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Article

Free-Fare Bus and Private Car Chauffeuring Among 10-12-Year-Old Children in Two Finnish Cities

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Abstract

Fare compensation policy effects on car use are unclear, particularly in the context of children's travel patterns. This study compares the bus and car travel patterns of 10-12-year-old children (n=427) in two Finnish cities, Mikkeli (with free-fare bus policy) and Kouvola (without) and investigates factors predicting the use of these modes. We found that more children were using bus in Mikkeli than Kouvola, but trip frequency and distance were no different within those using bus. There was no difference in number of children driven by car, car trip frequency nor car trip distance. Perceived easiness of bus use predicted bus use only, whereas sport hobbies frequency predicted car use only. Based on our research, we have found that the implementation of a free-fare public transport policy leads to an increase in the utilization of buses by children. However, it appears that this policy alone does not effectively address the issue of car chauffeuring. To tackle this problem, we propose interventions that promote access to sporting activities through public transport for children and their families. This approach has the potential to reduce the reliance on chauffeuring.

Keywords

Public Transport, Bus Travel, Car Travel, Chauffeuring, Urban Planning

Introduction

Independent travel among children and youth has decreased in Finland and several other countries (Liikennevirasto; Liikenne ja maankäyttö, 2018; Mackett, 2002). In Finland, chauffeuring accounts for 10% of all domestic trips, with 86% of those trips made by car (Liikennevirasto; Liikenne ja maankäyttö, 2018), and parents with children under 15 years old chauffeur the most (Liikennevirasto; Liikenne ja maankäyttö, 2018). This highlights the potential to increase children's independent mobility by providing families with feasible options for car travel, such as public transport.

Several factors are associated with bus or car use among children, such as the place of residence and the distance to places of interest, which affect how independently children can reach their destinations. In Finland, 63% of the population lives outside of inner urban areas, with an 80% higher car use in these areas as compared to inner urban areas (Helminen V, Nurmio K, 2020; Liikennevirasto; Liikenne ja maankäyttö, 2018). It is thus crucial to investigate travel patterns in

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rural areas, where long distances may pose a threat to children's independent mobility.

In a Swedish study the rural children used bus in almost every fifth of their leisure trips whereas bus use in the urban children was rare (Tillberg Mattsson, 2002). Despite the greater bus use, children living in rural areas were also chauffeured frequently to leisure activities by their parents (Tillberg Mattsson, 2002). Therefore, public transport could not fully meet the transportation needs of families. Our previous qualitative investigation of Mikkeli's free-fare policy also highlighted the influence of family time use and the convenience of using a car instead of a bus with fixed schedules (Berg, P., Rinne, T., Hakala, P., Tuuva-Hongisto, S., & Pesola, 2022). Investigating travel patterns and predictors of public transport use can provide valuable insights on how to develop public transport, especially in less densely populated regions where car use is common.

Fare compensation policies can be an effective intervention to influence rural and urban children's mobility patterns. In our previous study, we found that providing free-fare bus access for all children in Mikkeli, Finland, led to a three times greater bus travel duration compared to a reference city without fare compensation (Pesola, A.J. Hakala, P. Berg, P., Ramezani, S., Villanueva, K. Rinne, 2022). However, this study did not comprehensively compare bus travel distance to car chauffeuring, nor did it investigate factors associated with bus and car use.

The aims of the current study are to investigate bus and car chauffeur patterns and compare them between Mikkeli (free-fare bus) and Kouvola (reference city without free-fare bus), and identify factors associated with bus and car use in these cities.

Methods

The study protocol is available in detail (Pesola et al., 2020). School principals and the other responsible authorities were asked for permission to recruit from schools. All children were requested for oral consent and also their legal guardians were requested to provide a written informed consent. Aalto University Research Ethics Committee approved the study protocol on 10th October 2019.

Protocol

Kouvola (83,000 residents) and Mikkeli (54,000 residents) are located in South-Eastern Finland with similar geographical structure and climate. Both cities have similar possibilities for active transportation such as active bus networks to transport local traffic. We recruited children from primary schools located in neighborhoods paired between cities based on objective public transport accessibility metrics (Pesola et al., 2020). In total, there are 24 and 17 primary schools in Kouvola and Mikkeli, respectively. A total of 22 schools (i.e., 11 from each city) were contacted (Pesola et al., 2020). Since one school in Kouvola declined from data collection because of COVID-19 restrictions, the final number of schools in Kouvola decreased to 10. In total, there were 700 pupils (Mikkeli=331 and Kouvola=369) who were contacted. Data collection was performed between 8th of September to 16th of November 2020. Data collection was performed concurrently between the paired Kouvola and Mikkeli schools to minimize weather and other possible confounding conditions. During the time of data collection, all pupils were visiting school and hobbies normally and there were no regional COVID-19 restrictions for the activities. To comply with the COVID-19 restrictions, considering external visitors data collection was performed either at remotely (n=4 schools) or at the school (n=17). It took approximately 45 minutes to collect data from each pupil during one lesson.

Measurements

A PPGIS (Public participatory GIS) questionnaire was completed by pupils using a computer browser (Maptionnaire® tool) concurrently with their class peers either at home or during computer class. Each pupil was instructed how to complete the PPGIS questionnaire and how to navigate the map in the browser using a video conference software or in person. For a possible question or more instructions, there was one researcher available during the data collection period. Pupils were requested to mark on the map their school, home, hobbies and also other destinations that they had visited during the last seven days. After marking each place, pupils were requested to answer questions about each place, including on which days, how (by bus, by car, scooting, cycling, walking), and with whom (with peers, with adults, or alone), they visited the place. Pupils were requested to mark the same place multiple times if they visited it more than once per day. After filling the PPGIS questionnaire (i.e., map based questions) pupils were asked about use of public transport and subjective accessibility of public transport (Durand et al., 2016).

PPGIS data and spatial analyses

There are two distinct data types for PPGIS including spatial and non-spatial (Fagerholm et al., 2021). For collecting spatial data which needs mapping tasks in PPGIS survey (Maptionnaire®), and includes data attributes i.e., lines, points, or polygons. Each line of the data set contains one spatial entry that is mapped by a respondent. For collecting the non-spatial data, traditional structured or open questions within the same survey are used, which returns a further data set where each line represents one respondent. To analyze and clean the spatial data, QGIS version 3.10.9 and ArcGIS Pro version 2.9.0 were used. First, we downloaded the original data from Maptionnaire® software as a .csv file in three intervals and then using Well-known text (WKT) coordinates transformed into spatial data. Data cleaning included deleting those entries made by researchers, removing data of participants who did not consent to participate in the final research, removing duplicate entries, and finally returning the spatial data into xlsx. and csv. formats to start more statistical analysis. The final data set comprised 427 respondents and 2445 mapped points. Detailed information describing the processes of data cleaning is presented in our previous paper (Pesola et al., 2020). For calculating travel distance, Network Analysis was performed between each pupil's home and their mapped places after the data cleaning (Pesola et al., 2020). We used ArcGIS Pro and ArcGIS Online’s network road dataset to calculate network distance to all points from home. In those cases where there were several destination points that were too far from the nearest available street network segment, we snapped them to the nearest point in the network. After this, the Euclidean distance between the street network and the point location was calculated to the total network distance. Furthermore, network distance was calculated to nearest public transit stop from either home or all destination points to all reported traveling by public transit (Pesola, A.J. Hakala, P. Berg, P., Ramezani, S., Villanueva, K. Rinne, 2022). We used this distance to exclude the active travel share of the public transit tips. However, we were not able to exclude any possible active share of car travelling.

Total trip distance to each point was calculated by multiplying the total network distance by 2 to each point (i.e., visited by bus or car), showing a round-trip between each destination and home. We calculated the active travel part of public transport by multiplying the distance from home to the nearest bus stop by 2 and also from destination point to the nearest public transport by 2. By multiplying the reported visitation frequency, we calculated separately the trip distance for both weekdays and weekends.

The following formula was used to calculate separately the final active travel trip distance outcome variables for bus and car:

$$H1 = \sum(a * (2 * b))$$

In this formula $H1$ is the total travel distance by bus or car, a stands for visitation frequency and b is the distance between marked point and home.

Furthermore, using the urban structure monitoring zoning data (YKR) by Finnish Environment Institute (SYKE), an urban structural zone for each pupil was assigned.

Statistical analysis

Statistical analyzes were done using RStudio Version R-4.1.2 for windows. Statistical significance was set at $p < 0.05$ (two-tailed). Before further analysis data was checked for skewness, kurtosis, outliers and normal distribution. Wilcoxon test was used for all comparisons and package ”ggplot2” was used for drawing plots. Logistic regression was used to predict total distance traveled by public transport during the week and total distance traveled by car during the week by perceived easiness of using bus (Bus easy), distance to the closest bus stop (HomePTdistance), visit frequency to sport hobbies (SportHowOften), average distance to sport hobbies (SportDist), Number of cars in the family (Cars), age and gender. Package “rsq” was used to estimate r-squared.

Results

Background variables of the full sample by city are presented in table 1. On average, children were 11 years old, and 54% of the participants were girls. There were more 5^{th} grade pupils within Kouvola as compared to Mikkeli (*p<.001*, Table 1).

Table 1: Summary descriptives table by City

	Mikkeli	Kouvola	*p-value*
	N=194	*N=233*	
Age (years)	11.0 (0.81)	11.1 (0.72)	.329
Gender:			.299
Boy	92 (47.4%)	102 (43.8%)	
Girl	102 (52.6%)	128 (54.9%)	
Other	0 (0.00%)	3 (1.29%)	
School class:			<.001
4	42 (21.6%)	22 (9.44%)	
5	92 (47.4%)	150 (64.4%)	
6	60 (30.9%)	61 (26.2%)	

The weekly distance travelled by bus and car by city and within different public transport accessibility zones are presented in Figure 1. Overall, children in Mikkeli had a longer weekly distance travelled by bus (*p<.001*), driven by a difference within suburban zone only (*p<.0001*, Figure 1). There were no differences in the overall distance travelled by car. Within those who had any bus travels reported travelling a median of 45.1 [interquartile range 40.0; 89.7] km per week in Mikkeli (n=55) and 76.0 [interquartile range 43.9; 111.0] km per week in Kouvola (n=30, *p=.079*).

Similarly, within those who had any car travels reported travelling a median of 40.4 [18.8;72.8] km per week in Mikkeli (n=143) and 43.0 [16.6;90.9] km in Kouvola (n= 155, *p=.661*).

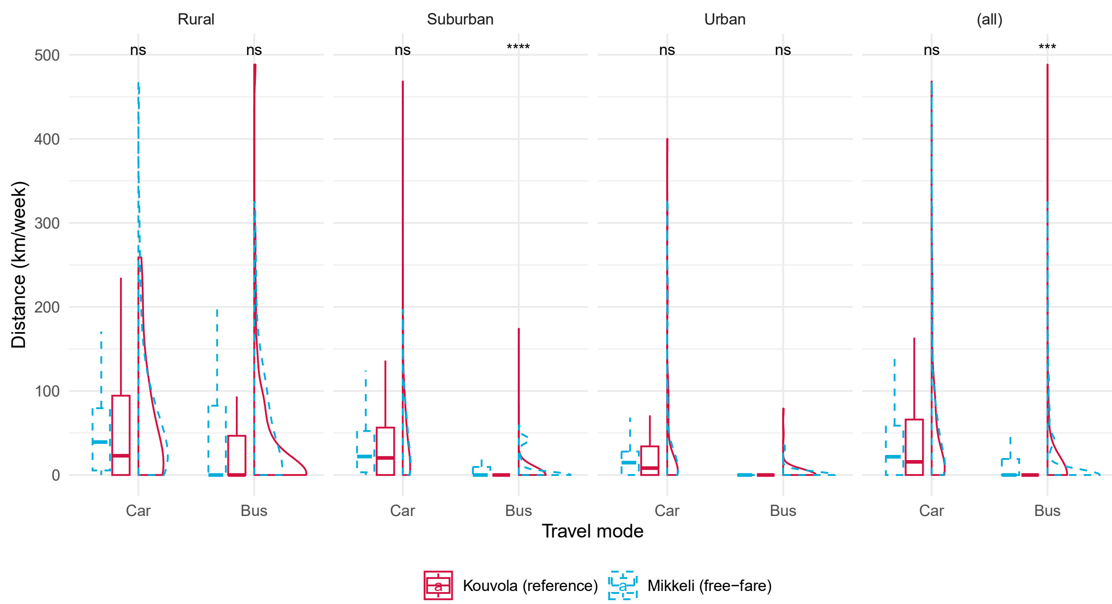

Fig 1: Weekly distance travelled by car and bus compared between cities overall and within different public transport accessibility zones.

The weekly bus and car trip frequencies by city and within different public transport accessibility zones are presented in Figure 2. The bus trip frequency was higher in Mikkeli as compared to Kouvola (*p<.001*) driven by a difference within suburban zone only (*p<.0001*, Figure 2). There were no differences in car trip frequency. Within those who had any bus trips reported similar median trip frequency of 5.0 [5.0; 5.0] within both cities (*p=.058*). Within those who had any car trips reported median trip frequency of 3.0 [2.0; 6.0] in Mikkeli and 4.0 [2.0; 6.0] in Kouvola (*p=.165*).

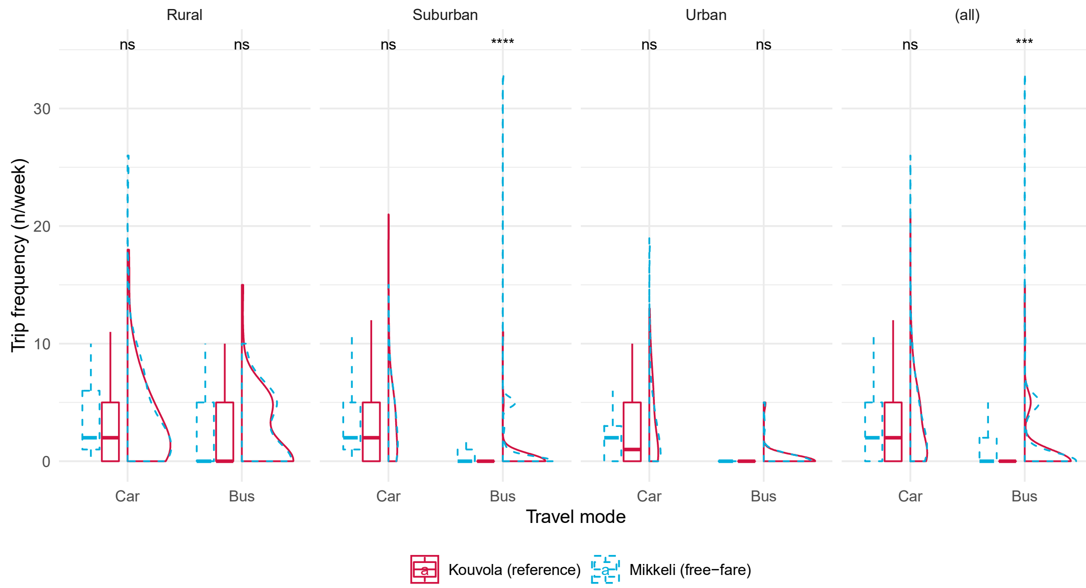

Fig 2. Weekly car and bus trip frequency compared between cities overall and within different public transport accessibility zones.

The median of average bus and car trip distances by city and within different public transport accessibility zones are presented in Figure 3. Median of average bus trip distance was higher in Mikkeli as compared to Kouvola, driven by a difference within suburban zone (*p<.0001*, Figure 3). However, within those having any bus trips, there was a tendency towards a higher median average bus trip distance in Kouvola 7.9 [4.5; 9.4] km as compared to Mikkeli 5.7 [4.2; 9.0] km, albeit this difference was not statistically significant (*p=.273*). Therefore, the greater median of average trip distance in Mikkeli as compared to Kouvola overall (including also children without any trips) was driven by a greater number of children having any bus trips in Mikkeli. Within those having any car trips, the median average distance travelled per car trip was 6.1 [4.1; 10.1] km in Mikkeli and 6.9 [3.5; 10.9] km in Kouvola (*p=.919*).

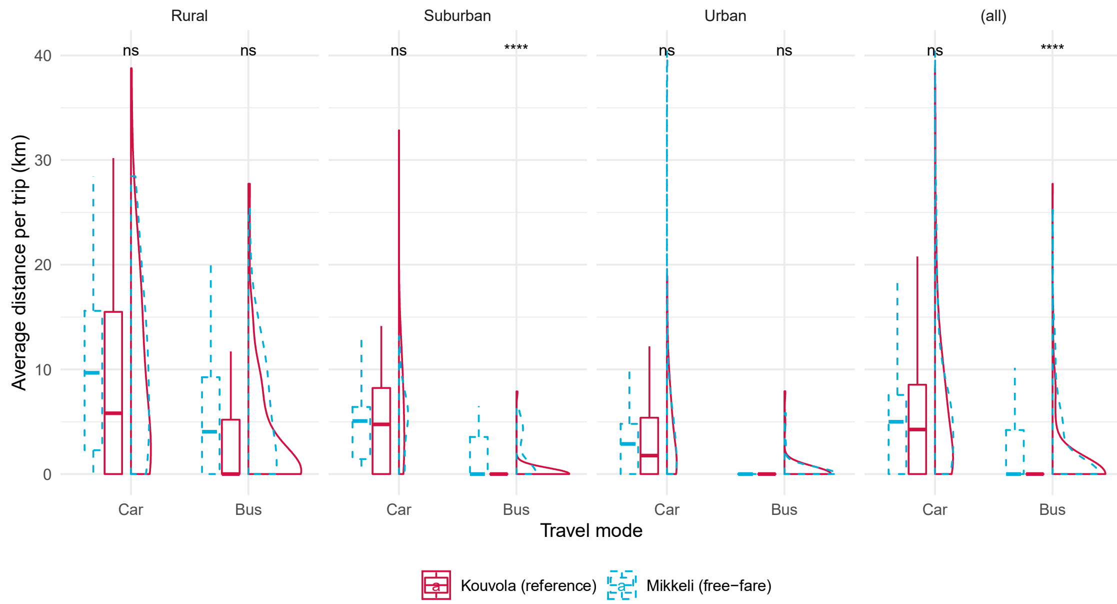

Fig 3. Average distance travelled by car and bus compared between cities overall and within different public transport accessibility zones.

Results of logistic regression (Table 2) show that weekly distance travelled by bus is predicted by perceived easiness of using bus (Bus easy) (OR=1.38, CI= 1.09-1.75, *p*= 0.008), SportDist (OR=1.00, CI= 1.00-1.00, *p*= 0.001), and Cars (OR=1.75, CI= 1.02-3.08, *p*= 0.047). Similarly, weekly distance travelled by car is predicted by SportHowOften (OR=1.39, CI= 1.08-1.83, *p*= 0.014) and SportDist (OR=1.00, CI= 1.00-1.00, *p*< 0.001), and Cars (OR=2.03, CI= 1.15-3.72, *p*< 0.017). The higher amounts of R^2 Tjur= 0.345 (Tjur, 2009) and R^2= 0.641 for weekly distance travelled by car model against weekly distance travelled by bus model with R^2 Tjur= 0.131 and R^2= 0.520 show it as a stronger model predicting total distance traveled by car vs. total distance traveled by public transport in children (Tjur, 2009). In other words, there is a more distinct difference for the means of independent variables in weekly distance travelled by car model where children used or did not use car for traveling during the week vs. weekly distance travelled by bus model.

Table 2. Logistic regression predicting total distance traveled by public transport or car

	Weekly distance travelled by bus			Weekly distance travelled by car		
Predictors	*Odds Ratios*	*CI*	*p*	*Odds Ratios*	*CI*	*p*
(Intercept)	0.00	0.00 – 0.55	0.034	0.10	0.00 – 45.20	0.463
Age	1.20	0.72 – 2.03	0.478	1.00	0.58 – 1.68	0.986
Gender	1.41	0.68 – 2.99	0.359	0.89	0.39 – 1.99	0.771
Bus easy	1.38	1.09 – 1.75	0.008	0.98	0.74 – 1.29	0.872
HomePTdistance	1.00	1.00 – 1.00	0.293	1.00	1.00 – 1.00	0.747
SportHowOften	0.90	0.68 – 1.15	0.426	1.39	1.08 – 1.83	0.014
SportDist	1.00	1.00 – 1.00	0.001	1.00	1.00 – 1.00	<0.001
Cars	1.75	1.02 – 3.08	0.047	2.03	1.15 – 3.72	0.017
Observations	257			257		
R^2 Tjur= 0.131		**R^2= 0.520**			R^2 Tjur= 0.345	R^2= 0.641

Note: we used code 1 for boys and 2 for girls in Gender.
Note: Bus easy: Perceived easiness of using bus
Home PT distance: Distance to the closest bus stop
Sport How Often: Visit frequency to sport hobbies
Sport Dist.: Average distance to sport hobbies
Cars: Number of cars in the family

Discussion

Fare compensation policies are significant local efforts to encourage public transport use. However, limited data exists on differences in bus and car use among children following such policies or factors predicting these travel modes. Previous investigations have evidenced a considerable increase in patronage, but travel mode shift has mostly been from active transport modes, not car travelling (Auvinen et al., 2020; Fearnley, 2013). However, these investigations have primarily considered adults' travel within large cities. In Finland, Mikkeli is the first to implement free-fare rides for children under 17, with approximately 5,000 elementary school pupils (Heikkinen, 2022). This policy reduces the workload in arranging tickets for those entitled to municipal transport and enables flexible use of scheduled bus traffic during the school day.

The main findings of this study indicate that free-fare public transport in Mikkeli is associated with a longer distance traveled by bus compared to children in Kouvola, where such a free-fare option is unavailable. This difference is primarily driven by suburban zones, not rural areas. Despite this, there were no differences in chauffeuring patterns between the cities, suggesting that the free-fare policy alone is insufficient to replace chauffeuring with public transport, which is consistent with previous investigations of free-fare policies (Auvinen et al., 2020; Hess, 2017; Samadi et al., 2017). However, perceived easiness of bus use positively correlated with bus use, indicating that further actions like behavioral interventions could increase bus use. Sport hobbies frequency uniquely correlated with car use, suggesting that leisure activities influences families' decisions to use cars instead of buses. These findings provide potential targets for future interventions aiming to improve sustainable development in cities.

There are specific life events when people's travel mode choices change, such as graduating, getting a driver's license, or moving to a new place (Auvinen et al., 2020). Mackett (2002) asserts that children dependent on cars while young are likely to become car-dependent adults (Mackett, 2002). Children's free-fare public transport might influence travel mode choice when people graduate or become eligible for a driver's license. Mackett (2002) concludes that children are following the same upward trend in car use as the rest of the population (Mackett, 2002). The most environmentally friendly result of free-fare buses might be the change in young adults' attitudes towards driving or buying a car. Nevertheless, additional interventions should be developed to decrease parental chauffeuring, emphasizing the importance of promoting public transport for both children and their families.

Both environmental and parental or child characteristics influence the decision to use a car for leisure activities (Johansson, 2006). To decrease chauffeuring and increase independent travel, Johansson suggests focusing on improving the traffic environment and promoting a favorable attitude towards independent travel. The free-fare ride may make bus travel more attractive (to the child) and safer (to the parent). A free bus card can encourage parents to consider the bus as an option for the first time, facilitating learning about how the card works. Parents play a crucial role in travel mode choice, with 73% of leisure time travel modes chosen by the parent in a Swedish study (Johansson, 2006). Hence, the focus should be on the entire family's travel.

The perceived safety of travel significantly influences the modes adults encourage or allow their children to use (Nevelsteen et al., 2012). Australian parents expressed concerns about traffic danger, child unreliability, and danger from adults (Carver et al., 2013). Swedish parents in rural Hällevik-Utvalnäs prioritize their children's wellbeing as a main reason for relocating to the countryside, yet they still express the need to chauffeur their children to leisure activities for safety (Tillberg Mattsson, 2002). Enhancing safety could involve limiting car parking or driving, along with providing efficient and free public transport for children. Johansson asserts that enhancing traffic safety is crucial but insufficient on its own to reduce chauffeuring (Johansson, 2006). Addressing parents' need to protect their child is necessary, as children's travel modes are difficult to change without ensuring the adults feel their child can travel safely.

Fearnley (2013) clarifies that persuading motorists to change travel modes by offering free public transport may be challenging, but free-fare buses increase mobility and bus access among other demographics (Fearnley, 2013). Pooley et al. (2012) propose that emphasizing personal benefits, such as attractive environments and better health, can more effectively reduce car usage (Pooley et al., 2012). Global concerns have less influence on people's modal split, necessitating integrated policies for health promotion, local environment improvement, and carbon reduction. Auvinen et al. (2020) reviewed literature on the impact of sustainable mobility measures on modal split, concluding that carrot methods alone are generally insufficient and should be combined with more effective, restrictive stick methods (Auvinen et al., 2020; Fearnley, 2013; Marletto, 2014). Furthermore, in a previous qualitative study, children did not perceive buses as an environmentally friendly option, comparing them to active travel modes rather than private cars (Berg, P., Rinne, T., Hakala, P., Tuuva-Hongisto, S., & Pesola, 2022). Fare-free public transport might reduce chauffeuring, but better results can be achieved by simultaneously making car usage more expensive or inconvenient and promoting local environmental benefits.

Urban mobility lies at the heart of global sustainability and urban livability, with pressure for change arising from increasingly strict urban circulation limits and tighter emission standards for motorized vehicles (Daffara, 2023; Marletto, 2014; Washington et al., 2020). Marletto (2014) analyzes possible city travel changes with three socio-technical scenarios: AUTO-city, ECO-city, and ELECTRI-city. The current dominance of individual cars would lead to the AUTO-city scenario without any policy shifts or actions (Marletto, 2014). Achieving more environmentally friendly scenarios requires enhancing public transport's role, with Marletto highlighting national authorities' restrictions on car use and local communities' public transport subsidies to achieve the more sustainable ECO-city scenario (Marletto, 2014). Good public transport availability, such as short distances to and high density of bus stops, is associated with greater public transport use in adults (Besser & Dannenberg, 2005; Djurhuus et al., 2014; Rissel et al., 2012; Villanueva et al., 2008) and children, as seen in this study where perceived bus use easiness correlated with greater weekly bus travel distance. Hence, carrot methods can be effective, particularly in relation to public transport.

Free public transport increases passenger numbers (Auvinen et al., 2020), often resulting in completely new trips due to increased mobility or shifts from cycling or walking. Motorists' transition to public transport, however, is minimal. Offering free public transport to specific groups, such as children under 17 in Mikkeli, enhances social equality. If one-quarter of fare-free bus trips replaced private car rides of average chauffeuring journey lengths (6 km according to (Liikennevirasto; Liikenne ja maankäyttö, 2018), 750,000 km less chauffeuring would occur (Tieto Traficom, 2022). Over a longer time interval, the potential change in travel behaviour becomes more substantial. In a few years, we may see children who are accustomed to independent bus travel for both leisure and school trips. As these generations reach the age of deciding on obtaining a driver's license, owning a car, and settling down, their perspective on everyday travel may differ from earlier generations. Crucial moments in people's lives, such as these, can potentially change even motorists' travel mode choices (Auvinen et al., 2020). Although fare-free public transport alone cannot create significant national change, it may contribute to a more sustainable lifestyle that is less reliant on multiple private cars per family. It may not single-handedly alter an entire family's travel patterns, but it could positively impact young adults' travel behavior in the long run. There is already a trend of young people obtaining their driver's licenses later; in Uusimaa, only 40% of 19-year-olds have a license, compared to the 1990s (Tieto Traficom, 2022). There are considerable regional differences, however.

A strength of the present study is its political relevance and the recruitment and measurement of children from regions with similar public transport characteristics (Pesola et al., 2020). However, weaknesses include self-reported travel patterns and the study being conducted during COVID-19 restrictions. We previously reported COVID-19 effects on travel patterns, with bus travel decreasing more in Mikkeli (41.8% reported decreased bus travel) than in Kouvola (24.9% reported decreased bus travel). 47.8% reported no change (Auvinen et al., 2020; Berg et al., 2022). No reported changes in chauffeuring to school habits occurred between the cities. Therefore, the differences highlighted in this study are conservative estimates of the free-fare policy effects, and the impact may be larger post COVID-19.

In conclusion, altering children's travel habits necessitates targeting the entire family, as adults make decisions for children and set examples. Free-fare public transport effectively increases public transport use and potentially familiarizes children and their parents with more sustainable travel modes. Although it cannot single-handedly reduce chauffeuring, it may play a crucial role in promoting a more sustainable transportation system.

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