dimension responds directly to a finding of the evaluation phase, namely that relevant local initiatives existed in Turin without having surfaced through systematic desk research (Section 6.2): by lowering the threshold for local actors to make their own initiatives visible, the platform turns that limitation into an ongoing, community-fed way of keeping the picture of local cycling activity complete. This participatory orientation is also consistent with the expert feedback discussed in Section 6.2, and in particular with the logic of supporting local actors in running initiatives rather than delivering them centrally: like that model, the platform treats its users as contributors to a shared ecosystem rather than as a passive audience.

6.4.3. Prototype and interface design

The current version of Turin Bike Kids Club is developed as a functional HTML prototype, constituting a complete and navigable representation of the platform's content architecture and interaction logic. While not yet a production-ready web application, the prototype goes beyond a static wireframe: all sections are fully populated with content, all navigation pathways are operational, and the interface reflects the visual and typographic register intended for the final product. It therefore functions as a high-fidelity proof of concept, sufficient to communicate the platform's purpose and experience to potential users and institutional partners, and to support the evaluation process described in Section 6.2.

Click here to access
Turin Bike Kids Club

The interface is designed around the principle of accessibility established in Section 6.1, prioritising clarity and ease of navigation for users who are not necessarily familiar with cycling advocacy or digital platforms of this kind. The visual language is warm and approachable rather than technical, employing a consistent typographic hierarchy, a restrained colour palette and generous spacing to ensure that content remains legible and inviting across all sections. The tone of the copy-writing throughout the platform is direct and practical, addressed to people who are interested in acting but may not yet know where to start.

The home page serves as the primary orientation layer. It introduces the platform's purpose concisely, presents the three main sections and offers the two user pathways as an alternative entry point for visitors who prefer a more guided experience. The decision to make both navigation modes available from the home page reflects the diversity of the platform's target audience: some users will arrive with a clear sense of what they are looking for, while others will benefit from being guided through a curated sequence that matches their role and context.

The card-based layout adopted across the Discover and Learn sections supports a non-linear reading experience and is meant to be allowing users to browse, filter and return to content without following a prescribed sequence. Each card is self-contained and structured consistently, so that users can rapidly assess the relevance of a given initiative or resource without having to read it in full. The action cards in the Act section follow a different logic, presenting content as numbered step sequences that guide the user progressively from a starting condition to a specific outcome, reflecting the more directed nature of that section's purpose.

6.4.4. Dissemination strategy and long-term sustainability

As noted by one of the field experts during the evaluation process, building a platform is relatively straightforward; maintaining it over time is the more fundamental challenge. The dissemination strategy for Turin Bike Kids Club must therefore address not only how the platform reaches its intended users but also how it sustains relevance and currency beyond the initial publication.

On the question of long-term governance, the Consulta della Mobilità Ciclistica is identified as the natural institutional home for the platform. The Consulta already operates at the intersection of civic advocacy and institutional decision-

"We have found it useful to think of platforms as infrastructure rather than projects: projects often have a clear beginning and end, whereas infrastructure evolves alongside the ecosystem it serves." (Expert feedback on the platform)

making, maintains relationships with the local associations most active in school cycling initiatives, and has the organisational capacity to keep the platform's content updated as new initiatives emerge or existing ones evolve. Entrusting the platform to the Consulta would also reinforce its legitimacy in the eyes of local actors, positioning it as a shared civic resource rather than an individual research output. This arrangement was discussed informally during the research process and received a positive response, though formalising it would require an explicit institutional commitment that falls outside the scope of this thesis.

The dissemination strategy is built around a core logic: Turin Bike Kids Club does not require mass visibility, but rather targeted reach through trusted intermediaries who already operate within the communities the platform is designed to serve. Four complementary channels are identified, sequenced by priority and time horizon.

The highest-priority channel is direct engagement with the institutional partners already involved in this research. Organisations including FIAB Torino Bici e Dintorni, Legambiente Metropolitano, Laqup and the Consulta della Mobilità Ciclistica represent the most immediate and credible pathway to parents, teachers and school communities in Turin. These organisations can distribute the platform through their existing newsletters, social media channels and events, embedding it within communication flows that already reach the platform's target audience.

The second channel targets school networks directly, with school mobility managers as the primary multiplier. A single contact per school can reach both teachers and families, making this a particularly efficient pathway. Distribution could be pursued through the Città Metropolitana di Torino via its CeSeDi, the Centro Servizi Didattici that already reaches teachers across the metropolitan area, as well as through FIAB Torino Bici e Dintorni, which could integrate Turin Bike Kids Club into its existing Mobility Manager events and training activities.

The third channel is digital and intended to build awareness over time at low cost. This includes the social media accounts of partner organisations, through which specific platform content can be shared in formats suited to each channel, as well as a dedicated Instagram presence for Turin Bike Kids Club itself. Ensuring that the platform is publicly accessible and indexed by search engines under relevant keywords in Italian is also considered a basic and necessary condition for organic discoverability by users who are not already connected to the partner network.

The fourth channel is event-based and opportunistic, relying on existing moments of cycling visibility in Turin's civic calendar. Events such as Bike Pride, Bimbimbici and the Salone della Mobilità Scolastica Attiva represent natural venues for presenting the platform to mobility managers, educators and families. The annual European Mobility Week in September provides a recurring and institutionally recognised moment of visibility that could anchor the platform's promotion calendar each year.

In terms of sequencing, the immediate priority is to share the platform with institutional partners for direct circulation within their existing networks. In the short term, the focus shifts to reaching school networks through the

CeSeDi and Mobility Manager channels. The digital presence is intended to develop in parallel as an ongoing and cumulative effort rather than a one-off launch.

6.5. The two-layer system in practice

The roadmap and the platform were conceived from the outset as a system rather than as two independent outputs, and their value is most fully realised when understood in relation to each other. This section draws together the logic of their connection and reflects on the conditions under which the system can function as intended.

The two layers operate at different scales and address different audiences, but they are oriented toward the same underlying objective: creating the conditions for a gradual and durable transition toward cycling as an everyday practice in Turin. The roadmap works at the institutional level, providing decision-makers with a structured and evidence-based framework for prioritising interventions across multiple domains and time horizons. Within this framework, cycling normalisation among children and schools is explicitly identified as one of the highest-leverage intervention territories, positioned in Cluster D as a strategic priority requiring upstream and long-term commitment. The platform then operationalises this strategic direction at the civic level, giving local actors the concrete resources needed to act within precisely that territory. In this sense the roadmap legitimises the platform's focus institutionally, while the platform translates the roadmap's strategic intent into tangible and replicable action.

The connection between the two layers also operates in the other direction. The initiatives aggregated and activated through the platform generate evidence of civic engagement and practical feasibility that can in turn inform future cycles of strategic planning. A school mobility manager who successfully implements a Bike to School programme, or a parent group that uses the platform to advocate for a school street, produces local evidence that strengthens the case for the very interventions the roadmap identifies as priorities. Over time, this feedback loop has the potential to make the relationship between strategic direction and civic action mutually reinforcing rather than unidirectional.

It is important to acknowledge, however, that this virtuous cycle depends on conditions that the design itself cannot guarantee. The roadmap requires institutional actors who are willing to engage with it as a shared reference and to translate its priorities into concrete decisions about funding, planning and space allocation. The platform requires a responsible actor committed to its long-term maintenance, and a sufficient density of local initiatives to remain relevant and useful to its users over time. Neither of these conditions is currently fully in place, and both represent implementation challenges that extend beyond the scope of this research. These constraints are consistent with the broader structural limitations of the governance and institutional landscape documented in Chapters 3 and 4, where fragmented planning, limited dedicated staff and political resistance were identified as systemic barriers that no single design intervention can resolve on its own.

What this two-layer system can credibly contribute, within the boundaries of what design research can achieve, is a reduction in two specific frictions that

"Designing involves both: locating and challenging the conditions of our current realities, while creating alternative conditions that allow for new realities to happen."
(Pais, 2016, p. 26)

currently limit progress: the absence of a shared strategic language among the actors responsible for cycling policy in Turin, and the invisibility of the civic energy that already exists but lacks the infrastructure to become cumulative. By making strategic priorities legible and local action replicable, the system creates conditions that are more favourable to change without presuming to produce that change unilaterally. In this sense it is consistent with the research's broader argument that effective intervention in a context like Turin requires working simultaneously on the material, cultural and institutional dimensions of the adoption gap, and that design can contribute most meaningfully not by solving the problem directly but by building the tools that make solving it more possible.

6.6. Concluding remarks

This chapter has translated the strategic directions established in Chapter 5 into two concrete design outputs. It began by making explicit the design principles that orient both outputs and that follow directly from the way the problem was framed in the design brief (Section 6.1), and by setting out the iterative, multi-source approach through which the work was evaluated, an approach that combined feedback from field experts, the Consulta della Mobilità Ciclistica and an international cycling NGO with a focused evaluation involving end users (Section 6.2). It then developed the two outputs in turn: the strategic roadmap, a poster-format reference framework that makes intervention priorities legible and sequenced for local decision-makers (Section 6.3), and Turin Bike Kids Club, a web-based platform that makes existing civic initiatives around cycling for children and schools visible, replicable and open to contribution (Section 6.4). Finally, it examined how the two layers function not as independent artefacts but as a single connected system (Section 6.5).

Taken together, these outputs constitute the design response through which this research addresses the third research question, moving from the identification of the most relevant leverage points to the question of how they can be addressed through strategic design intervention. Their contribution is deliberately bounded: rather than claiming to resolve the adoption gap, the two-layer system works to reduce two specific frictions that currently constrain progress in Turin, the absence of a shared strategic language among the actors responsible for cycling policy, and the invisibility of the civic energy that already exists but lacks the infrastructure to become cumulative. The table below brings the two layers together, summarising how each is grounded, who it addresses, what form it takes and how the two connect into a single system.

Table 7. *The two-layer system summarised*

	Layer 1: Strategic roadmap	**Layer 2: Turin Bike Kids Club**
Structural gap addressed (5.6.1)	Strategic prioritisation gap: no integrated tool connecting barrier evidence to intervention sequencing	Knowledge circulation gap: existing local initiatives invisible, fragmented and hard to replicate
Level and primary audience	Institutional: Municipality and Consulta della Mobilità Ciclistica	Civic: parents, teachers and school mobility managers
Form	Poster-format strategic reference artefact	Web-based platform (HTML prototype)

Core function	Translate the multi-criteria prioritisation of Section 5.4 into a shared, sequenced reference framework	Aggregate, make replicable, inspire and enable participation around cycling for children and schools
Empirical grounding	Multi-criteria prioritisation framework (Section 5.4)	Children and schools as upstream leverage point, plus iterative and user feedback
Evaluation status (6.2)	Expert and stakeholder feedback; not yet evaluated with its end users (municipal actors)	Expert and stakeholder feedback, plus an indicative end-user panel (two parents, two teachers)
Role in the two-layer system (6.5)	Legitimises the platform's focus institutionally, positioned as Cluster D	Operationalises the roadmap's intent and feeds civic evidence back into strategic planning

The following chapter steps back from the design outputs themselves to discuss the research as a whole: how its findings relate to the existing literature, what theoretical and methodological contribution it offers, what practical and policy implications follow from it, and within which limitations these claims should be read.

Chapter 7

Discussion and conclusion

7.1. Discussion of findings in relation to the literature

The findings of this research both confirm and extend the existing literature on barriers to cycling adoption, offering a locally grounded perspective that adds nuance to several of the theoretical positions reviewed in Chapter 2.

The most fundamental confirmation concerns the systemic and interdependent nature of cycling barriers. The empirical data collected in Turin consistently resist any single-factor explanation: barriers do not operate as isolated variables but as mutually reinforcing constraints that span infrastructural, behavioural, cultural and institutional dimensions simultaneously. This finding is of course aligned with the socio-ecological frameworks advocated by scholars such as Bhandal and Noonan (2022), Bishop et al. (2024) and den Hoed (2025), who do argue that modal choice cannot be understood as a rational cost-benefit calculation but must be read as a practice embedded in a broader social and material system. At the same time the Turin case adds empirical weight to a position that remains under-represented in the literature: the observation that the relative configuration of barriers is not universal but context-specific, shaped by the particular historical, cultural and institutional trajectory of each city. In a context where auto-mobility is not merely a transport preference but a deeply sedimented identity and economic legacy, the barriers that matter most are not simply the absence of infrastructure but the co-presence of structural conditions that make cycling feel socially illegitimate, physically precarious and institutionally marginal all at once.

A second and more original contribution concerns the consistent gap identified between user perception and expert evaluation across multiple barrier categories. The literature has extensively documented the role of perceived safety, social norms and habitual lock-in in shaping cycling behaviour, but has paid comparatively less attention to the systematic divergence between how these factors are experienced by everyday users and how they are assessed by mobility professionals. The findings of this research suggest that this gap is not incidental but structural: users tend to anchor their assessments in what is immediately and materially experienced in the urban environment, while experts identify latent or systemic conditions, such as the dominance of car culture, institutional lock-in and the opportunity costs of car ownership, that operate beneath the threshold of individual awareness. This asymmetry has direct implications for intervention design, as it suggests that the barriers most legible to potential cyclists are not necessarily the same as those most resistant to change, and that effective strategies must address both registers simultaneously.

A third finding extends rather than simply confirms the existing literature on motivational framing. While scholars such as Passafaro et al. (2014) and Semenescu and Coca (2022) have already questioned the effectiveness of the purely rational or the environmental appeals in promoting cycling adoption, the empirical data collected in this research offer a more specific and contextually grounded version of this same argument. In Turin the disconnect between the institutional framing of cycling as a sustainability measure and the experiential motivations of everyday cyclists, who consistently cite personal autonomy, physical well-being and enjoyment as primary drivers for their mobility choice, is not merely a communication problem but a structural misalignment between the language of policy and the language of practice. This finding suggests that reframing cycling around its personal and social benefits, rather than its collective environmental contribution, may be a more effective lever for reaching new audiences, particularly in Starter cities where the cycling identity is not yet established as desirable or accessible.

Finally the findings reinforce the contextual variability argument that has gained increasing prominence in the literature (Bruntlett and Bruntlett, 2018; den Hoed, 2025; Félix et al., 2019; Panter et al., 2019). The PRESTO framework's classification of cities according to cycling maturity (Dufour, 2010) provides a useful heuristic, and the Turin case confirms that in a city with low cycling maturity the barriers do not simply add up but interact in ways that amplify each other: the absence of infrastructure reinforces the perception of risk, which reinforces the social marginalisation of cycling, which reinforces the institutional resistance to investing in infrastructure. Breaking this cycle requires not a single intervention but a coordinated and sequenced system of actions that operates simultaneously across multiple levels, which is precisely the logic that the design outputs developed in Chapter 6 attempt to operationalise.

7.2. Theoretical contribution

The theoretical contribution of this research operates on two distinct but interconnected levels: a contextual level concerning the specific case of Turin, and a methodological level concerning the research process itself as a transferable framework.

At the contextual level, this study contributes an empirically grounded and systemically integrated understanding of cycling barriers in a city that has received limited dedicated academic attention despite representing a particularly relevant case of low cycling maturity within a morphologically favourable urban environment. While existing research on Turin has predominantly focused on infrastructural provision and quantitative mobility modelling, this study offers a qualitative and multi-perspective reading of how barriers manifest, interact and are perceived differently across user groups and institutional actors. The analytical framework developed in Chapter 2, organising barriers into five macro-categories across individual, relational, urban and institutional levels, and subsequently operationalised through the multi-criteria prioritisation framework of Chapter 5, constitutes a structured contribution to the literature on barrier categorisation that goes beyond existing taxonomies by explicitly integrating the dimensions of user relevance, systemic impact and difficulty of

intervention into a single interpretive logic. This combination of dimensions has not been systematically applied in previous studies on cycling barriers, and its application here demonstrates both its analytical value and its practical utility for design-oriented research.

At the methodological level, the more generalisable contribution of this research lies in the process itself. The study follows a coherent and replicable sequence of steps: a structured literature review producing a theoretically grounded categorisation of barriers; a contextual analysis of the specific urban case; a qualitative empirical investigation combining user and expert perspectives; a multi-criteria prioritisation framework translating empirical findings into actionable priorities; and a design phase producing outputs calibrated to the specific leverage points identified. This sequence is not incidental but constitutes a methodological proposition: a process through which research on mobility barriers can be translated into strategic design intervention in a way that is simultaneously evidence-based, context-sensitive and practically oriented.

Crucially, this process is not limited in its applicability to the Turin case, nor to cycling mobility more broadly. Any city facing a comparable gap between the recognised potential of a sustainable transport mode and its actual adoption could apply the same methodological logic to its own context, adapting each step to the specific barriers, actors and governance conditions it faces. The process is equally applicable to other domains of active mobility, such as walking or public transport adoption, where similar dynamics of structural lock-in, cultural resistance and institutional fragmentation operate. More broadly, the underlying logic of moving from systemic understanding to contextualised prioritisation to strategic design is transferable to any domain in which complex, multi-level barriers prevent the adoption of behaviours or practices whose benefits are widely recognised but whose uptake remains limited.

This transferability is the research's most durable theoretical contribution. By demonstrating that a design-oriented research process can produce both locally relevant outputs and a methodologically replicable framework, this study responds to one of the central challenges in the field of sustainable mobility: the difficulty of moving from general knowledge about what works to context-specific knowledge about what to do next, and how.

7.3. Practical and policy implications

The findings and outputs of this research carry practical implications at three distinct scales: the specific context of Turin, the broader landscape of cities in comparable conditions, and the level of national and European policy.

Within Turin, the most immediate implication concerns the need to shift from an incremental and reactive approach to cycling policy toward a more integrated and sequenced intervention logic. The empirical evidence presented in this study consistently shows that isolated interventions, however well-designed, are insufficient to produce durable change in a context where infrastructural, cultural and institutional barriers operate as a mutually reinforcing system. The strategic roadmap developed in Chapter 6 offers a concrete starting point for this shift, giving the Municipality and the Consulta della Mobilità Ciclistica

a shared reference framework that connects empirical evidence on barriers to a prioritised and temporally structured set of intervention directions. Its most immediate practical value lies less in any individual priority it identifies than in enabling actors with different mandates and timelines to align their efforts and evaluate progress against shared threshold conditions, supporting a coordinated logic that isolated interventions cannot achieve. Alongside the infrastructural and governance priorities identified in the roadmap, the research points to two practical recommendations that are particularly actionable in the short term: the reframing of institutional communication around cycling from an environmental to a personal and social well-being register, and the development of upstream interventions targeting children and schools as the most durable lever for cultural normalisation. The initiative platform developed in this research constitutes a direct and immediately deployable response to the second of these, providing local actors with the resources needed to act within this territory without waiting for structural conditions to change.

"Quality of life and climate action are complementary goals. It's just easier to get people excited about plans that improve their lives."
(Montgomery, 2013, p. 304)

For cities in comparable conditions, defined here as urban contexts characterised by low cycling maturity, morphological conditions that are in principle favourable to cycling, and a dominant car-centric culture with deep historical roots, the implications are primarily methodological. The process developed in this research offers a replicable pathway for translating locally specific barrier research into strategic design intervention, as discussed in Section 7.2. At the practical level, several of the substantive findings also carry transferable relevance: the importance of addressing the gap between user perception and expert assessment in the design of intervention strategies; the strategic value of low-threshold experiential interventions in dissolving barriers that resist structural change; and the role of upstream habit formation among children as a long-term lever that complements rather than substitutes for infrastructural investment. These insights are not unique to Turin but are likely to resonate in any city where cycling adoption is constrained by a similar configuration of structural and cultural barriers.

At the national and European level, the research contributes to the growing body of evidence supporting a differentiated approach to cycling policy that acknowledges the diversity of urban contexts rather than assuming that what works in cycling-mature cities can be directly transposed to Starter cities. The findings suggest that national frameworks, funding mechanisms and evaluation criteria should be designed to support context-sensitive strategies rather than standardised solutions, and that the capacity of local actors to conduct the kind of locally grounded investigation developed in this research should be treated as a prerequisite for effective intervention rather than an optional addition. In this sense the research speaks directly to the implementation challenges that persistently limit the impact of cycling-related commitments at the European level, where ambitions often outpace the institutional and analytical capacity needed to translate them into locally effective action.

7.4. Limitations and future research

Any research project operates within boundaries that shape what it can and cannot claim, and acknowledging these boundaries precisely is as much a condition of intellectual rigour as the quality of the work itself. This section

identifies the principal limitations of the present study and outlines the directions for future research that follow most directly from them.

The most fundamental boundary condition is the scope and duration of the research. As a master's thesis conducted within the constraints of a programme equivalent to approximately one hundred days of work, this study necessarily operates at a scale that precludes the depth of longitudinal investigation, the breadth of participant sampling and the extent of design iteration that a larger research project would allow. This constraint has shaped every phase of the work, from the size of the interview sample to the prototype status of the design outputs, and should be kept in mind when interpreting the findings and assessing the outputs. It does not diminish the validity of what has been produced, but it does define the register in which claims are made: this is exploratory and directional research, not definitive or exhaustive.

At the empirical level, several limitations are worth stating explicitly. The qualitative sample of fifteen users, while appropriate for an exploratory investigation of this kind, is not statistically representative of the Turin population and cannot support generalisations about the prevalence or relative weight of specific barriers across the city as a whole. The sampling strategy, which deliberately excluded residents of hilly or highly peripheral areas and individuals with young children, was motivated by a clear methodological rationale, as discussed in Section 4.2.2, but it also means that the barriers most salient to these groups are not captured in the findings. Similarly, the expert sample of three professionals, all based in the Netherlands, provides a valuable but inevitably partial perspective: their assessments are informed by deep expertise in cycling-mature contexts, which may introduce a systematic bias in how they evaluate the impact and difficulty of barriers in a city like Turin. The coding and analysis of interview transcripts was conducted by a single researcher without inter-coder validation, which, while mitigated by attention to consistency and transparency, remains a methodological limitation that more extensive research should address.

The design outputs developed in Chapter 6 are subject to a limitation concerning end-user evaluation that has already been introduced in Section 6.2. The platform was evaluated with a small panel of end users, two parents and two teachers from Turin, which confirmed the relevance of the concept and surfaced concrete directions for future iteration; however, with only four participants and the prototype's unfinished and English-language nature bracketed, this evaluation is indicative rather than representative. The roadmap, by contrast, has not been evaluated with its intended audience of municipal administrators and decision-makers at all, so its usability and practical effectiveness from their standpoint remain untested. A broader evaluation of the platform with a larger and more diverse group of users, and a first structured evaluation of the roadmap with municipal actors, would therefore constitute the most immediate next steps in the development of both outputs.

A further limitation, anticipated in Section 6.5, concerns the gap between design and implementation. Both outputs have been developed to a level of fidelity sufficient to communicate their purpose and demonstrate their potential, but neither has been deployed in a real institutional context: the roadmap has not yet been used in a working session between the Consulta

and the Municipality, and the platform, beyond the evaluation panel described in Section 6.2, has not yet been deployed for or accessed by its target users in everyday conditions. Whether the two-layer system succeeds in supporting more structured institutional dialogue and in making local cycling initiatives more visible and replicable therefore remains to be tested. This is an inherent constraint of design research conducted within an academic timeframe, and it points to the importance of follow-up work that tracks the trajectory of the outputs beyond the thesis.

These limitations collectively define a rich agenda for future research. The most immediate priority, as noted above, is to extend evaluation with the intended end users: broadening the platform evaluation beyond the initial panel and conducting a first evaluation of the roadmap with municipal actors, then incorporating this feedback, together with the concrete directions already surfaced by the platform evaluation in Section 6.2, into revised and more refined versions of both outputs. A second direction concerns the longitudinal tracking of the outputs' institutional uptake: whether and how the roadmap enters the governance conversation between the Consulta and the Municipality, and whether the platform succeeds in reaching and activating its target audience, are questions that only time and continued engagement with local actors can answer. A third direction involves the replication of the methodological process developed in this study in other urban contexts facing comparable challenges, either in cycling mobility or in other domains of active mobility such as walking and public transport adoption. Such replications would allow the methodological framework to be tested, refined and potentially formalised into a more explicit procedural guide for design-oriented mobility research. Finally, several of the substantive findings of this research point to specific areas that would benefit from deeper investigation: the role of childhood cycling habit formation as a predictor of adult cycling adoption; the mechanisms through which low-threshold experiential interventions dissolve attitudinal barriers; and the conditions under which the gap between user perception and expert assessment can be most effectively bridged in the design of cycling interventions.

7.5. Conclusion

This research began with a question that is deceptively simple: why does cycling remain marginal in a city where many of the apparent conditions for its adoption are present? The answer, as the preceding chapters have shown, is neither simple nor singular. In Turin, as in many cities caught between a favourable spatial structure and a deeply entrenched car-centric culture, the gap between the potential of cycling and its actual uptake is not the product of any single missing ingredient but of a system of mutually reinforcing barriers that spans the physical configuration of streets, the social norms that govern how people move, the everyday habits that make alternatives feel unthinkable, and the institutional dynamics that have historically made it easier to maintain the status quo than to challenge it.

"One size won't fit all, and — like Rome — the Dutch cycling utopia wasn't built in a day. It took over 50 years of incredibly hard work and some forward-thinking decisions that extended far beyond the current political cycle."
(Bruntlett & Bruntlett, 2018, p. 20)

Understanding this system was the first objective of the research, and it required moving across multiple levels of analysis simultaneously: from the theoretical landscape of the existing literature to the specific spatial

and cultural conditions of Turin, from the lived experiences of everyday mobility users to the professional assessments of field experts, and from the identification of barriers to the interpretive work of determining which ones represent the most meaningful leverage points for change. This process of progressive understanding, culminating in the multi-criteria prioritisation framework of Chapter 5, constitutes the analytical core of the thesis and its most direct response to the main research question: how can local decision-makers be supported in prioritising and addressing the most critical barriers to cycling adoption in Turin?

The design outputs developed in Chapter 6 translate this understanding into two concrete and complementary tools. The strategic roadmap provides a shared and evidence-based reference framework for the actors responsible for cycling policy in Turin, making strategic priorities legible and sequenced across time horizons and institutional responsibilities. The Turin Bike Kids Club platform operationalises the most upstream and culturally durable of those priorities, creating the informational infrastructure needed to make existing civic energy around cycling in schools visible, connectable and replicable. Together they do not solve the problem of cycling adoption in Turin, and they make no claim to do so. What they offer is more modest and more honest: a reduction in two specific frictions that currently limit progress, the absence of a shared strategic language and the invisibility of existing local action, and a demonstration that design research can contribute meaningfully to complex urban transitions not by replacing institutional action but by creating the conditions that make it more possible.

Beyond Turin, this research makes a methodological argument that extends its relevance beyond the specific context in which it was conducted. The process followed here, from structured barrier mapping to contextual investigation to empirical prioritisation to design, is replicable. It can be applied by researchers and practitioners working in other cities facing comparable conditions, in other domains of active mobility, and potentially in any field where the gap between the recognised value of a practice and its actual adoption calls for a response that is simultaneously analytical, strategic and designed. In this sense the most durable contribution of this thesis is not what it has produced for Turin, important as that is, but the demonstration that this kind of work is possible, that it is worth doing, and that the methodology to do it rigorously and responsibly is within reach.

"We build the happy city by pursuing it in our own lives and, in so doing, pushing the city to change with us. We build it by living it." (Montgomery, 2013, p. 380)

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Declaration on the use of AI

During the preparation of this thesis, the author made use of AI-based tools to support the revision and refinement of the written text. Their use was limited to language editing, improving clarity and readability, checking internal consistency, and assisting with the structuring and summarising of content that had already been researched, analysed and written by the author. These tools were not used to conduct the literature review, to collect or analyse the empirical data, or to generate the research findings, the design outcomes, or any of the original arguments presented in this work, all of which are the sole responsibility of the author. All AI-assisted output was critically reviewed, verified and edited by the author, who takes full responsibility for the content and integrity of the thesis.

Appendix 1 — Interview protocol (users)

Interviews with users were actually conducted in Italian, this protocol is therefore the translated version of the original. Great care has been taken to ensure that the translation is as faithful as possible to the original, so as to enable those who do not speak Italian to understand it clearly, whilst at the same time ensuring accuracy.

1. Information and consent to participate

This interview forms part of a Master's thesis research project conducted by Sveva Sacchi (TU Delft) on the topic of urban mobility and travel habits in the city of Turin.

The interview will last approximately 60 minutes and will consist of a semi-structured conversation about mobility habits, perceptions and opinions regarding different modes of transport, in particular cycling.

Participation is voluntary. You may refuse to answer any question or stop the interview at any time, without any consequences.

The interview will be recorded in audio format solely to enable the transcription and analysis of responses. All data will be anonymised: names or information that could identify participants will not be included in the transcripts or research findings.

The information collected will be used solely for academic research purposes within the context of the thesis and any scientific presentations or publications, always in anonymous form.

By signing below, I declare that I have read and understood the information above and voluntarily consent to participating in the interview.

Full name (optional) _____

Signature _____

Date _____

2. Participant profile (contextual information)

All information is collected anonymously and used exclusively for research purposes.

1. Gender

[ ] Female [ ] Male [ ] Prefer not to answer

2. Age group

[ ] 18–25

[ ] 26–35

[ ] 36–67

[ ] 67+

3. Highest level of education

[ ] Lower secondary school or below

[ ] High school diploma

[ ] Bachelor's or Master's degree

[ ] Postgraduate (Master/PhD)

4. Employment status

[ ] Student

[ ] Employed

[ ] Unemployed

[ ] Retired

[ ] Other: _____

5. Household composition

Total number of people in the household: _____

Children under 10 years old: [ ] No [ ] Yes, number: _____

6. Mobility resources within household

Valid driving license: [ ] Yes [ ] No

Number of cars in the household: _____

Number of bicycles in the household: _____

Use of bike sharing services: [ ] Yes [ ] No

7. Residence and travel habits

Area/neighbourhood of residence: _____

Average one-way distance of main trip (home–work/study) if applicable: _____ km

8. What modes of transport do you use for your daily commute (home to work/school)?

Please rank the modes you usually use in order of frequency, 3 max. (write 1 for the one you use most often, 2 for the second most, and 3 for the third most).

[ ] Car (driver)

[ ] Car (passenger)

[ ] Public transport (bus, tram, metro, train)

[ ] Bicycle (traditional or electric)

[ ] Walking

[ ] Motorcycle / scooter

[ ] E-scooter

[ ] Other: _____

9. Frequency of utilitarian (as a mode of transport) cycling in the last 12 months

[ ] Never

[ ] 1–2 times per year

[ ] 1–2 times per month

[ ] 1–2 times per week

[ ] 3+ times per week

[ ] Every day

10. Frequency of recreational (e.g. sport) cycling in the last 12 months

[ ] Never

[ ] 1–2 times per year

[ ] 1–2 times per month

[ ] 1–2 times per week

[ ] 3+ times per week

[ ] Every day

11. Motivations for cycling (if applicable)

Please select top 3 motives in order of importance (1 most relevant motivation, 2 is the second most relevant, 3 is the third most relevant)

[ ] Environmental sustainability

[ ] Health and physical well-being

[ ] Time efficiency

[ ] Economic savings

[ ] Flexibility and autonomy

[ ] Personal enjoyment

3. Evaluation and experience of barriers to cycling adoption

Scientific research shows that the decision to cycle or not is influenced by a range of barriers that go beyond the mere lack of cycle paths, touching on psychological, social and efficiency factors. For my study, I have summarised these barriers into five broad categories, four of which we will now examine together: I will read out each specific barrier and ask you to rate,

on a scale of 1 (not at all) to 5 (extremely), how much that factor influences or discourages you from using a bicycle for your everyday journeys in Turin. The aim is to understand citizens' real priorities in order to define an effective mobility strategy for our city. Where we feel it is useful, we will pause for a moment to explore the reason behind your rating with examples or personal experiences.

Category 1 — Risk and safety constraints

Let us now consider Category 1, related to risk and safety constraints. In this section, we will explore all those factors related to the perception or experience of physical vulnerability and risk.

A. Barrier 1 — Excessive motorised traffic and intrinsic vulnerability

By this we mean the structural asymmetry between cyclists and motorists due to differences in volume, speed and mass of vehicles, including close overtaking situations that create a continuous sense of exposure even in the absence of actual accidents.

B. "On a scale from 1 (not at all) to 5 (extremely), how much does this barrier influence your choice to use or not use the bicycle in Turin?"

A. Barrier 2 — Aggressive behaviour of motorists

By this we mean the perception of hostility, intimidation or lack of respect for the cyclist's position on the road, which generates stress and increases perceived danger.

B. "On a scale from 1 (not at all) to 5 (extremely), how much does this barrier influence your choice to use or not use the bicycle in Turin?"

C. For non-cyclists: "If you drive, what is your perception of cyclists? Do they make you feel unsafe, annoyed, etc.?" For cyclists (frequent and non-frequent): "If you cycle, does it often happen that you experience aggressive reactions from people driving cars or heavy vehicles in the city?" For cyclists (frequent and non-frequent): "If you cycle, you probably also drive; how do you experience this 'ambivalence' between the two roles? How do your perceptions change depending on the role you are in? For example, does cycling make you a more careful and considerate driver? Or when you are in a car do you forget about cyclists and take on the role of the typical driver who does not tolerate cyclists on the road?"

A. Barrier 3 — Lack of physical protection

By this we mean the absence of separated and segregated cycling infrastructure or effective traffic calming measures, which leaves you directly exposed in mixed traffic.

B. “On a scale from 1 to 5, how much does the lack of physical separation from cars influence your choice to cycle or not cycle in Turin?”

C. If they give a high rating: “What type of protection would make you feel safer? Do you consider the current painted lines on the road in Turin sufficient protection, or do you perceive them as unsafe?”

A. Barrier 4 — Complex intersections and dangerous manoeuvres

By this we mean conflict points at intersections that require risky manoeuvres, such as turning left across lanes or crossing fast flows of motorised traffic.

B. “On a scale from 1 (not at all) to 5 (extremely), how much does this barrier influence your choice to use or not use the bicycle in Turin?”

C. For cyclists: “Is there a type of intersection or a specific place in Turin that you systematically avoid because you consider it too dangerous to cross?”

A. Barrier 5 — Accident statistics as a psychological deterrent

By this we mean how awareness of cycling-related injuries and fatalities (heard in the news or read in newspapers) amplifies your perception of danger, discouraging you regardless of your personal experience.

B. “On a scale from 1 (not at all) to 5 (extremely), how much does this barrier influence your choice to use or not use the bicycle in Turin?”

C. “Do you think that Turin is on average a more dangerous city than others based on what you hear or read in the media?”

A. Barrier 6 — Personal insecurity in isolated areas

By this we mean the fear of assaults, robberies or harassment along isolated routes, a concern for personal safety independent of traffic-related risks.

B. “On a scale from 1 to 5, how much does concern for your personal safety (not related to cars) discourage you from using the bicycle in certain areas or at certain times in Turin?”

C. For cyclists: “Are there cycling routes in Turin (for example along parks or rivers) that you avoid because you fear being isolated or attacked, especially after dark?”

A. Barrier 7 — Theft and vandalism of the bicycle

B. “On a scale from 1 (not at all) to 5 (extremely), how much does this barrier influence your choice to use or not use the bicycle in Turin?”

C. For cyclists: “Does the fear of theft prevent you from using the bicycle to reach certain destinations where secure or supervised parking is not available?” For all: “Do you think that if there were safer parking facilities this would be a sufficient incentive for you to use the bicycle more often?”

A. Barrier 8 — Additional environmental risk factors

By this we mean elements such as poor lighting, limited visibility, unexpected obstacles or stray animals that increase exposure to harm and reinforce a general sense of insecurity.

B. “On a scale from 1 (not at all) to 5 (extremely), how much does this barrier influence your choice to use or not use the bicycle in Turin?”

Category 2 — Material and spatial feasibility constraints

We will now move to Category 2, in which we will explore the barriers that affect the objective feasibility of the trip, namely those physical, spatial or environmental obstacles that make it difficult or impossible to use the bicycle.

A. Barrier 1 — Unfavourable topography and hills

B. “On a scale from 1 (not at all) to 5 (extremely), how much does this barrier influence your choice to use or not use the bicycle in Turin?”

A. Barrier 2 — Adverse weather conditions

That is, factors such as persistent heat, heavy rain, strong wind or cold temperatures that reduce physical comfort and the practicality of the bicycle as a regular mode.

B. “From 1 to 5, how much do the weather conditions in Turin (think of summer heat or winter fog/frost) discourage your cycling trips? Consider both the impact of these conditions and how frequently they occur.”

C. For cyclists: “Is there a specific season in which you completely stop using the bicycle? What would you need in order to continue (e.g. more shade/trees against the heat or routes protected from rain)?”

A. Barrier 3 — Excessive distances and urban dispersion

This refers to routes that are too long between home and destination, often due to a low-density city, which increase travel time and energy expenditure beyond an acceptable threshold.

B. “From 1 to 5, how much does the distance of your usual trips in Turin represent an insurmountable obstacle?”

C. If they give a high rating: “To better understand your answer, could you quantify your typical trip (home–work/study)? For example, how many kilometres do you usually travel for this trip (one way)? How much time does it usually take you to reach your destination and by which mode? Of this time, how much is due to traffic or, for example, to searching for parking in Turin?”

A. Barrier 4 — Perceived excessive physical effort

B. “From 1 to 5, how much does the concern of exerting too much effort and arriving at your destination tired influence your choice to use the bicycle for your usual trips?”

A. Barrier 5 — Limited intermodal integration

This refers to the poor coordination between bicycles and public transport (for example lack of secure parking at stations or difficulty bringing bicycles on trams and buses).

B. “From 1 to 5, how much does the difficulty of combining the bicycle with bus,

tram or train in Turin influence your choice to use the bicycle?"

C. For non-cyclists: "Have you ever considered splitting your typical trip, for example if it is too long to be covered only by bicycle, between cycling and other modes such as public transport? Do you think that if the municipality or relevant actors worked on better integrating public transport, trains and bicycles, this would encourage you not to use the car and to include the bicycle in your daily mobility?"

A. Barrier 6 — Discontinuity of the cycling network

This refers to fragmented or interrupted cycling paths that force detours, mode changes or unsafe re-entry into mixed traffic, breaking the continuity of the journey.

B. "From 1 to 5, how much does the lack of continuous and interconnected cycling routes in Turin discourage your use of the bicycle?"

C. "In general, what is your opinion of the city's cycling infrastructure? Both in terms of quantity and quality? Please rate it again from 1 to 5, explaining your reasoning."

A. Barrier 7 — Lack of services at destination

This refers to the absence of secure parking, showers, changing rooms or lockers at the place of work or study.

B. "From 1 to 5, how much does the absence of these facilities at your destination prevent you from using the bicycle?"

C. If they give a high rating: "If, for example, your workplace offered a secure garage, would you change your travel behaviour in Turin in favour of the bicycle? And if it offered a changing room with showers?"

A. Barrier 8 — Poor road surface quality

This refers to uneven pavement, potholes, debris or poor maintenance that make cycling tiring and not smooth.

B. "From 1 to 5, how much does the condition of roads in Turin (think of tram tracks, cobblestones or potholes) influence your choice to use the bicycle?"

A. Barrier 9 — Route obstructions and spatial conflicts

This refers to cycle lanes being occupied by pedestrians, parked vehicles (double parking), waste bins or other obstacles that interrupt flow.

B. "From 1 to 5, how much does the presence of fixed or moving obstacles on cycling lanes in Turin discourage you from using them?"

Category 3 — Comparative utility and convenience constraints

This category concerns comparative constraints related to utility and convenience. In this section, we will therefore explore how the direct comparison between the bicycle and available alternatives (such as the car or public transport) influences your choice.

A. Barrier 1 — Inertia and consolidated habits

This refers to situations in which the use of a habitual mode (often the car) becomes an automatic process that prevents you from reconsidering the bicycle as an alternative, even when it would be functionally possible.

B. “On a scale from 1 to 5, how much does the consolidated habit of using another mode prevent you from actually choosing the bicycle for your daily trips?”

C. For frequent cyclists: “How difficult was it for you to break the ‘car automatism’ and make the bicycle your new routine?”; “When, how, but most importantly why did you start cycling? What were the triggers? (Convenience, suitability for the area where you live/work, not owning a car, enjoyment, influence of friends or family, flexibility, cost savings, sustainability)?” For less frequent cyclists: “Even if you usually use another mode, are there specific moments when you choose the bicycle? In which situations does this happen and why? What are the triggers that make you change your usual habit?”

A. Barrier 2 — Complexity of trips and dependent mobility

This refers to the need to combine multiple stops within a single trip (e.g. errands, shopping) or to accompany children or family members.

B. “On a scale from 1 to 5, how much does the need to run multiple errands or transport other people weigh on your decision not to use the bicycle in Turin? Also consider both the impact when these situations occur and how frequently they happen.”

A. Barrier 3 — Opportunity costs of car ownership

Once you already own a car (and have paid for insurance and taxes), the cost of each additional trip appears very low, reducing the economic incentive to switch to cycling.

B. “On a scale from 1 to 5, how much does having a car already available make choosing the bicycle economically unattractive or unnecessary?”

A. Barrier 4 — Comfort of the car and technological amenities

Factors such as heating/air conditioning, radio, seating and the presence of a roof make the car significantly more comfortable than the bicycle.

B. “On a scale from 1 to 5, how much does the desire to travel in the comfort of a car influence your decision not to use the bicycle?”

C. “Is there a specific aspect of car comfort (e.g. staying dry, listening to music, temperature control) that you consider irreplaceable for your trips in Turin?”

A. Barrier 5 — Perception of long travel times

The bicycle tends to be avoided when travel duration is perceived as excessive compared to motorised modes.

B. “On a scale from 1 to 5, how much does the belief that the bicycle is too slow for your needs influence your modal choice?”

A. Barrier 6 — Direct individual costs of cycling

This refers to the perceived costs of purchasing a bicycle, maintenance, or necessary equipment, which may reduce its economic attractiveness.

B. "On a scale from 1 to 5, how much does the expected cost of having a good bicycle and keeping it in proper condition discourage your decision to cycle in Turin?"

A. Barrier 7 — Preparation and organisational time

This refers to the perceived inconvenience of having to change clothes, manage personal appearance (e.g. sweat, hair), prepare equipment or plan the trip according to weather conditions.

B. "On a scale from 1 to 5, how much does this organisational burden negatively affect your decision to use the bicycle in Turin?"

Category 4 — Normative and identity constraints

Finally, we will now move to the category concerning normative and identity constraints. In this section we will explore barriers rooted in social norms, cultural meanings and individual identity.

A. Barrier 1 — Dominance of car culture

This refers to the idea that driving is the normal, desirable and almost taken-for-granted behaviour, while cycling is seen as an eccentric or second-class choice.

B. "From 1 to 5, how much do you feel that social pressure in favour of the car in Turin negatively influences your choice to use the bicycle?"

C. If they give a low rating: "Is this rating because you believe this social pressure does not exist at all, or because it does not personally matter to you?"

A. Barrier 2 — Lack of a widespread cycling culture

This refers to situations in which cycling is not perceived as an ordinary everyday practice. If it is not a typical behaviour, people tend to avoid it simply because it is not what everyone does; it may not even be considered as an option because it does not come to mind.

B. "From 1 to 5, how much does the fact that cycling is not yet 'the norm' in Turin discourage you from doing it?"

C. If they give a low rating: "Would you feel more encouraged to cycle if you saw many more ordinary people doing it every day in Turin?"

A. Barrier 3 — Absence of visible role models

The propensity to cycle is influenced by the presence of family members, friends or colleagues who already do it. Not having similar people within one's circle who use the bicycle may lead to feeling isolated or 'out of place'.

B. "From 1 to 5, how much does not having friends, relatives or colleagues who use the bicycle influence your decision not to use it? Or if you do have them,

how much does this influence your behaviour?"

A. Barrier 4 — Politicisation of cycling identity

This refers to the fear of being labelled as an environmental fanatic or ideologically aligned activist, rejecting an identity perceived as too militant.

B. "From 1 to 5, how much does the fear of being associated with a certain political identity discourage you from using the bicycle in Turin?"

C. If they give a low rating (1/2): "Is this answer because you do not believe this phenomenon occurs, or because you are actually comfortable being associated with this type of identity as you consider it positive?"

A. Barrier 5 — Association of cycling with poverty

In some contexts, the bicycle is seen as a sign of economic necessity rather than choice, signalling low social status or the inability to afford a car.

B. "From 1 to 5, how much does the concern that using the bicycle may convey this type of image influence your use of the mode?"

A. Barrier 6 — Cyclists as a stigmatised group

This refers to the perception of cyclists as arrogant, irresponsible road users or as obstructing traffic, fuelling hostility from motorists.

B. "From 1 to 5, how much does the fear of experiencing hostility from motorists due to these kinds of prejudices against cyclists discourage your use of the bicycle?"

C. "Do you feel that in Turin there is a sort of 'war' or strong tension between those who drive and those who cycle, where cyclists are seen as intruders?"

[To be asked only to women and parents]

A. Barrier 7 — Gender norms and/or care roles

This refers to social expectations (often linked to gender) that frame cycling as inappropriate, especially for those who have care-giving responsibilities such as transporting children.

B. "From 1 to 5, how much do you feel that your family responsibilities or social expectations regarding your role make cycling an unsuitable or inappropriate choice?"

A. Barrier 8 — Aesthetic stigma and norms of decorum

This refers to the conflict between cycling (sweat, messy hair, sporty clothing) and expectations of professionalism, elegance or respectability at work or in social contexts.

B. "From 1 to 5, how much does the concern of not appearing sufficiently neat or elegant upon arrival discourage the use of the bicycle for your trips in Turin?"

C. "In your work or social environment in Turin, is arriving by bicycle seen as unprofessional or careless?"

"Do you ever feel out of place or socially judged if you arrive at a work or social

appointment by bicycle? And have you perhaps had different experiences in other cities where you have lived?"

4. Last open question

In conclusion, now that we have discussed all these barriers in depth and you have had the opportunity to reflect on how much each of them influences your use or non-use of the bicycle, I would ask you to suggest concrete measures that could genuinely encourage you to use the bicycle (more), or that could in any case improve the situation. These do not need to be particularly feasible or unassailable measures, but rather useful ideas and inputs; anything that comes to mind will be very welcome. [Leave it open, but if they struggle, provide some examples: incentives for purchasing a bicycle, better and more cycling infrastructure, more parking facilities, increasing the cost of car parking, etc.]

5. Conclusion

At the end of the interview, participants are asked whether they would like to add any additional thoughts or reflections regarding cycling in Turin.

They are then thanked for their participation.

Appendix 2 — Interview protocol (experts)

Interviews with experts were conducted in English, therefore this protocol is the original version.

1. Information and consent to participate

This interview forms part of a Master's thesis research project conducted by Sveva Sacchi (TU Delft) on the topic of urban mobility and travel habits in the city of Turin.

The interview will last approximately 60 minutes and will consist of a semi-structured conversation about mobility habits, perceptions and opinions regarding different modes of transport, in particular cycling.

Participation is voluntary. You may refuse to answer any question or stop the interview at any time, without any consequences.

The interview will be recorded in audio format solely to enable the transcription and analysis of responses. All data will be anonymised: names or information that could identify participants will not be included in the transcripts or research findings.

The information collected will be used solely for academic research purposes within the context of the thesis and any scientific presentations or publications, always in anonymous form.

By signing below, I declare that I have read and understood the information above and voluntarily consent to participating in the interview.

Full name (optional) _____

Signature _____

Date _____

2. Evaluation of impact and difficulty of intervention of barriers to cycling adoption

I reorganised the factors that hinder the modal shift toward cycling identified in the literature into a single synthetic framework, structured around five functional macro-categories. The objective is to isolate the deeper deterrence mechanisms that prevent behavioural change, and then analyse them through interviews with experts (such as yourself) and with users in Turin, in order to

understand in depth how these mechanisms manifest in practice in the city that serves as the context for this study.

I would now ask you to evaluate the individual barriers within the framework from a dual professional perspective. For each obstacle, I will ask you — based on your experience — to assign two ratings from 1 to 5: the first concerns impact (how strongly it prevents modal shift in Turin or in similar cities), and the second concerns difficulty of intervention (how complex it is to implement an effective solution). In this scale, 1 represents the minimum value (no impact / extremely easy to address) and 5 the maximum value (critical obstacle / extremely high complexity).

These evaluations will help me create a fil rouge between these interviews and those I am conducting with users, while also providing a structural basis to guide our conversation, which will then explore in greater depth all the themes we consider relevant during our conversation.

Category 1 — Risk and safety constraints

Barriers related to the perception or experience of physical vulnerability.

Barrier 1 — Excessive motorised traffic and a constant sense of vulnerability (e.g., near misses).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 2 — Aggressive behaviour by motorists (hostility and perceived lack of respect).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 3 — Lack of physical protection (absence of segregated infrastructure).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 4 — Complex intersections and dangerous manoeuvres (conflict points and risky turns).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 5 — Accident statistics as a psychological deterrent (media influence on risk perception).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 6 — Personal insecurity in isolated areas (fear of harassment or assault outside traffic contexts).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 7 — Theft and vandalism (low trust in parking security).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 8 — Other environmental risk factors (poor lighting, tram tracks, degraded road surfaces).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Category 2 — Material and spatial feasibility constraints

Barriers that affect the objective feasibility of the trip, limiting the practical possibility of using a bicycle due to physical, spatial, or environmental conditions. [For you to know, the first barriers in this category are related

to topography, weather conditions and urban sprawl; however these will be evaluated through different methods.]

Barrier 4 — Perceived excessive physical effort (anticipation of fatigue or sweating upon arrival).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 5 — Limited intermodal integration (poor coordination between cycling and public transport).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 6 — Discontinuity of the cycling network (fragmented infrastructure forcing detours).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 7 — Lack of destination services (absence of secure parking, showers, or changing rooms).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 8 — Poor road surface quality (potholes or debris increasing physical strain).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 9 — Obstructions and spatial conflicts (cycle lanes invaded by pedestrians or parked cars).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Category 3 — Comparative utility and convenience constraints

Barriers emerging from the comparison between cycling and available alternatives. Cycling is discarded when perceived as less efficient in terms of time, flexibility, or comfort.

Barrier 1 — Habitual mode lock-in and inertia (established routines that are difficult to break).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 2 — Complexity of chained trips (difficulty managing multiple stops, loads, accompanying children, etc.).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 3 — Opportunity costs of car ownership (low marginal cost per trip once the car has been purchased).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 4 — Comfort and amenities of the car (climate control and insulation from external conditions).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 5 — Perception of long travel times (cycling perceived as too slow, especially for medium distances).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 6 — Direct individual costs (expenses for purchasing and maintaining a bicycle).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 7 — Preparation and organisational time (need for clothing changes or equipment management).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Category 4 — Normative and identity constraints

Barriers rooted in social norms and cultural meanings. Cycling is rejected when perceived as socially illegitimate or inconsistent with one's identity.

Barrier 1 — Dominance of "Car Culture" (the car as the socially validated default).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 2 — Lack of a widespread cycling culture (cycling not perceived as an ordinary behaviour).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5,

how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 3 — Absence of visible role models (lack of social support from peers, family, friends, colleagues, etc.).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 4 — Politicisation of cycling identity (fear of labels such as “fanatic” or “activist”).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 5 — Association with poverty or low status (cycling as a sign of economic necessity).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 6 — Cyclists as a stigmatised “out-group” (perceived as irresponsible or disruptive to traffic).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 7 — Gender norms and care roles (social expectations regarding domestic and parenting responsibilities).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 8 — Aesthetic stigma and decorum (conflict with standards of elegance or professional appearance).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Category 5 — Governance and political constraints

Meta-structural barriers generated by political priorities and institutional inefficiencies that allow other barriers to persist.

Barrier 1 — Chronic underfunding of infrastructure (resources primarily allocated to motor vehicles).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 2 — Fragmented planning and institutional silos (lack of coordination between departments or agencies).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 3 — Institutionalised car-centric paradigm (street design models rooted in motorised traffic flow).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 4 — Political resistance and “bikelash” (fear of losing electoral support due to parking removal).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 5 — Lack of data and specific expertise (statistical invisibility of cyclists in decision-making processes).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 6 — Inconsistent regulations and bureaucracy (rigid procedures that slow down street innovation).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 7 — Scarcity and discontinuity of incentives (lack of stable and long-term support policies).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.

Barrier 8 — Policy-driven structural competition (fiscal or regulatory advantages that favour cars over bicycles).

Question 1 (Impact): From a professional perspective, on a scale from 1 to 5, how much do you think this barrier actually affects modal shift in a city such as Turin? Where 1 = No impact and 5 = Extremely critical obstacle.

Question 2 (Difficulty): Based on your experience, on a scale from 1 to 5, how feasible or difficult do you believe a targeted intervention on this issue would be? Where 1 = Extremely easy and 5 = Extremely complex.