

Travel Behaviour Cycle and Factors Affecting It

Hoda Pourramazani^{*}, Josep L. Miralle-Garcia[†]

Department d'Urbanisme, Universitat Politècnica de València, València 46022, Spain

Corresponding Author Email: hpourra@doctor.upv.es



<https://doi.org/10.18280/ijtdi.070302>

ABSTRACT

Received: 2 February 2023

Revised: 6 June 2023

Accepted: 13 June 2023

Available online: 27 September 2023

Keywords:

modal split, sustainable mobility, travel behaviour, the social-economic mobility factor, urban form

The mobility of people, services and movement of goods is always considered as an essential economic-spatial factor. In addition, free movement is associated with the aim of achieving the desired goals and satisfying socio-economic, cultural and political needs in different places. This point creates different travel patterns and complications, which are usually influenced by physical, demographic, cultural and socio-economic factors that most studies have found. This research aims to identify the factors affecting the user's travel behaviour by acquiring more complete knowledge, systematic literature review (SLR), visual bibliometric analysis based on the characteristics and factors of travel behaviour and 120 selected publications in recent decades. Combining the data allowed us to select 62 publications and link them to the characteristics of travel behaviour and its factors. The results show that the complexity of travel behaviour requires a better assessment of resources and problems and predicting the impact of future trends. On the other hand, the population, the growing levels and mixing of multiculturalism and the influence of behavioural communication are increasing, and their influence should not be neglected, so the path of changing travel behaviour should be considered. This means that everyone's travel standards and assumptions need to be re-examined.

1. INTRODUCTION

In recent decades, cities have undergone great changes. The changes that have led to the transformation of the city and its economic and spatial structures, and hence the daily commuting process has experienced a significant increase. Webber et al. [1] define mobility as the ability of a person to move in environments that are beyond him, from home to neighbourhood and other areas. On the other hand, mobility is influenced by psychosocial cognition and physical, environmental and financial influences. Focusing on moving and increasing levels of personal dependence on cars has created significant environmental, economic and social problems. Challenges that increasingly threaten the quality of urban life. Therefore, a more complete understanding of the factors that affect travel behaviour can be used in preferences, and attitudes, achieving existing travel patterns, improving transportation planning, meeting needs and better preparing future infrastructure services and helping to implement better and more stable transportation policies.

The factors that affect the behaviour and the choice of trips can be generalized into two categories:

(1) External factors: factors related to the shape and spatial structure, the topography of the transport network, accessibility, the quality of the transport infrastructure, transport, services, politics and ownership.

(2) Personal factors: factors defined by the person or family related to demographic and socioeconomic characteristics.

Therefore, transportation characteristics such as travel cost, distance and external factors such as urban environment and

social and demographic characteristics are the main determinants in choosing the travel method and social variables that cause the modal split. On the other hand, gender, age, household composition, income, and car ownership are among the set of sociodemographic factors that have been shown to influence travel behaviour to vary degrees, as well as the modal split, such as older people not being able to drive a car, so each travel mode is affected by different travel variables and social features.

2. RESEARCH QUESTION

The study of travel behaviour as it has evolved over the past half-century has yielded important insights. Insights that show the choices of individuals and families regarding their daily commuting. However, the more we delve into travel behaviour, the more we realize how complex travel behaviour can be. The only way to discover this complexity is a more complete and accurate understanding of the factors influencing their formation. The question that arises is what factors can affect travel behaviour, what we have discussed in this section. On the other hand, the question is also raised about how these factors can be effective, which has been discussed in the analysis and discussion section.

2.1 Built environment and choosing a residential place

Today, cities are facing challenges such as traffic congestion and access to services, and in terms of sustainability, such as air pollution, GHG emissions, and

climate changes. Therefore, one approach to sustainable transportation is shaping the built environment to influence travel behaviour. Concepts of transportation and urban planning have grown to prevent or at least reduce urban sprawl by maintaining cohesive urban areas and with the goal of promoting sustainable transportation.

Research on the relationship between the built environment and transportation can be traced back to the 1950s. When Mitchell and Rapkin [2] published an article that considered land use measures and urban planning based on it as an effective tool to achieve the desired goals of transportation and its promotion.

The results of the studies generally support the policy that shaping the built environment can be used to influence travel behaviour, and the analyzes show that features of the built environment, particularly access to Destinations, can have an independent effect on travel behaviour.

In addition to the factor of the built environment, one should pay attention to another important concept, named choosing a residential place. Choosing a residential location requires understanding the travel attitude of the household. People often choose to live in dense, mixed-use areas with public transportation services, while people living in low-density areas use cars for most of their trips to access environments with limited public transportation access. Therefore, motivating people to live in urban areas is often considered as a way to prevent the use of cars, and a residential move can be a significant life event [3].

2.2 Social factors and demographic

Social conditions are different in each part of the population and are defined by various factors. This section is described under the demographic information that reflects the lifestyle and behaviour of users regarding the choice and time of daily travel; of course, the research of socio-economic differences in indicators such as budget or travel time, or even travel goals will be shown different behavioural patterns [3].

2.2.1 Gender factor

Gender is one of the key social and demographic variables that can affect travel behaviour. Even the slightest understanding of gender-based travel behaviour and more efficient transportation policies can help. Over time, the gender gap still exists in developing cities, and it is important to have a better understanding of the gender pattern for the fair implementation of policies.

Studies on travel behaviour in the last few decades show a trend of a completely different travel pattern based on more gender. In terms of mode of transport, travel time, the purpose of travel, route, and travel chain, women were found to have travelled less distance since the 1970s and, as a result, considered shorter travel time. These differences are mainly due to the complexity of the activities for which women are responsible [4].

2.2.2 Age

Living longer and maintaining an active lifestyle creates a variety of activities, but aging increases functional limitations that may complicate travel behaviour. Globally, the increase in the number of elderly people, along with changes in urban housing patterns, lifestyles and attitudes, has important implications for the future of cities. On the other hand, the activities of disabled people, young people, middle-aged

people and elderly people are very different according to age, time and budget, according to which investment in transportation should be considered [1].

2.2.3 Education and household size

The level of education and size of the household has a positive and significant relationship with users' travel behaviour. Travellers with a higher degree are less likely to choose driving in their travel chain but have a more positive association with public transportation. They are considering the importance of travel time. On the other hand, the size of the household has also shown its impact on the choice of travel mode [5].

2.2.4 Social inequality

Cities, especially metropolises, underwent tremendous social changes. Their economic and spatial structures have also been created and changed by urban expansion. This trend has caused an increase in daily trips. In this volume of expansion and change of social inequality, it happens when there is an unequal distribution of opportunities and destinations, which especially affects low-income people and social class. Disadvantaged people such as the elderly, women and low-income people usually have more problems, and this is where a concept called social justice comes into play [6].

2.3 Economic factor

Transportation is a vital element for everyone to be able to carry out tasks in daily life, and travel behaviour is very important depending on its economic dimension. An economically developed environment is associated with higher income, greater urbanization, and greater economic inequality. This gap affects all aspects of life, including the travel behaviour of the user. On the other hand, the effects of financial and social crises can cause decisive changes in the daily life of citizens. In times of crisis such as after the pandemic, living conditions and standards are rebalanced, and habits that have existed for years may change during the adjustment process [7].

2.4 Psychological factor (Attitudes)

The psychological theory of travel behaviour assumes that mode choice and behaviour change may be considered a general process resulting from behavioural habits and attitudes, and it is increasingly recognized from the literature that people's attitudes can change for many reasons. On the other hand, conventional transportation models are based on econometrics and utility theory and do not explicitly include attitude. But attitude is essential for understanding people's behaviour and can conceptualize factors affecting travel behaviour. Attitudes, social norms and perceived behavioural control may mutually influence each other [8]. Therefore, the attitude toward travel behaviour can be defined as follows: the degree that a person has a favourable or unfavourable evaluation of his behaviour.

2.5 Safety

Travel literature usually distinguishes between traffic volume, modal split and traffic distribution over time. On the other hand, any decision resulting from travel behaviour is summarized to reach the intended goals. These decisions lead

to risk exposure when combined with traffic, and the safety literature on risk exposure against crime, especially in public transport, relates directly to travel behaviour [3].

3. OBJECTIVES

As we know, mobility patterns play an essential role in the efficiency of a city as a critical part of transportation. Mobility patterns, in combination with travel behaviour, can provide the communication requirements and conditions in the surrounding space. On the other hand, different groups of users have their own specific needs and different time and financial resources that can change their behaviour.

Therefore, due to the importance of the user's travel behaviour cycle and its impact on the mobility pattern, we considered the following goals:

- (1) Awareness of changes in the travel behaviour cycle
- (2) Knowing the factors affecting travel behaviour
- (3) How these factors affect the cycle of user behaviour changes

4. METHODOLOGY

The systematic literature review (SLR) method considers a hybrid literature review model and bibliometric analysis for quality analysis and synthesis of results. SLR is a fully scientific method that considers, without bias, the evaluation and interpretation of aspects related to a research topic or phenomenon of interest. This method provides a deeper understanding of the topic under discussion, and its analytical approach using quantitative analysis of publications and their bibliographic features provides a comprehensive review of the literature and development of the topic under discussion. Analysis in this way uses publication data such as title, authors, keywords, summary, references, documents and other items as parameters and enables network analysis such as visual maps. Table 1 shows how publications were selected.

Table 1. Methodological procedures

| Phase 1. Literature Identification |
|---|
| Criteria: |
| Time limit: Published until 2022 |
| Databases: Web of Science, Scopus |
| International English publication |
| Keywords: |
| Travel behaviour, Modal split, Social factors (Gender, Age, Household size...), Economic, Attitudes, Safety |
| Publications with DOI identifier and criterion mean, especially since 2012 |
| Phase 2. Selection of Eligible Literature |
| Criteria: |
| Approaches, Variables, methods, goals and study them |
| Phase 3. Search Results and Selection Procedure |
| Descriptive document using VOS viewer software |
| Phase 4. Review Analysis and Discussion |
| Overview, results |

4.1 Literature identification

According to the aforementioned method, searching for articles in the desired databases until 2022 has been considered; therefore, the articles that were in the same direction as the

research goal from 2012 were more attention. English language articles were used more because, as an international language in communication and the largest volume of attendance, they are often more important. In addition, the keywords listed in Table 1 were used to search the titles of publications and their abstracts. The bibliometric parameters of citations and DOI were also considered as selection criteria. The selection and results were obtained according to Table 2.

Table 2. Total number of publications by groups of keywords

| Filed | Primary Results | | Secondary Results | |
|---|-----------------|--------|-------------------|--------|
| | Web of Science | Scopus | Web of Science | Scopus |
| Characteristics of travel behaviour (Travel purpose, Travel distance, Travel time, Travel mode) | 7 | 4 | 3 | 2 |
| Built environment | 9 | 6 | 8 | 4 |
| Social factors (Gender, Age, Education and Household size, Social inequality) | 36 | 15 | 16 | 10 |
| Economic factor | 8 | 5 | 6 | 2 |
| Psychological factors (Attitudes) | 10 | 6 | 6 | 3 |
| Safety | 9 | 5 | 5 | 2 |
| TOTAL | 120 | | 62 | |

4.2 Selection of eligible literature

In the continuation of this process, according to the effective factors considered on the travel behaviour, the articles were selected and classified with the desired approaches, methods and variables.

4.3 Search results and selection procedure

Finally, descriptive analysis was performed by VOS viewer software. In the selected bibliographic analysis network, publications have been arranged in thematic clusters. In this case, the nodes represent the topic, and its dimension represents the number of citations of the article.

5. REVIEW ANALYSIS AND DISCUSSION

5.1 Overview

As mentioned in section 2, based on the literature, the factors affecting travel behaviour can be generalized to the following set:

- (1) Built environment and choosing a residential place
- (2) Social factors and demographic
- (3) Economic factor
- (4) Attitudes
- (5) Safety

The mentioned category is shown as a bibliographic network, according to Figure 1. 120 selected articles in the period from 1959 to 2022 were considered, especially the articles that have been published since 2012 in the area of the discussed topics.

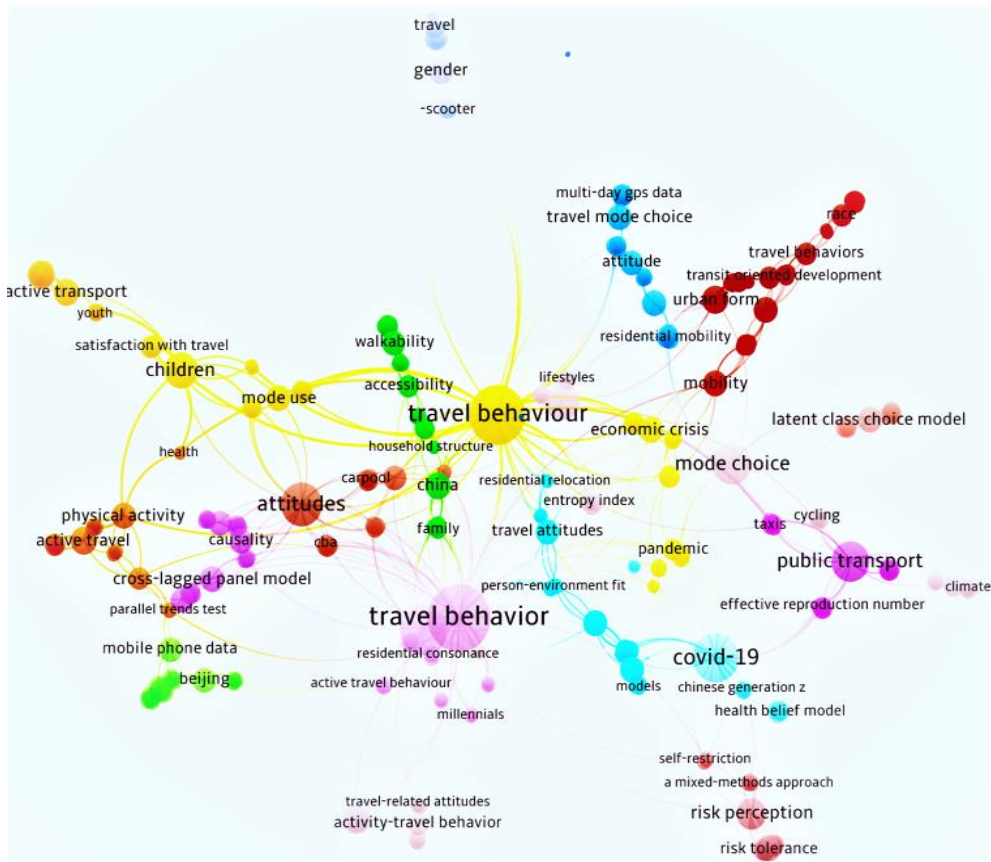


Figure 1. Bibliographic network
(Source: Authors, 2023)

5.2 Clusters

Among the 120 selected articles, 62 articles were separated and analyzed with more attention to the topic under discussion. Table 3 shows the final selected articles, which include the variables used for each cluster and the study methods and their approach (potential/utility).

Table 3. Approaches, methods and main data in travel behaviour studies

| |
|--|
| <p>Cluster 1: Built Environment, Choosing a Residential Place Main variables: Demographic, Spatial, geographic, traffic, travel, built environment, infrastructure data Approach Potential Utility Methods: GWR (Geographically weighted logistic regression), Moderation, Distance, Statical, SRMR (the standardized root mean square residual), RMSEA (The Root Mean Square Error of Approximation), CFI (the Comparative Fit Index), LMR (Linear multiple regression), OLS (ordinary least Squares), ATR (Active travel ratio), Last mile, NL (Nested Logit), MC (Monte Carlo method), SEM (structural equation Model), K-Means, Cross-Lagged Panel, Cohort approach [5, 9-16] [17-24]</p> |
| <p>Cluster 2: Social Factors, Demographic Main variables: Travel characteristics, Demographic, Travel patterns, Spatial, Transportation, Travel data, TAZ Approach Potential Utility Methods: MLR (Multiple linear regression), Multilevel linear mixed model, MNL (The multinomial logit), Clustering analysis, Binary Logistic</p> |

| |
|--|
| <p>Regression, RI-CLPM (three-wave random-intercept cross lagged panel model), Bivariate analysis, Multivariate regression, ATR, Correlation method Studies [4, 6, 25-41] [13, 19, 42-47]</p> |
| <p>Cluster 3: Economic Factor Main variables: Travel characteristics, Demographic, Habits, Travel data, Economic factor Approach Potential Utility Methods: Chi-Squared Test, MLR, MNL, T-test, Rho-Square model, Clustering method, SEM, DCM (discrete choice model) Studies [7, 25, 41, 48-51] [30, 52]</p> |
| <p>Cluster 4: Attitudes Main variables: Demographic, Travel and Behavioural parameters Approach Potential Utility Methods: Descriptive, Econometric, Statistic Analysis, Two-Wave panel, SEM, Probit model, Cohort approach, Cluster analysis Studies [15, 53-59] [37, 39, 40, 60, 61]</p> |
| <p>Cluster 5: Safety Main variables: Demographic, Travel criteria, Travel Behaviour Approach Potential Methods: MLR, ANN (Artificial Neural Network), IPA (Importance-Performance Analysis), Fidell's criteria, Cron-bach's alpha indicator Studies [62-66]</p> |

5.2.1 Built environment and choosing a residential place

Ewing and Cervero [67] summarize the empirical findings on the importance of the built environment in explaining people's travel behaviour as a significant predictor of vehicle miles travelled and determining the trip length and a vital mode choice factor. On the other hand, the results show that people tend to adjust their attitudes to the attitude of their built environment, including a little comment on proposed transit-oriented development. This supports some land use policies that aim to influence travel [19].

Research findings on different types of neighbourhoods in Beijing show significant differences in car ownership and time spent on outdoor activities, travel rates, and travel times. In addition, it indicates that the characteristics of the built environment have more important effects on the behaviour and activity of travel than its time [17]. It is also important to state that previous studies also show that the land use-transportation relationship changes for cities with different urban structures, and this indicates that the effects of the built environment on travel behaviour will change over time. The urbanization process will also affect the mobility culture that affects people's daily travel choices and their response to the built environment [12].

Based on the findings, it has been argued that the more people have access to public transportation, the more likely they are to drive less. This point is expressed based on the characteristics of the built environment, and its impact on car ownership is shown. Therefore, a lively social environment can reduce the amount of personal car travel based on the built environment [18].

But despite all the findings, some argue that the observed effects of the built environment and attention on travel behaviour could actually be due to personal preference. Therefore, the built environment may be the result of choices that are related to individual attitudes.

Importantly, moving to mixed areas has the potential to remove unwanted travel from the norm, such as frequent car use, and stimulate active and public travel. The extent to which residence is chosen based on travel preferences may also affect changes in travel behaviour, and after moving, if people themselves choose specific neighbourhoods based on preferences, it is likely that they will use the travel modes created by the new neighbourhood. use, if the choice is based on other elements unrelated to travel, such as affordability, housing characteristics, etc., mode switching may not occur or may not occur easily because residents' attitudes toward travel behaviour are stimulated by the new neighbourhood.

The findings show that based on the preferences of the neighbourhood and the residential location, the relationship between some characteristics of density measurement is moderated, and a significant difference is found in travel behaviour, which shows its impact on both the frequency and distance of travel. On the other hand, it has been shown that residents of neighbourhoods with a higher percentage of the green environment are more likely to understand neighbourhood stability than residents of neighbourhoods with a lower percentage of the green environment [9].

De Vos et al. [14] argue that travel attitudes often influence the choice of residential location and that both travel attitudes and travel mode choices change after relocation. Because attitudes can gradually change with the new situation of the residential environment.

Studies on residential self-selection also provide evidence of a statistically significant relationship between the built

environment and the impact of independent self-selection behaviour [26]. People who prefer to travel by car may be more inclined to live in the suburbs due to limited parking problems, while Cao et al. [15] show that people try to choose a location that enables them to make more satisfying trips. Give Recently, Wang and Lin [16], analyzing travel behaviour and attitudes before and after moving, stated that they did not find any significant effect of travel preferences before moving, but after moving, they show that the role of attitudes about the residential location is limited or at least uniform. Another study also shows that preferences often do not correspond to the chosen housing and the neighbourhood based on the attitude towards living in high density, travelling with alternatives to the car, and travelling by public transport, and a combination of travel and housing preferences has determined [14].

5.2.2 Social factors

(1) Gender

In recent decades, many efforts have been made to understand the gender patterns of travel behaviour in theory and practice. The dichotomy between the mobility patterns of women and men in developed and developing countries also has been observed according to the choice of travel mode, travel distance and frequency [40].

Women show less dependence on cars, and there is considerable evidence that women are much more active in using public transport than men. The findings also state that gender is an essential parameter in examining the user's travel behaviour and should be considered in the transportation policy in order to be able to respect equality in gender effects.

Due to the gender division of labour in the family, women often have multiple tasks and activities, and as a result, they are likely to experience different commuting distances and different chain trips.

Ng and Acker [4] state that women act differently from men in terms of choosing the mode and time of travel, and their travel has special characteristics, including the purpose, route, distance, justifications, and very different restrictions.

On the other hand, Levy [37] shows that women are more inclined to make chain trips during off-peak hours than men and states that they are most inclined to travel for the purposes of shopping and activities related to children.

Studies also consider lack of safety to be the strongest deterrent factor for women in choosing public transportation. Because the transportation services in some cities are still unsafe or considered. Research also shows that girls are more sensitive to the negative aspects of the environment, but when the choice of the travel mode is more important than the environmental effect, the gender contribution to the choice of the mode may change. The result that Zwerts et al. [38] reached.

(2) Age

Research shows that positive or negative critical events in the transportation environment can affect the travel behaviour of elderly and disabled users. They found that most problems occur in the physical environment of stations and cars and are related to ticket pricing. Therefore, better driving and better travel behaviour are considered key facilitators that improve predictability [39].

On the other hand, the importance of active trips based on age should not be neglected. Barnes et al. [20] note that access to transit and walking can support active travel behaviour in middle-aged and older adults, especially those for whom

walking may be important while still working.

Regarding children, it has been stated that they cannot act independently, and their behaviour affects the travel behaviour of their parents. The results show that children complete a behaviour pattern that is different according to their age, and the most important part of the trip for them is the social aspect [42].

These results are consistent with the results of Brown's research [68], which show that gender and age are closely related to each other and that girls give more importance to social aspects than boys. They also argue that the older they are, the more comfortable they understand the car, but the less they use it.

Other findings also show that travel behaviour in childhood is predictive of future behaviour, and supporting the key role of habit as a driver of travel behaviour should not be ignored. These findings indicate a paradigm shift in the theoretical understanding of theories of the determinants of travel behaviour, and it means that habits can be used as leverage points to change behaviour based on age [44].

It has been found that aging and related travel patterns are socially and culturally related. The results show that the elderly who live with their adult children tend to travel fewer and shorter distances. While they spend less time travelling than the elderly who live alone or as a couple, especially on leisure trips. On the other hand, young parents in extended families tend to travel longer in terms of distance and time [45].

(3) Household size and education

The results state that household structural elements play an important role in the travel behaviour of households that have more members and travel more total distance during their trips, and require a larger activity space. The presence of children in the family structure leads to more trips and more spatial dispersion, and complex changes in the family's travel pattern [29]. On the other hand, it has been stated that the effects of the built environment in this factor should not be ignored and can significantly differ between family members and based on the number of members [30].

Riggs and Sethi's [46] study show that the likelihood of walking and cycling depends more on factors such as household size, age, and the built environment and that cities may benefit from a better political effort that not only addresses issues related to the spatial activities of household members but also give special importance to more sustainable mobility and its promotion.

(4) Social inequality

Research results in the United Kingdom based on a modelling show important differences in household travel behaviours, income, presence of children, having a certificate and vulnerable groups and states that the inclusion of additional socio-economic variables to identify significant differences of social inequality in travel pattern and distance is very useful [42].

Foley et al. [47] also found similar results that individuals based on lower socioeconomic status face travel disparities and rely on walking and public transportation.

The research analyzes the mechanism of air pollution and attention to physical and mental health with the characteristics of travel behaviour. The findings show that the impact of pollution on health is significant and social inequalities in travel behaviour significantly affect its creation and the health of residents, and this result finally states that social equality and pollution can reduce the gap between the poor and the rich [16].

Research results in the city of Lyon show that residents of disadvantaged areas suffer more injuries from traffic accidents, and these inequalities are related to the contradictions of daily mobility conditions and socio-spatial inequality. It has been stated that travel distance is also strongly influenced by social status for all travel purposes, and according to this, social characteristics and inequality seem to be related to living in family and longer trips. The result that Scheiner [32] achieved.

5.2.3 Economic

The results of the research in the economic dimension showed that the effects of the economic crisis are more effective in limiting the use of cars compared to any type of sustainable mobility. However, households seem insecure based on their income and to maintain most of any mobility behaviour. In fact, it seems that his decision depends to a large extent on his economic conditions [50].

Participants in one study stated that they consider public transport more important than before. They attributed their main reason in part to personal car expenses and important variables related to reduced travel frequency, increased use of public transportation, and lower income. It was also shown that downtown residents were more active in terms of transportation during the economic crisis, perhaps due to easier access and reduced costs [50].

According to Vlastos [53], during the 2008 economic crisis, its consequences were observed with high intensity in such a way that citizens preferred to choose their residential location near city centers to have easier access to various destinations and the transportation network. These elections are mainly influenced by the financial crisis, politics and initiatives.

The findings based on the economic crisis experience in the field of transportation and the user's travel behaviour also show that changes in behaviour mean its relationship with household income, travel distance, and type of transportation. According to Lee's theory [51], the most significant changes related to travel are for purposes and activities that have existed for many other people and are now significantly reduced, such as work and shopping.

The relationship between income, vehicle ownership, and transportation use is relatively clear and universal. Studies report that household income has a direct relationship with vehicle ownership, and there have also been discussions about the negative relationship between the use of public transportation and income level on an individual and regional scale.

It should also be taken into account that low-income people are less mobile than other people. They tend to make fewer trips and shorter distances. However, their average travel time is longer than other people, and they make most of the trips to get to work activities or take their children to school, and they choose more sustainable mobility methods to get around. The results obtained by Guan and Wang [31].

5.2.4 Attitudes

Social psychologists tend to focus on the level of individual performance, which shows the processing of available and environmental information on behaviour and behavioural tendencies, such as social attitudes and personality traits, which play an important role in this case.

Attitudinal changes are important because, firstly, they affect travel behaviour and therefore include many social-related effects, and secondly, they can also be affected by evaluating effects such as the value of time and the value of

reliability. Accuracy in the attitude toward travel behaviour shows that mental norms and perceived behavioural control make a significant difference in actual behaviour, and these two are related to each other [57].

In his review article, De Vos [59] shows that travel behaviour research and recent empirical research on attitudes may change over time directly under the influence of behaviours and other factors such as the built environment. Therefore, according to its relationship with travel behaviour, studies consistently show that there are two-way effects between behaviours and attitudes.

This problem has been shown in the research of Kroesen et al. [61]. They argue that the use of a mode and the attitude towards its use mutually influence each other during the trip and found that people with inconsistent behaviour and attitudes show less stability in their travel behaviour.

On the other hand, Kalter et al. [62] also show that the changes in the frequency of using the mode have a stronger effect on the changes in preferences and attitudes. In addition, young adults who are exposed to life events are more likely to change their travel behaviour. The article by Van Wee et al. [54] also examines the reverse effect of the built environment and attitude and states that two issues prevail in this field. A change in attitude due to new preferences can be explained by learning theories, and a change in attitude due to a mismatch of attitudes and behaviour, smart cities and mobility, i.e. use of mobile to transport services, can be explained by psychological dissonance theories.

5.2.5 Safety

Research results show that fear of safety and security is one of the important factors in choosing a mode of transportation, especially for children. It has also been found that this factor seems to be more important in households with higher incomes because they can better have alternatives for mobility. Alex et al. [64] state that understanding current travel behaviour and developing sustainable and efficient traffic management measures to increase safety is only possible if studies in travel behaviour, especially educational sectors, and they also state that these behaviours are complex in nature and highly uncertain. On the other hand, the impact of new technologies in mobility and smart cities in creating changes in social behaviour and ensuring safety and security by providing more efficient and sustainable services should not be ignored. An option that is proposed as creating motivation and helps to understand its impact on the urban, social and economic environment [66].

6. CONCLUSION

Travel behaviour has generated important insights and challenged norms and assumptions. The results indicate that travel behaviour can show significant changes on a daily basis, and in terms of the degree of variability, the elements affecting it also show different characteristics and lead it out of the repetitive cycle and towards change. To give, travel behaviour is actually more focused on its location in the residential network, surrounding areas, available transportation and socio-economic conditions. However, as mentioned earlier, its modifiable trajectory should not be overlooked. In the meantime, Socio-economic and cultural characteristics are mentioned as the essential factors creating, changing and repeating the travel behaviour pattern. Therefore, discovering

general trends in user travel behaviour is a way to achieve more sustainable transportation and correct design, standard policies and appropriate to the prevailing conditions also are factors achieving it.

On the other hand, it is also necessary to know the decision-making factors in choosing the mode of transportation because of the effecting of many current or emerging issues in transportation, such as the elderly population, the existence of multiculturalism, communication and new technology.

REFERENCES

- [1] Webber, S.C., Porter, M.M., Menec, V.H. (2010). Mobility in older adults: A comprehensive framework. *The Gerontologist*, 50(4): 443-450. <https://doi.org/10.1093/geront/gnq013>
- [2] Mitchell, R.B., Rapkin, C. (1954). *Urban traffic: A function of land use*. Columbia University Press. New York. <https://doi.org/10.7312/mitc94522>
- [3] Pourramazani, H., Miralles-Garcia, J.L. (2022). Exploring the link between travel behaviour and sustainable mobility. *WIT Transactions on Ecology and the Environment* (Online), 260: 217-228. <https://doi.org/10.2495/SC220181>
- [4] Ng, W.S., Acker, A. (2018). Understanding urban travel behaviour by gender for efficient and equitable transport policies. *International Transport Forum Discussion Paper*. <https://doi.org/10.1787/eaf64f94-en>
- [5] Nkeki, F.N., Asikhia, M.O. (2019). Geographically weighted logistic regression approach to explore the spatial variability in travel behaviour and built environment interactions: Accounting simultaneously for demographic and socioeconomic characteristics. *Applied Geography*, 108: 47-63. <https://doi.org/10.1016/j.apgeog.2019.05.008>
- [6] Zhao, P., Liu, D., Yu, Z., Hu, H. (2020). Long commutes and transport inequity in China's growing megacity: New evidence from Beijing using mobile phone data. *Travel Behaviour and Society*, 20: 248-263. <https://doi.org/10.1016/j.tbs.2020.04.007>
- [7] Papagiannakis, A., Baraklianos, I., Spyridonidou, A. (2018). Urban travel behaviour and household income in times of economic crisis: Challenges and perspectives for sustainable mobility. *Transport Policy*, 65: 51-60. <https://doi.org/10.1016/j.tranpol.2016.12.006>
- [8] Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behaviour and Human Decision Processes*, 50(2): 179-211.
- [9] Haybatollahi, M., Czepkiewicz, M., Laatikainen, T., Kytä, M. (2015). Neighbourhood preferences, active travel behaviour, and built environment: An exploratory study. *Transportation Research Part F: Traffic Psychology and Behaviour*, 29: 57-69. <https://doi.org/10.1016/j.trf.2015.01.001>
- [10] Van Goeverden, C.D., De Boer, E. (2013). School travel behaviour in the Netherlands and Flanders. *Transport Policy*, 26: 73-84. <https://doi.org/10.1016/j.tranpol.2013.01.004>
- [11] Zhou, M., Wang, D., Guan, X. (2022). Co-evolution of the built environment and travel behaviour in Shenzhen, China. *Transportation Research Part D: Transport and Environment*, 107: 103291. <https://doi.org/10.1016/j.trd.2022.103291>

- [12] Klinger, T., Lanzendorf, M. (2016). Moving between mobility cultures: What affects the travel behavior of new residents? *Transportation*, 43: 243-271. <https://doi.org/10.1007/s11116-014-9574-x>
- [13] Song, Y., Preston, J.M., Brand, C. (2013). What explains active travel behaviour? Evidence from case studies in the UK. *Environment and Planning A*, 45(12): 2980-2998. <https://doi.org/10.1068/a4669>
- [14] De Vos, J., Ettema, D., Witlox, F. (2018). Changing travel behaviour and attitudes following a residential relocation. *Journal of Transport Geography*, 73: 131-147. <https://doi.org/10.1016/j.jtrangeo.2018.10.013>
- [15] Cao, Z., Zhang, X., Chua, K., Yu, H., Zhao, J. (2021). E-scooter sharing to serve short distance transit trips: A Singapore case. *Transportation Research Part A: Policy and Practice*, 147: 177-196. <https://doi.org/10.1016/J.TRA.2021.03.004>
- [16] Wang, D., Lin, T. (2019). Built environment, travel behavior, and residential self-selection: A study based on panel data from Beijing, China. *Transportation*, 46(1): 51-74. <https://doi.org/10.1007/s11116-017-9783-1>
- [17] Wang, D., Chai, Y., Li, F. (2011). Built environment diversities and activity-travel behaviour variations in Beijing, China. *Journal of Transport Geography*, 19(6): 1173-1186. <https://doi.org/10.1016/j.jtrangeo.2011.03.008>
- [18] van de Coevering, P., Maat, K., Kroesen, M., van Wee, B. (2016). Causal effects of built environment characteristics on travel behaviour: A longitudinal approach. *European Journal of Transport and Infrastructure Research*, 16(4). <https://doi.org/10.18757/ejtir.2016.16.4.3165>
- [19] Broberg, A., Sarjala, S. (2015). School travel mode choice and the characteristics of the urban built environment: The case of Helsinki, Finland. *Transport Policy*, 37: 1-10. <https://doi.org/10.1016/j.tranpol.2014.10.011>
- [20] Barnes, R., Winters, M., Ste-Marie, N., McKay, H., Ashe, M.C. (2016). Age and retirement status differences in associations between the built environment and active travel behaviour. *Journal of Transport & Health*, 3(4): 513-522. <https://doi.org/10.1016/j.jth.2016.03.003>
- [21] Hickman, R., Vecia, G. (2016). Discourses, travel behaviour and the last mile in London. *Built Environment*, 42(4): 539-553. <https://doi.org/10.2148/benv.42.4.539>
- [22] Bao, J., Xu, C., Liu, P., Wang, W. (2017). Exploring bikesharing travel patterns and trip purposes using smart card data and online point of interests. *Networks and Spatial Economics*, 17: 1231-1253. <https://doi.org/10.1007/s11067-017-9366-x>
- [23] Aditjandra, P.T., Cao, X.J., Mulley, C. (2012). Understanding neighbourhood design impact on travel behaviour: An application of structural equations model to a British metropolitan data. *Transportation Research Part A: Policy and Practice*, 46(1): 22-32. <https://doi.org/10.1016/j.tra.2011.09.001>
- [24] Holz-Rau, C., Scheiner, J., Sicks, K. (2014). Travel distances in daily travel and long-distance travel: What role is played by urban form? *Environment and Planning A*, 46(2): 488-507. <https://doi.org/10.1068/a4640>
- [25] Naess, P. (2014). Tempest in a teapot: The exaggerated problem of transport-related residential self-selection as a source of error in empirical studies. *Journal of Transport and Land Use*, 7(3): 57-79. <https://doi.org/10.5198/jtlu.v7i3.491>
- [26] Zhang, N., Jia, W., Wang, P., Dung, C.H., Zhao, P., Leung, K., Su, B., Cheng, R., Li, Y. (2021). Changes in local travel behaviour before and during the COVID-19 pandemic in Hong Kong. *Cities*, 112: 103139. <https://doi.org/10.1016/j.cities.2021.103139>
- [27] Cubells, J., Miralles-Guasch, C., Marquet, O. (2023). Gendered travel behaviour in micromobility? Travel speed and route choice through the lens of intersecting identities. *Journal of Transport Geography*, 106: 103502. <https://doi.org/10.1016/j.jtrangeo.2022.103502>
- [28] Pourhashem, G., Buzna, L., Kováčiková, T., Hudák, M. (2019). Exploring women travel behaviour in the region of Žilina from large scale mobility survey. In *Reliability and Statistics in Transportation and Communication: Selected Papers from the 18th International Conference on Reliability and Statistics in Transportation and Communication, RelStat' 18*, 17-20 Oct. 2018, Riga, Springer International Publishing. Latvia, 18, pp. 105-120. https://doi.org/10.1007/978-3-030-12450-2_10
- [29] El-Geneidy, A.M., Manaugh, K. (2012). What makes travel 'local': Defining and understanding local travel behaviour. *Journal of Transport and Land Use*, 5: 15-27. <https://doi.org/10.5198/jtlu.v5i3.300>
- [30] Yang, S., Fan, Y., Deng, W., Cheng, L. (2019). Do built environment effects on travel behavior differ between household members? A case study of Nanjing, China. *Transport Policy*, 81: 360-370. <https://doi.org/10.1016/j.tranpol.2017.12.006>
- [31] Guan, X., Wang, D. (2019). Residential self-selection in the built environment-travel behavior connection: Whose self-selection? *Transportation Research Part D: Transport and Environment*, 67: 16-32. <https://doi.org/10.1016/j.trd.2018.10.015>
- [32] Scheiner, J. (2010). Social inequalities in travel behaviour: Trip distances in the context of residential self-selection and lifestyles. *Journal of Transport Geography*, 18(6): 679-690. <https://doi.org/10.1016/j.jtrangeo.2009.09.002>
- [33] Allen, J., Palm, M., Tiznado-Aitken, I., Farber, S. (2022). Inequalities of extreme commuting across Canada. *Travel Behaviour and Society*, 29: 42-52. <https://doi.org/10.1016/j.tbs.2022.05.005>
- [34] Veterník, M., Gogola, M. (2017). Examining of correlation between demographic development of population and their travel behaviour. *Procedia Engineering*, 192: 929-934. <https://doi.org/10.1016/j.proeng.2017.06.160>
- [35] Bradley, M., Greene, E., Spitz, G., Coogan, M., McGuckin, N. (2018). The millennial question: Changes in travel behaviour or changes in survey behaviour? *Transportation Research Procedia*, 32: 291-300. <https://doi.org/10.1016/j.trpro.2018.10.053>
- [36] Adetunji, M.A. (2013). Gender travel behaviour and women mobility constraints in Ilesa, Nigeria. *International Journal for Traffic & Transport Engineering*, 3(2). [http://dx.doi.org/10.7708/ijtte.2013.3\(2\).09](http://dx.doi.org/10.7708/ijtte.2013.3(2).09)
- [37] Levy, C. (2013). Travel choice reframed: "Deep distribution" and gender in urban transport. *Environment and Urbanization*, 25(1): 47-63. <https://doi.org/10.1177/0956247813477810>

- [38] Zwerts, E., Allaert, G., Janssens, D., Wets, G., Witlox, F. (2010). How children view their travel behaviour: A case study from Flanders (Belgium). *Journal of Transport Geography*, 18(6): 702-710. <https://doi.org/10.1016/j.jtrangeo.2009.10.002>
- [39] Sundling, C., Nilsson, M.E., Hellqvist, S., Pendrill, L.R., Emardson, R., Berglund, B. (2016). Travel behaviour change in old age: The role of critical incidents in public transport. *European Journal of Ageing*, 13: 75-83. <https://doi.org/10.1007/s10433-015-0358-8>
- [40] MacInnes, S., Ong, F., Dolnicar, S. (2022). Travel career or childhood travel habit? Which better explains adult travel behaviour?. *Annals of Tourism Research*, 95: 103413. <https://doi.org/10.1016/j.annals.2022.103413>
- [41] Feng, J., Dijst, M., Wissink, B., Prillwitz, J. (2013). The impacts of household structure on the travel behaviour of seniors and young parents in China. *Journal of Transport Geography*, 30: 117-126. <https://doi.org/10.1016/j.jtrangeo.2013.03.008>
- [42] Lucas, K., Bates, J., Moore, J., Carrasco, J.A. (2016). Modelling the relationship between travel behaviours and social disadvantage. *Transportation Research Part A: Policy and Practice*, 85: 157-173. <https://doi.org/10.1016/j.tra.2016.01.008>
- [43] Huang, Y., Gao, L., Ni, A., Liu, X. (2021). Analysis of travel mode choice and trip chain pattern relationships based on multi-day GPS data: A case study in Shanghai, China. *Journal of Transport Geography*, 93: 103070. <https://doi.org/10.1016/j.jtrangeo.2021.103070>
- [44] Simićević, J., Milosavljević, N., Djoric, V. (2016). Gender differences in travel behaviour and willingness to adopt sustainable behaviour. *Transportation Planning and Technology*, 39(5): 527-537. <https://doi.org/10.1080/03081060.2016.1174367>
- [45] Kattiyapornpong, U., Miller, K.E. (2009). Socio-demographic constraints to travel behavior. *International Journal of Culture, Tourism and Hospitality Research*, 3(1): 81-94. <https://doi.org/10.1108/17506180910940360>
- [46] Riggs, W., Sethi, S.A. (2020). Multimodal travel behaviour, walkability indices, and social mobility: How neighbourhood walkability, income and household characteristics guide walking, biking & transit decisions. *Local Environment*, 25(1): 57-68. <https://doi.org/10.1080/13549839.2019.1698529>
- [47] Foley, L., Brugulat-Panés, A., Woodcock, J., Govia, I., Hambleton, I., Turner-Moss, E., Mogo, E.R.I., Awinja, A.C., Dambisya, P.M., Matina, S.S., Micklesfield, L., Karim, S.A., Ware, L.J., Tulloch-Reid, M., Assah, F., Pley, C., Bennett, N., Pujol-Busquets, G., Okop, K., Anand, T., Mba, C.M., Kwan, H., Mukoma, G., Anil, M., Tatah, L., Randall, L. (2022). Socioeconomic and gendered inequities in travel behaviour in Africa: Mixed-method systematic review and meta-ethnography. *Social Science & Medicine*, 292: 114545. <https://doi.org/10.1016/j.socscimed.2021.114545>
- [48] Ding, C., Wang, D., Liu, C., Zhang, Y., Yang, J. (2017). Exploring the influence of built environment on travel mode choice considering the mediating effects of car ownership and travel distance. *Transportation Research Part A: Policy and Practice*, 100: 65-80. <https://doi.org/10.1016/j.tra.2017.04.008>
- [49] Tirachini, A., del Rio, M. (2019). Ride-hailing in Santiago de Chile: Users' characterisation and effects on travel behaviour. *Transport Policy*, 82: 46-57. <https://doi.org/10.1016/j.tranpol.2019.07.008>
- [50] Ulfarsson, G.F., Steinbrenner, A., Valsson, T., Kim, S. (2015). Urban household travel behavior in a time of economic crisis: Changes in trip making and transit importance. *Journal of Transport Geography*, 49: 68-75. <https://doi.org/10.1016/j.jtrangeo.2015.10.012>
- [51] Lee, S. (2010). Transport and the recession: An opportunity to promote sustainable transport. *International Planning Studies*, 15(3): 213-226. <https://doi.org/10.1080/13563475.2010.509475>
- [52] Cheng, L., Bi, X., Chen, X., Li, L. (2013). Travel behavior of the urban low-income in China: Case study of Huzhou City. *Procedia-Social and Behavioral Sciences*, 96: 231-242. <https://doi.org/10.1016/j.sbspro.2013.08.030>
- [53] Vlastos, T. (2007). Athens and public transport: Past, present and future (in Greek). In *Horse-Buses Metro: 170 Years Public Transport. Athens, Piraeus Suburbs: Militos*.
- [54] Van Wee, B., De Vos, J., Maat, K. (2019). Impacts of the built environment and travel behaviour on attitudes: Theories underpinning the reverse causality hypothesis. *Journal of Transport Geography*, 80: 102540. <https://doi.org/10.1016/j.jtrangeo.2019.102540>
- [55] Chen, C.F., Lai, W.T. (2011). The effects of rational and habitual factors on mode choice behaviors in a motorcycle-dependent region: Evidence from Taiwan. *Transport Policy*, 18(5): 711-718. <https://doi.org/10.1016/j.tranpol.2011.01.006>
- [56] Singh, V., Gupta, K., Agarwal, A., Chakrabarty, N. (2022). Psychological impacts on the travel behaviour post Covid-19. *Asian Transport Studies*, 8: 100087. <https://doi.org/10.1016/j.eastsj.2022.100087>
- [57] van Wee, B., Kroesen, M. (2022). Attitude changes, modelling travel behaviour, and ex ante project evaluations. *Transportation Research Interdisciplinary Perspectives*, 16: 100724. <https://doi.org/10.1016/j.trip.2022.100724>
- [58] Neuburger, L., Egger, R. (2021). Travel risk perception and travel behaviour during the COVID-19 pandemic 2020: A case study of the DACH region. *Current Issues in Tourism*, 24(7): 1003-1016. <https://doi.org/10.1080/13683500.2020.1803807>
- [59] De Vos, J. (2022). The shifting role of attitudes in travel behaviour research. *Transport Reviews*, 42(5): 573-579. <https://doi.org/10.1080/01441647.2022.2078537>
- [60] Zanni, A.M., Ryley, T.J. (2015). The impact of extreme weather conditions on long distance travel behaviour. *Transportation Research Part A: Policy and Practice*, 77: 305-319. <https://doi.org/10.1016/j.tra.2015.04.025>
- [61] Kroesen, M., Handy, S., Chorus, C. (2017). Do attitudes cause behavior or vice versa? An alternative conceptualization of the attitude-behavior relationship in travel behavior modeling. *Transportation Research Part A: Policy and Practice*, 101: 190-202. <https://doi.org/10.1016/j.tra.2017.05.013>
- [62] Kalter, M.J.O., Puello, L.L.P., Geurs, K.T. (2021). Exploring the relationship between life events, mode preferences and mode use of young adults: A 3-year cross-lagged panel analysis in the Netherlands. *Travel Behaviour and Society*, 24: 195-204. <https://doi.org/10.1016/j.tbs.2021.04.004>
- [63] Ikeda, E., Mavoa, S., Cavadino, A., Carroll, P., Hinckson, E., Witten, K., Smith, M. (2020). Keeping kids safe for

- active travel to school: A mixed method examination of school policies and practices and children's school travel behaviour. *Travel Behaviour and Society*, 21: 57-68. <https://doi.org/10.1016/j.tbs.2020.05.008>
- [64] Alex, A.P., Manju, V.S., Isaac, K.P. (2019). Modelling of travel behaviour of students using artificial intelligence. *Archives of Transport*, 51. <http://dx.doi.org/10.5604/01.3001.0013.6159>
- [65] Behrens, R., Jobanputra, R. (2013). The impact of traffic safety and crime on travel behaviour and attitudes in Cape Town: A review of empirical evidence. *Safety, Sustainability and Future Urban Transport* (New Delhi: Eicher Goodearth).
- [66] Khansari, N., Mostashari, A., Mansouri, M. (2014). Impacting sustainable behavior and planning in smart city. *International Journal of Sustainable Land Use and Urban Planning*, 1(2): 46-61.
- [67] Ewing, R., Cervero, R. (2001). Travel and the built environment: A synthesis. *Transportation Research Record*, 1780(1): 87-114. <https://doi.org/10.3141/1780-10>
- [68] Brown, B., Mackett, R., Gong, Y., Kitazawa, K., Paskins, J. (2008). Gender differences in children's pathways to independent mobility. *Children's Geographies*, 6(4): 385-401. <https://doi.org/10.1080/14733280802338080>