

# Unpacking mobility cultures: a review of conceptual definitions and empirical approaches

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## ABSTRACT

While “Mobility Culture” is an emerging concept in transport science and policy, it is often defined and applied in different ways. We conducted a systematic literature review focusing on the definitions of the concept and how it has been approached empirically. We found that definitions of Mobility Culture are heterogeneous, often indirect and implicit, or missing entirely. We assigned papers to five definition groups based on similarity: (1) *Objective and subjective characteristics*, (2) *subjective-only characteristics*, (3) *social groups and communities*, (4) *normative-sustainable notions of future transportation*, and (5) *papers lacking definitions*. Among empirical papers, we identified three broader approaches: *Comparative* (e.g. city typologies or pre-and-post relocation studies), *single-culture* (e.g. place-specific mode choice, local discourses) and *intervention studies*. We discuss the suitability of these approaches for different research goals and how they relate to the definition groups. Overall, we observe a lack of conceptual clarity in the Mobility Culture discourse, which is also reflected in the frequent mismatch of definitions and empirical operationalisations. We recommend that future Mobility Culture definitions consistently acknowledge the phenomenon’s (i) complexity and multidimensionality, (ii) the relational character among its dimensions and attributes, and (iii) its sensibility for social and geographical differences.

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## SUBJECT CLASSIFICATION

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## 1. Introduction

The transport sector poses many challenges to societies worldwide. Due to its strong reliance on individual motorised transport, it is responsible for approximately a quarter of global carbon emissions (IPCC, 2022), considerable noise and air pollution (Nieuwenhuijsen, 2020), adverse health outcomes (Mueller et al., 2015; Patterson et al., 2020), traffic casualties (Bergman, 2019), congestion (Afrin & Yodo, 2020), and vast consumption of public space (Creutzig et al., 2020).

Individual interventions (e.g. awareness campaigns, incentives) and structural interventions (e.g. changes in infrastructure or regulations) have aimed to achieve modal shifts from

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the car to active or public transport in response to these issues. However, many yield heterogeneous and partly inconsistent effects (Doğru et al., 2021; Xiao et al., 2022). This may, in part, be due to differences in cultural context moderating the impact of policy interventions (Aldred & Jungnickel, 2014; Pucher et al., 2010). For example, it has been argued that culturally shared norms, stereotypes, and emotions related to driving may act as considerable barriers to policy success if not accounted for (Sheller, 2004; Sovacool & Griffiths, 2020).

The interdisciplinary scientific discourse on “Mobility Cultures” addresses this issue of context in transport. It aims to conceptualise place-specific mobility patterns based on their local socio-cultural attributes and commonly also spatial, infrastructural, and economic indicators (Deffner et al., 2006; Institute for Mobility Research, 2013; Klinger et al., 2013). Following this perspective, attributes such as shared travel-related attitudes and behaviours (Bosen & Leicht-Scholten, 2020), lifestyle orientations, and political discourses are equally important in explaining everyday mobility as infrastructures (Deffner et al., 2006). Mobility Culture is thus understood as the interplay of symbolic and material transport system characteristics (Deffner et al., 2006; Klinger et al., 2013). Moreover, central to the discourse is the assumption that the mobility sector is culturally loaded and not free of the various actors’ underlying values and ideologies (Mögele & Rau, 2020).

This paper aims to structure the existing body of research on Mobility Cultures. An initial overview was provided by Mögele and Rau (2020) that briefly summarises three streams of Mobility Culture research alongside the underlying aims and involved disciplines: First, normative research of “how mobility culture should be” (p. 16); Second, empirical, quantitative comparisons of different Mobility Cultures; Third, studies investigating the symbolic and cultural meaning of mobility. That said, the authors state that the conceptual meaning of Mobility Culture remains somewhat unclear (p. 16), reflecting existing notions in the literature (Bamberg et al., 2020; Hoor, 2020; Næss, 2005). This lack of clarity is complicated further by contrasting calls for a more narrow (Bamberg et al., 2020) versus “all-embracing” (Institute for Mobility Research, 2013, p. xvi) definition of Mobility Culture. Such inconsistencies may be problematic and impair the theoretical debate and practical application of mobility concepts in general (Bosen & Leicht-Scholten, 2020). Thus, our review seeks to summarise and discuss the conceptual works in the field by following the first research question:

**RQ1:** Which definitions and descriptions of Mobility Culture exist in the academic literature?

Second, it is not clear how Mobility Culture can be investigated empirically. An overview of empirical research approaches could inspire future research, identify research gaps, and elicit the relationship between empirical methods and the underlying definition of Mobility Culture. It could further spark discussions about research design, for example, how and under which circumstances Mobility Culture should be deployed as explanatory (e.g. Haustein & Nielsen, 2016; Klinger et al., 2013) versus dependent variable (e.g. Bamberg et al., 2020; Rollin et al., 2021). To address these issues, we additionally focus on a second research question:

**RQ2:** Which empirical approaches to investigating Mobility Culture exist in the academic literature?

The remainder of the paper is structured as follows: First, we will describe the chosen literature review method. Next, we will report our findings of prevalent definitions and summarise them in a visual framework before outlining the main types of empirical

approaches, research goals, and methods encountered. Lastly, we will discuss our key findings in the light of prior evidence, reflect on the limitations of this review, and suggest future perspectives for research and policy.

## 2. Methodology

To assess our research questions, we performed a systematic literature review for two main reasons; First, the keyword-based database search ensures that as much of the relevant body of research is covered as possible (De Vos & El-Geneidy, 2022). Second, systematic reviews provide a transparent and replicable scientific procedure that reduces reviewer bias (Tranfield et al., 2003).

### 2.1. Eligibility criteria

The targeted data type was published academic literature yielded by a specific keyword search in selected databases. We chose the databases *Scopus*, *Web of Science*, *Transport Research International Documentation* (TRID), and *DTU Findit* (a Technical University of Denmark library service that additionally indexes open-access and pre-print archives) and applied the following search string:

"Mobilit\* Culture\*"¹

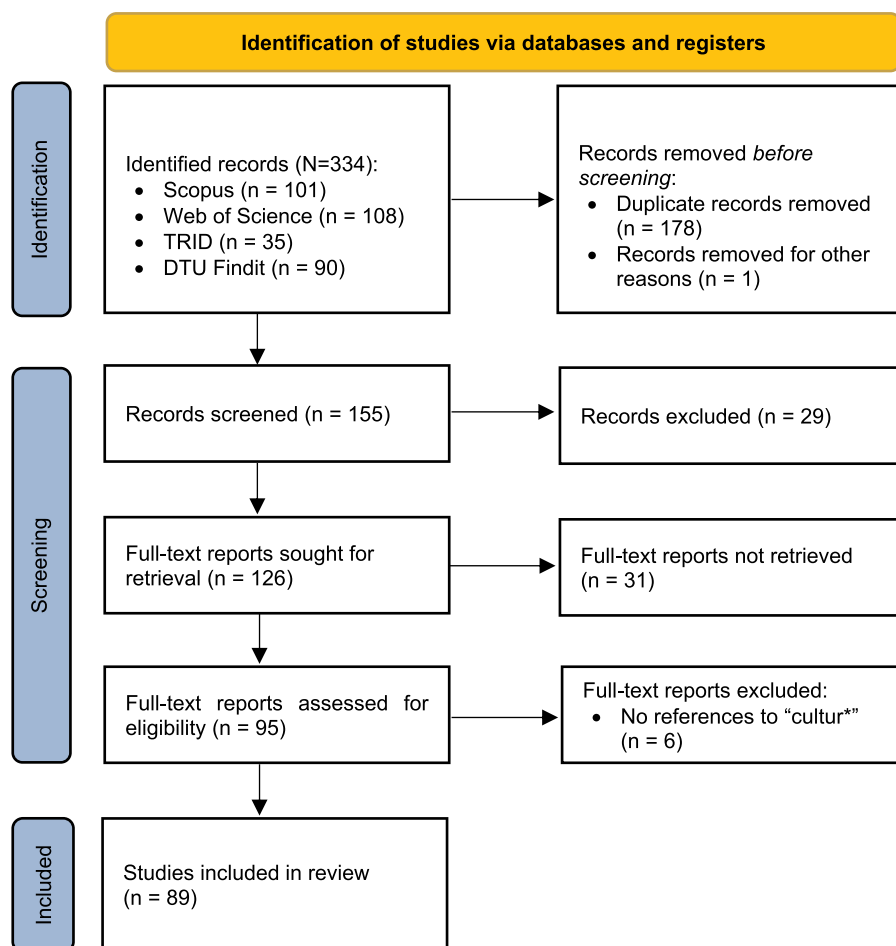
This is because we were interested in the *specific* concept of Mobility Culture as opposed to other related yet distinct concepts (e.g. "car culture", "cycling culture"). These tend to conceptualise culture based on specific, dominant transport modes. The Mobility Culture discourse conceptualises mobility systems on a broader level and independently of specific modal orientations. Thus, we assume that Mobility Culture represents a discourse in its own right that can be accessed with this simple search term. Moreover, we added an asterisk to each keyword to allow for variations we had encountered previously (e.g. "Mobility Cultures", "Mobilities Culture").

This search did not apply any filters and yielded a total of 334 records (see Figure 1). Subsequently, we excluded non-English materials and those unavailable in full length (after requesting corresponding authors). After removing duplicates, we screened the remaining abstracts to only include papers dealing with the transport of people. Subsequently, we excluded articles lacking instances of "cultur\*" in their abstract and main text as some only included it in their keywords or title. This resulted in 89 papers being included for review in December 2022.

In September 2023, we repeated this process and included nine additional, more recent papers. Although these papers did not inform our prior analysis, they fitted well into the existing definition groups and were thus allocated accordingly after screening. We highlight some of these works in our findings if they added more nuance to the groups; however, they are not reflected in the summary statistics due to the later inclusion.

### 2.2. Screening and analysis

The screening phase entailed multiple rounds of in-depth reading and extracting information on Mobility Culture definitions (RQ1) and related empirical approaches (RQ2).



**Figure 1.** Process of identification, exclusion, and inclusion of literature.

Throughout multiple screening rounds, we modified this set of targeted information features to best address our research questions after mutual discussion (see Appendix for a detailed review table).

Specifically, definitions were screened by assessing the descriptions and notions authors linked directly to the Mobility Culture term. In this step, we noticed instances where the term "Mobility Culture" was used interchangeably with alternative versions such as "Car Culture" or "Cycling Culture". In these cases, we assumed the definitions of the alternative terms to also be indicative of the authors' general understanding of Mobility Cultures. For example, if social norms toward driving were described as shaping car cultures, and if car cultures were equated with (specific types) of Mobility Cultures, mode-related social norms were interpreted as constitutive of Mobility Cultures.

Furthermore, we identified different levels of explicitness in definitions. We coded papers as *explicit* if a dedicated text passage existed that introduced and outlined Mobility Culture in a straightforward way. Moreover, we coded them as *implicit* (after thorough assessment) if only indirect notions about the meaning of Mobility Culture were provided.

Lastly, if Mobility Culture was mentioned but neither defined nor described, we coded it as *not defined*.

As we discovered considerable overlaps between definitions, we grouped papers with similar definitions. This followed an inductive procedure of reviewing the specific attributes (e.g. travel attitudes) and socio-spatial level ascribed to Mobility Culture (e.g. country, city, or community level).

Importantly, these groups were formed based on *definitions only* but not empirical research designs. The latter were evaluated separately by examining features such as sample sizes, data collection method, analytical method, measured constructs, sampled unit, or chosen spatial focus. We classified empirical approaches, based on similarity, as comparative, single-culture, or intervention studies.

### 3. Findings

The 89 selected papers included scientific journal publications (61), conference papers (12), book sections (9), books (6), and one report. The yearly publication rate on Mobility Culture has increased over time. While the earliest works date back to 1994 and 2001, most were published between 2014 and 2023. We found 47 different country affiliations among authors, most of which were in Europe, North America, Asia, and Australia. More than 20% of papers had affiliations in Germany, followed by Poland, England, Denmark, Sweden, and Australia (with at least 4 papers each). Moreover, we found variation in the use of terminology: Apart from expected references to “Mobility Culture(s)”, various papers additionally involved terms like “Cycling Culture(s)”, “Car Culture(s)”, “Urban Mobility Culture(s)”, “Local Mobility Culture(s)” or “New Mobility Culture”.

#### 3.1. Definitions

The extent to which Mobility Culture is defined across publications varied considerably. Out of all 89 papers, we classified 36 papers as defining or describing Mobility Culture *explicitly*, 30 *implicitly*, and 23 papers as not providing any definition (this ratio appears quite consistent over time). Based on definition similarity (or lack thereof) we identified 5 groups of papers as summarised below.

##### 3.1.1. Group 1: Mobility Culture defined by objective and subjective characteristics (n = 36)

The first definition group highlights a two-fold conceptualisation of Mobility Culture as the interplay of *objective* and *subjective* transport characteristics (Haustein et al., 2020; Kal-lenbach, 2020; Klinger et al., 2013; Nilsson, 2019). These definitions often reflect the conceptualisation by Deffner et al. (2006). Some also refer to this dualism as the combination of *material* and *social* (Nello-Deakin & Nikolaeva, 2021), *soft* and *hard* (Leung & Le, 2019), or *tangible* and *intangible* (Monteiro et al., 2021) mobility attributes. Almost all papers in this grouping conceptualise these dimensions as tightly interwoven via “reciprocal co-constitutive relations” (Sonnberger & Graf, 2021, p. 176). For example, the vast availability of bike lanes may promote cycling, but widespread pro-cycling attitudes may promote the construction of new bike lanes, thus marking a “physical extension of cultural priorities” (Klinger & Lanzendorf, 2016, p. 246).

A focus on spatially bounded cultures emerged in this group, especially in cities, countries, and regions. Stephenson et al. (2015) add that Mobility Cultures are “multi-scalar” (p. 118) as they may exist on further cross-cutting levels (e.g. family, generation, business, industry). Juschten and Hössinger (2020) state that Mobility Culture is place-specific but may become internalised by individuals and influence travel behaviour when visiting other places.

The typical *objective* factors of Mobility Culture in this group are the following: Characteristics of the physical environment, specifically the built environment (Kallenbach, 2020; Klinger et al., 2013; Klinger & Lanzendorf, 2016). This is often defined as density, diversity, and design (Cervero & Kockelman, 1997), spatial form (Juschten et al., 2020), topography (Institute for Mobility Research, 2013), or common housing types (Hasibuan & Permana, 2022). Others highlight the role of infrastructural network connectivity (Haustein et al., 2020) and quality (Institute for Mobility Research, 2013), such as the design and maintenance of bicycle lanes (Guo et al., 2022). Also, the prevalence of certain vehicle types (Ryghaug & Skjølsvold, 2019; Stephenson et al., 2015) or mobility-related tools (Wickland, 2022) such as media devices in cars (Weber, 2011) were linked to the concept. Some also counted socio-economic features like population income, employment rates, productive ages (Hasibuan & Permana, 2022), expenditures (Urbanek, 2018), and vehicle ownership (Stephenson et al., 2015) to the objective Mobility Culture dimension.

Typical *subjective* factors refer to shared symbolic and non-material attributes (Mögele & Rau, 2020). For example, “mainstream legitimized practices” (Ryghaug & Skjølsvold, 2019, p. 159) and social norms related to mode choice (Haustein et al., 2020) were commonly highlighted. These are seen as critical for travel habits (Juschten et al., 2020; Klinger et al., 2013) and, thus, local mobility patterns overall. Furthermore, subjective features involve mode-related preferences (Klinger et al., 2013), attitudes (Haustein et al., 2020; Heinonen et al., 2021) and emotions (Nitschke, 2022). Shared knowledge (Klinger & Lanzendorf, 2016) and skills play another important role, such as the ability to ride a bicycle (e.g. Nello-Deakin & Nikolaeva, 2021). Common lifestyles in a given area such as car independence (von Behren, Bönisch, et al., 2020), high individual mobility (Stephenson et al., 2015) or “hip and modern lifestyle[s]” (Nilsson, 2019, p. 1657) additionally describe subjective components of Mobility Culture. Symbolic meanings of transport modes, for example, “freedom, independence, comfort, and social status” (Urbanek, 2018, p. 13) or a city’s image and reputation (Institute for Mobility Research, 2013; Monteiro et al., 2021) further count as subjective attributes. These can be promoted via public discourses (Kallenbach, 2020; Mögele & Rau, 2020) and narratives such as framing buses as “loser cruisers” (Juschten et al., 2020, p. 12). Additionally, the subjective dimension involves transport planning and policy-making (Haustein et al., 2020; Juschten & Hössinger, 2020), public “competing interests and conflicts” (Klinger & Lanzendorf, 2016, p. 247), and power dynamics (Mögele & Rau, 2020) that shape mainstream practices (Ryghaug & Skjølsvold, 2019) and mode superiority (Wickland, 2022).

### 3.1.2. Group 2: Mobility Culture defined by subjective-only characteristics (n = 19)

In the second grouping, papers conceptualise Mobility Culture exclusively by subjective and non-material transport aspects and as going beyond the “instrumental movement[s] of people from point A to point B” (Jensen, 2008, p. 2). Hence, latent phenomena such as mobility-related mindsets (Mausbach et al., 2019; Papageorgiou & Demetriou, 2019b,

2019a), perceptions (Bamberg et al., 2020), or social customs (Jensen, 2008) are seen as the defining features of Mobility Culture in this group. Although some papers acknowledge the influence of material aspects (e.g. infrastructure) on travel patterns, they portray Mobility Culture as a non-material concept (Krysiński & Szczepański, 2020; Pojani et al., 2017; Sattlegger & Rau, 2016).

On the more individual level, Mobility Culture is frequently associated with mobility-related, socio-psychological attributes. For instance, social norms play a defining role (Jensen, 2008; Sattlegger & Rau, 2016) and may relate both to observed behaviours and perceived community consensus about transport policy and development (Bamberg et al., 2020; Rollin et al., 2021). Kandt et al. (2015) associate Mobility Cultures with 'psychographic profiles' of travel-related attitudes. Similarly, mode-specific attitudes (Papageorgiou & Demetriou, 2019b), affect, emotions, and relationships (Krysiński & Szczepański, 2020) are highlighted as key determinants. However, Divall (2012) also emphasises attitudes towards being mobile in general as an attribute defining Mobility Culture. Moreover, socialisation and learning may consolidate Mobility Cultures, for instance, through early parental instructions on riding a bicycle (Jensen, 2008). Related knowledge and skills may become most salient when individuals migrate to Mobility Cultures where practices, rules and meanings of travel differ greatly from where they lived previously (Geis, 2019). Certain lifestyles mark another individual-level attribute, for example, car-centredness (Taylor, 2021) or car independence (Sattlegger & Rau, 2016).

Furthermore, this group also stresses a more structural level of non-material attributes. This involves societal mobility discourses and narratives (Taylor, 2021) as well as widespread symbolic meanings of mobility (Divall, 2012; Jensen, 2008; Krysiński & Szczepański, 2020) such as certain vehicles embodying social status (Pojani et al., 2017) and individual freedom (Mausbach et al., 2019). Bicycles, specifically, may be associated with youth and athleticism in some cultures (Pojani et al., 2017) and with low social status in others. Moreover, the history of a given Mobility Culture may partially explain its mobility practices and meanings today (Divall, 2012). Additionally, law and policymaking differ between Mobility Cultures, for example, the regulation and provision of car parking space (Taylor, 2021). Lastly, this grouping counts power geometries (Bergman, 2019), (im)balances and hegemonomies (Sattlegger & Rau, 2016) as cultural dynamics that may determine travel mode dominance or inferiority.

### **3.1.3. Group 3: Mobility Culture defined by social groups and communities (n = 4)**

In the third grouping, researchers relate Mobility Culture more strongly to specific social groups and communities. O'Regan (2012), for instance, explored so-called "alternative mobility cultures" (p. 131) of hitch-hiking communities. He explains how they are not defined by geographical borders but by attributes shared among members of this group (e.g. preferences, social norms, practices, identities, and lifestyles). Similarly, Burrell (2011) examined the Mobility Culture of Polish migrants in the UK, specifically focusing on the trajectories they take between both countries and the symbolic (e.g. rituals, identities) and material (e.g. airlines, aeroplanes, airports) cultural phenomena involved. Adding a similar perspective, Biehl et al. (2019) considered different ethnic groups in Chicago, finding that each showed unique social norms, values, and acceptance towards active travel. Hopkins and Stephenson (2014) conceptualised generation-specific Mobility Cultures. Focusing on the example of Generation Y they state that members of



this generation share similar beliefs, knowledge, behaviours, and materials when it comes to their mobility. In summary, this group falls between the previous two definition groups due to both objective & subjective and subjective-only conceptualisations; however, they are united in the primary focus on group-specific cultures and thus require a distinct definition group.

#### **3.1.4. Group 4: Mobility Culture defined as sustainable future transport (n = 7)**

This group collects notions of Mobility Culture as improved, sustainable instances of transport systems. This is emphasised by common usage of the term *new* Mobility Culture (Commission of the European Communities, 2007; Okraszewska et al., 2014) in this group. This *new* culture carries normative assumptions: “New mobility culture is [...] a way to a better and more environmentally friendly transportation in the cities” (Janecki & Krawiec, 2011, p. 206). Central to this group is a Green Paper by the Commission of the European Communities (2007) that aimed to spark a debate among citizens and stakeholders about improving urban mobility. This document calls for policies addressing matters of congestion, air pollution, safety, and accessibility. It explicitly formulates the notion of a “new urban mobility culture” (p. 3) as a proxy for improved transport systems in European cities that tackle or solve these issues. However, improvements are understood quite heterogeneously. For example, Iamtrakul and Wongbumru (2019) equate this with improved efficiency, safety, accessibility, use of resources, and environmental impact of transport. Others stress that life quality, social interactions, physical activity, and health shape sustainable Mobility Culture (Dietz et al., 2021). Another example by Mendieta Ávila and Pons (2021) assumes sustainable Mobility Culture as the general availability of sustainable transport modes and infrastructure.

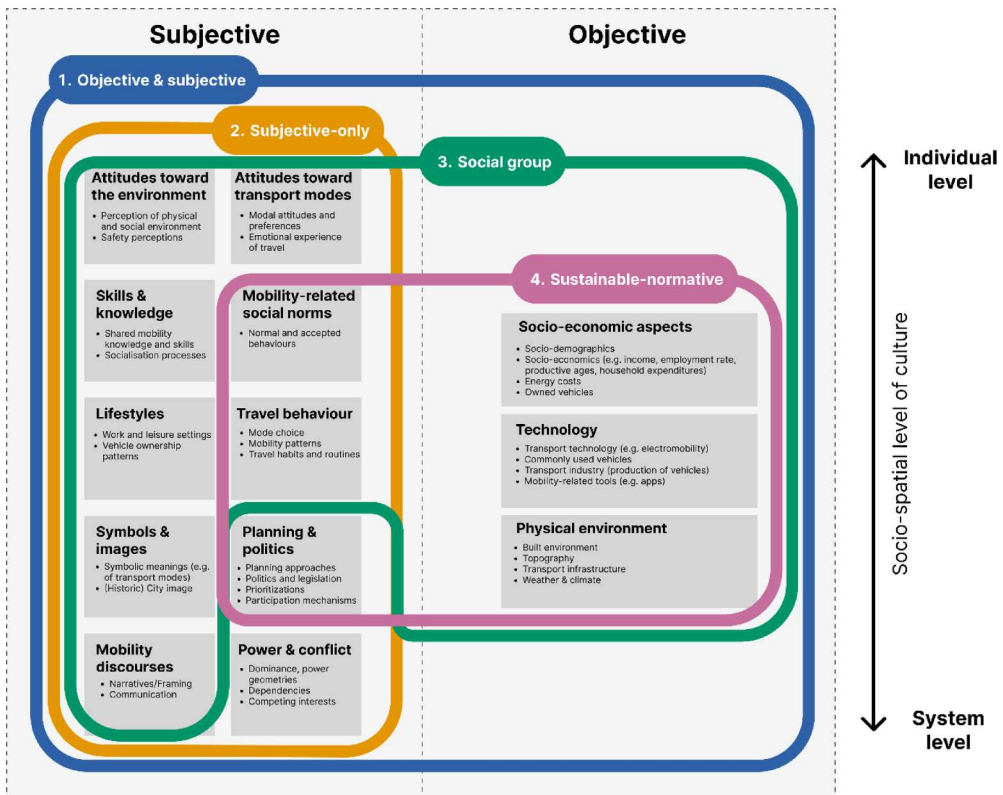
#### **3.1.5. Group 5: papers lacking definitions (n = 23)**

Lastly, around a quarter of papers did *not* offer definitions or clear descriptions of Mobility Culture. While “Mobility Culture” appears as an established term in these papers, they discuss it only vaguely, if at all, and rarely go beyond mere mentions. It seems likely that some studies suppose their readers to be familiar with the particular conceptualisation by Deffner and colleagues (Busch-Geertsema & Lanzendorf, 2017; Kesselring et al., 2023). For others, this appears unlikely, where Mobility Culture is generically equated with geographically “diverse backgrounds” (Fu, 2020, p. 203) or observed travel patterns (Blinkin & Muleev, 2016). In summary, Mobility Culture is rarely the core research focus but rather mentioned as a possible explanation for regional differences that should be considered when transferring findings across contexts (Cantelmo et al., 2022; Tao et al., 2019).

#### **3.1.6. Summarising framework of definitions**

Given our aim of structuring existing research on Mobility Culture, Figure 2 summarises the key characteristics of Mobility Culture encountered across definition groups visually. We chose to represent all definition groups on a dual spectrum of a subjective and objective dimension as it provides a common denominator on which all encountered attributes could be summarised clearly. On the left-hand side, the subjective dimension represents non-material aspects of Mobility Culture such as social norms, attitudes, perceptions, and lifestyles. In addition, this involves practices and procedures, such as transport planning approaches, politics, and power (im)balances, along with discourses and narratives





**Figure 2.** Summary of attributes associated with Mobility Culture across all reviewed papers. The coloured areas represent the different definition groups identified through our analysis.

about mobility. This is juxtaposed by the objective dimension comprising the physical and built environment as well as the availability and use of mobility technology (e.g. electromobility, charging facilities). Some articles highlighted that Mobility Cultures may also be shaped by socio-economic factors, such as income and employment rates, or the types and numbers of vehicles prevalent in the population. Although we depict the two dimensions as separated, they should be understood as highly interactive and mutually influential.

Additionally, this framework depicts each definition group by circling and labelling their corresponding attributes in varying colours.

Since our analysis further identified different levels on which these attributes exist, we arranged the figure to show *individual-level* characteristics closer to the top, and the more *system-level* ones at the bottom (see arrow on the right). For example, mode-specific attitudes and car ownership are situated more closely to the individual end of the range, while mobility politics and the physical environment characteristics are closer to the more collective and *systemic* end. Importantly, this range needs to be understood as flexible meaning that some attributes are relevant on multiple levels: Individual travel attitudes might become system-level attributes if more and more people share a collective attitude about a transport mode. Vice versa, widespread, system-level attitudes might affect an individual's attitude, for example when moving to a different Mobility Culture.

### 3.2. Empirical approaches

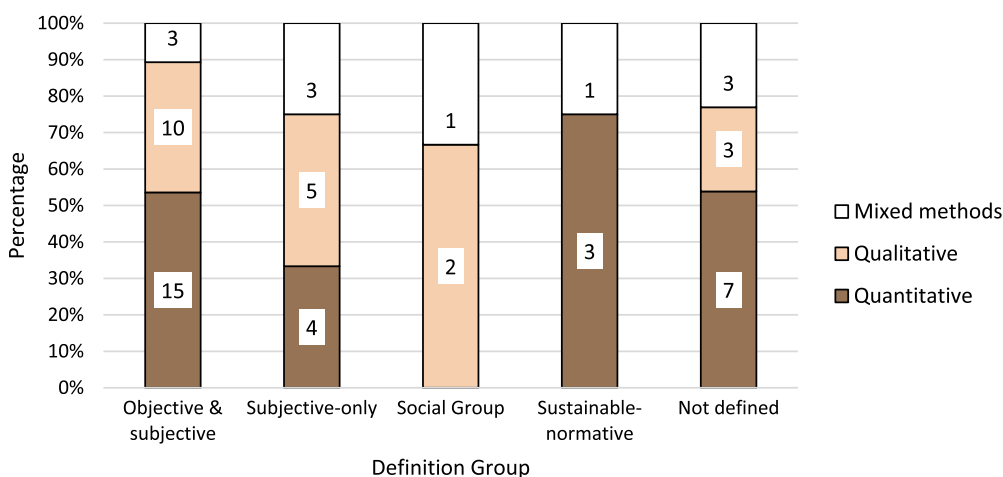
In total, 60 papers carried out empirical research. Around half used quantitative methods, one-third used qualitative methods, and the remaining were mixed-methods studies. We analysed all studies' approaches to examining Mobility Culture, finding three approaches; *comparative*, *single-culture*, and *intervention studies* (described later in this section). The objective & subjective group shows a slight tendency toward quantitative (see Figure 3), and comparative approaches (see Figure 4), the subjective-only and social group papers toward qualitative, mixed method, and single-culture study designs, while the sustainable-normative group tends to rely on quantitative intervention studies.

#### 3.2.1. Comparative studies

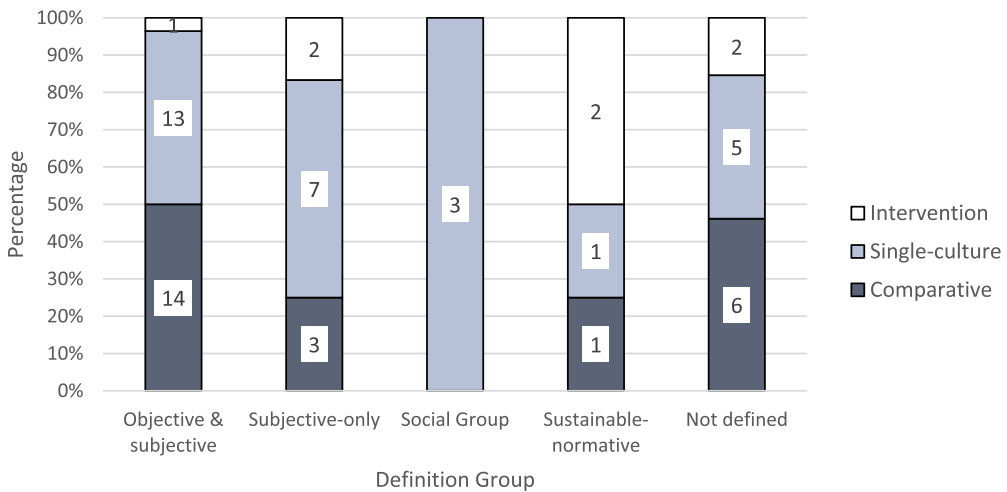
Many studies (24) investigated Mobility Cultures by comparing spatial units such as cities, regions, or countries. This approach seems to follow the rationale that Mobility Culture characteristics emerge by identifying similarities and contrasts among different cultural settings (Klinger et al., 2013). We identified three types of comparisons: Classification/clustering studies, in-depth comparisons of selected cultural settings, and spatiotemporal comparisons.

The *classification and clustering approaches* seek to identify different types of Mobility Cultures by clustering a range of spatial and individual-level attributes. The main motivation for this approach is to reveal potentials for and barriers to sustainable transport transition that are assumed to differ across heterogeneous cities (Klinger et al., 2013). These approaches may consider objective variables (e.g. urban sprawl, vehicle density, congestion) (Institute for Mobility Research, 2013), combine them with subjective indicators (e.g. mode and infrastructure perceptions) (Klinger et al., 2013), or focus only on the latter (Haustein & Nielsen, 2016). Following this method, places or regions with similar mobility orientations can be identified, such as car, cycling, or transit-oriented cities (Klinger et al., 2013).

Studies performing *in-depth comparisons* typically assessed 2–3 selected places to draw conclusions about local conditions of Mobility Culture. Several studies explicitly compared



**Figure 3.** Types of research methodologies across the definition groups.



**Figure 4.** Broader empirical approaches across the definition groups.

cities within the same type of Mobility Culture regarding the dynamics underlying their common mobility patterns. For instance, two studies compared cities classified as hybrid urban mobility cultures (e.g. Berlin, San Francisco) based on survey measures on psychological determinants of mode choice (von Behren, Bönisch, et al., 2020; von Behren, Schubert, et al., 2020). Another study compared cycling rates in Stockholm and Copenhagen (as culturally similar cities) based on survey measures of perceived cycling stress, safety, and prioritisation. Conducting qualitative interviews, Pojani et al. (2017) compared 3 small-sized cities assumed to represent cycling cultures regarding underlying sets of cycling-related beliefs, guiding their interview questions via the Theory of Planned Behaviour (Ajzen, 1991). Adding another empirical perspective, Taylor (2021) compared parking policy approaches across various German cities by performing a desk review and expert interviews, guiding her analysis by the different types of German Mobility Cultures identified by Klinger et al. (2013).

Lastly, *spatiotemporal comparisons* assess the impact of changes in the Mobility Cultures on travel behaviour. For example, Klinger and Lanzendorf (2016) investigated whether moving between Mobility Cultures might alter individuals' travel perceptions and mode choices. Following a similar goal, Monteiro et al. (2021) conducted semi-structured interviews among international newcomers in Portugal to elicit their adaptation to a new Mobility Culture. Analogously, Nello-Deakin and Nikolaeva (2021) investigated cycling uptake of international newcomers to Amsterdam, focusing especially on the impact of "human infrastructure" (p. 289) and social norms on their cycling behaviour. Focusing on the same spatial settings over time, Greene et al. (2022) investigated changes in Mobility Culture throughout the COVID-19 pandemic. They assessed three selected cities (assumed as different Mobility Cultures) via qualitative interviews, document reviews, and data on online trip searches to reconstruct pre-pandemic cultures and to retrace their evolution to the status quo.

Most of these comparative studies belong to the objective-subjective definition group and applied quantitative approaches to investigate Mobility Cultures, though, with a few

qualitative exceptions. While some classification and clustering approaches seek to empirically represent all/most attributes of their underlying definitions, we observe a clear tendency to select fewer variables for investigation. This may be due to a lack of data availability or feasibility of the chosen research approach. Furthermore, a small number of subjective-only definition group articles ran comparative studies and targeted subjective variables of Mobility Culture. In other words, the research ambitions of both groups show considerable overlaps despite differing definitions. Importantly, comparative approaches were also common among the non-defining articles. These papers seem to understand Mobility Cultures as equal to certain, unexplained differences across spatial contexts. However, cultural differences in these studies were neither explicitly theorised nor clearly introduced to the study design.

### 3.2.2. *Studies focusing on singular Mobility Cultures*

Several studies selected singular settings to assess their corresponding Mobility Culture (17). These inquiries tended to adopt more exploratory approaches deployed via qualitative and mixed methods rather than quantitative studies that utilised Mobility Culture as an explanatory variable.

A larger portion of these investigated cultural aspects of *place-specific transport mode choices*. For instance, Heinonen et al. (2021) investigated reasons for car ownership in a car-oriented Mobility Culture, relying on qualitative interviews and survey data. This combination allowed them to identify local residents' internalised, mode-specific norms and stigmas, environmental considerations, and spatial perceptions, as well as to regress car ownership on quantitative, subjective (e.g. pro-car attitude) and objective variables (e.g. distance to the city centre, income). Analogously, Leung and Le (2019) modelled active mobility choice via similar measures but included survey items on perceived local Mobility Culture, i.e. descriptive norms, accident experiences, and perceived feasibility of active transport options.

Another approach is found in studies on *community mobility cultures*. While few in number, these adopt mostly exploratory, qualitative methods, for instance, to explore how two different communities in Chicago relate to active mobility choices and what this reveals about the local Mobility Culture (Biehl et al., 2019). Adding to that, O'Regan (2012) explored hitch-hiking mobility culture by participating in two community events and interviewing selected individuals subsequently. He thus focused less on spatial boundaries than the community's mobility attitudes and knowledge acquisition required for this practice. Lastly, Jungnickel and Aldred (2014) examined cycling cultures qualitatively by identifying certain "sensory strategies" (e.g. using an audio device) of cycling commuters while roaming different environments.

A smaller stream sought to characterise Mobility Culture via *analyses of societal discourses*. For example, Mögele and Rau (2020) explored narratives of tension and disagreements in regional debates related to the strong local car industry. Similarly, Kallenbach (2020) performed narrative analysis of newspaper articles and participant observations to shed light on discourses that maintain or challenge the dominant local Mobility Culture.

Other scholars studied the *history of Mobility Cultures* by gathering secondary data sources. These focused typically on how past developments impacted current cultures and practices, such as Ryghaug and Skjølsvold (2019) analysis of the reasons for the

emerging electric vehicle culture in Norway, or Nilsson's (2019) examination of path dependencies of the tourist cycling culture in Copenhagen, Denmark.

### 3.2.3. *Intervention studies*

A lower number of articles focused on interventions or policies aimed at altering aspects of mobility (4). For instance, some studies examined the impact of urban living labs seeking to promote sustainable transport by involving the local population and examining its impacts (Dietz et al., 2021; Rollin et al., 2021). In this context, Bamberg et al. (2020) evaluated the impact of this intervention by measuring perceptions of the local Mobility Culture. This was done via a self-developed measure comprising 22 statements on perceived social support for a more car vs. multimodality-oriented local mobility culture. In addition, Mateo-Babiano et al. (2020) focused on a university-based bike-sharing program assumed to influence the pre-existing Mobility Culture. They evaluated predictors of active participation via survey items on cycling beliefs and attitudes, among others.

## 4. Discussion of key findings

This review aimed to structure the rich body of research on Mobility Culture by critically assessing related definitions and empirical approaches in the academic literature.

The first main finding was the heterogeneity of definitions as captured by five definition groups. While Mobility Culture is commonly defined as more than mere materials and infrastructures, the specific, included attributes and their relationships differ across papers. This heterogeneity has implications for research and policy as the term is increasingly mentioned across these domains. For example, suppose changes to a given Mobility Culture were called for. In that case, scholars of the objective-subjective definition group might consider both infrastructures and urban design as well as travel norms and attitudes, while those of the subjective-only group might think of softer, social attributes only. Such contrastive understandings have surfaced in interviews with different transport experts (Scherer, 2023).

Another finding was that different research communities in the Mobility Culture discourse tend to adopt different definitions, research questions, and empirical approaches. For instance, the objective & subjective definition group largely represents a Germany-based geographical and sociological community. These tend to focus on larger transport systems and guide their work by an explicit Mobility Culture framework (Deffner et al., 2006). Many scholars in the subjective-only group appear rooted in the 'mobilities turn' (Sheller & Urry, 2006), studying the experiences, perceptions, social, and symbolic meanings of mobility more often qualitatively and inductively. In contrast, a smaller part of the subjective-only group is rooted in social psychology and a quantitative, replicable operationalisation of mobility culture (Bamberg et al., 2020; Rollin et al., 2021). While the social group definitions comprise few papers only, the sustainable-normative group embodies a community concerned with a green paper by the European Commission on improving urban mobility. This illustrates that the same term can be understood and studied differently in different research domains.

Adding to the conceptual heterogeneity, articles differ in whether they understood culture as a singular vs. plural entity (i.e. "Mobility Culture" vs. "Mobility Cultures"). For example, some scholars define and investigate a single, dominant (e.g. Blinkin &

Muleev, 2016) or strived-for culture (e.g. Janecki & Krawiec, 2011), while others stress the importance of understanding Mobility Cultures as part of a network of multiple, simultaneous cultures that can coexist in the same setting (Hoor, 2023). This variation might suggest that the concept is flexible and can be utilised for different research goals. However, some works, especially articles in the normative-sustainable definition group, appeared to understand Mobility Culture exclusively as one idealised version of a transport system. Such singular perspectives have been criticised for homogenising co-existing, heterogeneous, and potentially conflicting Mobility Cultures to one supposedly dominant orientation (Götz et al., 2016; Hoor, 2023). This issue of singularity/plurality often remains unmentioned and unexplored across the discourse, which makes it hard to detect whether different understandings might be hidden behind the same term.

We understand these examples of theoretical heterogeneity as potential symptoms of a lack of conceptual clarity. It is indeed no new criticism that theoretical descriptions of Mobility Culture are often unclear and arbitrary (Hoor, 2020). Theoretical criticism often points out the “catch-all” nature (Götz et al., 2016) that includes too many mobility characteristics at once to be precise enough (Bamberg et al., 2020). Moreover, it has been criticised that researchers conceive of Mobility Culture as tautological and tend to explain culture with itself (Götz et al., 2016).

Podsakoff et al. (2016) stress that a lack of conceptual clarity is problematic and can create confusion across entire research fields. While well-defined concepts “serve as the essential building blocks of theory” (p. 165), ill-defined concepts might lack the precision that differentiates them from other phenomena. Unclear theoretical boundaries thus can cause different phenomena to be referred to by the same label and vice versa, according to the authors. We found support for this because many scholars referred to Mobility Culture to describe theoretically different ideas, despite potential overlaps. The emergence of five different definition groups underlines these different conceptual directions.

Low conceptual clarity also implies empirical issues: Podsakoff and colleagues explain that the less clear the concept is, the more mismatched, “deficient and/or contaminated” (p. 167) any operationalisation will be. We find this reflected in the studies’ empirical approaches that often focused on a subset of Mobility Culture attributes (e.g. mode-specific attitudes and norms) instead of their entirety. Adding to the conceptual blur, we found that studies were often based on different definitions of Mobility Culture, yet they chose to measure the same/similar empirical constructs. For example, some studies of the objective & subjective definition group could be mixed up with studies of the subjective-only definition group because they exclusively measured subjective attributes. This could indicate a common issue with low conceptual clarity – that Mobility Culture might be “too broadly defined” (Podsakoff et al., 2016, p. 167) for empirical approaches to be feasible (Bamberg et al., 2020), consistent, and comparable.

One may also conclude that empirical approaches should operationalise the whole set of Mobility Culture attributes much more often. While we note some more holistic inquiries (Klinger et al., 2013; Kuhnimhof & Wulfhorst, 2013; Wulfhorst et al., 2013), complete operationalisation might be difficult due to the limited data availability on the relevant attributes for one or multiple spatial setting(s), considering limited research capacities and funding resources. However, even if only a few studies achieve this, their results may help to identify a smaller and more feasible set of core variables that can be utilized in more extensive studies over time and regions.

Furthermore, a lack of conceptual clarity may have caused the large variability in research designs where Mobility Culture acted as either the independent or dependent variable if not explored without conventional variable designs altogether. This might suggest differing researcher opinions on whether Mobility Culture influences or is being influenced by other factors, or if it should be explored beyond one-directional causality. In contrast, one may also argue that this empirical variability exists because Mobility Culture is a flexible concept due to its holistic, systemic nature.

In addition, low conceptual clarity might partially explain why around one in four papers was missing a Mobility Culture definition. This may be due to a general tendency to view culture as a “residual factor” (von Behren, Schubert, et al., 2020, p. 2) that conventional approaches cannot capture. Furthermore, Mobility Culture might be seen as fashionable yet empty terminology (Bamberg et al., 2020) and thus left undefined. However, the opposite might also be the case where scholars do not provide definitions assuming that their reader will know. This does not seem far-fetched for the German side of the discourse, where Mobility Culture is mostly equated with a specific framework by Deffner et al. (2006). However, this is much less the case for all other articles, which do not seem to interpret the term as an explicit theoretical framework but as a term that allows more inductive theorising. Thus, in the international discourse, Mobility Culture appears as established terminology rather than an established and conceptually clear framework. This makes further conceptual development and clarification necessary.

To reach this, researchers should first define Mobility Culture as explicitly and clearly as possible, regardless of their specific understanding of the term. This practice should reduce uncertainty as scholars transparently reflect on their perceived meaning of this concept. Secondly, we believe that the different conceptual definitions need to ultimately converge into one clear and consistent definition. Based on this review, we recommend this definition to reflect three core principles. First, it should acknowledge the *complexity and multidimensionality* of mobility. Both objective-subjective and subjective-only conceptualisations, for instance, may fulfil this principle as each entails variety and heterogeneity. Second, it should incorporate a *relational understanding* of mobility that captures and explains the interplay of these different dimensions and attributes. Third, this definition should emphasise a *sensibility for local or group-specific differences* along these characteristics, meaning that Mobility Cultures might differ across social and geographical contexts. This implies that multiple Mobility Cultures can exist between and within different contexts (Deffner et al., 2006; Hoor, 2023).

Regarding the empirical studies, we identified three broad approaches (i.e. comparative, singular-culture, and intervention studies), each bundling a variety of quantitative, qualitative, and mixed-method inquiries.

Scholars interested in identifying different types of Mobility Cultures in a given region have followed *comparative* approaches. These can take the shape of clustering multiple places (e.g. cities) based on their similarity on certain indicators, which could inform how policy interventions would need to be tailored to these local conditions. However, gathering subjective data consistently for multiple geographical units will arguably be more difficult to achieve. Researchers interested in detailed comparisons of Mobility Cultures may thus have tended to select fewer study settings (e.g. 2-3), allowing for collecting nuanced quantitative (e.g. Haustein et al., 2020) or qualitative data (Poiani et al., 2017) on subjective attributes, specifically. Additionally, scholars investigating the impact of



residential relocations on travel behaviour have examined pre- and post-move Mobility Cultures via self-reported perceptions (e.g. Klinger & Lanzendorf, 2016). Future comparative studies might further focus on the (competitive) interrelations and power dynamics of Mobility Cultures in the same spatial settings (Hoor, 2023). Qualitative approaches appear especially capable of this, for example, by examining power narratives in public discourses or individuals' perceptions. Such insights could inform our knowledge of how certain practices become widely legitimized and dominant while others remain inferior and niche (Geels, 2011).

In some situations, focusing on *singular cultures* warrants some advantages. For example, researchers may be motivated to study in-depth what it means to belong to a mode-specific mobility culture (e.g. cycling culture). Here, qualitative techniques seem especially promising because they can unveil an individual's travel perceptions and practices feeding into their community's Mobility Culture and vice versa (e.g. O'Regan, 2012). In addition, they can assess how narratives and communication signify and impact Mobility Cultures (e.g. Mögele & Rau, 2020). Additionally, reviewing and integrating different historical data and reports is a valuable approach for scholars studying the preconditions of present-day mobility patterns and cultures (e.g. Ryghaug & Skjølsvold, 2019).

Those interested in the role of Mobility Culture in transformative research may be inspired by approaches evaluating transport *interventions* based on pre and post-measures of individuals' perceptions relating to the local Mobility Culture (e.g. Bamberg et al., 2020).

In conclusion, our literature review identified five ways in which the concept has been theorised and three in which it has been studied empirically, providing orientation and inspiration. Most scholars understand Mobility Culture as a holistic account of mobility systems going beyond mere infrastructure and 'hard facts' by (equally) emphasising various 'soft', subjective, and social attributes of culture. This is where the discourse offers a novel and enriching perspective on transport and mobility phenomena. However, our review finds that the international discourse Mobility Culture lacks conceptual clarity. This surfaces in considerably heterogeneous definitions addressed by the same labels (i.e. "Mobility Culture(s)") and tends to complicate clear and consistent empirical assessments. While we believe that these issues are signs of the concept's ongoing evolution, definitions need to converge and become more precise and consistent across scientific communities.

## 5. Limitations

We identified three main limitations that may have affected our findings.

First, our theoretical preconceptions and familiarity with specific frameworks of Mobility Culture (Deffner et al., 2006; Klinger et al., 2013) may have influenced which cultural attributes we paid special attention to while screening. In addition, our pre-conception of Mobility Culture as a two-fold concept with a material and symbolic dimension arguably influenced the objective-subjective spectrum of our summarising framework in this article. We aimed to tackle this limitation in the screening phase by ensuring that those attributes were linked clearly to the respective author's description of Mobility Culture.

Second, the simple structure of the search string might have excluded materials indexed under similar yet different terms (e.g. "cycling culture"). We accepted this

limitation as we were interested in the specific scientific concept of Mobility Culture instead of all cultural phenomena related to mobility.

Third, we observe a considerable German bias in the author affiliations, which might limit the relevance for an international audience at this point. However, the increasing number of international scholars in this field seem to suggest that Mobility Culture is (increasingly) found on the agenda of international transport researchers (Ryghaug et al., 2023).

## 6. Future perspectives

Looking beyond the literature included for review, we find further promising methods in other study fields. Data mining approaches can be utilised to quantify Mobility Culture attributes when conventional data sources are difficult to attain. For example, text mining of Wikipedia entries can allow for identifying a city's transport orientations (Rath & Chow, 2022). In addition, researchers aiming to classify Mobility Cultures might draw inspiration from studies that utilise large amounts of data to identify spatial units with similar attributes (e.g. Lee et al., 2022; McIntosh et al., 2014; Moody et al., 2019; Oke et al., 2019).

Based on author affiliations and the study regions, we observed Eurocentric tendencies in the reviewed materials, stressing the need for more research in other parts of the world evaluating their potentially contrasting Mobility Cultures (Götz et al., 2016). This matters both for issues of representation and for the adequacy of local transport planning (Hasi-buan & Permana, 2022). That said, across the Global North and South, a closer look at how different national cultures (Ashmore et al., 2019) may influence local Mobility Cultures seems promising for a better theoretical understanding of the concept.

Beyond the evolving concept of Mobility Cultures, it is important to increase decision-makers' awareness of cultural factors in the transport sector. This awareness may help them to reflect on their own (sub)culturally-rooted preferences (e.g. "Elite Projection"; Walker, 2017) and to become more sensitive to marginalised user groups (Delbosc, 2023; Grengs, 2005). Meanwhile, some politicians framed cultural sensitivity as "obstructive to rational and "value-neutral" decision-making" (Mögele & Rau, 2020, p. 15), which ironically might strengthen already dominant Mobility Cultures (Mattioli et al., 2020) and overlook issues of social equity (Grengs, 2005).

## Note

1. For *DTU Findit*, the search term was adjusted to "Mobility Culture\*" as otherwise no results were returned.

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## Appendix

Author (year)	Definition group <sup>a</sup>	Methodology <sup>b</sup>	Data Collection	N	Empirical Unit	Spatial Level	Research aim	Emp. focus on MC	MC role <sup>c</sup>	Emp. Approach <sup>d</sup>
Al-Mohannadi, Awwaad, Furlan, Grosvald, Al-Matwi, and Rima J. Isaifan (2023)	(1) OBJ-SUB (added later)	mixed	survey, site observations, photographic documentation, maps, aerial images, statistical analysis of census data	n.a.	city district, local public transport users	city district	Assessment and improvement of Transit-Oriented Development conditions in Doha, Qatar	no	unclear	SING
Basaran, Kristoffersen, and Haustein (2021)	(1) OBJ-SUB*	quant	survey	254	residents, international moving residents	country	Identifying the influence of Mobility Culture on cycling behaviour and safety perceptions	yes	explain	COMP
Greene et al. (2022)	(1) OBJ-SUB*	qual	semi-structured interviews, secondary data (reports, mobility survey + statistics)	63	urban residents	city	Identify how pre-pandemic mobility cultures have influenced post-pandemic mobility in three case study cities	yes	explorat	COMP
Hasibuan and Permana (2022)	(1) OBJ-SUB*	mixed	Survey + Document Analysis	400	residents	greater capital region	Examine how socio-cultural characteristics of people living in local TOD areas influence the local mobility culture	yes	unclear	SING
Haustein and Nielsen (2016)	(1) OBJ-SUB*	quant	survey	27868	residents	country	Identify different mobility cultures in Europe based on survey data	yes	explain	COMP
Haustein et al. (2020)	(1) OBJ-SUB*	quant	survey	2301	city, residents	city	Do people in culturally similar cities perceive cycling differently, and does this influence cycling behaviour?	yes	explain	COMP
Heinonen et al. (2021)	(1) OBJ-SUB*	mixed	semi-structured interviews, survey	15, 686	residents	city	What are the reasons for vehicle ownership in car-oriented cities?	yes	explain	SING
Hudde (2023a)	(1) OBJ-SUB (added later)*	quant	survey	51411	urban residents (medium and large cities)	city/country	Examine differences in seasonal and climatic influences on cycling between the Netherlands and Germany	yes	explain	COMP
Hudde (2023b)	(1) OBJ-SUB (added later)*	quant	survey	93,643	urban residents (medium and large cities)	city/country	Does level of education influence cycling rates equally in Germany and Netherlands?	yes	explain	COMP
Institut für Mobilitätsforschung (2013)	(1) OBJ-SUB*	quant	Data Mining	n.a.	city	city	What patterns do emerge across megacities' transport systems	yes	explain	COMP
Juschten and Hössinger (2020)	(1) OBJ-SUB	quant	Survey	877	tourists	rural area	Which factors influence destination and travel mode decisions of urban-resident tourists?	no	unclear	SING

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Author (year)	Definition group <sup>a</sup>	Methodology <sup>b</sup>	Data Collection	N	Empirical Unit	Spatial Level	Research aim	Emp. focus on MC	MC role <sup>c</sup>	Emp. Approach <sup>d</sup>
Juschten et al. (2020)	(1) OBJ-SUB*	mixed	Q sorting, survey, semi-structured interviews	25	domestic tourists	city	How does a car-oriented Mobility Culture influence domestic tourist's travel choices?	yes	explain	SING
Kallenbach (2020)	(1) OBJ-SUB*	qual	Newspaper articles, Participant observation	n.a.	newspapers, public events	country	What does the public discourse reveal about current perceptions and alternative imaginations of the mobility sector in Germany?	yes	explorat	SING
Klinger (2017)	(1) OBJ-SUB*	quant	survey	1450	moving residents	city	To what extent do mode combinations change after moving to another city?	yes	explain	COMP
Klinger and Lanzendorf (2016)	(1) OBJ-SUB*	quant	survey	1450	moving residents	city	Could travel changes be explained by the Mobility Culture of the new residential location after moving?	yes	explain	COMP
Klinger et al. (2013)	(1) OBJ-SUB*	quant	data mining	n.a.	city, residents	city	Identifying different types of mobility cultures in Germany based on demand and supply-side indicators	yes	explain	COMP
Klinger, Kenworthy, Lanzendorf, and Association for European Transport (AET) (2010)	(1) OBJ-SUB*	quant	data mining	n.a.	City, residents	city	Quantifying mobility cultures based on a set of indicators	yes	explain	COMP
Leung and Le (2019)	(1) OBJ-SUB*	quant	survey (2x)	964 (525)	adolescents/residents	city	How do social and physical factors influence adolescent active travel?	yes	explain	SING
Mateo-Babiano et al. (2020)	(1) OBJ-SUB	quant	survey	326	users and non-users of bikesharing	local university (or "community")	What determinants of taking part in a university-based bike sharing program?	yes	outcome	INTV
Monteiro et al. (2021)	(1) OBJ-SUB*	qual	Semi-structured Interviews	10	exchange students + researchers	city, country	How do temporary residents adapt their intra-urban travel behavior in response to an international relocation?	yes	explain	COMP
Mögele and Rau (2020)	(1) OBJ-SUB*	qual	Qualitative data on automobile initiatives (platform and event)	n.a.	various qualitative data on initiatives / i.e. interviews?	state	How are mobility-cultural meanings and practices influenced by political negotiations about car manufacturing in Southern Germany?	yes	outcome	SING
Nello-Deakin and Nikolaeva (2021)	(1) OBJ-SUB*	qual	semi-structured interviews	28	expats	city	What encourages international newcomers to Amsterdam to start cycling?	yes	explain	COMP

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Author (year)	Definition group <sup>a</sup>	Methodology <sup>b</sup>	Data Collection	N	Empirical Unit	Spatial Level	Research aim	Emp. focus on MC	MC role <sup>c</sup>	Emp. Approach <sup>d</sup>
Nilsson (2019)	(1) OBJ-SUB*	qual	document analysis, field observations, informal expert interviews	n.a.	tourists, residents	capital region	How have past mobility characteristics and innovations impacted Copenhagen's urban bicycle tourism?	yes	explain	SING
Nitschke (2022)	(1) OBJ-SUB*	qual	semi-structured Interviews, ethnography	41	carsharing individuals (private and industrial)	social group	Explorative investigation of the practice of community carsharing	unclear	unclear	SING
Ryghaug and Skjølsvold (2019)	(1) OBJ-SUB*	qual	Interviews, secondary data, policy documents, scientific literature	n.a.	EV users, Key Figures, society	country	Checking whether the emergence of Norway's successful EV market is merely due to policy success	yes	explain	SING
Stephenson, Hopkins, and Doering (2015)	(1) OBJ-SUB*	qual	In-depth expert Interviews	36	international transport experts	global(?)	What are the lock-in factors of prevailing transport cultures and what drives new emerging transport cultures?	yes	explorat	SING
Tzvetkova (2018)	(1) OBJ-SUB	quant	secondary data analysis	n.a.	residents	city	How could cycling transport be improved in the city of Sofia?	unclear	unclear	SING
Urbanek (2018)	(1) OBJ-SUB	quant	secondary data analysis	n.a.	Polish citizens, EU citizens	Country (Poland)	Do Polish household expenditures suggest the existence of a car culture in this country (as compared to other European countries)?	yes	explorat	COMP
von Behren, Bönisch, Niklas, and Chlond (2020)	(1) OBJ-SUB*	quant	survey	836	residents	city	How do the affective and instrumental motives influence car use in cities with well-developed public transit?	yes	explain	COMP
von Behren, Schubert, and Chlond (2020)	(1) OBJ-SUB*	quant	survey	1800	residents	city	To what extent might psychological factors might influence mode choice differently in cities with identical mobility cultures (i.e. "hybrid cities")?	yes	explain	COMP
Wickland (2022)	(1) OBJ-SUB*	qual	archival research, literature review, informal interviews, observations, photography, mobile methods, and historical analysis, comparative analysis	n.a.	stilt-walkers	region	Understand the political, colonial, and developmental underpinnings of a local mobility culture through studying its past	yes	explorat	SING
Bamberg et al. (2020)	(2) SUB*	quant	survey (3x)	173, 610, 725	students, households, residents	city	Conceptualising, operationalising, and validating a Mobility Culture measure	yes	outcome	INTV
Bergman (2019)	(2) SUB	mixed	narrative interviews	32	residents	US states (without developed passenger rail infrastructure)	How does individual (car-oriented) agency relate to agencies of sustainable alternatives in the US American mobility culture?	yes	explorat	SING

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Author (year)	Definition group <sup>a</sup>	Methodology <sup>b</sup>	Data Collection	N	Empirical Unit	Spatial Level	Research aim	Emp. focus on MC	MC role <sup>c</sup>	Emp. Approach <sup>d</sup>
Geis (2019)	(2) SUB	mixed	focus groups, survey	27, 41	migrants, transport planners, public organisations	region	Analyse the challenges and opportunities related to immigrant short distance mobility in Germany	no	unclear	SING
Isetti, Ferraretto, Stawinoga, Gruber, and DellaValle (2020)	(2) SUB	quant	survey	591	residents	rural region	How are propensity towards sustainability, mobility patterns and lifestyles related in rural areas?	unclear	explorat	SING
Jungnickel and Aldred (2014)	(2) SUB	qual	interviews, ethnography	132	cyclists, stakeholders (cycling organizations, policy-makers, etc.)	city/social group	How do cyclists mediate their sensory exposure to urban environments?	yes	explorat	SING
Kandt et al. (2015)	(2) SUB	quant	computer aided Telephone Interviews (CATI)	2171	residents	city	Understand travel attitudes and behaviours in different mobility cultures	yes	explain	COMP
Krysiński and Szczepański (2020)	(2) SUB	quant	survey	2001	residents	city	How do functional and cultural aspects interact to influence current mode choice?	yes	explain	SING
Mladenović and Stead (2020)	(2) SUB	qual	workshops, focus group	>80, 5	transport/spatial planners and practitioners	region	Explore plausible future changes in space allocation from a qualitative perspective while taking account of the wider social and technological transitions in mobility	unclear	unclear	SING
Pojani et al. (2017)	(2) SUB	qual	semi-structured Interviews	46	residents	city	What similarities and differences exist cycling beliefs in different cycling-oriented cities?	yes	explorat	COMP
Rollin et al. (2021)	(2) SUB*	mixed	Survey (2x), qualitative interview with mayor, secondary data on program participation	610 (first survey), 515 (second survey),	residents, employees (living lab)	city	Evaluating the impact of participatory transformative research on mobility culture	yes	outcome	INTV
Sattlegger and Rau (2016)	(2) SUB	qual	open-ended narrative-biographical interviews	15	car-less residents	region/social group(?)	(How) do mobility, biography, social and cultural meaning interact to influence a deliberate, carless lifestyle in a car-dominated mobility culture?	yes	explorat	SING
Taylor (2021)	(2) SUB*	qual	interviews, desktop review	21	transport planners	city	How do higher-level legal norms and rights shape and constrain parking management across heterogenous German cities?	yes	explain	COMP

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Author (year)	Definition group <sup>a</sup>	Methodology <sup>b</sup>	Data Collection	N	Empirical Unit	Spatial Level	Research aim	Emp. focus on MC	MC role <sup>c</sup>	Emp. Approach <sup>d</sup>
Biehl et al. (2019)	(3) GROUP	mixed	semi-structured focus group sessions (5x)	24	local communities	neighbourhood	Identify how different neighbourhood mobility cultures relate to active mobility choices	yes	explorat	SING
Bosen, Fuchte, and Leicht-Scholten (2023)	(3) GROUP (added later)	qual	qualitative interviews	10	utility cyclists	city	Understand the risk perceptions and mitigation strategies embedded in a local utility cycling mobility culture	yes	explorat	SING
Burrell (2011)	(3) GROUP	qual	in-depth interviews (10x), shorter interviews (25x)	35	polish migrants	social group	Reveal migrants' narratives about the low-fare flying mobility culture focusing especially on the role of the collective.	yes	explorat	SING
O'Regan (2012)	(3) GROUP*	qual	semi-structured interviews	10	hitch-hikers	social group	What comprises the phenomenon of hitch-hiking and what Mobility Culture does it represent?	yes	explorat	SING
Dietz et al. (2021)	(4) SUS-NORM	mixed	real-world laboratory experiments (4x) (accompanied by e.g. ethnography, qualitative interviews, workshops, etc.)	n.a.	civil society actors, academic staff, students, local wardens	city	Investigate the effectivity of an participatory transformative urban intervention in changing a local mobility culture	yes	outcome	INTV
Iamtrakul and Wongbumru (2019)	(4) SUS-NORM	quant	Field observations and site visits, survey	1200 (survey)	residents	city	Evaluation of usage and perception of canal transport	unclear	unclear	SING
Mendieta Ávila and Pons (2021)	(4) SUS-NORM	quant	secondary data (transport ministry)	n.a.	urban development projects	country	Evaluate the success of policies targeting sustainable transport modes in Chile throughout last decades	unclear	unclear	COMP
Okraszewska et al. (2014)	(4) SUS-NORM	quant	Case study (intervention), survey	747	students, academic staff	country	Examine the role of universities in influencing travel behaviour in Poland	unclear	outcome	INTV
Blinkin and Muleev (2016)	(5) n.d.	mixed	survey, travel diaries	8028 (survey), 1041 (travel diaries)	residents	country	The characteristics of Russian mobility patterns in comparison to other countries	no	unclear	SING
Busch-Geertsema and Lanzendorf (2017)	(5) n.d.	quant	panel survey (3 waves)	4295, 2912	university graduates	city	Reasons and mechanisms of travel behaviour changes in young adults starting full-time employment	yes	explan	COMP
Cantelmo et al. (2022)	(5) n.d. (added later)	mixed	focus groups, in-depth interviews, survey	30, 18, 1277	existing and potential carsharing users, service providers, and local authorities	city	Assess needs and goals of different stakeholders of the carsharing market and the efficacy of certain incentives	no	unclear	COMP
Carson and Carson (2014)	(5) n.d.	quant	secondary data (census data and public documents)	n.a.	city, city residents	city/town	Investigate path dependencies and how they affect alternative development scenarios for struggling, remote rural towns	no	unclear	SING

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Ferri and Popp (2023)	(5) n.d. (added later)	qual	shadowing, interviews ("Destination Task Investigation" method)	12	transit users	city	Understand how transit users use analogue and digital technologies for wayfinding	no	unclear	SING
Findlay, Stockdale, Findlay, and Short (2001)	(5) n.d.	quant	survey (2x)	≈700, ≈600	rural residents	rural area	What constitutes travel patterns in rural populations in the UK?	yes	explorat	SING
Fu (2020)	(5) n.d.	quant	survey (5x), activity-travel diary	3248, 7624, 6861, 1382, 284	out-of-home workers	city	Assess the influence of socio-demographic characteristics on time-use patterns among workers in 5 Chinese cities	yes	explain	COMP
Kesselring et al. (2023)	(5) n.d. (added later)	mixed	structured narrative interviews, secondary data	45 (15 per city)	local residents	city	Presentation of urban living labs as a method to involve citizens in sustainable transformative processes	yes	outcome	INTV
Kos-Labędowicz and Urbanek (2017)	(5) n.d.	mixed	Survey	452	university students	city	Investigating the potential of carsharing and – pooling systems in a car culture	unclear	explorat	SING
Kwiatkowski (2021)	(5) n.d.	qual	in-depth interviews, ethnography, photographic documentation	19	commune representatives (aiming to introduce bikesharing systems)	commune	What are the goals pursued by different municipalities to initiate bike sharing systems?	unclear	unclear	COMP
Magelund (2019)	(5) n.d.	qual	ethnography, narrative interviews, workshops	n.a.	co-housing communities	city	How do co-housing inhabitants and entire communities organize their everyday mobility and which role does sustainability play?	yes	outcome	COMP
Mateo-Babiano (2016)	(5) n.d.	quant	Survey (3x)	405, 397, 408	residents	city	What are users viewpoints of indigenous transport?	yes	explorat	COMP
Mitsakis, Aifadopoulou, Grau, Chrysohoou, and Morfoulaki (2014)	(5) n.d.	quant	survey	5007	residents	capital region	Presentation of a transportation planning methodology applied in Cyprus	no	unclear	SING
Sopjani, Stier, Ritzén, Hesselgren, and Georén (2019)	(5) n.d.	mixed	interviews, questionnaire, sensor tracking	51 (interviews), n.a. (questionnaire)	employees (of workplaces introducing light electric vehicle sharing)	not specified	Which types of different users can be identified in participatory EV sharing interventions and does their involvement lead to contrasting outcomes regarding sustainability?	unclear	unclear	INTV
Stephenson, Spector, Hopkins, and McCarthy (2018)	(5) n.d.	qual	Delphi-technique (expert panel interactions)	86	transport experts	country	The identification of sustainable transport interventions that are tailored to the New Zealand context	unclear	unclear	INTV

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Author (year)	Definition group <sup>a</sup>	Methodology <sup>b</sup>	Data Collection	N	Empirical Unit	Spatial Level	Research aim	Emp. focus on MC	MC role <sup>c</sup>	Emp. Approach <sup>d</sup>
Tao et al. (2019)	(5) n.d.	quant	Survey (2x)	733, 449	residents	city	Does car ownership influence public transport attitudes differently in different contexts?	yes	explain	COMP
Guo et al. (2022)	(1) OBJ-SUB	not emp.								
Kesseling and Wulffhorst (2016)	(1) OBJ-SUB*	not emp.								
Klinger (2016)	(1) OBJ-SUB*	not emp.								
Privitera (2020)	(1) OBJ-SUB	not emp.								
Song (2013)	(1) OBJ-SUB*	not emp.								
Sonnberger and Graf (2021)	(1) OBJ-SUB*	not emp.								
Stephenson et al. (2015)	(1) OBJ-SUB	not emp.								
Weber (2011)	(1) OBJ-SUB	not emp.								
Bakogiannis, Siti, Kyriakidis, and Vassi (2017)	(2) SUB	not emp.								
Divall (2012)	(2) SUB*	not emp.								
Girginkaya Akdağ (2021)	(2) SUB*	not emp.								
Hoor (2023)	(2) SUB (added later)	not emp.								
Jensen (2008)	(2) SUB*	not emp.								
Mausbach et al. (2019)	(2) SUB	not emp.								
Mietzsch (2023)	(2) SUB (added later)*	not emp.								
Papageorgiou and Demetriou (2019a)	(2) SUB	not emp.								
Papageorgiou and Demetriou (2019b)	(2) SUB	not emp.								
Hopkins and Stephenson (2014)	(3) GROUP	not emp.								
Chamier-Gliszczyński and TANGER Ltd (2016)	(4) SUS-NORM	not emp.								
Commission of the European Communities (2007)	(4) SUS-NORM	not emp.								
Janecki and Krawiec (2011)	(4) SUS-NORM*	not emp.								
Davis (1994)	(5) n.d.	not emp.								
Gopakumar (2022)	(5) n.d.	not emp.								
Karoń and Mikulski (2012)	(5) n.d.	not emp.								
Kim and Jung (2019)	(5) n.d.	not emp.								

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Author (year)	Definition group <sup>a</sup>	Methodology <sup>b</sup>	Data Collection	N	Empirical Unit	Spatial Level	Research aim	Emp. focus on MC	MC role <sup>c</sup>	Emp. Approach <sup>d</sup>
La Rocca (2015)	(5) n.d.	not emp.								
Lessan, Fu, and Bachmann (2020)	(5) n.d.	not emp.								
Mom (2014)	(5) n.d.	not emp.								
Reimer (2016)	(5) n.d.	not emp.								
Schwedes and Keichel (2021)	(5) n.d.	not emp.								
Starowicz, Zakowska, and City Net Scientific Research Center Ltd. (2014)	(5) n.d.	not emp.								

Notes: \*explicit definition of Mobility Culture in this paper.

<sup>a</sup>OBJ-SUB = objective & subjective; SUB = subjective-only; GROUP = social group; SUS-NORM = sustainable-normative; n.d. = no definition; numbers in brackets refer to the definition group number.<sup>b</sup>quant = quantitative; qual = qualitative; mix = mixed methods; not emp. = paper not empirical.<sup>c</sup>explain = explanatory variable; outcome = outcome/dependent variable; explorat = exploratory role; unclear = empirical role unclear.<sup>d</sup>COMP = comparative study approach; INTV = intervention study approach; SING = singular culture study approach.