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Review

Drivers of Driving: A Review

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Abstract: As car ownership and usage expand globally, understanding the factors that influence the propensity to drive is crucial for promoting sustainable transportation. This literature review examined the factors influencing driving decisions through a systematic search of databases, rigorous screening of over 1000 articles, and analysis of 142 studies. The findings reveal that attributes of the built environment (e.g., density, diversity, accessibility), economic factors (e.g., income, costs of car ownership, policies), and psychological aspects (e.g., attitudes, social norms, perceptions) have significant impacts on driving behaviors. By employing an integrative methodology involving targeted searches, keyword analysis, and detailed evaluation, this review offers insights into the multifactorial nature of driving decisions. The synthesis of studies across multiple domains emphasized the need for a holistic approach to understanding and addressing the factors influencing the propensity to drive, laying a foundation for informed transportation policy and practice.

Keywords: driving propensity; car dependency; transportation; travel behavior; urban mobility; sustainable transportation

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1. Introduction

1.1. Global Trends in Car Ownership and Usage

The global number of registered cars has experienced a significant increase over recent decades, progressing from 246 million in 1970 to 1.446 billion in 2022 [1,2]. In 2020, approximately 78 million new vehicles were produced, adding to the existing global car fleet; this number rose to about 80 million in 2021 [3]. The surge in car ownership is not limited to developed countries alone. Consistent economic growth in developing countries and the Global South has led to a notable increase in car ownership and usage [1,4–6]. A study by Li et al. [7] showed that private car ownership in China grew significantly from 2000 to 2018, increasing from 6.25 million to 207 million, with an annual growth rate of 21.4%. Furthermore, the study projected that by 2030, private car ownership in China is expected to reach 475 million, marking a 76-fold increase from the levels in 2000. Dargay et al. [8] also predicted that by 2030, non-OECD nations will own 56% of the world's cars, up from 24% in 2002.

The rise in car ownership is significant, as it enables various applications, such as long-distance travel, the transportation of large items, and new leisure activities dependent on personal vehicles [9–11]. Consequently, the increase in car ownership is likely accompanied by a rise in car usage [12,13]. Empirical studies on car usage patterns support this, revealing that in German, Swiss, and Austrian cities, around half of all trips are made by private cars, and in American cities, this figure is 86% [14]. In the United Kingdom, private cars account for two-thirds of all weekly trips, covering three-quarters of the distance traveled by an average citizen [15].

1.2. Negative Impacts of Excessive Car Use

The trend toward increased car usage partly stems from the user's perception of cars as the most convenient and preferred transportation mode, which is associated with enhanced mobility, quality of life, and flexibility [16]. However, this excessive reliance on cars can lead to numerous societal externalities, as extensively discussed in the literature [17]. The primary externalities linked to car usage include climate change and air pollution, traffic congestion, noise pollution, road safety concerns, and health risks (it is noteworthy that other less-studied externalities, like emergency services, natural resource depletion, water pollution, and urbanization effects, also play a significant role in the overall costs of road transport externalities and are estimated to be around 10% [18]).

Climate change and air pollution: Wee [19] identified three main environmental problems stemming from the transport sector: (1) climate change caused by CO_2 emissions; (2) acidification of the environment, including agricultural land; and (3) large-scale local air pollution as a result of emissions from the transport sector and chemical reactions in the atmosphere. Private cars, which are a significant source of greenhouse gas emissions, emit pollutants, such as carbon monoxide (CO), nitrogen oxide (NO_x), and hydrocarbons (HCs) [20]. These emissions are central to the discussion on sustainable transportation, as Bickel et al. [21] estimated the annual environmental costs of road transportation in Europe to exceed EUR 86 billion, which encompasses climate change and air pollution.

Traffic congestion: Cravioto et al. [22] defined congestion as a waste of time resulting from the excessive use of limited road infrastructure. Urban road congestion in the USA causes substantial travel delays, where Schrank et al. [23] recorded 6.9 billion hours of delay in 2014, leading to an economic loss of USD 160 billion. This is exacerbated by the growth of private vehicles disproportionate to the available space and infrastructure, which is a common issue in metropolitan areas [18].

Noise pollution: The relationship between noise and health is well-established, where Suter [24] found that noise can lead to stress-related illnesses, high blood pressure, speech interference, hearing loss, sleep disruption, and reduced productivity. Road traffic is a major source of noise, accounting for 90% of the health impact caused by noise [25]. Evans et al. [26] estimated the average cost of urban traffic noise per 1000 passenger-kilometers for cars, buses, and trains, indicating the significant role of transportation in noise pollution, which, in turn, affects public health and quality of life.

Road safety: Road traffic accidents are a major global concern, with approximately 1.3 million fatalities annually and 20 to 50 million non-fatal injuries, with many resulting in disability [27]. The economic impact of these accidents varies by country income level, with a notable effect on national economies. Traffic-related trauma, as Paniker et al. [28] highlighted, is a leading cause of death and disability globally, emphasizing the importance of addressing safety in transportation policies and driving behavior analysis.

Health risk: Sugiyama et al. [29] conducted a systematic review on the relationship between car use and health risk; they found that prolonged periods in cars are associated with increased cardiovascular disease risk. Moreover, driving in congested areas or other stressful conditions can affect mental health issues, such as anxiety and depression.

1.3. Research Aims and Scope

The existing research on car dependence initially emerged from concerns about the depletion of fossil fuel resources and subsequent energy crises. The motivation behind this study, however, was rooted in the broader externalities of car dependence. While the current literature provides insights into the consequences of car usage, it often overlooks a comprehensive analysis of the underlying factors that encourage driving. This gap is significant, given that understanding these drivers is essential for mitigating the negative impacts of car usage and for promoting sustainable transportation options. Our study aimed to fill this gap by providing a detailed examination of the reasons behind individuals' driving behaviors. We investigated factors that influence not only the decision to drive rather than use alternative modes of transportation but also those that impact the overall

driving distance. Although the choice of mode and the distance driven are separate elements of driving behavior, they are interrelated and both contribute to the societal impacts and challenges mentioned previously. This study sought to enhance urban mobility and accessibility by offering a clearer insight into the complex motivations for driving.

We acknowledge certain inherent limitations. The scope, while broad, may not encompass every relevant study, partly due to the constraints in the search terms and databases used. Furthermore, the majority of the studies reviewed focused on urban settings in developed countries, which might limit the applicability of our findings in different socioeconomic and infrastructural contexts, such as rural areas or developing nations. The rapid evolution of transportation technologies, like electric vehicles and intelligent mobility solutions, may also date some of the referenced literature, necessitating continuous updates to this review. Additionally, our emphasis on quantitative research might overlook qualitative insights that could offer a deeper understanding of personal motivations and context-specific factors influencing driving behavior. These limitations notwithstanding, our review aimed to provide a comprehensive and current perspective on the factors influencing driving decisions.

The subsequent sections of the paper are structured as follows: Section 2 outlines the review methodology. Section 3 presents an analysis of the various factors influencing driving behavior. Finally, Section 4 provides a summary and conclusion of the paper.

2. Review Methodology

This section details the comprehensive and methodical approach employed for conducting the review, i.e., following the PRISMA guidelines [30] to ensure a transparent, systematic, and replicable process.

2.1. Identification of Relevant Sources

At the initiation of our research process, we embarked on an extensive search to identify the most suitable sources, aiming to ensure access to a broad range of high-quality scholarly materials relevant to our study. This critical phase involved a careful evaluation of various databases, each of which are recognized for their rich collection of scholarly literature in the domains of transportation studies and decision-making related to driving behaviors.

The databases searched included Google Scholar, which was selected for its extensive coverage across multiple academic disciplines; PubMed, which was chosen for its specific focus on health-related aspects; Scopus and Web of Science, which were utilized for their thorough indexing of peer-reviewed articles in transportation and environmental research; and JSTOR, IEEE Xplore, and the Transportation Research Board (TRB) database, which were included to capture historical perspectives, technological advancements, and policy-related studies on transportation.

To add depth to our research, we also searched a range of academic journals focused on transportation, including *Transport Reviews*; *Transportation Research Parts A*, *B*, *C*, and *D*; *Transportation*; *Transportation Science*; *Journal of Transport and Land Use*; *Journal of Urban Planning and Development*; *Cities*; *Journal of Transport Geography*; *Transport Policy*; and *Accident Analysis and Prevention*. These journals were selected for their contributions to urban planning, geographical aspects of transportation, policy discourse, and safety research.

Furthermore, we delved into specialized databases and digital repositories, like the National Transportation Library and the EU Transport Research and Innovation Portal (TRIP) to gain access to technical reports, government publications, and policy documents, incorporating practical insights and regional studies into our comprehensive review.

2.2. Development of Search Strategies

To comprehensively capture the breadth and depth of research on driving propensity and car dependency, our literature search strategy employed a multidimensional approach. We meticulously curated a set of keywords and subject headings, as detailed in Table 1,

to reflect the intricate nuances of car ownership and usage. Boolean operators (AND, OR, NOT) were instrumental in effectively combining search terms to create a cohesive and robust search string.

Table 1. Keywords and subject headings for literature search on car ownership and usage patterns.

Category	Keywords and Subject Headings
General terms	Car ownership, vehicle ownership, automobile dependence, driving propensity, car usage, vehicle-use patterns, motor vehicle trends, auto mobility
Economic factors	Cost of car ownership, vehicle maintenance costs, fuel prices, car affordability, transportation economics, ownership cost analysis, vehicle insurance costs, vehicle financing, economic impact of car ownership
Environmental factors	Environmental impact of cars, CO_2 emissions from vehicles, urban pollution and cars, sustainable transportation, eco-friendly vehicles, vehicle emissions, climate change and automobiles, green vehicles, electric car environmental impact
Demographic factors	Age and car usage, gender differences in driving, socioeconomic status and vehicle ownership, family structure and car needs, demographic trends in car ownership, youth and vehicles, elderly driving patterns, income level and car use
Built environment factors	Urban design and car use, walkability and driving patterns, neighborhood design and vehicle usage, transit-oriented development, land-use mix, street connectivity, built environment and sustainable mobility, urban density and car use, accessibility and car dependence
Psychological aspects	Psychological drivers of car use, car as a status symbol, emotional attachment to cars, convenience and independence, perception of car ownership, motivation for car use, car and identity, psychological effects of driving, vehicle choice psychology
Social and behavioral	Attitudes toward car ownership, behavioral economics of driving, sociocultural influences on car usage, transportation behavior, travel behavior, social norms in driving, lifestyle and car usage, personal transportation choices, mobility behavior
Urban planning	Urban sprawl and car use, public transport accessibility, city planning and vehicle use, traffic congestion, parking availability, urban transport planning, land use and transportation, public transit development, urbanization and car use
Policy and legislation	Transportation policy, emission regulations, car taxation, urban mobility policies, public transportation funding, transport regulations, environmental policy for vehicles, infrastructure policy, urban transport governance
Technological advances	Electric vehicles, hybrid cars, autonomous vehicles, car sharing, ride-hailing services, vehicle technology innovation, smart cars, connectivity and automobiles, future of automotive technology
Health and safety	Road safety, health risks of car usage, traffic accidents, active transportation, pedestrian-friendly planning, driver safety, vehicle-related injuries, health impacts of driving, traffic safety measures

In addition to database searches, we adopted the technique of reference list checking, examining the reference lists of key papers to uncover additional relevant studies that may have been overlooked in the initial search. Our strategy also extended to include grey literature, such as conference proceedings and technical reports, to ensure a holistic view of the topic.

2.3. Inclusion and Exclusion Criteria

To determine the eligibility of studies for inclusion in our review, we established the following inclusion criteria:

- Peer-reviewed journal articles, conference papers, technical reports, or government publications.
- Published in the English language.
- Focused on factors influencing car ownership, car usage, or driving propensity.

- Contained empirical data or rigorous conceptual analysis.

Studies were excluded if they did not focus on factors influencing driving behaviors, were not in English, did not contain original research (e.g., commentaries, editorials), or had severe methodological limitations.

2.4. Screening and Study Selection

The process of selecting studies, as depicted in the PRISMA flow diagram (Figure 1), commenced with initial searches in databases, which produced 1243 records. These records were screened by title and abstract, leading to the elimination of 640 records that failed to meet the inclusion criteria. The full texts of the remaining 603 articles were evaluated for eligibility, which resulted in the exclusion of 352 articles for various reasons, such as a lack of focus on factors affecting driving behaviors (n = 209), absence of original research (n = 98), or significant methodological flaws (n = 45).

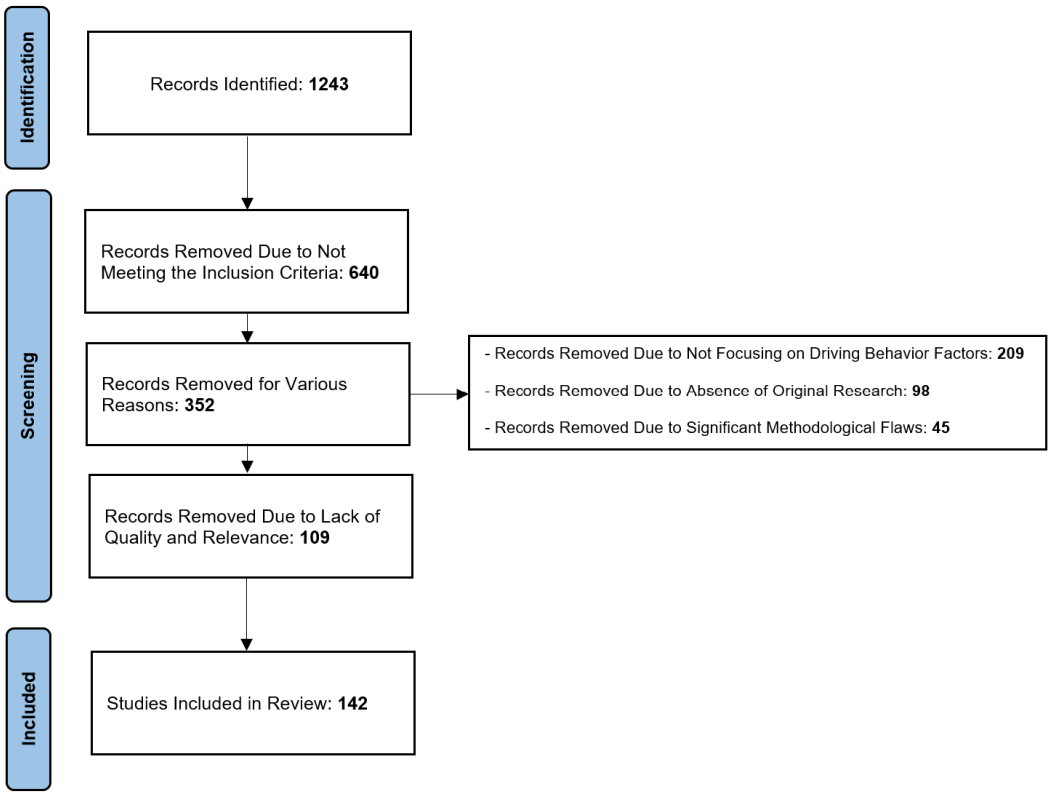

Figure 1. PRISMA flow diagram of the study selection process.

Given the potential for redundancy in the literature, we prioritized including the most relevant and recent studies when multiple articles offered overlapping content. This approach allowed us to strike a balance between being thorough and succinct. The remaining 251 articles were then thoroughly evaluated based on their study design, sample size, methodological rigor, and the strength of the statistical analysis to ensure the highest quality and relevance for our review. Ultimately, 109 articles were excluded due to insufficient quality and relevance, while 142 articles were selected for the final qualitative synthesis. These articles collectively provided a comprehensive understanding of the drivers of driving behavior, representing a wide array of perspectives and methodologies.

This curated collection of literature formed the backbone of our review, offering valuable insights into the various factors influencing driving decisions. By adhering to the PRISMA guidelines and employing a rigorous, transparent methodology, we ensured that our review was systematic, comprehensive, and replicable.

3. Analysis of Driving Determinants

This section offers a detailed review of the various factors that influence driving decisions and their implications for transportation policy and practice. Through our extensive search, we identified three primary categories of driving determinants: built environment attributes, economic factors, and psychological factors. Each of these categories was examined in depth to assess how they impact an individual's choice to drive (Appendix A provides a summary table of the reviewed articles, including key details, such as author(s), publication year, study location, temporality, objectives, methods, and main findings for quick reference).

3.1. Built Environment Attributes

The built environment, encompassing the physical characteristics and features of a place, such as the layout, design, and infrastructure of a city or region, has been extensively researched [31–34]. Factors such as the availability of public transportation, the density of housing and businesses, and the connectivity of streets and sidewalks are critical built environment attributes that significantly influence travel choices. These attributes of the built environment, commonly known as the "six Ds" [35–38], are density, diversity, design, destination accessibility, distance to transit, and demand management.

Density: This term refers to the concentration of individuals and buildings within a specific area. It not only directly influences driving propensity but also acts as an indicator of other land-use factors related to density, such as parking availability [39]. The effect of density on driving propensity and car dependency was thoroughly analyzed in previous studies using various density measures, including residential density [40–42] and job density [40,43]. These studies consistently show that higher densities are associated with lower driving propensity rates. The logic behind this is straightforward: as the mix of employment and residential areas increases in a location, so does its accessibility, leading to a reduced reliance on individual cars [40]. This relationship between density and driving propensity is supported by various empirical studies. For example, the 2001 Household Travel Survey for California [44] found that areas with densities below 1000 housing units per square mile experienced a 4.8% increase in vehicle kilometers traveled. A meta-analysis of 23 planning studies from 18 metropolitan areas in the USA [45] estimated that increasing the density could reduce vehicle kilometers traveled by 17% by 2050 compared with a "business as usual" scenario. Leck [46] also identified residential density as the most significant factor in mode choice within the built environment, followed by mixed land use and the street configuration. Ding and Cao [39] found that residential and employment densities were the most influential factors in the relationship between the built environment and car usage after evaluating several studies on this topic. Furthermore, research in Flanders, Belgium [47], demonstrated that higher densities promoted the use of alternative modes of transportation, such as walking, cycling, and public transit.

Diversity: This term describes the variety of different land-use forms. Extensive literature discusses the link between land-use diversity and driving propensity, with numerous studies showing a positive relationship between increased land-use diversity and reduced driving propensity [48,49]. This effect is attributed to the fact that land-use diversity enhances access to proximal destinations, thereby reducing the need for individual car usage [38]. Empirical evidence from a travel survey in Jinan, China [50], indicated that improvements in the balance between employment and housing were associated with a decrease in car ownership and usage. Beyond the direct relationship between land-use diversity and driving propensity, it is vital to consider mediating factors that may influence this relationship. For example, the availability and quality of public transportation, as well as the accessibility of non-motorized modes of transportation, such as walking and cycling, may affect the relationship between land-use diversity and driving propensity. The presence of these alternative modes of transportation can enable individuals to access nearby destinations without relying on cars, leading to a decrease in driving propensity [51].

Design: This term refers to the characteristics of the street network in a particular area, including factors like intersection design and average block size. Research examining the relationship between street design and driving propensity has produced mixed results. Some studies identified a relationship between pedestrian-friendly design elements, such as walkways and overhead street lighting, and lower driving propensity rates [49,50]. However, other studies have found no significant link between pedestrian-friendly design and driving propensity [52]. These inconsistent findings suggest that the impact of design on driving behavior may depend on contextual factors, such as land-use density and diversity. Additionally, the availability and reliability of alternative transportation modes, as well as individual attitudes and preferences toward transportation, can influence this relationship. Despite mixed evidence, it is widely recognized that design plays a crucial role in shaping transportation behavior. For example, street and intersection designs that prioritize the safety and convenience of active transportation modes, like walking and cycling, can promote their use and potentially decrease car ownership or usage. Similarly, designs that facilitate public transit use can make it a more attractive and convenient option, leading to reduced car ownership or usage [53].

Destination accessibility: This term describes the ease and availability of transportation options that enable individuals to reach desired locations efficiently and conveniently. It is a critical component of community livability and sustainability, potentially affecting mobility, economic opportunities, and social interactions. The likelihood of using alternative transportation modes, such as walking, biking, or public transit, instead of driving increases when destinations are easily accessible, potentially reducing driving propensity [54]. However, the influence of destination accessibility on driving propensity can vary based on the location and cultural context. For instance, studies in the USA [55,56] have shown that households closer to metropolitan centers typically have fewer cars. In contrast, research in Beijing and Chengdu, China [57], indicates the opposite trend, with households further from metropolitan centers having fewer cars. This variation could be attributed to differences in social structures and transportation systems between developed and developing countries, or it may be specific to developing countries based on historical growth trends and the extent to which affluent residents centralize or relocate to urban outskirts. A study in Jinan, China [50], for example, found that proximity to the city's major and secondary centers had no significant effect on car dependency, underscoring the complex nature of destination accessibility and the need for a thorough understanding of its determinants.

Distance to transit: This term pertains to how close a location is to public transportation stations and services. Research has consistently shown that there is an inverse relationship between the proximity to transit infrastructure and car ownership and usage rates. For instance, Li and Zhao [38] discovered that the closeness to public transportation stations significantly affects car ownership and usage. Similarly, Potoglou and Kanaroglou [48] observed that residents living within 500 m of bus stops tended to have lower car ownership rates. Zegras [49] found that households in areas with limited bus access compared with those with better access to cars had more vehicles. Moreover, Chatman [58] indicated that improved bus services in neighborhoods could deter the acquisition and use of personal vehicles. Correspondingly, living near rail transit systems, such as subways or light rails, has been associated with reduced car ownership and usage. Studies by Kim and Kim [59] and Chatman [60] noted a negative impact of rail proximity on car ownership and usage. Gossen [61] revealed that only 19.9% of total trips by residents living within 0.25 miles of a metro station were made by car, in contrast with 45% by those living a mile away from transit stations. However, the relationship between transit proximity and driving propensity can be complex. For instance, Cao and Cao [62] found that in Minneapolis, light rail proximity did not affect car ownership when controlling for other factors, and Cervero and Murakami [63] reported a weak connection between metro station proximity and vehicle miles traveled. Furthermore, Combs and Rodríguez [64] analyzed Bogota's TransMilenio BRT and found no significant impact on car ownership related to access to the TransMilenio route, except in transit and pedestrian-friendly areas. A study in the

Indian cities of Hubli and Dharwad by Doddamani and Manoj [65] highlighted the nuanced nature of this relationship, showing significant effects of the road network density and proximity to key amenities, like hospitals and bus stops, on motorcycle ownership, even after considering travel attitudes.

Demand management: This concept involves strategies designed to control the demand for parking and other transportation services, including the regulation of parking capacity, and the implementation of parking fees and congestion pricing. The availability of parking has a significant impact on car ownership and usage. For example, Weinberger et al. [66] and Weinberger et al. [67] found that homes with ample off-street parking options were more likely to be occupied by households with higher rates of car ownership and usage compared with similar neighborhoods with restricted parking availability. This suggests that parking availability can influence both the decision to own a car and how frequently it is used. Guo [68,69] also noted a strong impact of home parking availability on car ownership, implying that home parking availability is a crucial factor in the decision to own a car, especially in urban areas where on-street parking is limited. The relationship between parking availability and driving propensity has been explored in both developed and developing countries. In a study conducted in Norway, Christiansen et al. [70] found that access to private or reserved home parking significantly increased the likelihood of car ownership. Conversely, Sobhani et al. [71] investigated the influence of residential parking space on car ownership in developing countries and suggested that the relationship might be less pronounced in these settings. This implies that within a city, variations in car ownership are more likely attributable to differences in parking demand and regulations, rather than merely the availability of residential parking.

3.2. Economic Factors

As discussed by Van Eenoo et al. [72], simply altering the built environment may not be enough to significantly reduce car dependency. Various studies [48,73–75] have demonstrated that a range of economic factors critically influence the decision to own and use a car. These factors include an individual's income; education; occupation; and the costs associated with car ownership, such as fuel and maintenance expenses. Additionally, government policies, such as subsidies and tax incentives for alternative modes of transportation, play a significant role. Therefore, it is essential to consider the impact of economic factors on driving behavior. We categorized these factors into three main groups: socioeconomic characteristics, the costs of owning and maintaining a car, and government policies, all of which significantly affect an individual's propensity to drive.

3.2.1. Socioeconomic Characteristics

Extensive research has established the significant influence of socioeconomic characteristics on travel behavior and driving propensity. Numerous studies have consistently shown that factors such as income, household structure, education, and age are closely associated with car ownership and travel habits [76–85]. These sociodemographic characteristics play a crucial role in shaping an individual's travel behavior and reliance on a car.

Household income, in particular, is a key factor affecting driving propensity. Households with higher incomes, regardless of their location, generally own more cars and use them more frequently for transportation compared with those with middle or lower incomes [86–88]. This trend is attributed to the ability of higher-income households to afford multiple vehicles, as well as the associated costs of fuel, insurance, and maintenance. On the other hand, households with lower incomes may find it challenging to bear the expenses related to car ownership, and thus, may rely more on alternative transportation modes, like public transit, biking, or walking. Research from various developing countries, such as India [89], South Africa [90], China [57], Kenya [91], Iran [88], and Nigeria [92], supports the view that higher income is a significant determinant of household car ownership and usage. It is crucial to recognize that household income influences driving propensity

not only through financial capability but also by affecting the availability of alternative transportation options. For example, households in low-income neighborhoods often have limited access to public transit, making car ownership essential for commuting and other transportation needs. Similarly, in rural areas where public transit access is scarce, households are more likely to depend on cars for transportation due to the absence of viable alternatives [93,94].

Additionally, the structure of a household significantly influences driving propensity due to its effect on the mobility needs of the household members. Research indicates that having more children often leads to the need for a car to meet increased mobility demands, such as transporting children to school and other activities [95,96]. This is especially relevant in single-parent households, where a car becomes essential for managing children's schedules. Contrarily, other studies suggest that having more children may reduce the likelihood of car ownership due to the allocation of household resources to other expenses [97]. The number of adults in a household, along with their work and transportation habits, can also influence car use. Households with multiple adults who work from home or have flexible schedules might be less dependent on a car and more inclined to use alternative transportation, such as public transit, biking, or walking. Conversely, households with several children might require multiple vehicles to cater to the transportation needs of the entire family. Households without children, or with adult children who have moved out, are typically less reliant on cars and may prefer other modes of transport [98].

Expanding on the theme of household structure, other factors like the characteristics of the household head and the number of employed individuals within the household also play a role in driving propensity. Studies have shown that male-headed households tend to own and use cars more than female-headed households, possibly reflecting societal gender roles and expectations [99]. Furthermore, households with more working members are likely to own and use more vehicles to meet their commuting and transportation needs, as they generally have higher mobility requirements [43,48,87]. However, this trend may vary according to regional and cultural contexts. For instance, a study in Chennai, India, found that households with female employees and school-aged children were more likely to own cars [100], highlighting the influence of different societal norms. Conversely, households with fewer employed individuals or those working remotely might be less dependent on cars and more inclined to use alternative transportation modes, like public transit, biking, or walking.

Other socioeconomic factors also impact an individual's reliance on a car for transportation. These factors include the level of education [84,101,102] and age [103,104]. People with higher education levels may have more awareness of the environmental and economic implications of car use and the availability of alternative transportation modes. For instance, more-educated individuals might be more knowledgeable about the effects of car emissions on air quality and climate change, hence more inclined to use alternatives, like public transit, biking, or carpooling. They are also more likely to live in urban areas with efficient public transportation systems, offering alternatives to car use [105]. Their occupations might allow for flexible work schedules or remote work options, reducing the need for car commuting [106]. On the other hand, older individuals may depend more on cars due to reduced mobility or challenges using alternative transportation modes [107]. Conversely, younger individuals are often more open to using alternative modes of transport, like public transit, biking, or carpooling, which is driven by their willingness to try different options and a desire to lessen their environmental impact. They are also more likely to live in urban areas with robust public transportation systems, reducing their need for cars [108].

3.2.2. Cost of Cars

Decisions about car ownership are often influenced by the cost of owning a car, encompassing both the initial purchase price and ongoing expenses, like fuel, maintenance, insurance, and taxes [109]. Research, however, has shown that car owners frequently underestimate the full costs of car ownership, which include both private costs (such as fuel

and maintenance) and social costs (like environmental and health impacts) [110,111]. In an empirical study involving 6233 German car users, Andor et al. [110] found that while 88% of the participants claimed to understand their monthly car ownership and usage costs, about 50% substantially underestimated these costs, with an average underestimation of EUR 221 per month, or 52% of the actual cost. Based on these findings, Andor et al. [110] suggested that a more accurate understanding of the true cost of driving could lead to a significant reduction, approximately 37%, in car ownership rates.

Moreover, the costs associated with parking significantly affect car ownership rates [112]. Parking subsidies, such as employer-provided parking, can encourage individuals to drive alone since they are more likely to use their cars when parking is free or offered at a low cost [113–116]. For instance, in the USA, around 95% of commuters benefit from free parking [116]. While this arrangement is beneficial for employers, as it allows them to offer lower wages and save on payroll taxes while retaining employees, it also contributes to the expansion of urban areas by making car commuting more cost-effective [117].

3.2.3. Government Policies

From an economic perspective, government policies play a significant role in influencing car dependence by affecting the costs and benefits of various transportation options. These policies are instrumental in shaping the decision-making of individuals and households, thereby impacting the driving propensity within communities [118,119].

Policies that modify the costs associated with car ownership or usage, such as fuel taxes or incentives for electric or hybrid vehicles, can lead to substantial changes in the relative costs of different modes of transportation. Such measures often promote the use of more fuel-efficient vehicles or public transit, which can reduce the overall dependence on cars [120]. In addition, investment in public transit systems has significant economic implications for car reliance. Adequately funded and reliable public transit can present a more affordable transportation alternative, especially for individuals in lower-income brackets who may struggle with the costs related to car ownership [121]. Land-use policies are also crucial; those that encourage compact, pedestrian-friendly urban designs can diminish the need for cars, leading to reductions in transportation expenses [122]. Conversely, policies that promote urban sprawl tend to increase the reliance on personal vehicles, resulting in higher long-term transportation costs [123,124]. Moreover, regulations that target vehicle emissions can increase the costs of manufacturing and owning traditional gasoline-powered vehicles, encouraging a shift toward electric or hybrid vehicles, which are generally more economical to operate [125].

Additionally, government responses to recent global events have had a profound impact on driving behaviors. Specifically, the COVID-19 pandemic introduced unique challenges and policy measures that significantly altered transportation dynamics. A study that focused on the pandemic's impact in European urban areas by Vega-Gonzalo et al. [126] noted an increased dependence on cars. This increase was particularly evident among demographics that traditionally relied less on private vehicles. The surge in car usage emerged as a direct response to government-imposed restrictions, changes in public transportation services, and heightened public concerns about health and safety. These changes took place against a backdrop of evolving socioeconomic conditions, highlighting the dynamic relationship between government policies and the factors that influence car usage and ownership.

3.3. Psychological Factors

In the existing literature on driving decisions, the focus has predominantly been on physical and economic factors, with less attention given to the roles of attitudes, perceptions, and preferences. As Handy [127] highlighted, the exploration of attitudinal theories in understanding travel behavior has not been as extensive as the examination of economic factors. Nonetheless, Anable [128] emphasized the importance of including a wider range of explanatory variables to comprehensively understand what influences an individual's

choice of transportation mode. This section begins with an overview of the primary theories in this area, followed by a detailed analysis of empirical studies that explore the psychological determinants shaping individual behaviors in the realm of transportation.

3.3.1. The Prevalent Theories

Understanding choice behavior, particularly in the context of how individuals select their mode of transportation, is crucial for analyzing driving propensity. Travel behavior analysis often employs behavioral theories derived from microeconomics, with rational choice theory being a notable approach. This theory asserts that individuals are capable of evaluating their options thoroughly and making optimal decisions based on comprehensive information [129,130]. As outlined by Lucas and Jones [131], rational choice theory fundamentally suggests that decision-making is driven by cost–benefit analyses of available alternatives, focusing on self-interest and informed deliberation. It presumes a stable context with fixed preferences, allowing individuals to process all relevant information to make the best decisions.

Rational choice theory's widespread use in travel behavior research is largely due to its ability to be mathematically operationalized through discrete choice theory [132]. This framework supports policies that provide individuals with sufficient information to make well-informed transportation choices. Lucas and Jones [131] proposed that driving can be seen as a rational consumer choice, where vehicles contribute to well-being by facilitating access to various goods and services. However, the application of rational choice theory in analyzing driving behaviors has been criticized for overlooking human preference inconsistencies and not fully considering the utility concept, the maximization of decision-makers' utility, or the processes leading to observed choices [133]. Therefore, to thoroughly understand driving behaviors, it is essential to consider not only sociodemographic and physical factors but also attitudes and behaviors [134]. Wu et al. [86] advocated for a broader definition of rationality that includes intangible factors related to car ownership and usage.

The emergence of alternative theories, mainly from social psychology—including self-perception theory [135], social learning theory [136], the theory of planned behavior [137], social cognitive theory [138], and social exchange theory [139]—has renewed interest in the complexities of travel behavior, including driving. A significant development in this area is the concept of automotive psychosocial satisfaction, addressing both functional and psychosocial needs, such as belongingness, self-esteem, and autonomy [131]. Jackson [132] noted two key insights from this research: first, cars are valued not only for their practical utility but also for their symbolic significance in people's lives, and second, individuals often remain entrenched in their consumption patterns due to various factors, including habits, routines, social norms, expectations, cultural values, access inequalities, and limited choices.

3.3.2. Attitudes toward Car Ownership/Usage

Considerable research has been conducted on attitudes toward private car ownership and usage [140,141]. These studies, which utilized a variety of methodologies, focused on different demographic segments, including students [142–145], younger individuals [146,147], and various generational cohorts [104]. Additionally, some research compared attitudes toward car ownership and usage across different countries or cities [148,149], and others examined these attitudes in relation to alternative modes of transportation [108,148,150].

In the field of automotive psychology, Wu et al. [86] introduced the concept of "symbolic utility" to represent the psychological satisfaction derived from car ownership and usage. This influential study underscored the impact of attitudinal factors on car ownership and usage preferences, indicating that integrating symbolic utility into models could enhance their predictive accuracy. Building on this concept, Wright and Egan [151] applied Maslow's hierarchy of needs [152] to argue that cars fulfill various psychological needs, such as shelter, security, warmth, and self-expression. Sheller [153] further expanded this

discussion, suggesting that "automotive emotions" often surpass rational considerations for public welfare, moving beyond a simple economic cost–benefit analysis. More recently, Li et al. [154] investigated the effects of car ownership and usage on travel and life satisfaction. They found that owning multiple vehicles is associated with increased life satisfaction, which is a trend that is not observed in single-car ownership. The study also revealed that neither acquiring a more expensive vehicle nor increasing usage rates enhanced life satisfaction. Conversely, infrequent car usage was associated with higher levels of both travel and life satisfaction. Additionally, the study identified a positive relationship between attitudes toward the instrumental and affective roles of cars and the levels of satisfaction in travel and life among car owners.

Material possession theory [155] formed the basis of the research by Steg [108,140,156] on car ownership and usage. In their study, Steg et al. [156] aimed to identify the primary motivational dimensions that make car usage appealing and discovered that the instrumental and symbolic–affective functions of cars significantly contribute to their attractiveness. Building upon this, Steg [140] sought to empirically categorize various car usage motives and evaluate the extent to which Dittmar's model is supported by empirical evidence. Their survey, which involved participants from the Dutch cities of Groningen and Rotterdam, showed that the respondents distinguished between the instrumental, symbolic, and affective motives fulfilled by cars. The study further found that even functional commuting is more influenced by symbolic and affective motives than instrumental ones. It also revealed a tendency among male participants, younger individuals, and those in lower-income groups to value the symbolic and affective functions of cars more highly.

In addition to the instrumental, affective, and symbolic aspects already recognized as crucial in understanding car ownership and usage, further motivators have been identified in various studies. For instance, Steg [140] highlighted "independence" as a separate motivator in her qualitative analysis. Likewise, Gatersleben [157] identified a relationship between feelings of independence and positive experiences associated with car usage. Contrasting with traditional car ownership, innovative models, like mobility as a service (MaaS), introduce new perspectives. Some research also integrated different psychological motivators into unified concepts. For example, Bergstad et al. [158] conducted a comprehensive analysis of statements related to car usage motivators and identified two interrelated motivational categories: "affective–symbolic" and "instrumental–independence".

Additionally, the relationship between car ownership or usage and sociodemographic factors, such as age, income, and education level, was examined, with these factors being influenced by psychological motivators, including affective, symbolic, instrumental, and independence motivators. The study by Bergstad et al. [158] suggested that these psychological motivators could partially account for variations in car usage across different sociodemographic groups. For example, the affective–symbolic motivator was found to play a role in mediating the relationship between the frequency of car trips and gender, while the instrumental–independence motivator influenced the relationship between weekly car use and the overall extent of driving. These findings indicate that psychological factors significantly influence car usage preferences, though the direct impact of sociodemographic variables on car usage remains notable.

Van and Fujii [148] investigated attitudes toward cars and public transport in six Asian countries—Japan, Thailand, Vietnam, Indonesia, China, and the Philippines—with each one characterized by distinct cultural, developmental, and social norms. This research concentrated on three factors—symbolic, affective, and instrumental—which were previously identified as key in shaping attitudes toward cars and public transport. The study also introduced a new factor called "social orderliness", which includes considerations of environmental friendliness, safety, quietness, and altruism associated with cars or public transport. The results show diverse perceptions of the symbolic and affective aspects of cars and public transport in these countries. For instance, individuals in lower-income societies tend to view cars as a more significant status symbol. Notably, the concept of

social orderliness was particularly salient in the responses from Japan, indicating a possible perception of cars as less valuable due to societal concerns, like air pollution and congestion.

Complementing the existing research on attitudes toward car ownership and usage, several studies have underscored the significant role of social influence in decision-making processes. As described by Cialdini et al. [159] in the theory of normative action, car ownership decisions are influenced by two main types of social norms: descriptive norms, which reflect the prevalent behaviors among others, and injunctive norms, based on perceived expectations from others. The impact of social peers and neighbors on individual decisions regarding car ownership is further evidenced by the studies of Weinberger and Goetzke [160] and Weinberger and Goetzke [161] in the USA.

In contemporary research, it is increasingly recognized that cultural and psychological values associated with cars frequently overshadow the practical advantages of alternative modes of transportation, such as public transit [108,150,162,163]. For example, a survey by Linda [108] among Dutch respondents shows a strong preference for cars over public transportation, influenced by both their instrumental utility and symbolic importance. In a similar vein, research by Cullinane and Cullinane [164] in Hong Kong highlighted that practical aspects, such as convenience and comfort, are primary motivators for car ownership and usage, often taking precedence over considerations for public transport. These findings emphasize the predominance of car-centric values in shaping transportation preferences.

Beyond these discussed factors, several less-explored psychological elements play a crucial role in shaping driving decisions. For example, cars significantly contribute to the organization of daily life, providing solutions for individuals balancing demands from work, family, or childcare [165–167]. Stress and anxiety can also amplify reliance on personal transport, offering a sense of familiarity and control [168]. In certain situations, psychological conditions, such as anxiety disorders or phobias, may limit the feasibility of alternative modes of transportation, leading to increased dependency on cars [169]. Car usage often becomes habitual, with individuals preferring to drive for convenience, ease, or due to a lack of familiarity with other options [170]. Additionally, concerns about using public transit or cycling can further reinforce this dependency [171,172]. On the other hand, negative driving experiences could heighten future apprehensions about driving, potentially reducing reliance on cars [173].

4. Summary and Conclusions

Over recent decades, the global landscape of transportation has significantly evolved, marked by a substantial increase in car ownership and usage. This trend, which is predominantly attributed to the perceived convenience and preference for cars, is linked to their role in enhancing mobility, quality of life, and flexibility. However, this growing reliance on personal vehicles brings with it a spectrum of societal challenges, including environmental concerns, like climate change and air pollution; urban issues, such as traffic congestion and noise pollution; and health risks encompassing road safety and lifestyle-related diseases.

The imperative to understand the driving forces behind this shift toward increased car usage lies at the heart of both mitigating these negative externalities and fostering sustainable transportation systems. This comprehensive study delved into the diverse factors influencing individuals' decisions to drive, categorizing them into three primary domains: built environment attributes, economic factors, and psychological influences. By conducting a thorough review of the literature, this research unravelled the intricate web of elements that shape driving behaviors, offering a nuanced understanding that is crucial for shaping transportation policies aimed at enhancing urban mobility and accessibility.

The built environment attributes, which are crucial in shaping driving propensity, encompass six key categories: density, diversity, design, destination accessibility, distance to transit, and demand management. Despite some discrepancies in the research findings, the consensus indicates that higher levels of these attributes generally correspond with reduced car ownership and usage. Specifically, denser urban environments, diverse land use, well-designed infrastructure, accessible destinations, and proximity to transit are associated

with lower reliance on personal vehicles. Conversely, demand management strategies, particularly those addressing parking availability and cost, often lead to increased car ownership and usage, highlighting the significant influence of these built environment factors on transportation choices.

Regarding economic factors, three primary categories emerge as influential in driving propensity: socioeconomic characteristics, car ownership costs, and governmental policies. Among these, household income stands out as a pivotal determinant, with higher-income households typically exhibiting greater levels of car ownership and usage. Household composition also plays a critical role, with the presence of children, male-headed households, and the number of employed individuals in a household often linked to increased car ownership. Education level, which is inversely related to driving propensity, and age, with older individuals more inclined toward car usage, further influence the economic factors shaping driving behavior. Direct costs of car ownership, including acquisition and maintenance expenses, and indirect costs, like parking fees, significantly impact the decision to own and use a car. Government policies, such as fuel taxation, incentives for eco-friendly vehicles, public transit funding, and urban planning regulations, profoundly influence the degree of car dependence, demonstrating the interplay between economic considerations and transportation choices.

Psychological factors, although less explored compared with built environment attributes and economic factors, significantly influence car ownership and usage. These include life satisfaction; instrumental, affective, and symbolic values associated with vehicles; the sense of independence; social orderliness; and the impact of daily life structure, stress, and anxiety related to public transportation usage. Additionally, the pursuit of convenience and ease through car usage is a notable psychological driver. In contrast, negative driving experiences leading to increased fear of driving can reduce driving propensity. These psychological dimensions, which encompass both positive and negative aspects, underline the complex and multifaceted nature of factors influencing driving behavior, extending beyond mere physical and economic determinants.

In Figure 2, the hierarchical tree diagram graphically illustrates the findings from our literature review. Factors positively associated with driving propensity are marked in red, while those negatively associated are in blue (this color coding is indicative rather than absolute, as factors' impacts can vary based on cultural and locational contexts). This review highlights the multifaceted nature of driving propensity, emphasizing the need for a holistic approach to understand and address its drivers. A comprehensive understanding of these factors' interplay is crucial for developing effective interventions to mitigate car use's negative externalities, promote sustainable transportation, and enhance urban mobility and accessibility.

This study provides a structured framework for policymakers, outlining various factors influencing driving propensity and illustrating potential trade-offs. To this end, it emphasizes the necessity of balancing sustainable transportation advancement with community and individual quality of life enhancements. A multifaceted approach is essential to mitigate excessive driving's harmful effects. This approach could encompass designing compact, well-connected communities with efficient public transportation systems, promoting electric and hybrid vehicles through regulations and incentives, and investing in public transit infrastructure. Additionally, increasing public awareness of driving's negative impacts and promoting alternative transportation methods, such as carpooling, cycling, and public transit, can reduce personal vehicle dependency. Addressing psychological drivers of behavior is crucial, necessitating an examination of psychosocial constructs and negative driving experiences. Enhancing life satisfaction, alleviating stress and anxiety linked to public transportation, and improving alternative transportation modes' accessibility and convenience are vital.

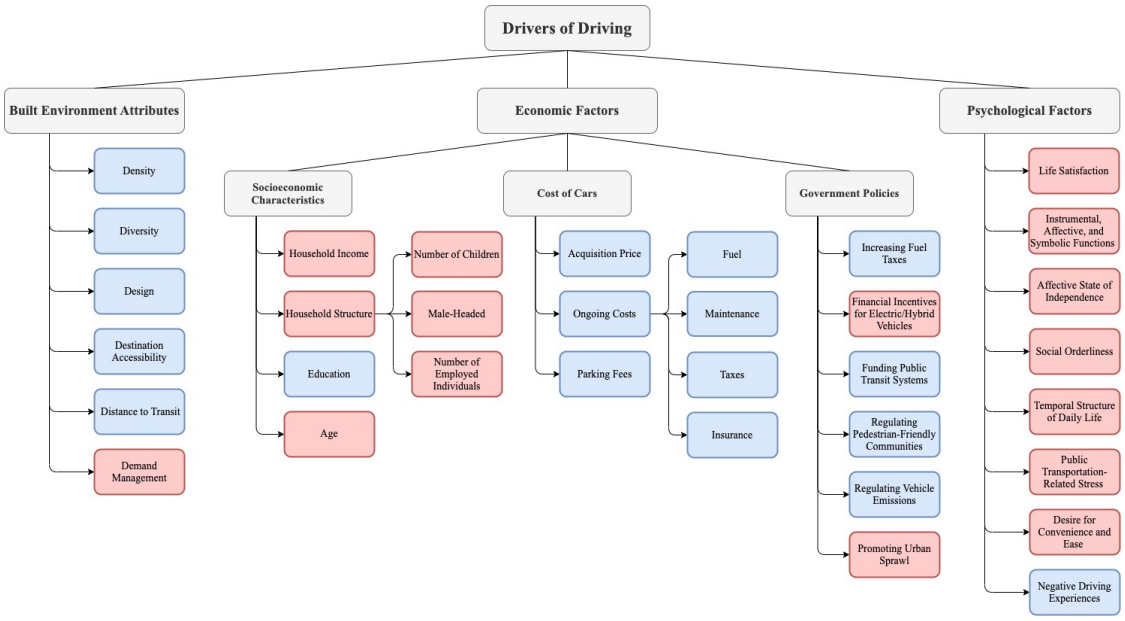

Figure 2. Hierarchical tree diagram for drivers of driving. The factors that have a generally positive association with driving propensity are represented in red, and those that have a generally negative association are depicted in blue.

While this review aimed to provide a comprehensive analysis, its scope was inevitably limited by potential omissions due to search term and database constraints, which possibly affected the included perspectives' diversity. The primary focus on urban settings in developed countries might limit the applicability to rural or developing areas with distinct socioeconomic and infrastructural dynamics. Moreover, rapid advancements in transportation technologies, like electric vehicles, may quickly date some findings. The review's quantitative emphasis might overlook qualitative insights, revealing deeper individual motivations and context-specific driving behaviors. Future research should bridge these gaps by investigating diverse geographical contexts and assessing emerging technologies' impacts on driving patterns. Delving into psychological and sociocultural dimensions of driving, examining transportation's intersection with critical issues like climate change and public health, and conducting longitudinal studies are imperative for understanding driving behaviors' evolution in response to policy changes and urban development.

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Appendix A. Description of Reviewed Articles

Table A1 provides a concise overview of the reviewed articles. It summarizes key information about each study, including the authors, publication year, study location, time period covered, research objectives, methodologies employed, and the main findings.

Table A1. Key details of the reviewed articles.

Paper	Location	Temporality	Objectives	Methods	Main Findings
Nielsen et al. [31]	Denmark	2009–2011	Examine cycling's environmental correlates	Danish travel survey, urban data analysis, and statistical modeling	Density, connectivity, and access to services boost cycling.
Sun et al. [32]	Shanghai, China	2009	Investigate built environment's impact on commuting	Copula-based model and survey in parks	Residential characteristics impact commuting more than job sites; more jobs in residential areas increase driving likelihood.
Yin and Sun [33]	China	2012	Investigate built environment's impact on car ownership	Multilevel logistic regression on CLDS data	City and neighborhood environment influences car ownership; higher density and metro availability reduce it, while land-use diversity might increase it.
Yang et al. [34]	China	2010	Examine built environment's influence on commuting mode choice among car owners	Household travel survey and multilevel discrete choice model	Built environment factors significantly influence commuting choices, with notable spatial variation.
Cervero and Kockelman [35]	San Francisco, USA	1990–1991	Study impact of density, diversity, and design on travel demand	Factor analysis and regression modeling of travel diary data	Compact, mixed-use, pedestrian-friendly neighborhoods reduce driving and encourage walking, cycling, and transit use, though the impacts are modest.
Ewing and Cervero [36]	USA	1990	Synthesize findings on how density, diversity, and design influence travel	Literature review, meta-analysis, and elasticity calculations	Density, land-use diversity, and pedestrian-oriented design reduce car trips and distances; impacts are modest but cumulatively significant.
Ewing and Cervero [37]	Mainly USA	Up to 2009	Meta-analysis of built environment effects on travel	Literature review, meta-analysis, and weighted average elasticities	Destination accessibility most strongly related to VMT, walking, and transit use. Density has weakest association with travel behavior.
Li and Zhao [38]	Beijing, China	2015	Explore car ownership and use near metro stations	Travel survey, GIS analysis, and regression modeling	Land-use mix, mall proximity, and attitudes impact car ownership and VKT; metro proximity has limited effect.
Ding and Cao [39]	Washington, USA	2007–2008	Examine how built environment at residential and work locations affects car ownership	Bayesian cross-classified multilevel ordered probit model	Density, diversity, design, and transit access around residences and distance to CBD affect car ownership. Employment density and bus stop density at workplaces also influence car ownership.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Chen et al. [40]	New York, USA	1997–1998	Assess density's role in mode choice for home-based work tours, controlling for confounding factors	Household travel survey and simultaneous equations modeling of car ownership and propensity for auto use	Employment density at work influences auto use more than residential density, after controlling for travel cost, job access, and transit access.
Shen et al. [41]	Shanghai, China	2010–2011	Examine car ownership and commuting mode choice in rail-transit-supported suburbs	Household travel surveys in 4 neighborhoods, binary logit model of car ownership, and nested logit model of commute mode choice	Rail proximity relates to higher rail use for commuting but not car ownership; income, job type, and attitudes also influence car ownership and rail commuting.
Ding et al. [42]	Baltimore, USA	2001	Investigate the influence of built environment on travel mode choice considering the mediating effects of car ownership and travel distance	Integrated structural equation modeling (SEM) and discrete choice modeling (DCM) using 2001 National Household Travel Survey (NHTS) data	Higher density, connectivity, and accessibility reduce driving, while distance to transit increases it. Car ownership and travel distance mediate the effects of the built environment on mode choice.
Bhat and Guo [43]	San Francisco, USA	2000	Model residential sorting effects in assessing built environment impacts on car ownership	Joint model of residential location choice and car ownership using a mixed multinomial logit-ordered response structure	Built environment attributes affect residential choice and car ownership; self-selection effects are important to consider.
Brownstone and Golob [44]	California, USA	2001	Measure the relationship between residential density, household vehicle use and fuel consumption	Joint model of residential density, vehicle use, and fuel consumption, accounting for self-selection and missing data	A 40% lower density implies 4.8% more annual mileage and 5.5% more fuel consumption per household.
Bartholomew and Ewing [45]	USA	Various	Evaluate effectiveness of scenario planning for compact growth	Meta-analysis of 85 scenarios from 23 studies in 18 metro areas	Compact growth scenarios reduce VMT in 2050 by 17% vs. trend scenarios on average.
Leck [46]	USA	1990–2005	Assess the impact of density, land-use mix, and street configuration on travel while resolving contradictory findings	Meta-analysis of 17 empirical studies	Density and land-use mix have significant effects on travel behavior; street configuration does not.
Boussauw et al. [47]	Flanders, Belgium	2010	Examine compact city impacts on commuting distance	Analysis of spatial proximity measures and reported commuting distances	High density, diversity, and job access reduce resident commutes; jobs–housing balance near 1 reduces commutes overall.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Potoglou and Kanaroglou [48]	Hamilton, Canada	2005	Explore the influence of urban form and sociodemographics on household car ownership levels	Multinomial logit model of household survey data with GIS-derived urban form measures	Higher density, land-use mix, and transit access are associated with lower car ownership, after controlling for sociodemographics.
Zegras [49]	Santiago de Chile, Chile	N/A	Analyze built environment's influence on motor vehicle ownership and use	Econometric models using 2001 household survey and land-use data	Income majorly influences vehicle ownership and use; built environment characteristics moderately impact vehicle kilometers traveled and ownership likelihood.
Jiang et al. [50]	Jinan, China	2014	Examine land-use and street effects on car ownership and use	Household travel survey, GIS data, factor analysis, and two-step modeling	Job–housing balance, land-use mix, neighborhood permeability, parking, and BRT access impact car ownership and use.
Frank et al. [51]	USA	N/A	Develop a walkability index and test its validity	GIS analysis, census data, and travel surveys	The walkability index, which is composed of land-use mix, residential density, retail floor area ratio, and street connectivity, is related to walking and vehicle miles traveled.
Soltani [52]	Adelaide, Australia	1999	Explore built environment impacts on vehicle ownership	Logistic regression modeling using household travel survey and land-use data	Higher density and land-use mix are associated with lower levels of vehicle ownership.
Vuchic [53]	N/A	N/A	Classify and describe urban transit modes	Explanatory review	Transit modes are defined by ROW, technology, and operations. Street, semi-rapid, and rapid transit have increasing performance, investment costs, and ability to influence urban form.
Yin et al. [54]	Changchun, China	2012	Investigate built environment and parking availability impacts on car ownership and use	Household travel survey, GIS data, and binary logistic regression	Built environment factors, like land-use mix, transit access, and parking supply, significantly influence car ownership and commuting mode, with parking availability having key effects.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Schimek [55]	USA	1990	Investigate how residential density affects household vehicle ownership and use	1990 Nationwide Personal Transportation Survey data analysis and multivariate regression modeling	A 10% density increase is associated with only a 0.7% reduction in household vehicle travel, much less than the effect of income. Even large urban density increases would have little impact on total vehicle travel.
Bento et al. [56]	USA	1990	Examine how urban spatial structure affects household travel demand	NPTS household survey data analysis and vehicle ownership and use modeling	Population centrality, jobs–housing balance, rail transit supply, and other urban form factors have significant but modest individual effects on driving. Moving sample households from an Atlanta-like city to a Boston-like city reduces the annual VMT by 25%.
Li et al. [57]	Beijing, China	2005–2006	Explore urban form's influence on car ownership across Chinese megacities	Household surveys, OLS regression, and binary logit models	Urban affluence, scale, and road supply positively affect car ownership; high population density suppresses it.
Chatman [58]	New Jersey, USA	2013	Assess factors beyond rail access affecting auto use near TODs	Survey of households near rail stations and analysis of parking	Housing type, tenure, density, and bus service and parking availability impact auto use more than rail access.
Kim and Kim [59]	USA	2003	Predict effects of transit access on auto ownership and use	Ordered logit model for auto ownership and regression for VMT	Licensed drivers are the main factor in auto ownership; transit access reduces VMT more for multi-vehicle households.
Chatman [60]	California, USA	2003–2004	Examine how different aspects of development density influence household travel	Original travel survey data analysis and count and Tobit regression modeling	Network load density slows auto speeds and reduces auto trips and VMT. The combination of high network load density, high activity density, and high built form density encourages walking and biking.
Cao and Cao [62]	Minneapolis, USA	2011	Investigate LRT, neighborhood design, and self-selection's impact on auto ownership	Survey, statistical control, and quasi-longitudinal design	Neighborhood design significantly affects auto ownership; LRT impact is indirect through neighborhood characteristics and resident self-selection.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Cervero and Murakami [63]	USA	2003	Examine built environments' impact on vehicle miles traveled (VMT)	Structural equation modeling using data from 370 urbanized areas	High population densities are associated with reduced VMT; however, dense road infrastructure and retail access moderate these effects.
Combs and Rodríguez [64]	Bogotá, Colombia	1995–2005	Analyze BRT's impact on vehicle ownership	Quasi-longitudinal analysis using difference-in-differences	BRT access reduces car ownership for wealthy households; effect depends on built environment for poor households.
Doddamani and Manoj [65]	Hubli-Dharwad, India	2018–2019	Investigate built environment influences on car and motorcycle ownership	Cross-sectional analysis using ordered logistic regression	Built environment effects vary by vehicle type and city; subjective measures, like cleanliness and women-/child-friendliness, impact ownership.
Weinberger et al. [66]	New York, USA	2012	Examine impacts of residential parking requirements on auto ownership and use	Analysis of parking requirements and vehicle ownership/use data	Parking requirements encourage car ownership and use, undermining sustainability and congestion reduction goals.
Weinberger et al. [67]	New York, USA	2009	Examine the impact of residential off-street parking on car ownership, vehicle miles traveled, and carbon emissions	Analysis of demographics, highway and transit access, and off-street parking in two NYC neighborhoods; plausible development scenario testing	Off-street residential parking significantly influences commuting behavior, with accessory parking linked to higher auto commutes than commercial centralized parking, challenging the city's sustainable future vision.
Guo [68]	New York, USA	1998–2010	Examine residential parking's effect on household car ownership	Nested logit modeling of car ownership with parking supply variables from online images	Parking supply strongly influences car ownership, even outperforming income and demographics; garage, driveway, and street parking have differential effects.
Guo [69]	New York, USA	2012	Examine impact of street parking on car ownership for households with off-street parking	Measure on-/off-street parking via Google Street View/Bing Maps and multivariate modeling	Free street parking increases car ownership by 9% for households with off-street parking.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Christiansen et al. [70]	Norway	2013–2014	Analyze impacts of home parking on car ownership and use	Norwegian travel survey with in-depth parking questions and statistical analysis	Access to private parking triples car ownership odds. Longer home–parking distance reduces the car share.
Sobhani et al. [71]	Bangladesh	2017	Analyze impacts of socioeconomic factors on parking demand in developing cities	Field surveys of parking in Dhaka and multiple linear regression modeling	Floor space, household rent, population density, literacy rate, etc., significantly affect parking demand for various land uses.
Van Eenoo et al. [72]	Belgium	2019–2020	Test if urban residents are multimodal and feel car dependent	Cluster analysis of survey on car use, bike use, VKT, and perceived car dependence in Flanders	Four multimodal clusters found. Car ownership does not always mean perceived dependence for those who cycle. High VKT and car use do not always mean feeling car dependent.
Stead [73]	Britain	1978–1993	Analyze relationships between land use, socioeconomic factors, and travel patterns	Regression analysis of national and local travel survey data	Socioeconomics explain more travel variation than land use. Car ownership, employment, and density are key factors. Land use still plays a role.
Zhou et al. [74]	Nanjing, China	2015	Cluster human activity patterns using a Markov-chain-based mixture model	Nanjing household travel survey, Markov-chain-based mixture model, and logistic regression	Identified three main human activity patterns: working and education oriented, recreation and shopping oriented, and schooling drop-off/pick-up oriented, which are correlating with specific sociodemographics.
Shao et al. [75]	Zhongshan, China	2019	Analyze nonlinear effects of land use and motorcycles/E-bikes on car ownership	Gradient boosting decision trees model with travel survey data	Income dominates car ownership; built environment has threshold effects; motorcycles/E-bikes moderate effects of income and distance on car ownership.
Hanson and Hanson [76]	Uppsala, Sweden	1971 (5 weeks)	Analyze relationships between sociodemographics and multidimensional travel patterns	Principal components analysis and regression on individual travel diaries	Both socioeconomic status and household roles significantly explain travel dimensions, but differently for each. Role variables are particularly important.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Pas [77]	N/A	1983	Examine influence of sociodemographics on daily travel behavior	Classification of travel patterns and parametric models of contingency tables	Role, life-cycle, and lifestyle attributes significantly influence daily travel; segments have different likelihoods of travel patterns.
Bhat and Koppelman [78]	Conceptual	N/A	Develop a conceptual framework of individual activity program generation	Synthesis of theories from multiple disciplines	Framework with four interrelated modules: household needs, auto ownership, activity allocation, and individual activity programming. Subsistence work hours and leisure are endogenous.
Sarmiento [79]	N/A	1987	Discuss household circumstances and gender differences in travel constraints	Literature review and synthesis	Travel demand management overlooks household composition, gender roles, and complex constraints, limiting behavior change effectiveness.
McGuckin and Murakami [80]	USA	1995	Compare trip-chaining behavior between men and women	Descriptive analysis of 1995 Nationwide Personal Transportation Survey data	Women, especially those with children, make more stops and chain more trips to and from work compared with men. Life stage influences trip-chaining behavior.
Mokhtarian and Chen [81]	Various	Various	Review and analyze empirical literature on travel time and money budgets	Literature review and synthesis	Travel time expenditures are not constant, except perhaps at the most aggregate level. They are related to socioeconomics, activities, and built environment. Mechanisms underlying aggregate stability are not well understood.
Manaugh et al. [82]	Montreal, Canada	2003	Analyze effects of neighborhood characteristics, accessibility, home–work distance, and demographics on commuting distances	Factor cluster analysis of neighborhood types and simultaneous equation modeling of trip distance	Home–work distance has major effect on commuting distance; urban form and job accessibility are important; deciding whether to live and work in same sub-region is influenced by unobserved factors.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Yang and Timmermans [83]	The Netherlands	2004–2009	Analyze impact of fuel price on activity travel time expenditure	Dutch travel survey data and seemingly unrelated regression analysis	Fuel price negatively correlated with car travel time, which differs between weekdays and weekends.
Kotval-K and Vojnovic [84]	Detroit, USA	2007–2008	Explore socioeconomic impacts on travel and environmental burdens	Detroit region travel survey and ordinary least squares regression	Higher incomes associated with more car travel and emissions across neighborhood types.
Li et al. [85]	Shenyang, China	2015	Examine socioeconomic factors affecting low-carbon and non-low-carbon travel modes for shopping	Questionnaire surveys and binary logistic regression modeling	Car ownership, gender, and income significantly impact travel mode choice for shopping trips.
Wu et al. [86]	Xi'an, China	1997	Explore psychological and sociological factors in household vehicle ownership	Survey, LISREL model, and multinomial logit model	Attitudes toward vehicle ownership, which are influenced by personality traits and perceptions, significantly impact ownership preferences; symbolic utility is a key determinant.
Karlaftis and Golias [87]	Athens, Greece	1996	Investigate the relationship between traffic parameters and automobile ownership/autolessness	Detailed local travel survey, Poisson regression for ownership, and binary logit model for autolessness	Traffic and efficiency parameters significantly influence automobile ownership but not autolessness; ownership is more affected by socioeconomic factors and less by urban traffic conditions.
Soltani [88]	Shiraz, Iran	2016	Investigate impact of urban form and socioeconomic factors on vehicle ownership using discrete choice modeling	Household travel survey, GIS analysis of urban form measures, and nested logit model	Land-use mix, distance to work, housing type, household size, and income influence car ownership levels.
Kumar and Krishna Rao [89]	Mumbai, India	N/A	Model car ownership using stated preference data	Stated preference experiment and multinomial logit models of car ownership	Models show good fit; stated preference approach is effective for modeling car ownership in developing countries.
Mokonyama and Venter [90]	South Africa	2002	Forecast household car ownership using alternative models	Household travel survey data and category analysis model based on income and dwelling type	Car ownership increases with income and varies by housing type; large growth potential in disadvantaged areas.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Salon and Aligula [91]	Nairobi, Kenya	2004	Analyze urban travel behaviors, focusing on the implications for transport policy	Household travel survey analysis and multinomial logit models	Lack of suitable transport infrastructure significantly impacts residents across income levels. Major reliance on walking and informal public transport. Suggests enhancing non-motorized transport safety and public transport service to prevent increased car usage with rising incomes.
Joseph et al. [92]	Akure, Nigeria	2016	Investigate factors influencing car ownership	Household survey and multinomial logit model	Increased income and smaller households lead to higher car ownership, with sensitivity to income changes.
Rosier and McDonald [93]	Australia	2011	Examine transport disadvantages in Australia	Literature review	Transport disadvantages more common in low-income, outer-urban, rural/remote areas, and for young families, Indigenous people, and people with disabilities.
Mattioli [94]	Great Britain	2002–2010	Examine car dependence and carless households	Analysis of National Travel Survey data	In car-dependent areas, carless households are more concentrated among disadvantaged groups and have lower mobility levels compared with car-owning households.
Kermanshah [95]	Mashhad, Iran	1994	Model household car ownership using disaggregated approach	Two-level nested logit model based on household socioeconomic and demographic data	Household demographics, socioeconomics, and life stage significantly impact car ownership. Nested logit model is appropriate when IIA violated. Rich datasets needed.
Yamamoto et al. [96]	California, USA	1993–1996	Analyze household vehicle transaction behavior	Panel survey and competing risks duration model	Transaction type affects future transactions; household changes influence vehicle decisions.
Bhat and Koppelman [97]	The Netherlands	1984–1988	Jointly model employment, income, and car ownership	Simultaneous equation system of endogenous switching	Wife's employment and income depend on husband's income and life cycle variables; car ownership depends on income and wife's employment.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Mackett [98]	Great Britain	1985–2000	Examine children's increasing car travel and dependency	Analysis of National Travel Survey data	Children's car travel has increased dramatically, while walking and cycling have declined due to car availability, time pressures, and safety concerns. This reduces independence and physical activity, and may lead to future car dependence.
Matas et al. [99]	Barcelona and Madrid, Spain	2001	Analyze effect of job accessibility on car ownership	Ordered probit model with job access by public transport	Higher job access significantly reduces the probability of owning cars; elasticities of −0.25 and −0.19 for Barcelona and Madrid.
Srinivasan et al. [100]	Chennai, India	1999–2004	Examine mobility and travel pattern changes	Retrospective household survey combined with ordinal response and multinomial logit models	Increases in vehicle ownership, workers, and female drivers drive travel demand growth; significant mode choice shifts influenced by vehicle availability and socioeconomic changes.
Scheiner and Holz-Rau [101]	Germany	1994–2008	Examine gendered travel mode choice in car-deficient households	Regression modeling of German Mobility Panel data	In car-deficient households, men drive more than women. Social roles, economic power, and gender norms impact intra-household car allocation.
Van der Waerden et al. [102]	The Netherlands	2011	Examine effect of car drivers' characteristics on maximum acceptable walking distance to destinations	Survey of University Parking Panel and multinomial regression	Frequency of car use and duration of stay most influence acceptable walking distances, which are shortest for work and weekly shopping trips.
Cui et al. [103]	Various	2016	Explore travel behavior impacts of aging populations	Literature review on older adult travel patterns, influencing factors, and alternatives to driving	Aging poses transport challenges; need accessible, safe mobility options via infrastructure, services, and land use, considering new older cohort behaviors.
Zhou and Wang [104]	Beijing, China	2016	Examine generational differences in car attitudes and attitude–behavior links	Travel survey and multiple-group structural equation modeling	Young adults have less favorable attitudes toward cars and weaker attitude–behavior associations compared with older generations.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Acheampong and Siiba [105]	Ghana	2019	Model factors influencing car-sharing adoption intentions	Survey of young adults and structural equation modeling	Perceived benefits, previous Uber experience, and pro-environmental attitudes positively influence car-sharing intentions, while dissatisfaction with transit also underpins them.
Wheatley [106]	Nottingham, England	2006	Explore conflicts between work–life balance, flexible working, and travel-to-work policies	Case study with interviews and surveys	Professional work cultures and travel-to-work arrangements, like parking, create barriers to effective work–life balance policies, especially for working mothers.
Jansuwan et al. [107]	Cache County, Utah	2010	Assess transportation needs of low-mobility individuals (elderly, disabled, low-income)	In-person interviews and mail surveys on travel patterns, social networks, and transit access	Private vehicle reliance is high for those who are elderly and on a low income; transit and paratransit reliance high for those who are disabled. Social networks and walking access to transit are key factors.
Linda [108]	The Netherlands	2001	Compare the attractiveness and importance of car vs. public transport	Survey of Dutch residents	The car is seen as more attractive and important than public transport, especially among frequent car users, due to instrumental and psychological factors.
Whelan [109]	Great Britain	2001–2031	Model and forecast car ownership at disaggregated household level	Discrete choice models of car ownership level as function of household and area attributes and costs; application via prototypical sampling	Models match 2001 ownership well; forecast 42% increase in cars to 36.4 M and 1.24 cars/household by 2031.
Andor et al. [110]	Germany	2018	Assess consumer understanding of total car ownership costs	Survey of 6000+ citizens, comparison with actual costs, and analysis of public transport preference changes	Consumers underestimate car ownership costs by ∼50%, impacting public transport preferences and potential car ownership reduction.
Gössling et al. [111]	Germany	2020	Evaluate the full private and social costs of car ownership	Assessment of private and social cost items for three car models	Total lifetime cost of car ownership ranges from EUR 599,082 for an Opel Corsa to EUR 956,798 for a Mercedes GLC, with society bearing 29–41% of the costs.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Ostermeijer et al. [112]	The Netherlands	2000–2016	Explore the impact of residential parking costs on car ownership	Transaction data on houses, household survey, and MNL model	Residential parking costs significantly reduce car ownership; the elasticity of car demand is about −0.7.
Wilson [113]	Los Angeles, USA	1986	Assess the impact of employer-paid parking on commute mode choice and parking demand	Multinomial logit model and downtown Los Angeles commuter survey	Employer-paid parking significantly increases solo driving. Removing subsidies could reduce cars driven to work by 25–34%
Hess [114]	Portland, USA	1994	Assess the effect of free parking on commuter mode choice	Household activity survey and multinomial logit model	Free parking increases solo driving. Charging for parking could reduce cars driven by 21% per 100 commuters, impacting VMT significantly.
Khordagui [115]	California, USA	2012	Investigate the impact of parking prices on commute mode choice	California Household Travel Survey and discrete choice model	A 10% increase in parking prices leads to a 1–2 percentage point decline in driving to work, confirming parking pricing as an effective travel demand management tool.
Franco [117]	Los Angeles, USA	2020	Examine the effects of parking prices and availability on mode choice and urban form	Literature review and policy analysis	Parking policies influence urban mobility and form; reforms like eliminating MPRs, implementing parking cash-out, and demand-based pricing for on-street parking can enhance sustainability.
Litman and Burwell [118]	Global	2006	Identify sustainable transportation issues	Literature review and policy analysis	Explores definitions, goals, and methods for sustainable transportation, emphasizing the need for comprehensive planning, equity, and integrated solutions.
Fagnant and Kockelman [119]	USA	2015	Evaluate autonomous vehicles' impacts, barriers, and policy recommendations	Literature review and benefit–cost analysis	AVs may save lives, reduce congestion, and offer USD 196 billion in benefits annually at 90% penetration; barriers include costs, certification, liability, security, and privacy concerns.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Diamond [120]	USA	2001–2006	Analyze the impacts of government incentives on hybrid vehicle adoption	Cross-sectional analysis, hybrid registration data, and socioeconomic and policy variables	Gasoline prices significantly influence hybrid adoption, while the relationship between incentives and adoption is weak.
Dong et al. [121]	Global	2021	Optimize transport communication in megacities via environmental–economic approaches	Multi-criteria optimization, Pareto efficiency, mathematical models, and statistical analysis	Identified critical factors for transport system efficiency in megacities; proposed logistic models for performance improvement, highlighting the importance of vehicle load optimization and scheduling.
Pojani and Stead [122]	Developing countries	2015	Assess sustainable urban transport beyond megacities	Literature review and policy analysis	Smaller cities have potential for sustainable transport. Priorities include street conditions for green modes, pedestrian zones, exclusive lanes for buses and bicycles, reasonable parking fees, and maintenance over new infrastructure. BRT is highlighted as being cost-effective for public transportation.
Dieleman and Wegener [123]	Randstad, The Netherlands	1966–2004	Examine urban form and sprawl containment	National spatial planning, policy analysis, and urban growth management	Policies effectively directed growth to designated areas, promoting compact urban development and preserving open spaces.
Crane and Chatman [124]	USA	1985–1997	Examine the impact of employment decentralization (sprawl) on commuting	Panel regression of commute distance on metro employment deconcentration measures from American Housing Survey data	Greater employment suburbanization associated with shorter average commutes overall, but varies by industry; wage and cost endogeneity addressed.
Al-Buenain et al. [125]	Qatar	2021	Assess EV adoption's environmental benefits	Well-to-wheel LCA and survey	EVs have lower emissions than gasoline vehicles; strong government incentives required for widespread adoption.
Vega-Gonzalo et al. [126]	European urban areas	2021	Analyze COVID-19's impact on car use	EU-wide Urban Mobility Survey and path analysis	COVID-19 increased car use among lower-car-dependency groups, with high-income teleworkers reducing car use the most.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Handy [127]	USA	2004	Assess relationships among transportation, land use, and physical activity	Literature review and theory synthesis	Identifies gaps in understanding the causal links between built environment and physical activity, emphasizing the need for comprehensive models and refined measurement of variables.
Anable [128]	NW UK	2004	Identify travel behavior segments using attitude theory	Mail-back survey and factor and cluster analyses	Identified six psychographic groups varying in mode-switching potential, underscoring the need for targeted transport policies.
Lucas and Jones [131]	UK	1989–2009	Investigate car ownership and use trends and understand car dependence	National Travel Survey analysis and literature review	Car use continued to grow until the late 1990s but has leveled off since; disparities in car ownership by income decreased, with significant growth among lower-income households.
Gärling [133]	N/A	Up to 1998	Critique microeconomic theory's basis of travel choice modeling	Literature review and synthesis	Travel choice models should account for interdependencies, information biases, decision rules, social motives, and automaticity; current theory is overly simplistic.
Bem [135]	N/A	Up to 1972	Propose self-perception theory as alternative to cognitive dissonance theory	Conceptual analysis and review of empirical evidence	People infer own attitudes and emotions from observations of own behavior and circumstances, like an outside observer, especially when internal cues are weak. Reinterpret dissonance phenomena.
Ajzen [137]	Multiple	Up to 1991	Review and address unresolved issues of the theory of planned behavior	Literature review and theoretical analysis	Empirical evidence supports the TPB. Intentions predict behavior accurately when perceived behavioral control is included. Past behavior remains an influential factor, suggesting not all determinants are captured by the TPB.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Bandura [138]	N/A	N/A	Present an agentic perspective of social cognitive theory	Conceptual analysis and synthesis of research	Human agency involves intentionality, forethought, self-reactiveness, and self-reflectiveness. People are producers and products of social systems through personal, proxy, and collective modes of agency.
Cropanzano and Mitchell [139]	Various	Up to 2004	Review and clarify social exchange theory (SET) ambiguities	Literature review and theoretical analysis	Identified key components and conceptual ambiguities in SET, stressing the importance of distinguishing between types of exchanges and relationships, as well as highlighting future research directions in organizational behavior.
Steg [140]	The Netherlands	2004	Explore instrumental, symbolic, and affective motives for car use	Questionnaire studies	Car use fulfills instrumental, symbolic, and affective functions. Symbolic and affective motives significantly relate to car use levels, suggesting policies should also target these aspects.
Gardner and Abraham [141]	Various	2008	Synthesize research on psychological correlates of car use	Meta-analysis	Supports predictive utility of the theory of planned behavior variables for car use. Strong effects of intention, habit, and PBC on behavior; stronger effects for non-car use intentions.
Bamberg and Schmidt [142]	Giessen, Germany	1997	Compare predictive power of the TPB, Triandis, and Schwartz models on car use for university commutes	Questionnaire and analysis of models	TPB and Triandis models confirmed empirically; Schwartz model partly confirmed. Intentions and habits strongly predict car use, overshadowing moral norms.
Zhu et al. [143]	Yangtze Delta, China	2009	Explore car ownership aspirations among university students	Survey and theory of planned behavior	High aspiration for car ownership, driven by psychosocial values over instrumental ones, indicating a strong emerging car culture among young adults.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Belgiawan et al. [144]	Bandung, Indonesia	2016	Understand car ownership motivations among Indonesian students	Survey, principal component analysis, and SEM	Independence, arrogant prestige, and income significantly influence car purchase decisions, with symbolic/affective motives also playing a role.
Luke [145]	South Africa	2015	Investigate car ownership intentions among students	Survey and exploratory factor analysis	Students intend to purchase cars as soon as financially able, which is driven by inadequate public transport and offers insights for policy directed at improving public transport services to mitigate rising car ownership.
Verma et al. [146]	Bangalore, India	2016	Analyze attitudinal factors influencing car ownership decisions among young adults	Survey and structural equation modeling (SEM)	Comfort and status-seeker attitudes predict future car ownership; education level and family car ownership significantly influence ownership intentions.
Pojani et al. [147]	Tirana, Albania	2014	Explore adolescents' car ownership and use intentions	Survey and structural equation modeling (SEM)	Despite Tirana's compactness, adolescents aspire to car ownership, viewing cars as status symbols. Attitudes, not environmental concerns, drive these aspirations.
Van and Fujii [148]	Japan, Thailand, China, Vietnam, Indonesia, and the Philippines	2005	Explore attitudes toward cars and public transport across six Asian countries	Survey and principal component analysis	Identified three attitude factors toward car and public transport: symbolic–affective, instrumental, and social orderliness. Differences across countries in attitudes, with symbolic–affective values for cars being generally higher than for public transport.
Belgiawan et al. [149]	China, Indonesia, Japan, Lebanon, The Netherlands, Taiwan, and USA	2013	Explore car ownership intentions among students	Web survey on attitudes, social norms, and demographics	Students in developed countries show less desire to own cars; social expectations significantly influence car-purchasing intentions.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Beirão and Cabral [150]	Porto, Portugal	2007	Explore attitudes toward public transport and car use	Qualitative study with in-depth interviews	To increase public transport usage, services must align with customer needs, focusing on travel time, cost, comfort, and information availability. Mode choice is influenced by lifestyle, perceived service performance, and individual characteristics, suggesting targeted policies for specific segments.
Wright and Egan [151]	UK	2000	Explore potential for de-marketing car use to reduce traffic	Theoretical analysis and review of de-marketing concepts	Proposes de-marketing the car through public campaigns focusing on altering public attitudes and perceptions using negative marketing and demand restraint to make car use less desirable and promote public transport as an alternative.
Maslow [152]	N/A	N/A	Explore the inherent nature of basic needs	Analysis of instinct theory errors, argumentation for basic needs' hereditary nature, and proposal of new instinct hypothesis	Identifies past instinct theory flaws, argues for basic needs' instinct-like nature, and suggests a new instinct hypothesis aiming for societal improvement. Education, law, and religion should promote recognition and fulfillment of these needs.
Sheller [153]	Various	2004	Explore the emotional and cultural dimensions of car use	Theoretical analysis and literature review	Highlights the deep emotional and cultural ties to cars, emphasizing their role in personal identity, family life, and national cultures. Advocates for a nuanced understanding of automotive emotions in shaping transport policies.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Li et al. [154]	Beijing, China	2016	Examine effects of constrained car ownership and use on travel and life satisfaction	Survey and structural equation modeling	Multiple car ownership increases life satisfaction; car ownership not directly related to life satisfaction. Infrequent car use contributes to higher travel and life satisfaction. Attitudes toward cars significantly influence satisfaction levels.
Steg et al. [156]	The Netherlands	2001	Clarify symbolic–affective vs. instrumental-reasoned motives for car use	Similarity sorting, Q-sorting, and semantic differential method	Symbolic–affective and instrumental-reasoned motives both significant. Car use valued for independence, availability, and utility; negative attitudes toward costs, environmental impact, and driving conditions.
Bergstad et al. [158]	Sweden	2007	Investigate how affective–symbolic and instrumental–independence motives mediate sociodemographic effects on car use	Mail survey and principal component analysis	Affective–symbolic motive partially mediates the relationship between weekly car trips and gender; instrumental–independence motive mediates effects of sociodemographic factors on car use.
Cialdini et al. [159]	Various	1990	Refine and evaluate the influence of norms on behavior	Field experiments and norm activation methods	Demonstrated the potent impact of activating descriptive and injunctive norms on behavior, such as littering, with implications for understanding and leveraging social norms for behavioral change.
Weinberger and Goetzke [160]	USA	2000	Investigate how previous living environments affect auto ownership decisions	2000 U.S. Census data and multinomial probit model	Residents moving from metropolitan areas, especially those with strong transit systems, are more likely to own fewer vehicles. Prior experience in environments where car ownership is optional influences current car ownership decisions.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Ibrahim [162]	Singapore	2003	Examine attitudes toward transport modes for shopping	Survey and perception analysis	Car owners and non-car owners show distinct attitudes toward transport modes. Public transport and walking is viewed favorably for shopping, with differences in perceptions highlighting the need for tailored policy strategies.
He and Thøgersen [163]	Guangzhou, China	2013	Understand attitudes and perceptions affecting travel mode choice and car ownership intentions	Survey, factor analysis, SEM, and logistic regression	Car ownership is a key determinant of travel mode choice. Attitudes significantly influence intentions to buy a car, with preferences for car over public transport driven by affective well-being, functionality, and negative externalities.
Cullinane and Cullinane [164]	Hong Kong	2001	Examine reasons for car ownership and car dependence in a city with extensive public transport	Survey of 401 car owners	Despite low car ownership, those with cars are dependent on them for all journey purposes. Carrying capacity, time savings, and comfort are key reasons for ownership. Policies targeting car ownership and enhancing public transport's convenience are crucial for sustainability.
Jarvis [165]	UK	1999	Investigate household strategies for coordinating home and work	Qualitative interviews and thematic analysis	Households employ diverse strategies influenced by social and kin networks, with implications for mobility, employment structure, and place attachment.
Jarvis [166]	West Coast U.S. cities	2003	Examine whether compact, mixed-use design reduces "wasteful" journeys	Qualitative household research in Portland, Seattle, and San Francisco	High levels of dissonance between preference for compact living and actual non-localized practices; compromises on school choice and work significantly influence travel behavior.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Jarvis [167]	London, UK	2005	Explore the impact of urban living on household time coordination	In-depth biographies and thematic analysis	London's urban dynamics exacerbate the "time squeeze" for working families, with housing affordability, childcare shortage, transport failure, and school choice posing significant challenges.
Summala [168]	Various	2007	Analyze motivational and emotional factors in driver behavior, focusing on "comfort through satisficing"	Theoretical analysis and review of literature on driver behavior models	Introduces the concept of "comfort through satisficing" to explain driver behavior. Drivers aim to keep safety margins, vehicle/road system experience, rule adherence, and progress of trip within a "comfort zone", balancing between safety, legal, and efficiency considerations.
Roth [169]	Various	2005	Examine physiological markers for anxiety, focusing on panic disorder and phobias	Ambulatory study and physiological measurements	Concordance between self-reported anxiety and physiological markers, such as autonomic activation and respiratory abnormalities in driving phobics and patients with panic disorder. Demonstrates the potential of physiological measurements for understanding anxiety disorders.
Lucas [170]	UK	2005–2008	Explore the nature and effects of car dependence	Literature review, NTS data analysis, interviews, and focus groups	Identified broad and nuanced definitions of car dependence; emphasis on lifestyle impacts and vulnerability to policy changes. Focus on a car's role in providing access, independence, and the implications of potential enforced car use reduction measures.

Table A1. *Cont.*

Paper	Location	Temporality	Objectives	Methods	Main Findings
Thomas [172]	Wellington, New Zealand	2009	Investigate social environment and interpersonal discomfort in public transport	Naturalistic observation, survey, and exploratory questionnaire	Public transport forces intimate distances causing social discomfort. Interactive strategies, like talking, reduce discomfort more effectively than defensive strategies. Identifies the balance between privacy need and social interaction in public transport settings.
Corlătianu et al. [173]	Romania	2022	Evaluate PTSD symptoms and stress's influence on anxious driving among novice drivers	Survey, scales for PTSD symptoms, driving stress, and anxious driving behavior	Aggression, dislike of driving, thrill-seeking, and fatigue predict anxious driving behavior. Aggression increases hostile behavior, while dislike decreases it and increases performance deficits.

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