

Project Group 5 - Long-Term Trends in Travel Behavior in the Netherlands

Members: Djura Been, Daan Boitelle, Marit van Wolffelaar, Lisa Franse en Jord Stubbé

Student numbers: 4954734, 5403731, 5646057, 5615666 en 5617553

Link to the GitHub repository: <https://github.com/maritvw/projectgroup5>

Research Objective

The objective of this research is to analyze travel patterns, modal split and mobility preferences in the Netherlands between 2018 and 2023, to explore how these patterns have evolved and to identify factors driving these changes.

Subquestion 1: Trend analysis by travel modes

"How has the share of each mode of travel, such as car, public transport, cycling and walking, changed in the Netherlands between 2018 and 2023?"

Subquestion 2: Regional differences

"How do preferences for different modes of travel vary across provinces, for example between the Randstad and non-Randstad regions?"

Subquestion 3: Trend analysis by travel motives

"How do travel motives such as work, education, leisure, and shopping vary by travel modes and how have these patterns changed over time?"

1. Introduction

Over the last couple of years, the world has undergone a lot of changes. The beginning and ending of the COVID-19 pandemic caused tremendous impact on the public transport system and on travel behaviour in general. Furthermore, shifts in technology and societal habits have influenced why and how people move from A to B. To better understand these changes, this study examines the long-term trends in travel patterns, modal preferences, and mobility choices in the Netherlands between 2018 and 2023.

This report researches how the use of different modes of transport have changed over time and if this varies in the different provinces of the Netherlands and the travel purposes. By

analyzing data from the Centraal Bureau voor Statistiek, which provides detailed statistics on trips, distances, and travel times, the aim is to identify the underlying factors driving these trends. The findings will offer insights into the trends of mobility use in the Netherlands, helping to inform future transport planning and policy decisions.

2. Analysis of Travel Modes

Figure 2.1 illustrates the share of each mode of travel in relation to the total number of trips over the period 2018–2023. In the Netherlands, the bicycle remains the most dominant mode of transport in the long term, exhibiting only minor fluctuations over the observed period. This stability reflects the country's deeply embedded cycling culture, supported by extensive infrastructure. The use of the car showed a slight decline during the COVID-19 pandemic, primarily as a consequence of the widespread shift to working from home (Bakker & Moorman, 2021). Since 2022, however, car use has gradually increased again. Overall, car dependency remains structurally stable, indicating that the private car continues to play a central role in Dutch mobility patterns despite sustainability concerns. The train experienced a substantial reduction in ridership during the pandemic due to the rise in remote working practices (Kroesen et al., 2023). This behavioural change appears to be structural rather than temporary. Although train use has shown signs of recovery since 2022, levels have not yet returned to those recorded before 2019.

Similarly, bus, tram, and metro modes experienced a significant decline in passenger numbers during the pandemic (Bakker & Moorman, 2021). Recovery has been gradual, and usage levels remain below those of 2019. This trend suggests a broader shift away from collective modes of transport, particularly for commuting purposes. The share of walking increased during the pandemic, likely as a substitute for other travel modes and as a leisure activity. After 2021, walking levels decreased slightly but remained higher than before the pandemic, suggesting a modest, lasting behavioural change (Bakker & Moorman, 2021). In conclusion, the bicycle and the car continue to constitute the structurally dominant modes of transport in the Netherlands, while public transport modes are still in a phase of gradual recovery from the pandemic's long-term effects.

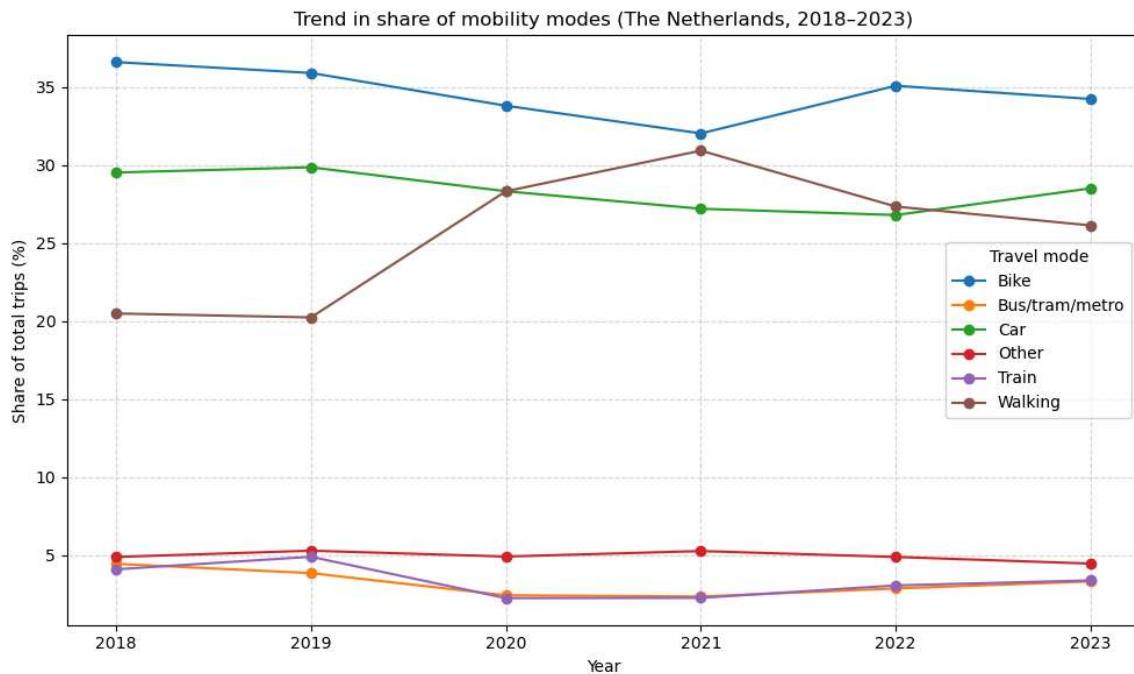


Figure 2.1: Trend in the share of mobility modes of total trips between 2018 and 2023

3. Analysis of Regional Differences

For the transportation modes bike, bus/tram/metro, car, train, walking and other categories, the percentage of trips made with each mode was analyzed across the provinces. Six bar plots were created to visualize and compare these differences, and these are presented in Figures 3.1 to 3.6. Since the y-axis scale varies between plots, this should be taken into account when assessing the magnitude of differences among provinces. Additionally, data on bus/tram/metro usage were unavailable for the provinces of Drenthe, Friesland, Overijssel, and Zeeland. Train usage data were also missing for Drenthe and Zeeland, and are therefore not shown in the plots.

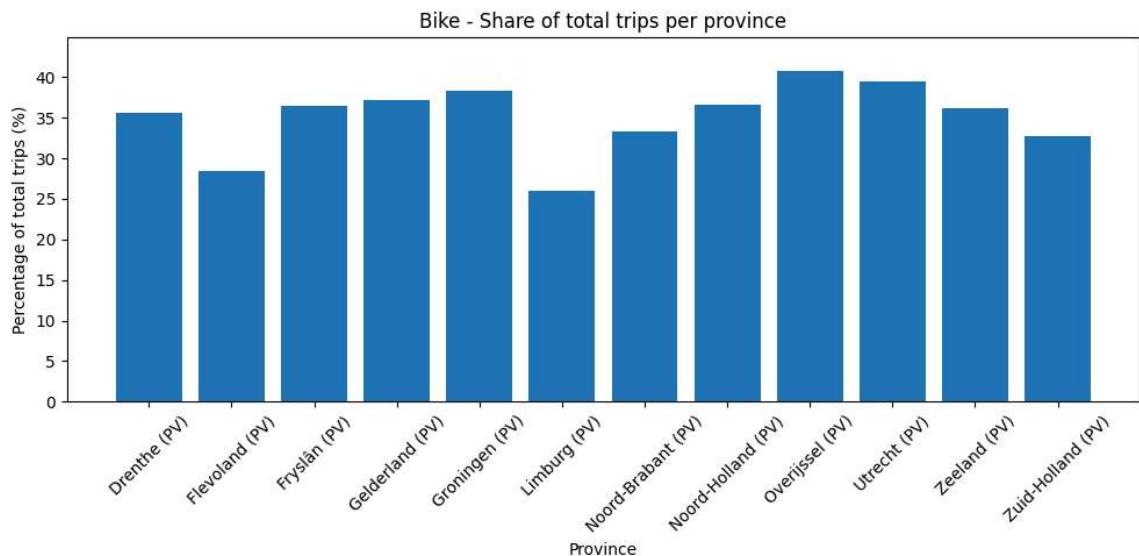


Figure 3.1: Share of trips by bike within total trips across all provinces

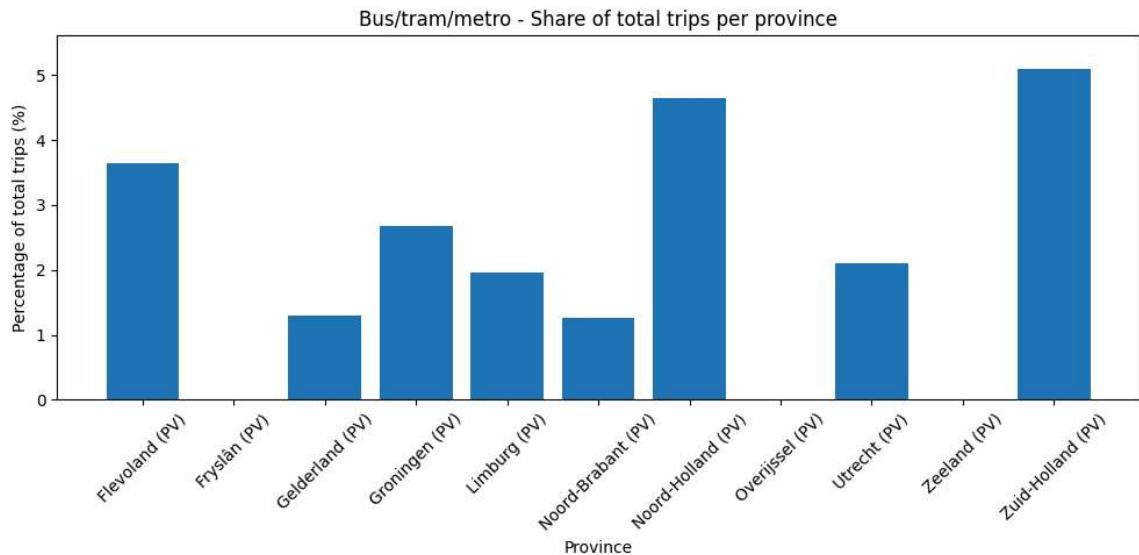


Figure 3.2: Share of trips by bus/tram/metro within total trips across all provinces

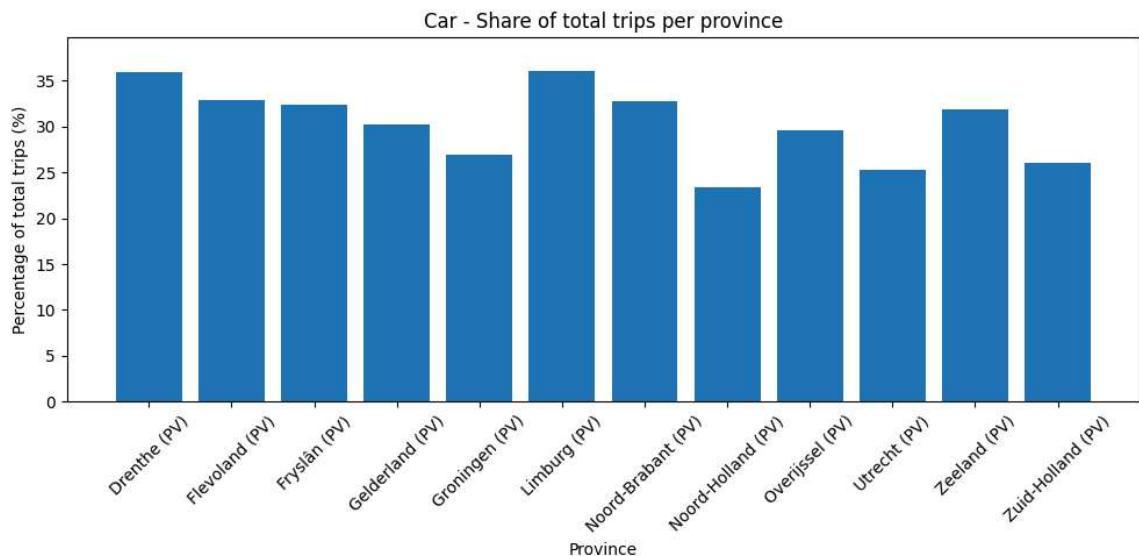


Figure 3.3: Share of trips by car within total trips across all provinces

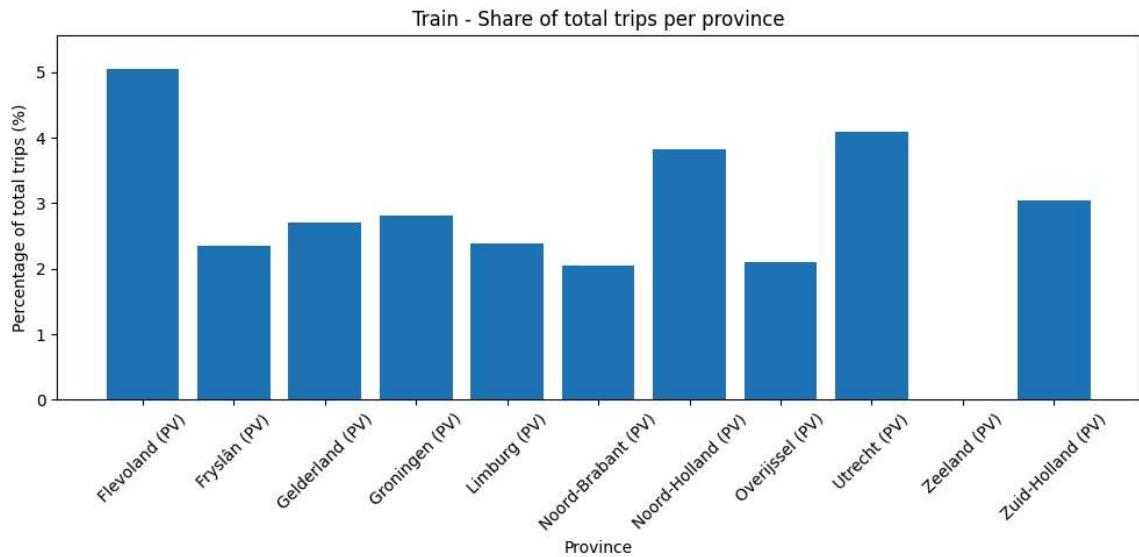


Figure 3.4: Share of trips by train within total trips across all provinces

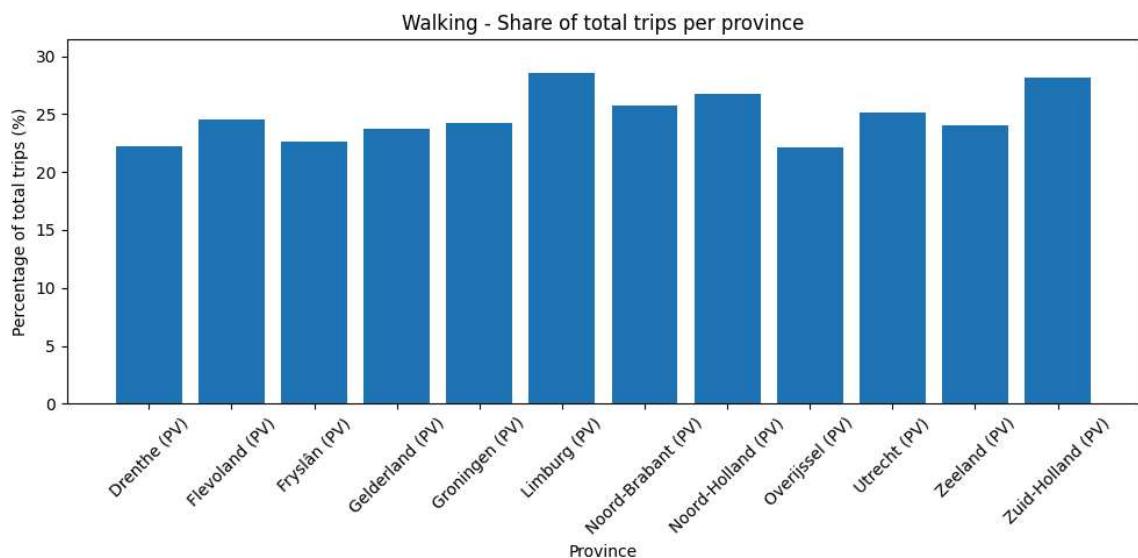


Figure 3.5: Share of trips by walking within total trips across all provinces

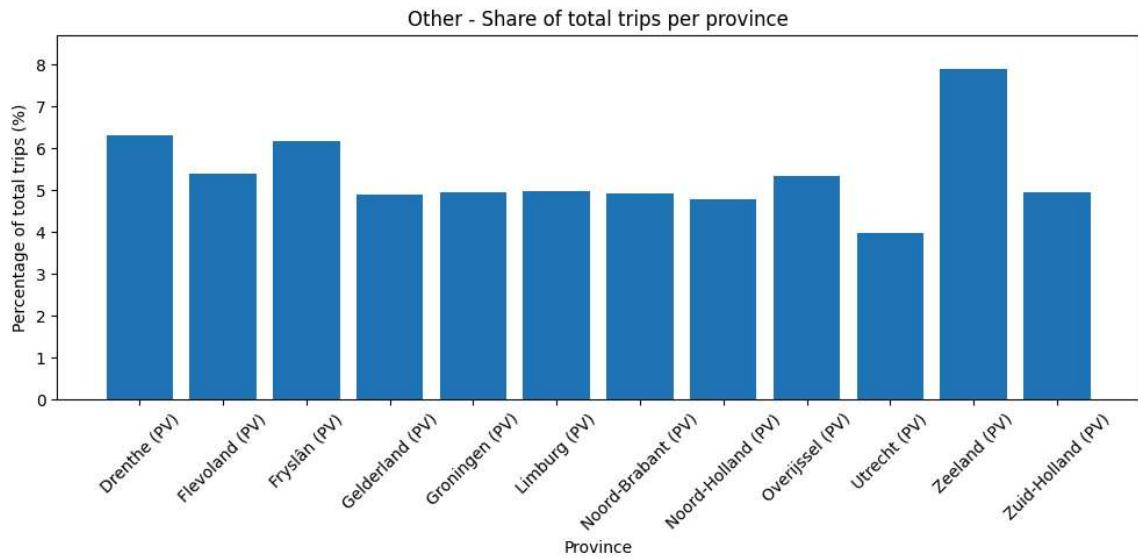


Figure 3.6: Share of trips by other modes of travel within total trips across all provinces

To make comparison of the model split across different provinces easier, a stacked bar plot was also created, as shown in Figure 3.7. The bar plot is stacked to display the proportions of each travel mode per province, summing up to 100% for each province. As mentioned earlier, data for Drenthe, Friesland, Overijssel, and Zeeland is missing, so not all travel modes are shown for each province.

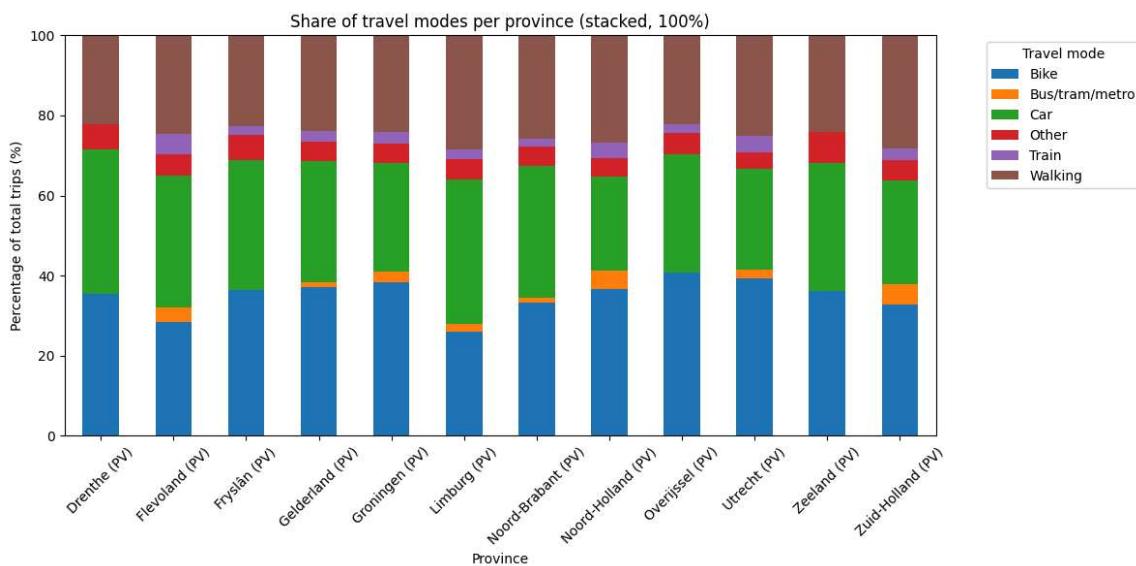


Figure 3.7: Stacked bar plot showing the share of travel modes per province

From the Figures 3.1 to 3.7, it can be observed that the distribution of transport mode use is relatively similar across all provinces. Cars and bicycles account for the largest shares everywhere, while 'train', 'bus/tram/metro', and 'other modes' consistently represent smaller proportions. Car travel is most prevalent in Flevoland, Drenthe, Limburg and Zeeland, while provinces in the Randstad region such as Utrecht, North Holland and South Holland tend to have higher use of public transport.

A possible explanation is that residents of more rural areas tend to travel longer distances on average than those in urban areas, making them more dependent on cars and less likely to use public transport or other travel modes (Jorritsma et al., 2023). Interestingly, the average number of train trips per person is highest in Flevoland among all provinces. Differences in modal choice between provinces have not been extensively studied, so no specific source was available to explain this finding. However, a plausible explanation is Flevoland's excellent accessibility by train to the north of the Netherlands, Amsterdam, and Utrecht. The Hanzelijn railway, connecting Flevoland and Zwolle, is the most important railway connection between the northern Randstad and the north of the Netherlands (Van Vulpen, n.d.).

Other research has highlighted that the availability of transport modes and the degree of urban density strongly influence people's mode choice (Ton et al., 2020). In high-density cities, public transport is widely available and therefore used more frequently. In medium-sized cities, the availability of public transport is more limited and consequently less utilized. In rural areas, public transport is often scarce and difficult to access, leading residents to rely more on other modes of transport, such as the car. However, it should be noted that in this dataset, data on bus/tram/metro use are not available for the more rural provinces of Drenthe, Friesland, Overijssel, and Zeeland.

Bicycle use is relatively high in Groningen, Friesland, Utrecht, Gelderland, and North Holland. These provinces are urban or semi-urban, where travel distances are generally short enough

to make cycling a convenient option.

4. Analysis of Travel Motives

Figure 4.1 below presents the trends in the use of different modes of travel depending on travel purpose over the period 2018-2023.

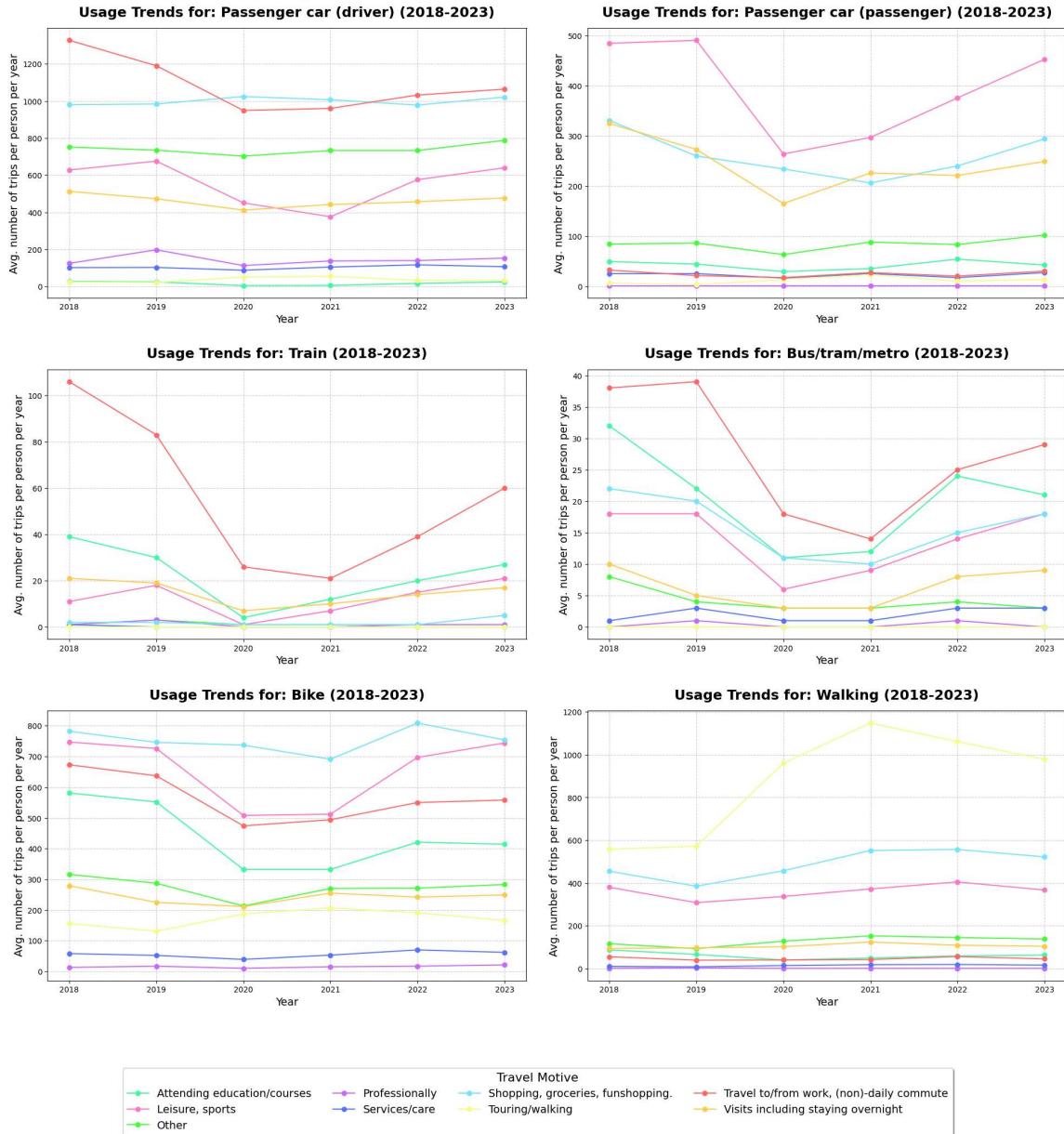


Figure 4.1: Trends in travel motives for each travel mode

Firstly, the average number of walking trips per person per year for touring increased sharply during the pandemic and has since stayed at a structurally high level, indicating a lasting embrace of individual physical activities. Similarly, cycling for these recreational purposes has also increased a little. The walking trend for shopping also experienced a small increase. While at a lower absolute level, it also shows this pattern of being maintained at a relatively

high level after the initial pandemic period, indicating that people continued to prefer walking for short trips. Cycling for commuting rebounded after 2020 but, like driving, has not fully returned to its previous levels, due to changes in work culture.

This trend is shown in the amount of trips made for work purposes. For almost all the modes, this decreased a lot during COVID-19. This is logical, since many people were not able to go to their jobs during these times and worked from home. However, after the pandemic ended, the amount of trips for work increased but did not go back to their original state. This is mainly because the culture surrounding work has permanently shifted. The trend in the graphs is reflecting the adoption of more hybrid work environments where people work partly from home, partly on-site. The widespread adoption of remote work has evolved into a lasting acceptance of employees splitting their time between the office and home. What was once a temporary necessity has now become a standard practice for many companies. As a result, the traditional five-day commute is no longer the norm, leading to a structurally lower number of work-related trips even after all restrictions were lifted (Breukelen, 2021). The graphs in Figure 4.1 clearly illustrate this "new normal" for commuting.

5. Conclusion

This research analyzed long-term trends in travel behavior in the Netherlands between 2018 and 2023, revealing significant structural changes in mobility patterns largely influenced by the COVID-19 pandemic and evolving work practices.

Travel Mode Evolution

The bicycle and car remain the dominant modes of transport in the Netherlands, demonstrating remarkable resilience throughout the study period. While bicycle use showed only minor fluctuations, maintaining its position as the most popular transport mode, car usage experienced a temporary decline during the pandemic but has since recovered to near pre-pandemic levels. In contrast, public transport modes (train, bus, tram, and metro) suffered substantial ridership losses during COVID-19 and have shown only gradual recovery, indicating a potential structural shift away from collective transport.

Regional Variations

Clear geographical patterns emerge in transport preferences across Dutch provinces. Rural provinces such as Flevoland, Drenthe, Limburg, and Zeeland show higher car dependency, while Randstad provinces (Utrecht, North Holland, South Holland) demonstrate greater reliance on public transport and cycling. These differences reflect the influence of urban density, infrastructure availability, and travel distance requirements on modal choice.

Travel Purpose Transformation

The most pronounced changes occurred in work-related travel patterns. The pandemic accelerated the adoption of remote and hybrid working arrangements, resulting in a permanent reduction in commuting trips across all transport modes. Conversely, leisure and recreational travel, particularly walking for shopping and touring purposes, increased significantly and remained elevated even after pandemic restrictions ended, suggesting a lasting shift toward local, individual mobility activities.

Implications

The findings indicate that the Netherlands is experiencing a "new normal" in mobility characterized by reduced commuting, sustained recreational travel, and a gradual recovery of public transport. These structural changes have important implications for transport planning, infrastructure investment, and sustainability policies. The resilience of cycling and the partial shift toward local mobility present opportunities for sustainable transport development, while the challenges facing public transport recovery require targeted policy interventions.

Contribution Statement

All members contributed actively to the project. The data for this research was selected collaboratively, and the relevant background material was reviewed together. The research questions were formulated together, after which the tasks were divided among the members. Throughout the process, members supported each other, and results were discussed. The final report was written and revised collectively to ensure both clarity and accuracy.

Djura Beenen:

- Analysis and visualisation for subquestion 3
- Writing report paragraph for introduction and subquestion 3

Daan Boitelle:

- Obtaining data and cleaning steps for further analysis
- Wrote data used, data pipeline, general contribution statement and Research Objective.
- Overall layout (titles, figures and references), organising files and folders (Github) and wrote README.

Marit van Wolffelaar:

- Data processing, analysis and visualisation for subquestion 2.
- Writing report for subquestion 2.

Lisa Franse:

- Data processing, analysis and visualisation for subquestion 1.
- Writing report for subquestion 1.

Jord Stubbé:

- Writing and optimizing data cleanser, data used and data pipeline.
- Conclusion.

Data Used

The dataset from CBS StatLine provides detailed statistics on mobility patterns in the Netherlands. It includes data on the average number of trips, distance traveled, and time spent per person per day or year, categorized by mode of travel, purpose of travel, and region. This dataset is valuable for analyzing trends in transportation behavior across different provinces and for various travel purposes. The dataset can be found in the CBS StatLine database through the following link:

<https://opendata.cbs.nl/statline/#/CBS/en/dataset/84710ENG/table?ts=1759132886441>

Before cleaning the dataset, a set of filters was applied to include only the relevant observations.

Applied data filters:

- Population: Population 6 years or older
- Margins: Value
- Travel motives: All
- Travel modes: All
- Periods: 2018, 2019, 2020, 2021, 2022, and 2023
- Region characteristics: The Netherlands & Provinces
- Topic: Average per person per year

These filters restrict the dataset to individuals aged six years and older and cover all travel purposes and modes of transport. The dataset reports the average per person per year for 2018–2023, disaggregated by the Netherlands and its provinces.

Data Pipeline

The data are obtained from CBS StatLine in the form of a CSV file. Using Python, the data were loaded into a Pandas DataFrame, followed by a series of cleaning steps to prepare it for further analysis. First, numeric formats were standardized by replacing commas used as a decimal separator with a dot. Next, any unused or irrelevant columns were dropped to simplify the table. Then, columns were renamed with more meaningful and descriptive names.

The cleaned DataFrame was saved to a new CSV file for downstream analysis. Subsequently, the cleaned dataset was used to answer each subquestion. Relevant subsets were filtered and processed using Python to generate visualizations. The analysis covers the period 2018–2023, and conclusions are drawn on the basis of the resulting plots.

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