Fare-reduction vouchers for pupils on public transport: comparison of first and second survey-wave

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Abstract

The city of Lucerne serves as an open-space Urban Living Lab (ULL) for mobility-interventions. As a timely-limited intervention the city of Lucerne provides their pupils reduction vouchers for public transport stimulated by a participatory process rooted in the children's & youth parliament. Our research examines how this intervention is linked to the living lab (LL) methodology and shows first results how the provision of vouchers changes the travel behavior of young children in the age from 6 to 16. The survey-waves for a cross-sectional study were carried out in the years 2023 and 2024. First results of this trend study will be presented that analyses the mobility behaviour before and after the intervention. Based on the results of this study, decisions will be made as to whether the public transport subsidy should be introduced or whether adjustments of the vouchers are necessary. From a policy dimension, we will reflect in future project steps on the efficiency of this intervention regarding energy consumption in the mobility domain.

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Keywords

Public Transportation; Transportation Behaviour; Pupils; Intervention Design; Price Reduction; Voucher; Participatory Approach; cross-sectional trend study

Preferred citation style

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1 Introduction

Children and young people are excluded from the political process due to missing eligibility to vote. One possible response to this situation is children's parliaments allowing children to become involved into the political process. To a large extent, children and young people deal here with the issues that concern themselves (DSJ 2019: 4f.). In Lucerne, for example, the idea of a children's parliament was to support families regarding their mobility behaviour and to provide children with vouchers for public transport. By means of this measure, sustainable mobility is to be trained and promoted at a young age.

The city of Lucerne has accepted this mandate introduced by its children's parliament and provides free vouchers for public transport. In fact, children and young people between the ages of 6 and 16 will be provided with a voucher worth 300 Swiss francs to use public transport every year. This intervention will be tested for three years starting in summer 2023. The city council aims on the one hand to relieve families financially and on the other hand to create an incentive to use public transport. Children should increasingly use public transport and travel independently.

At the same time, the effects of public transport vouchers on the travel behaviour of children and adolescents will be evaluated. We will investigate how the intervention changes the travel behaviour of young people over time and how they favour sustainable forms of mobility. The survey focuses on trips to school, leisure trips (to sports, to music lessons, to visit friends) and accompanying trips (e.g. with parents to go shopping).

In summer 2023, the intervention was rolled out by distributing the vouchers to households. The survey will be conducted in three survey waves 2023, 2024 and 2025 so that changes over time can be determined through a cross-sectional trend-study design. In March 2023, prior to the introduction of the vouchers and 2024, after the first intervention wave, a questionnaire was sent to 600 parents' households with pupils each year to survey the pupil's travel behaviour. Empirical analyses of the data from this trend study will be used to measure the effectiveness of the intervention in form of vouchers for public transport.

This paper presents the methodology of the study and the results of the first and second wave of the survey. On this basis, a first interpretation of the results will be given with a preview of future steps in the project.

2   Literature review

Adolescents and young adults are seen as bearers of hope for future sustainable developments in the domain of "mobility and transport". Mobility encompasses more than just the ability to move from one place to another in physical space. It also describes the ability to participate in social activities and enables interactions in social space (Jahn & Wehling 1999: 130f.). Attending school or meeting friends are activities in physical and social space that require mobility decisions. Various literature show that basic mobility decisions are formed in childhood and adolescence (Limbourg, Flade & Schönharting 2000: 8; VCÖ 1999: 9; Flade 1999: 107; Flade 1997: 3). Research on mobility biographies shows that new living situations can lead to new mobility decisions (Rabe, Miller & Lien 2002: 141; Heinickel & Dienel 2006). For this reason, there is great potential in studying the mobility behaviour of children and adolescents that is under change (Hunecke 2002; Tully & Alfaraz 2017).

Streets have traditionally been multifunctional public spaces and have in earlier days served as playgrounds for children. As an important consequence of the mass motorization of the 1950s, they were increasingly transformed into monofunctional spaces reserved for cars. It became apparent that children's action spaces were increasingly being restricted (Haefeli & Kaufmann 2009: 317). Especially after 1970, the appropriation of public space by children and their mobility behaviour became an object of study. In this context, a growing interest in planning and transport sciences in childhood, developmental psychology and pedagogy in the physical design of settlement and traffic space can be observed (Bongard & Winterfeld 1977; Schulte 1978, Moore & Young 1987).

The general restrictions on children's freedom of movement in public spaces become particularly obvious when it comes to ways to and from school, which became both a political issue and a subject of research in the 1990s (Haefeli & Kaufmann 2009: 318). Walking to school independently has traditionally been a developmental task that children must master when they start school. This entails several challenges for the children, their parents and society.

For the past fifteen years, studies have shown that more and more children are no longer making the journey to school (nor leisure journeys) unaccompanied and are increasingly being driven in cars. Overlapping trends to accompany children on their way to school and to do so by car can be seen throughout Europe (Haefeli & Kaufmann 2009: 320).

Although social responses to children's exposure to traffic hazards (road safety, traffic education) and to their displacement from road spaces (child-friendly cities) have had visible effects for some time, the trend to accompany and drive children on their everyday journeys continues unabated (Haefeli & Kaufmann 2009: 323).

Especially in Switzerland, the mobility patterns of children and adolescents are an important indicator of their quality of life and of how transport behaviour develops in the future. These mobility patterns of children and adolescents have changed in Switzerland over the last twenty years in line with the international trend. In this context, Sauter's (2019) research report on Mobility of Children and Adolescents compares the behaviour patterns of children and adolescents in Switzerland between 1994 and 2015, based on the Swiss National Travel Survey. Since 1994, the the National Travel Survey has allowed time series analyses. Data is available for 1994, 2000, 2005, 2010 and 2015. Included in the microcensus are both mobility preconditions, e.g. the availability of bicycles or public-transport season tickets, and household availability of cars, as well as trip lengths and transport use, presented by purpose, school and leisure trips based on the stage-concept, age, gender, part of the country and other criteria.

The time comparison of Sauter (2019) reveals a variety of findings. For example, a different development of transport use can be seen depending on the age group. For 6- to 12-year-old children, little change over time is evident. The data reveals that the share of parental transport on school-related trips is not as high as generally assumed and only occasionally in double digits (Sauter 2019: 8). For 13- to 15-year-olds, the low share of bicycle use stabilizes after shifting to pedestrian traffic, public transport and MIV (Sauter 2019: 10). In particular, the mobility patterns of young people between the ages of 16 and 20 have changed markedly. They now make many more trips by public transport and on foot. This replaces trips by bicycle and, to some extent, motorized private transport (Sauter 2019: 10f.). Education and leisure are the most important mobility purposes. Basically, shifts in the availability of modes of transport can be seen. The availability of bicycles continues to decrease, while the ownership of public transport passes is increasing. Also, a car license is acquired later today. There are also major regional differences in the choice of transport in Switzerland (Sauter 2019: 11f.). For example, the share of bicycles is significantly lower in French-speaking Switzerland than in German-speaking Switzerland (Sauter 2019: 7ff.).

Furthermore, although children have short distances to school, for young people, the distances to and from school are becoming longer and longer. One's own feet, a bicycle and public transport are the most important modes of transport on school routes. Distances for leisure travel are increasing sharply, but half of them are still in the local area. In their leisure time, children and young people travel mainly on foot or by motor vehicle. The availability and quality of bicycle parking spaces, the availability of a public transport pass and the number of cars in the household also have a decisive influence on the choice of transport mode (Sauter 2019: 11ff.).

In summary, current research on the mobility behaviour of children and adolescents in Switzerland shows that between 1994 and 2015 there was a strong decrease in cycling and a strong increase in taking public transport and walking. It is assumed that the increasing

distances of routes to and from educational institutions are one of the causes of the changes in mobility behaviour. This circumstance leads to the fact that some young people can no longer cover the way to school by bicycle and are switching to public transport (Sauter 2019: 10.). The increase in the use of public transport means that journeys to and from bus stops or railway stations are often made on foot. In addition, at the destination, more independent walking trips are made (Sauter 2019: 10). Increased use of public transport is also accompanied by an increase in walking trips in one's leisure time. The share of both private cars and bicycles has therefore also continuously decreased here (Sauter 2019: 10f).

3 Study Background and Method

3.1 Study background

In September 2020, the Children's Parliament submitted a motion asking the Lucerne city council to enable children and young people in tariff zone 10 (city and conurbation) to use public transport (PT) free of charge or at a greatly reduced rate.

This is intended to promote the independence of children and young people and reduce the use of parental cars. The City Council supported the will of the Children's Parliament and in May 2021 passed the motion for realisation.

The idea of the Children's Parliament is to provide a discount on the use of public transport through a voucher that can be personalized and used for a specific purpose. The voucher has a value of 300 Swiss francs, which corresponds to around 50 percent of the cost of an annual season ticket for children and young people in zone 10 in the Canton of Lucerne.

The voucher is available to all children and young people between the ages of 6 and 16 who are required to attend elementary school in the city of Lucerne, regardless of their main place of residence. Use of the voucher is limited to predefined public transport products: monthly and annual season tickets in fare zone 10 and other fare zones (fare zone 10 must be included), multi-ride tickets, multi-ride tickets for short trips, multi-day tickets in fare zone 10, and the General Abonnement (GA) for children.

The introduction of these public transport concessions will take the form of a three-year pilot study. City of Lucerne children and young people between the ages of 6 and 16 will thus receive vouchers worth 300 Swiss francs for the purchase of bus and train tickets from summer 2023. The first voucher was sent to parents or guardians by mail in mid-June 2023. The second voucher is sent to parents or guardians by mail in mid-June 2024. The last voucher will follow

in the summer of 2025. In this way, the City Council aims to relieve the financial burden on families and, as proposed by the Children's Parliament and the City Council, create an incentive to use public transport.

A special credit of almost 5 million Swiss francs is being made available for this three-year pilot trial. After the pilot phase, the City Council wants to decide whether this form of promoting public transport will be introduced permanently. For this, the regulations for sustainable urban mobility would have to be changed.[1]

The introduction of the voucher creates an incentive to use public transport. The price of public transport should not be a reason to forego leisure activities or to depend on one's parents' car. Getting children and adolescents to use public transport is considered an important step in the sustainable development of children's and adolescents' independence. Especially if adolescents increasingly use public transport instead of parental cars, this not only contributes to the thrust of the mobility strategy of the city of Lucerne to shift to area-efficient modes of transport, it also promotes mobility awareness. Children and young people should develop a conscious approach to mobility. This also includes the fact that mobility has its price. The proposed solution of reducing the cost of public transport for children and young people can meet all these requirements. Therefore the intervention contains four research questions:

- Can modal split shifts be achieved in general?
- Can the use of PT be increased?
- Can the use of private cars be reduced?
- Are there differences between travel purposes, especially for school- and leisure trips?

The next section explains the underlying living lab methodology.

3.2   Living lab methodology

Living labs have been addressed in transdisciplinarity research for many years, and practices for identifying problems in societies and addressing them in real experiments have been discussed (Lawrence et al., 2022). A living lab introduces (temporary) transformative change in a real-world setting. It aims to foster 'people's engagement in new ways of doing' within the discourse on climate change through a participatory environment involving the co-design of interventions (Sahakian et al., 2021, p. 3). The living-lab approach builds on practice-based design in two ways.

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[1] www.kinderunterwegs.stadtluzern.ch (access at 02.05.2023)

First, living labs are a temporary space where different rules apply, moving beyond the design phase into the experimentation phase in a real-world setting (Voytenko et al., 2016). Routinized practices are thus interrupted for a period of time to encourage people to engage in new ways of doing things.

Secondly, living labs are a process. Rather than achieving a specific outcome, collaboration between citizens, research teams, implementation partners and other stakeholders is favoured to foster collaborative and social learning. This is in contrast to approaches that 'try to make people behave better, relying on liberal paternalism or the assumption that an authority knows best how subordinates should behave' (Sahakian et al., 2021, p. 3).

Experiences through experiments in living labs can contribute to systemic changes in real living environments (Schäpke et al., 2018; Torrens and von Wirth, 2021). In social systems such as living labs, cities or areas, regional effects can be tested, and important steps towards sustainable lifestyles can be taken.

In the field of energy studies, living labs have been used to experiment, among others, with zero-emission homes (Korsnes et al., 2018) and smart heating systems (Sovacool et al., 2020), or to test new ways of rehabilitating historic city centres (Claude et al., 2017), revealing new dynamics between actors involved in the energy transition (Canzler et al., 2017).

Within the domain of transportation, and especially mobility studies, various efforts are being made to achieve social effects by means of sustainability- or realworld-experiments. These are understood as both a research approach with the aim of gaining knowledge and a strategic instrument for activating concrete processes of transformation on the ground (Wagner and Grunwald, 2015). The goal is to identify the conditions of success and acceptance, as well as to understand resistances and barriers. Living labs provide the institutional framework for experiments or interventions. Overall, there is a great diversity of both labs and approaches in the field of mobility (see Evans et al., 2016; Parodi et al., 2016).

For the case of the paper, the living lab is located in the city of Lucerne and was set up for three years. It was initiated by the children's parliament. The intervention is evaluated by the city and the university of applied sciences and arts. The pupils and students are surveyed and an exchange takes place with the children's parliament as well as the city and the transport association. The aim is to investigate whether the intervention should be continued or even extended to the entire fare network in a collaborative manner.

However, there are challenges to participatory practices. For example, valid population data on mobility behavior before and during the intervention is needed to measure its effectiveness.

This requires quantitative monitoring, as key data is the backbone of evaluation studies in the transport sector. In urban living labs in the transportation sector, a major challenge is therefore how to obtain this key data. The following section will therefore show which key data can be used to evaluate the living lab in the city of Lucerne.

4 Survey with trend study design: wave 1 and 2

4.1 Survey and intervention timeline

This research project aims also to measure the impact of the voucher over time on pupil's travel behaviour. We ask which modes of transport the children and their families use and for what purposes, both before and after implementation. Based on the analyses of the data from a trend study, the effectiveness of the public transport vouchers are assessed. The results based on this research design form an important basis for the City Council to decide whether this form of public transport promotion should be continued or even adapted after the three-year pilot phase.

Three surveys will be conducted to evaluate the intervention. The study is carried out in three waves (2023, 2024 and 2025) so that changes over time can be determined by means of a trend study design. The trend study with random samples from the elementary schools of the city of Lucerne allows to determine temporal changes in pupils' mobility for those three cross-sections (2023, 2024 and 2025) that can be attributed to the public transport vouchers. Data will be analysed cross-sectionally and over time. Since the vouchers are distributed to households annually, they are presented as three interventions in Figure 1.

Figure 1: Long-term intervention and survey design
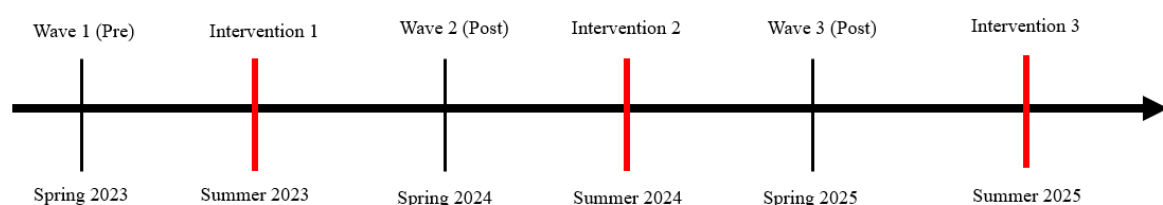
Source: own graph.

No survey will be conducted after intervention 3 (vouchers in the third year); instead, the status quo will be measured before implementation (base line study). In the next section, the sampling methodology will be discussed in more detail.

4.2   Sampling frame

Sampling is based on the registers of elementary schools to ensure randomness of selection and field access. In this case, the population of the study is defined as all elementary school students in the city of Lucerne. To ensure the representativeness of the study, the method of cluster sampling is used. This is a multi-stage random sample to ensure representative statements (Kauermann & Küchenhoff 2011: 160 ff.).

To ensure comparability of the study results across the three waves, the general conditions of the study with regard to sampling and the survey and evaluation design are kept identical for each wave.

In the first stage, 8 of the 19 elementary schools are randomly selected. This selection is made on a quota basis according to the proportions of school types (13 elementary schools, 6 secondary schools). In each of these 8 elementary schools, 5 classes are randomly selected. Thus, 40 school classes in the city of Lucerne are randomly selected each year, in which all children are invited to participate in the survey. Thus, all of the selected households in the city of Lucerne are contacted by mail. On average, 15 pupils form part of a school class. The information on the class and address data of parental homes are taken from the elementary school's official registers.

In these 40 classes, an exhaustive survey is aimed for, although refusals to answer are to be expected in principle. With this sample, participation in public transport use can be reliably determined for the population by means of a representative simple random sample.

Table 1 compares the population of all classes differentiated by school type and grade level with the result from the random sampling (cluster=classes) for the years 2023 and 2024. The random sample at the class level reflects the proportions in the population well.

Table 1: Population and Sample (Level: School classes)

	Population 2023		Sample 2023		Population 2024		Sample 2024	
	n	%	n	%	n	%	n	%
1st grade	59	18.3	6	15.0	64	18.9	7	17.5
2nd grade	22	6.8	1	2.5	22	6.5	2	5.0
3rd grade	66	20.5	9	22.5	70	20.6	7	17.5
4th grade	23	7.1	3	7.5	23	6.8	4	10.0
5th grade	62	19.3	9	22.5	69	20.4	7	17.5
6th grade	23	7.1	2	5.0	20	5.9	3	7.5
Secondary level 1	24	7.5	3	7.5	25	7.4	4	10.0
Secondary level 2	22	6.8	4	10.0	24	7.1	3	7.5
Secondary level 3	21	6.5	3	7.	22	6.5	3	7.5

Total	322	100	40	100	339	100	40	100

Own calculations.

4.3 Organization in the field

Participants are not offered any incentives for completion of the survey. Incentives may lead to bias due to self-selection. It is assumed that the reason for the survey should be a sufficient incentive to participate in it. In addition, the covering letter is written so as to motivate the parents as well as the pupils to participate in the study.

The selected families received a letter with a personal covering letter, a physical copy of the German survey and a QR code, which will lead the individuals to a digital survey link. The motivation letter was prepared in two forms. The covering letter was addressed to both parents and children. It was pointed out that the survey would ideally be conducted together, with the children accompanying the parents as they completed it, so as to provide the best information. The questions are to be completed by the parents or guardians on behalf of, and ideally accompanied by, the child. The survey is anonymous. Regarding the input option, the survey uses a mixed-channel approach (online and in writing with enclosed questionnaire).

The Unipark survey platform is used as the survey instrument for the online survey. It is also possible to fill out an online version of the questionnaire in English. The questionnaire contains survey items for the children's households and mobility tool ownership.

The children and adolescents report retrospectively on a "typical" school week in the form of a mobility diary for Monday, Wednesday and Saturday. Since it is of interest to see how the children travelled to school or to their leisure activities on these days, they were advised not to complete the survey until the following Saturday and no later than the following Sunday. For each of the three waves, the third week of school after the carnival vacations was selected for comparison purposes.

4.4 Response rate

The city of Lucerne and the Lucerne University of Applied Sciences and Arts conducted an initial survey in March 2023 and a second one in March 2024. A total of 343 responses in 2023 and 368 responses in 2024 were received. Due to the high response rate in the first instance, the city decided in both survey waves not to send a reminder. In fact, the response rate was 55.5% in 2024 and 55.4% in 2024.

Table 2: Response table of year 2023 and 2024

	2023		2024	
	n	**%**	**n**	**%**
Gross sample	600	100	664	100
Sample-neutral defaults (relocations, etc.)	0	0	2	0
Brutto adjusted	600	100	662	100
Response rate	**343**	**55.5**	**368**	**55.4**
…of which German survey	340	99.1	363	98.6
…of which English survey	3	0.9	5	1.4
…of which physical survey	231	66.7	238	64.7
…of which online survey	112	33.3	130	35.3
Note: own calculations.				

Table 3 shows a non-response analysis. The results of the study are compared with the population for the number of pupils in classes. Overall, it can be stated that the characteristics of the population are comparable to those of the sample. However, Table 3 shows in 2023 that the 1st and 2nd grade are slightly underrepresented, whereas the 6th grade has a tendency to be overrepresented. In 2024, the 1st, 2nd and 5th grade are slightly underrepresented, whereas the 6th grade and also the secondary level 1 has a tendency to be overrepresented. The data were not reweighted since this deviation can be tolerated.

Table 3: Non-Response Analysis (Level: Pupils)

	Population 2023		Sample 2023		Population 2024		Sample 2024	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
1st grade	614	12.6	23	6.8	828	16.2	41	11.4
2nd grade	590	12.2	21	6.2	419	8.2	26	7.2
3rd grade	612	12.6	46	13.7	864	17.0	66	18.3
4th grade	602	12.4	45	13.4	421	8.2	40	11.1
5th grade	596	12.3	41	12.2	853	16.7	46	12.7
6th grade	601	12.4	55	16.3	378	7.4	35	9.7
Secondary level 1	451	9.3	35	10.4	453	8.9	44	12.2
Secondary level 2	415	8.6	36	10.7	485	9.5	30	8.3
Secondary level 3	375	7.8	35	10.4	404	7.9	33	9.1
Total	**4856**	**100**	**337**	**100**	**5105**	**100**	**361**	**100**
Note: mixed classes were divided equally between the two grade levels. Own calculations.								

Figure 2 shows the non-response analysis visually.
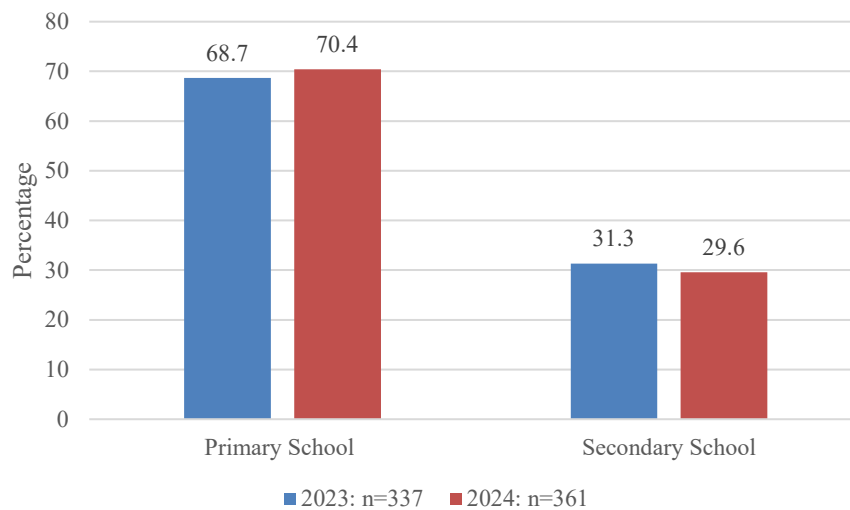
Figure 2: Non-Response Analysis
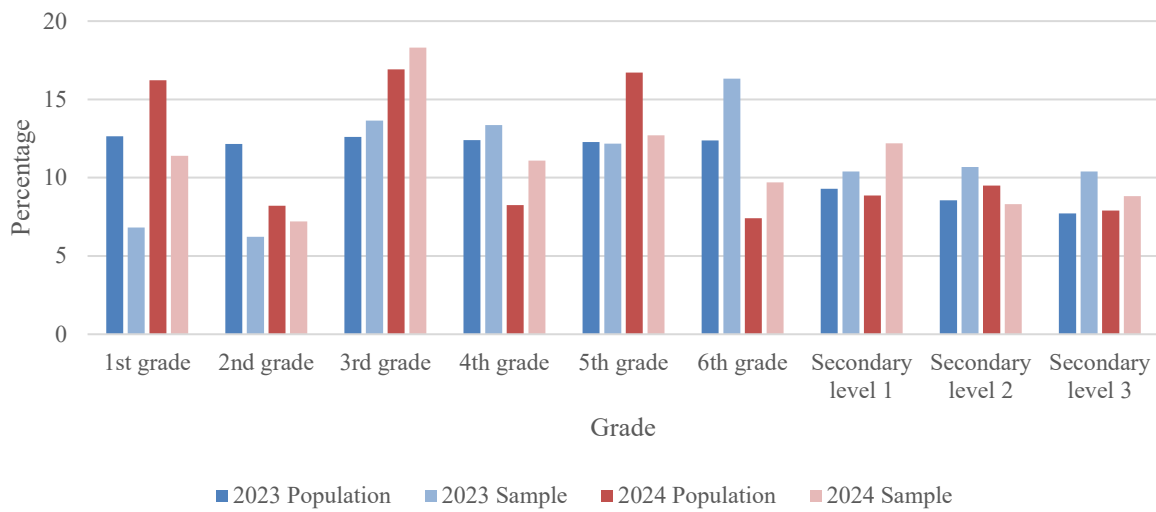
Source: own graph.

4.5   Sample characteristics

Figure 3 presents the results of the question as to which school classes the children surveyed attend.

Figure 3: Primary vs. Secondary School

Source: own graph.

Figure 3 shows that most of the children surveyed in the sample attend a primary school in the city of Lucerne. Table 4 presents an allocation of the school buildings in the city of Lucerne indicated in the survey, grouped between city-centre and outer quarters according to our own classification.

Table 4: Assignment of selected school buildings

School in the city of Lucerne	Assignment
Moosmatt	City center
Hubelmatt	City center
Säli	City center
Maihof	City center
Grenzhof	Outer districts
Tribschen	Outer districts
Unterlöchli	Outer districts
Matt	Outer districts
Note: Own assignment to the categories "city centre" and "outer districts".	

The allocation shows an even distribution of schoolhouses in schools in the city centre and the outer neighbourhoods of the city of Lucerne (Figure 4).
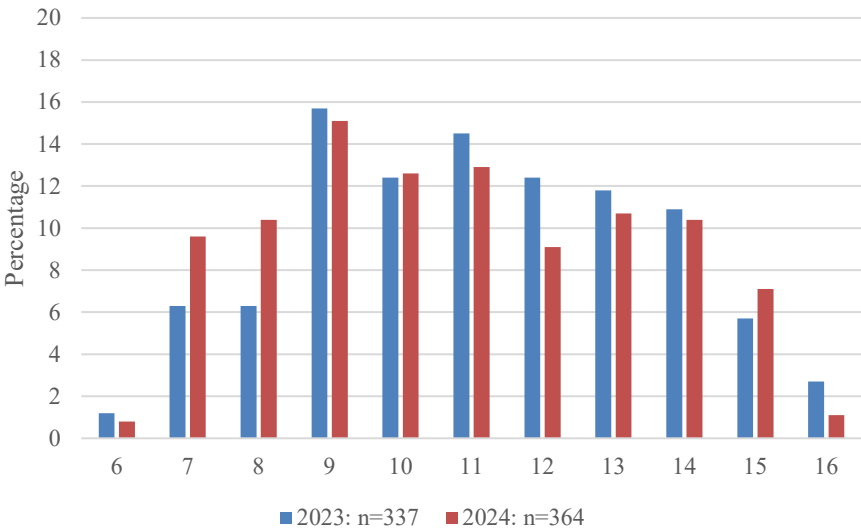
Figure 4: School location: centre vs. outer districts (aggregated)
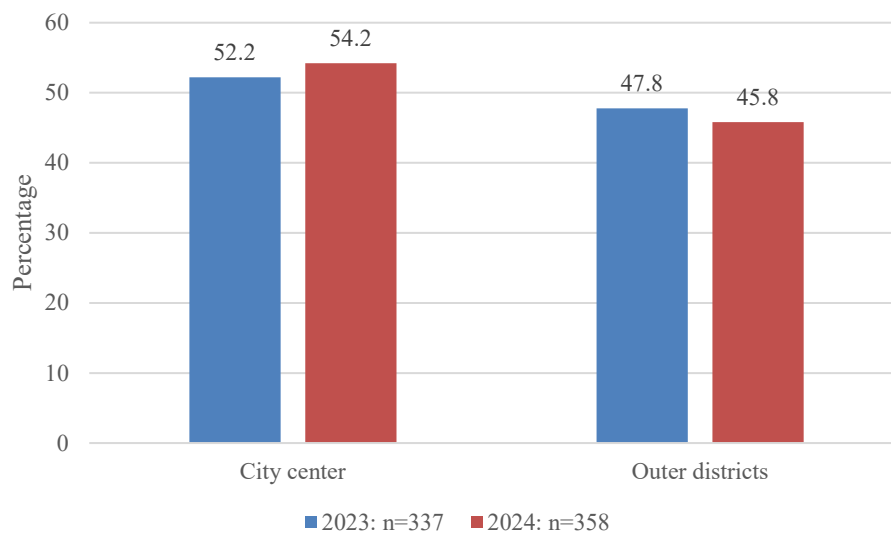
Source: own graph.

Figure 5 shows the age of the children in the sample.

Figure 5: Age

Source: own graph.

Figure 5 shows that there is a difference of children in 2023 and 2024 mostly in the ages of 7 and 8 as well as 12 and 13 years.

Two questions were only surveyed in the survey wave of 2024. Figure 6 and 7 show the respective questions and their results.
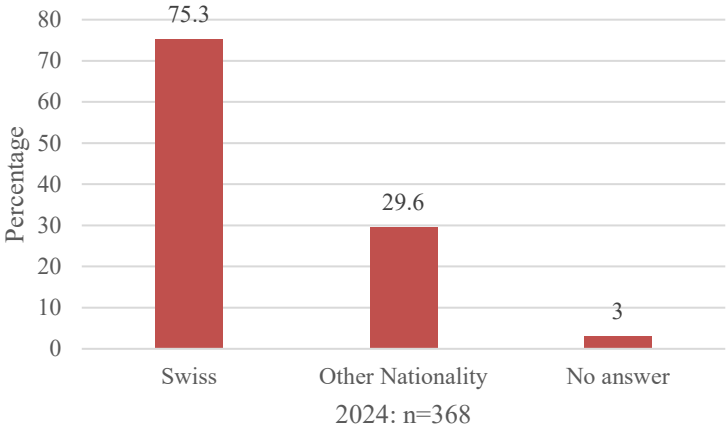
Figure 6: Average income of household per month (before taxes)
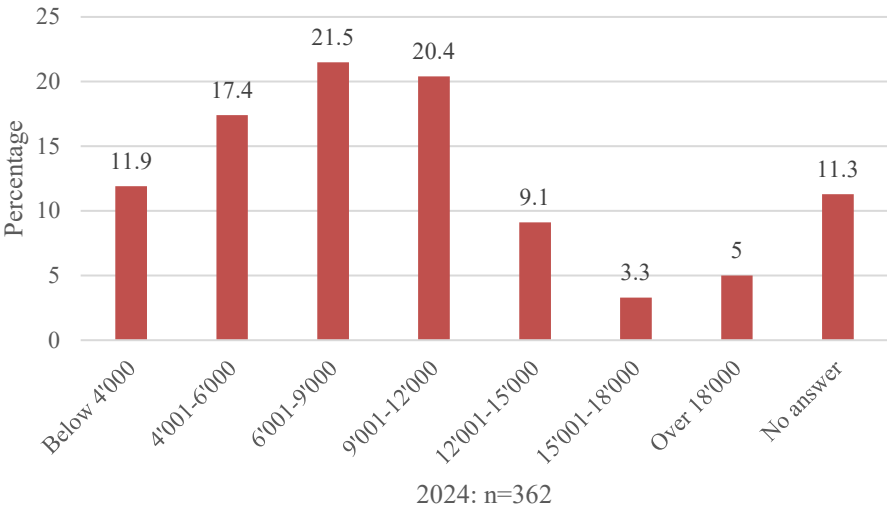
Source: own graph.

Figure 6 shows that most households in 2024 earn between 6001 and 9000 Swiss francs per month.

Figure 7: Nationality (multiple answers)

Source: own graph.

Figure 7 shows that a majority of the children surveyed in the City of Lucerne hold a Swiss passport.

5   Descriptive results: wave 1 and 2

In the following, the content-related results of the first and second survey wave are presented descriptively. First, the survey asked how many people had already heard about this voucher offer. The responses to this question are shown in Figure 8.

Figure 8: Knowledge about voucher offer
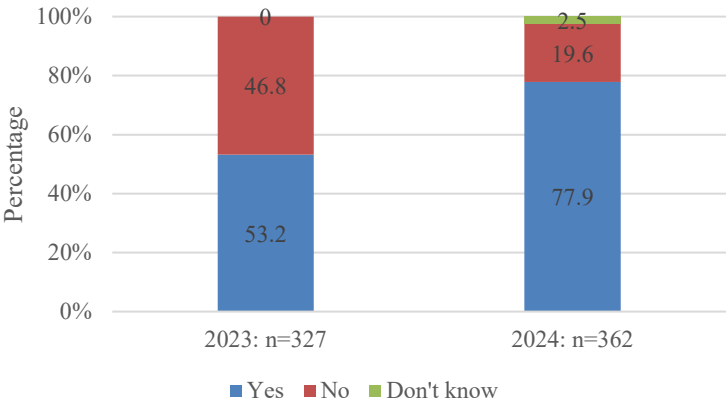
Source: own graph.

It can be seen in figure 8 that 53.2% of people had already heard of this voucher before the survey from the media or other sources and that 46.8% had not yet heard of this offer. After the first intervention, figure 8 shows that 77.9% of people had heard of this voucher and that 19.6% had not heard of this offer yet.

Figure 9: Voucher received
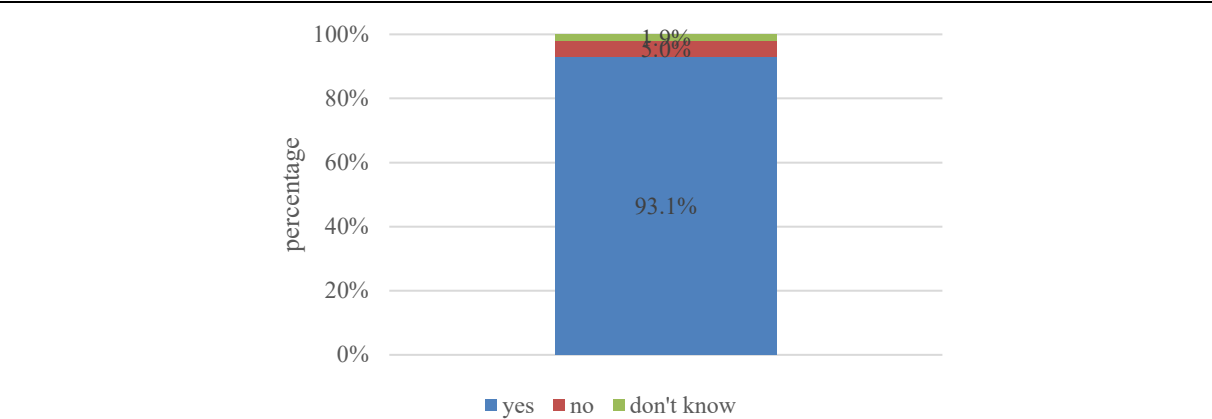
Source: own graph.

In 2024, figure 9 shows that 93.1% of the people stated that they have received a voucher (n=363).

Figure 10: Voucher cashed-in
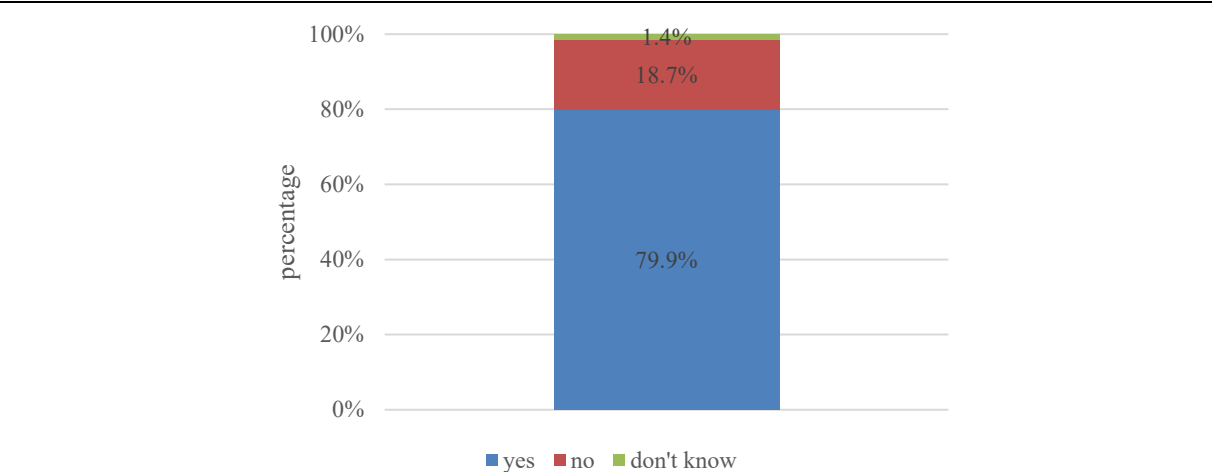
Source: own graph.

In 2024, figure 10 shows that 79.9% of the people cashed-in the voucher (n=363).

Furthermore, it was asked how likely it would be that participants would also cash-in the voucher for their child. The question was asked using a five-point likert scale with the

expressions "very unlikely", "rather unlikely", "neither nor", "rather likely" and "very likely". From these, the dichotomous expressions "likely" were generated by categories 5 and 6, and "not likely" by categories 1 to 3. Figure 9 presents the feedbacks.

Figure 11: Willingness to cash-in the voucher
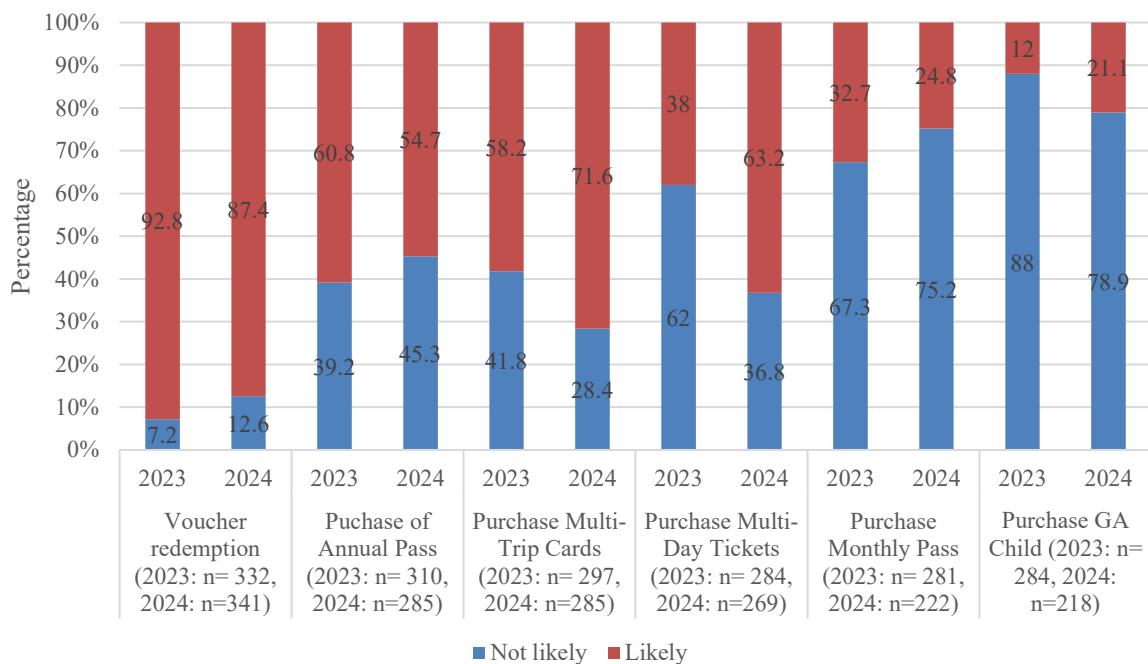
Source: own graph.

Overall, Figure 11 shows that in 2023, 92.9% of participants are likely to cash-in the voucher. Furthermore, 60.8% indicate that they would use the voucher to purchase an annual season ticket, while 58.4% would use the voucher to purchase multi-ride tickets. 38% would purchase multi-day passes, 32.7% would use the money for a monthly pass, and 12% would use the money to pay for a portion of a General Abonnement for children. In 2024, 87.4% of participants are likely to cash-in the voucher. Furthermore, 54.7% indicate that they would use the voucher to purchase an annual season ticket, while 71.6% would use the voucher to purchase multi-trip tickets. 63.2% would purchase multi-day passes, 24.8% would use the money for a monthly pass, and 21.1% would use the money to pay for a portion of a General Abonnement for children. The following section reports some of the household information that was collected in the survey.

5.1   Public transport tickets in the household

Figure 12 shows which public transport subscriptions are available in the households.

Figure 12: Public transport season ticket ownership for households (multiple answers)
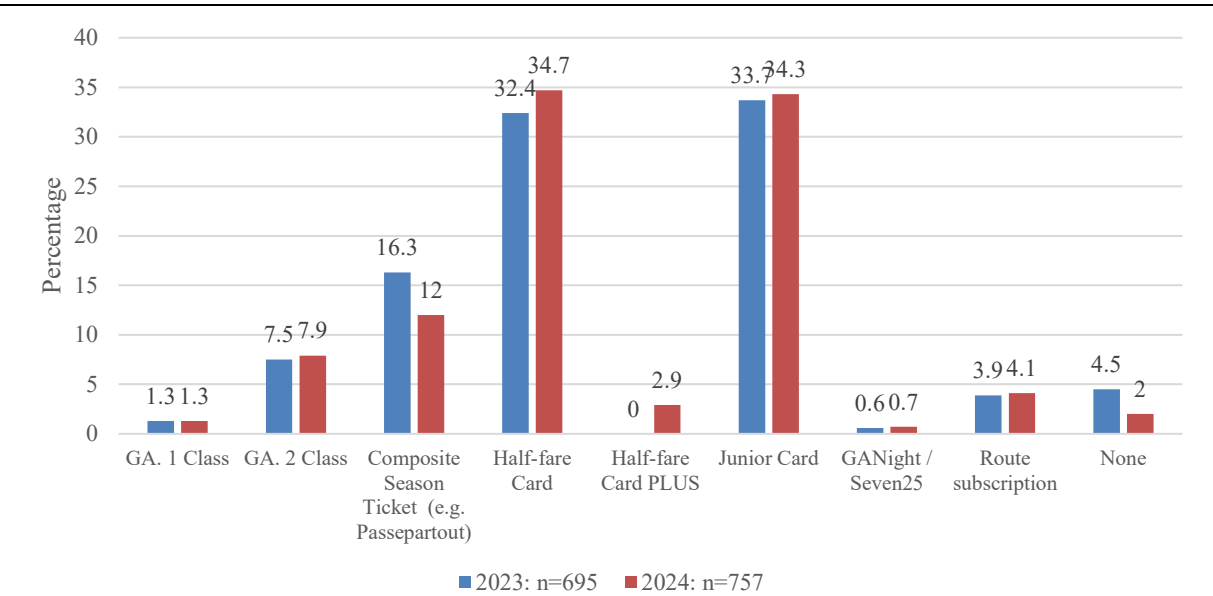
Source: own graph.

A total of 695 responses were received for this question in year 2023 and 757 in year 2024 (multiple responses). Of the responses in year 2023, 33.7% stated that a Junior Card was available. 32.4% of the responses were for the Half-Fare Card and 16.3% of the responses were for the regional travel system passes. Of the responses in year 2024, 34.3% stated that a Junior Card was available. 34.7% of the responses were for the Half-Fare Card and 12% of the responses were for the regional composite season tickets.

5.2   Attitude of the household towards mobility

Likert scales were used to assess items relating to attitudes towards mobility. The mean values on a scale from 1 (strongly disagree) to 5 (strongly agree) are given below.

Figure 13: Attitudes (mean values)
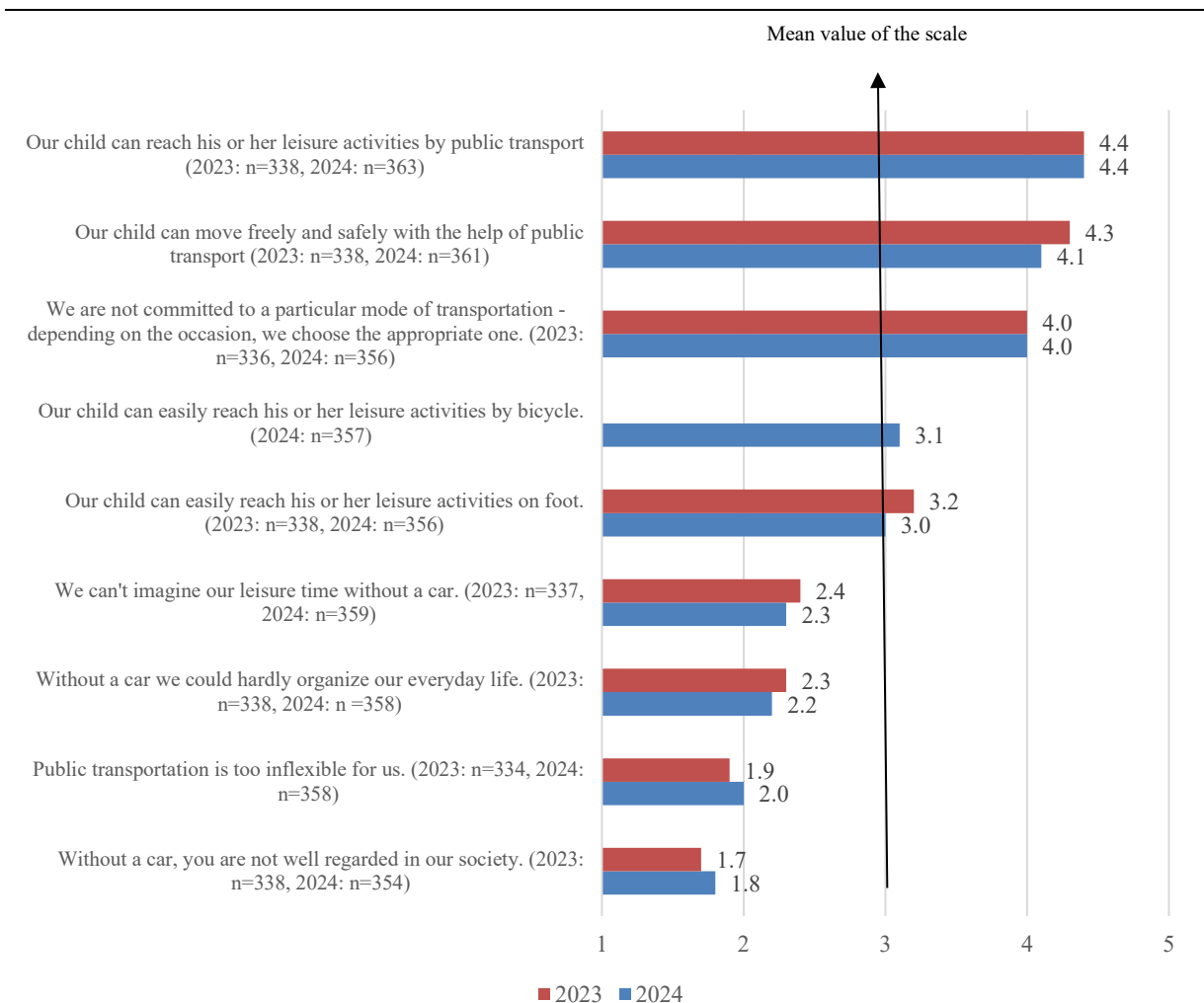
Source: own graph.

The feedback shows that children can reach leisure activities well by public transport (scale mean value = 4.4 in 2023, 4.4 in 2024). In addition, there is a high level of agreement with the statement that children can move freely and safely with the help of public transport (scale mean value = 4.3 in 2023, 4.1 in 2024). The mean value is also in the positive range for the statement that one is not committed to a particular mode of transport and chooses the appropriate one depending on the occasion (scale value = 4.0 in 2023, 4.0 in 2024). Furthermore, it is shown that not all leisure activities can easily be reached by bicycle (3.1 in 2024) as well as on foot (scale value = 3.2 in 2023, 3.0 in 2024). The statements that one cannot imagine leisure time

without a car (scale value = 2.4 in 2023, 2.3 in 2024), that one can hardly organize everyday life without a car (scale value = 2.3 in 2023, 2.2 in 2024), that public transport is too inflexible (scale value = 1.9 in 2024, 2.0 in 2024) and that one is not so well regarded in society without a car (scale value = 1.7 in 2023, 1.8 in 2024) received less agreement. In the next section, the general use of the children's modes of transport is reported.

5.3   General use of children's modes of transport

Furthermore, Figure 14 shows how a child gets to school on a regular basis.

Figure 14: Modes of transport used usually for school trip (multiple answers)
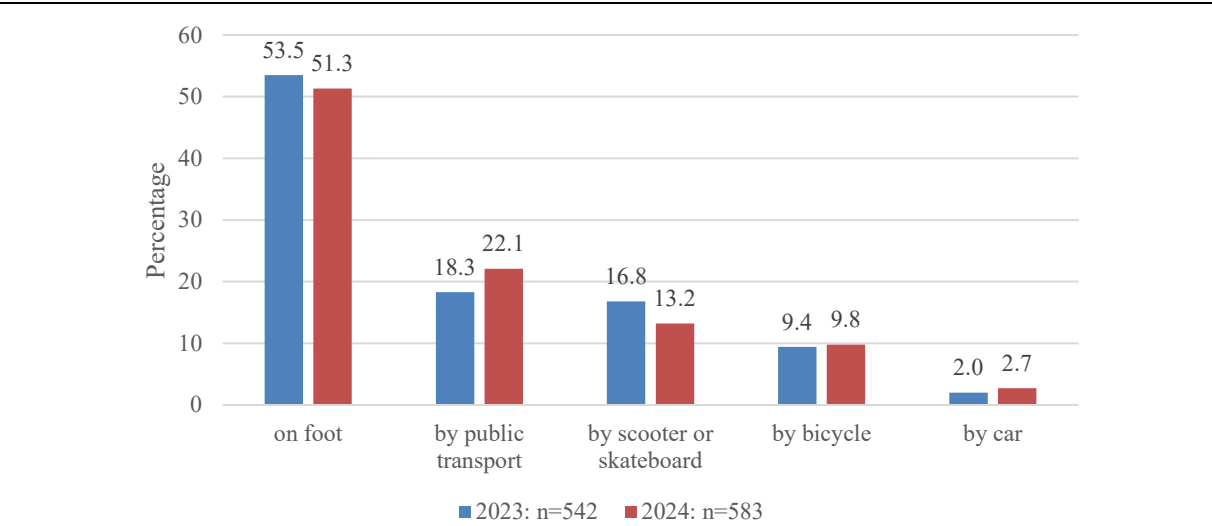
Source: own graph.

The diagram shows that in 2023, 53.5% of the multiple answers state that children walk to school, 18.3% that they use public transport, 16.8% that they go by scooter or skateboard, and 9.4% that children make their way to school by bicycle. Only 2% of the multiple answers state that the children are taken to school in their parents' cars. In 2024, 51.3% of the multiple answers state that children walk to school, 22.1% that they use public transport, 13.2% that they go by scooter or skateboard, and 9.8% that children make their way to school by bicycle. Only 2.7% of the multiple answers state that the children are taken to school in their parents' cars. Figure 15 shows how the surveyed children usually get to leisure activities.

Figure 15: Modes of transport used usually for leisure trip (multiple answers)
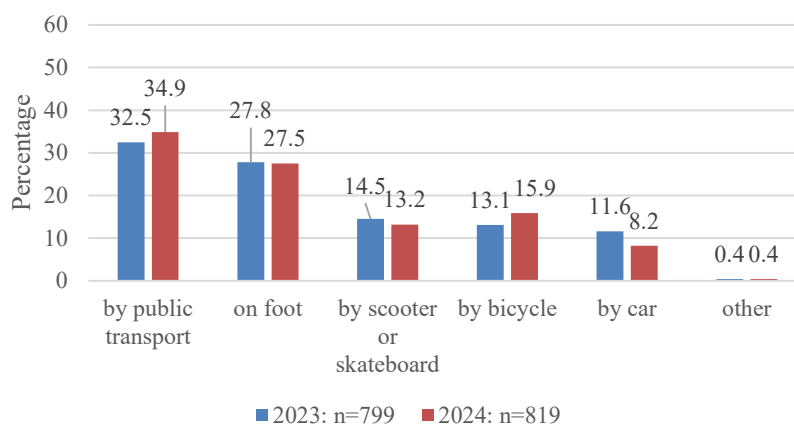
Source: own graph.

Figure 15 shows that in 2023, 32.5% of the multiple answers state that public transport is used to get to leisure activities, 27.8% do so on foot, 14.5% by scooter or skateboard, and 13.1% ride their bike. 11.6% of the answers indicate that the children are taken by their parents to leisure activities by car. 0.4% of the children use another modes of transport. In 2024, 34.9% of the multiple answers state that public transport is used to get to leisure activities, 27.5% do so on foot, 13.2% by scooter or skateboard, and 15.9% ride their bike. 8.2% of the answers indicate that the children are taken by their parents to leisure activities by car. 0.4% of the children use another modes of transport.

5.4   Results from the mobility diary

Furthermore, a mobility diary supplements the information given in figure 16 and 17. The following figures explain the data of the mobility diary, which were collected within the survey. Figure 16 presents the mobility diary by mode of transport.

Figure 16: Mobility diary by modes of transport
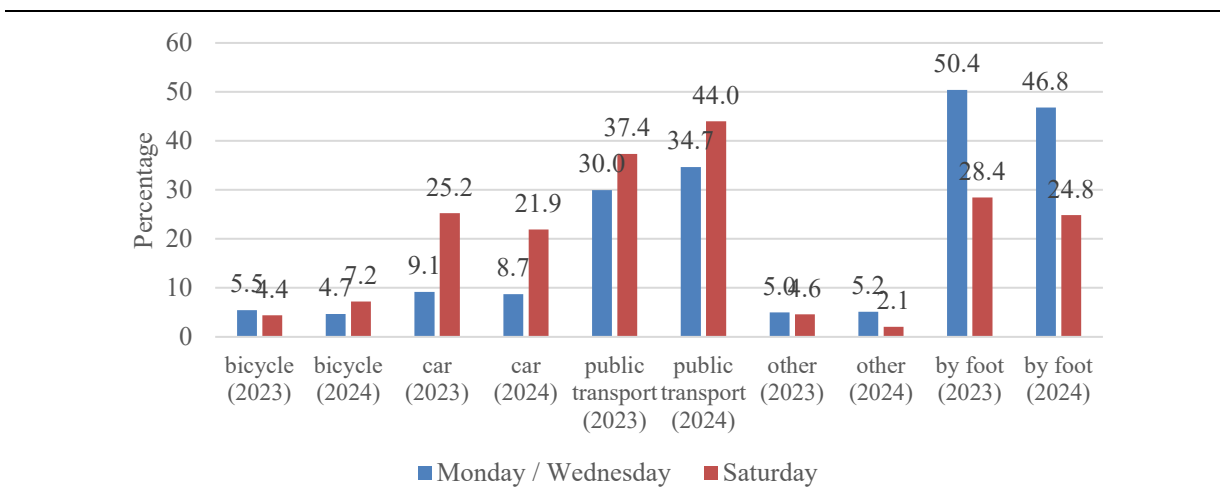
Source: own graph.

Figure 16 shows that car use on monday/wednesdays has remained the same between the two years, but has decreased on saturdays. In the case of public transport, it can be seen that use has increased both on mondays/wednesday and on saturdays. The mobility diary by modes of transport shows that journeys to school are mainly made on foot or by scooter on both Mondays and Wednesdays. Accompanying routes, leisure routes and visiting routes, however, are more likely to be covered by public transport, car or bicycle by the children surveyed on Mondays, Wednesdays and Saturdays. Figure 17 shows the mobility diary according to the accompaniment of the children.

Figure 17: Mobility diary by accompaniment
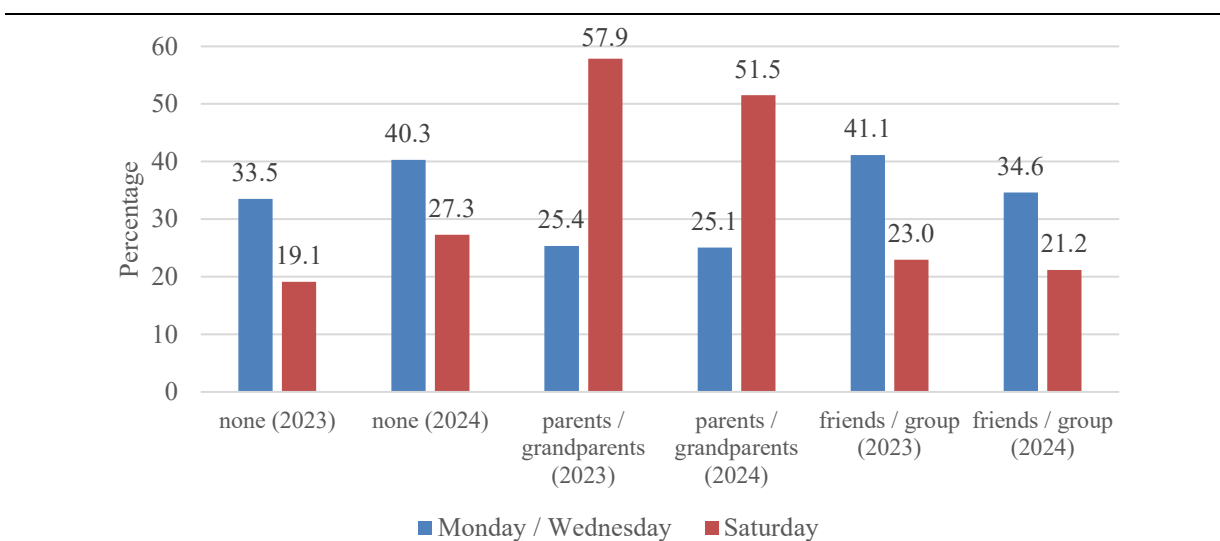
Source: own graph.

Figure 17 shows that journeys are made alone more frequently both on monday/wednesdays and on weekends. It can be seen, that both school routes on Mondays and Wednesdays and leisure and visiting routes on Mondays, Wednesdays and Saturdays are mostly completed by the children alone or with friends or in groups. The accompanying routes, on the other hand, are accompanied by parents and/or grandparents on Mondays, Wednesdays and Saturdays.

5.5   Shares & VI for modes of transport used usually and trip purpose by years

In the following section, shares and 95%-confidence intervals are presented for MoT (Mode of Transport) for school- and leisure trips used usually as well as shares of PT and shares for car by day and trip purpose by years from dummy variables. Figure 18 shows the comparison of confidence intervals for the way to school as well as for leisure trips, based on modes of transport most frequently used.

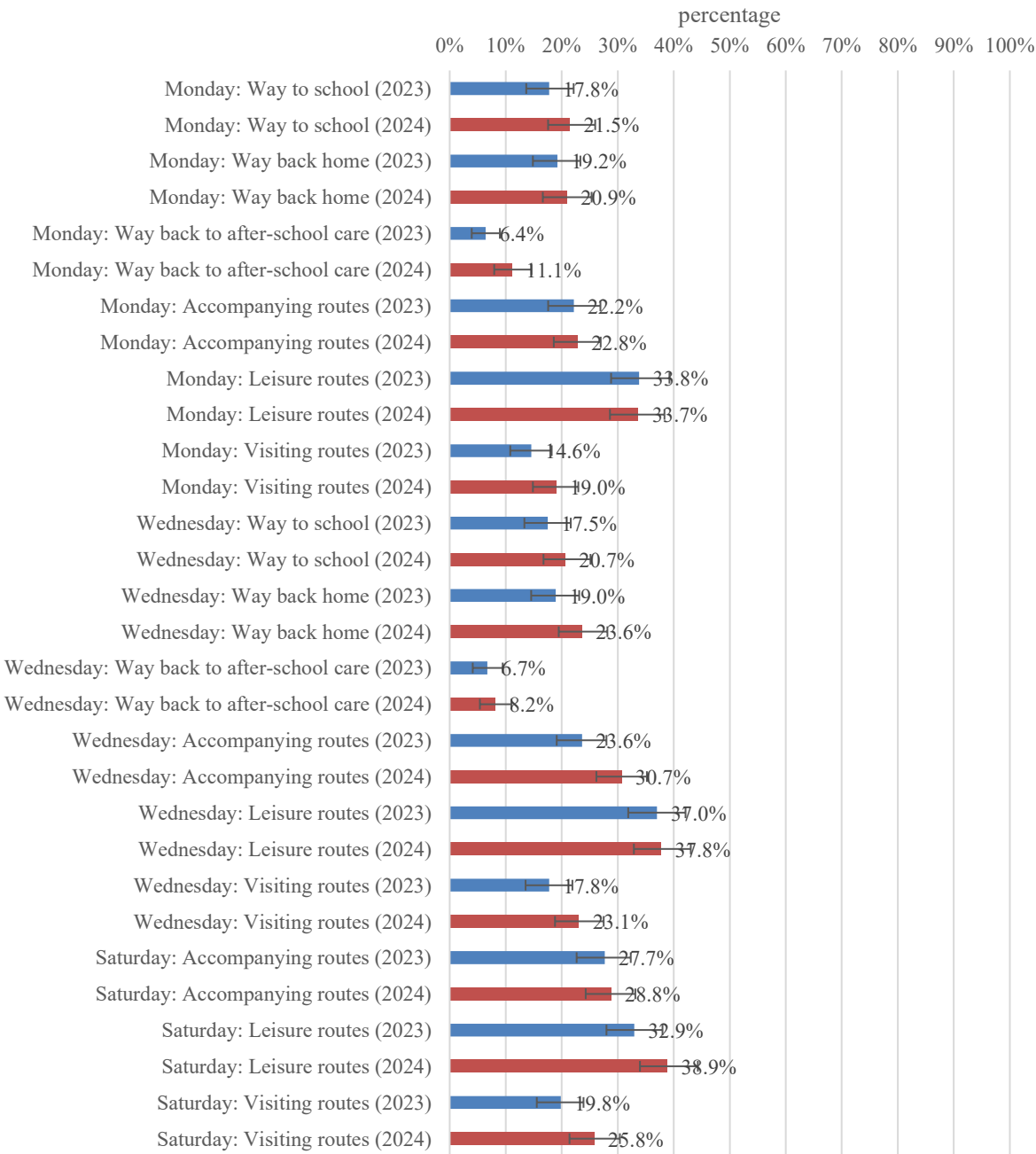Figure 18: MoT for school- and leisure trips used usually by years (shares and 95%-CI)
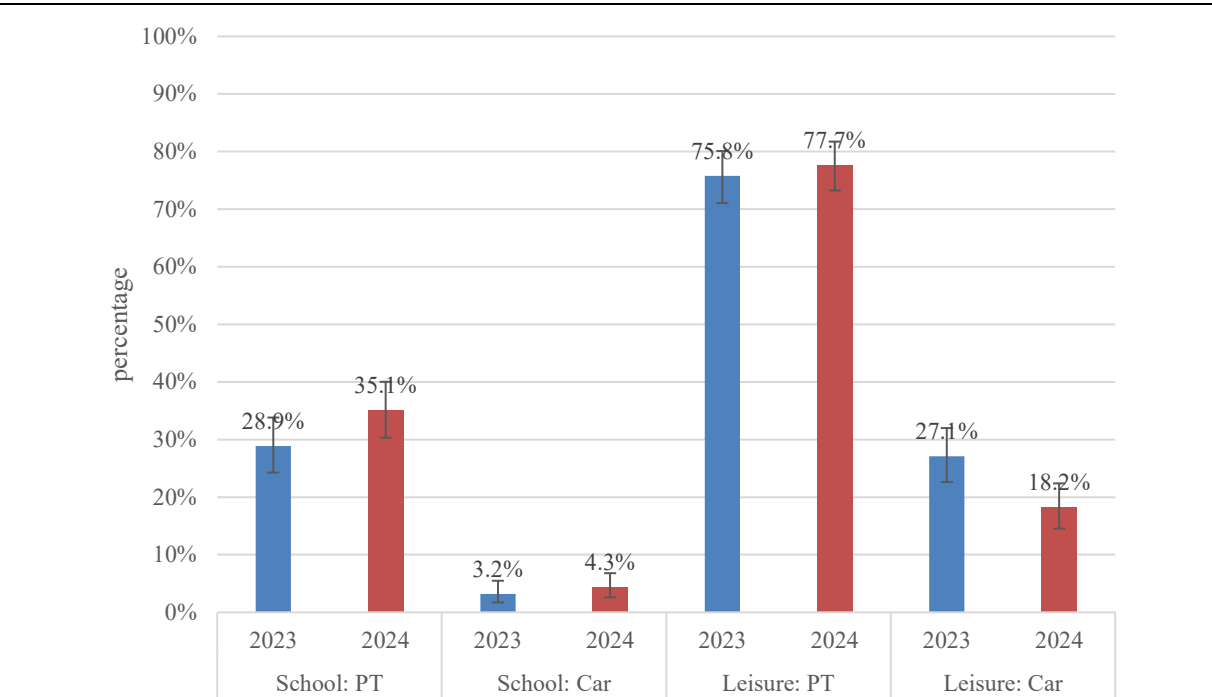
Source: own graph.

It can be seen in figure 18 that there are no significant differences by modes of transport of public transport and car for school and leisure trips between the years 2023 and 2024. Figure 19 shows the comparison of confidence intervals from the mobility diary, based on public transport trips with dummy variables.

Figure 19: Shares of PT by day and trip purpose by years (shares and 95%-CI)

Label	Value
Monday: Way to school (2023)	17.8%
Monday: Way to school (2024)	21.5%
Monday: Way back home (2023)	19.2%
Monday: Way back home (2024)	20.9%
Monday: Way back to after-school care (2023)	6.4%
Monday: Way back to after-school care (2024)	11.1%
Monday: Accompanying routes (2023)	22.2%
Monday: Accompanying routes (2024)	22.8%
Monday: Leisure routes (2023)	33.8%
Monday: Leisure routes (2024)	33.7%
Monday: Visiting routes (2023)	14.6%
Monday: Visiting routes (2024)	19.0%
Wednesday: Way to school (2023)	17.5%
Wednesday: Way to school (2024)	20.7%
Wednesday: Way back home (2023)	19.0%
Wednesday: Way back home (2024)	23.6%
Wednesday: Way back to after-school care (2023)	6.7%
Wednesday: Way back to after-school care (2024)	8.2%
Wednesday: Accompanying routes (2023)	23.6%
Wednesday: Accompanying routes (2024)	30.7%
Wednesday: Leisure routes (2023)	37.0%
Wednesday: Leisure routes (2024)	37.8%
Wednesday: Visiting routes (2023)	17.8%
Wednesday: Visiting routes (2024)	23.1%
Saturday: Accompanying routes (2023)	27.7%
Saturday: Accompanying routes (2024)	28.8%
Saturday: Leisure routes (2023)	32.9%
Saturday: Leisure routes (2024)	38.9%
Saturday: Visiting routes (2023)	19.8%
Saturday: Visiting routes (2024)	25.8%

Source: own graph.

It can be seen in figure 19 that there are no significant differences by modes of transport of public transport between the years 2023 and 2024. Figure 20 shows the comparison of confidence intervals from the mobility diary, based on car trips.

Figure 20: Shares of car by day and trip purpose by years (shares and 95%-CI)
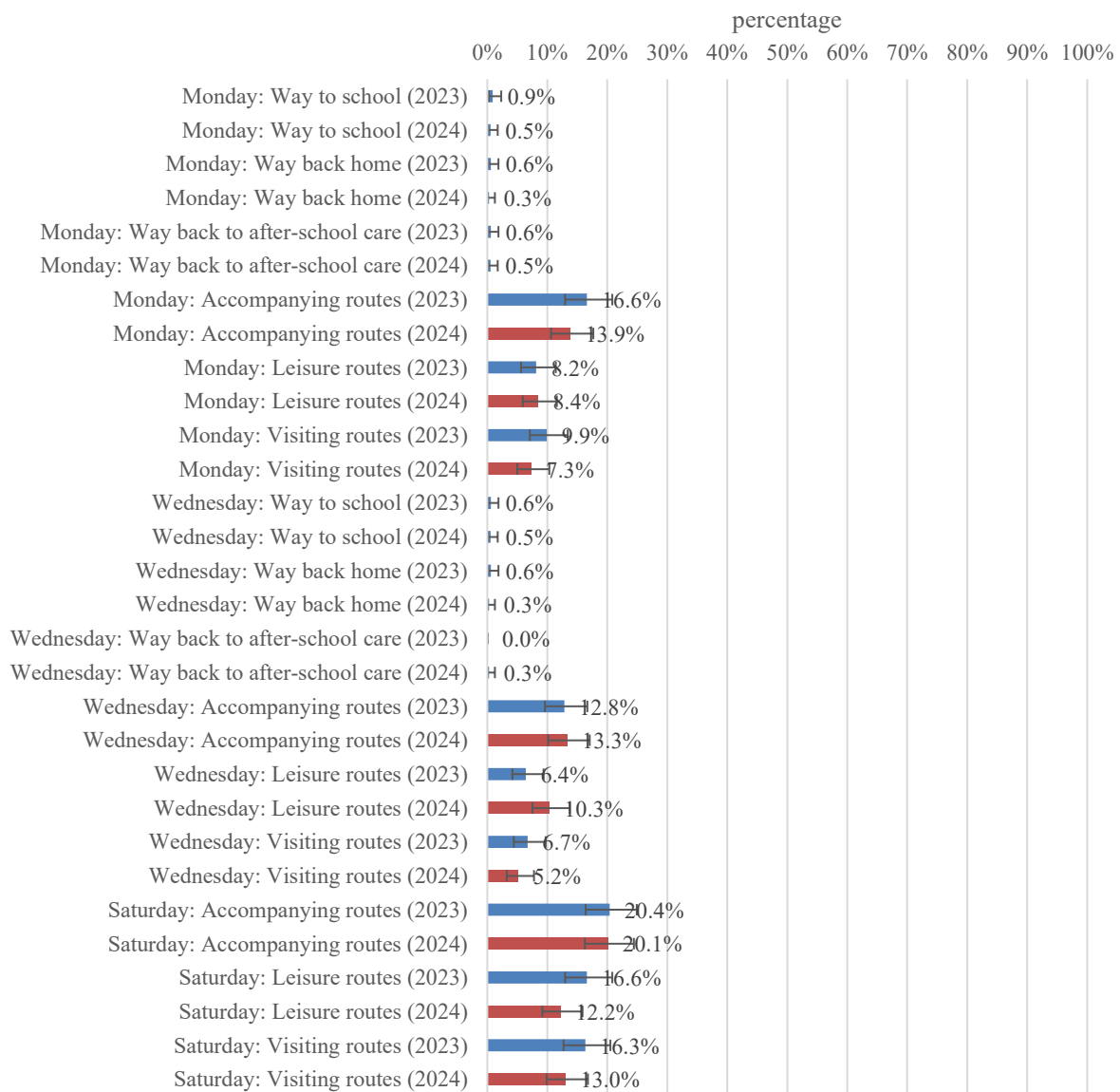
Source: own graph.

It can be seen in figure 20 that there are no significant differences by modes of transport of public transport between the years 2023 and 2024.

5.6   Group differences for children and adolescents

As to the questions of whether the use of public transport with the voucher can be increased and whether car use can be reduced, initial indications are emerging for people who plan to

cash-in the voucher stemming from both survey waves and people who cash-in the voucher stemming from survey wave 2 in 2024.

Not all tested group differences concerning children and adolescents contain significant results. However, significant group differences at the p<5%-level can be found in the mean value comparison of all people who plan to cash-in the voucher (first and second wave): There are significant group differences for boys and girls, the location of the school in the city center and outer districts, the age groups of 6-12 and 13-16 years and attendance at a primary and secondary school, between the years 2023 and 2024 using car or PT for school or leisure trips.

Initial indications are emerging for people who plan to cash-in the voucher stemming from both survey waves.

There are differences between the age groups using public transport for leisure trips. This can be seen in Figure 21.

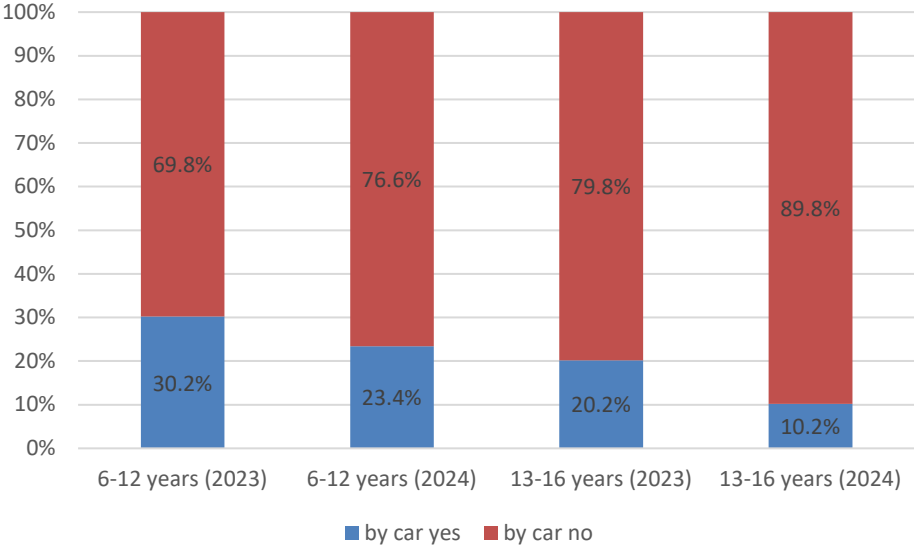Figure 21: Leisure trips with PT by people who plan to cash-in the voucher (used usually)
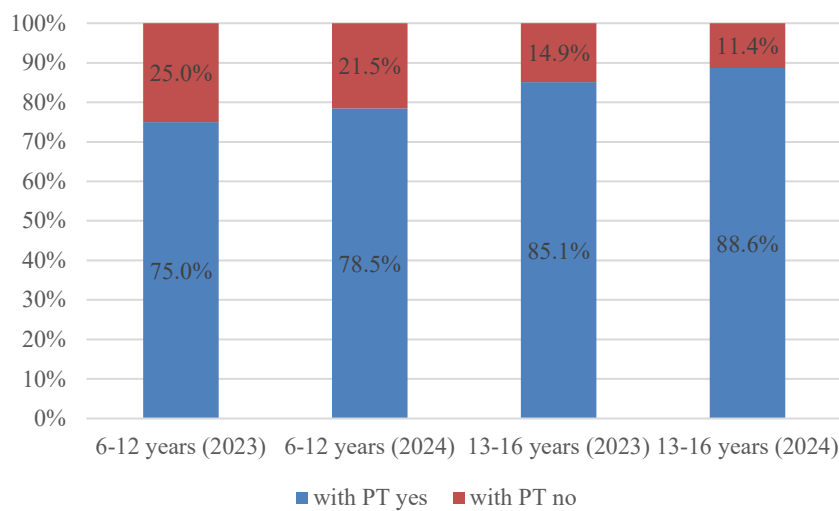
Source: own graph.

Children aged 13-16 years old use public transport significantly (p<0.5) more often for leisure trips than children 6-12 years old.

Furthermore, there are differences in the use of cars between the age groups for leisure trips as visualized in figure 22.

Figure 22: Leisure trips with car by people who plan to cash-in the voucher (used usually)
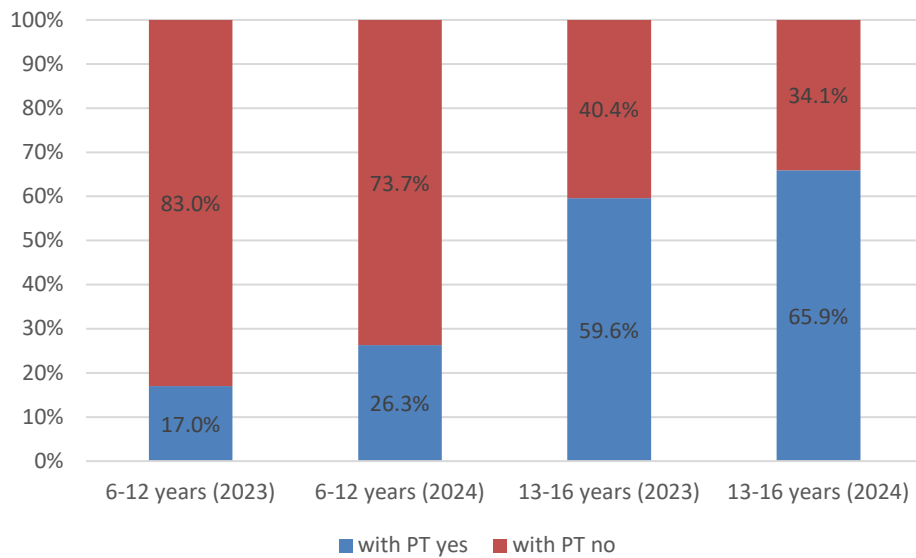
Source: own graph.

Children aged 13-16 years old use the car significantly ($p<0.5$) less often for leisure trips than children 6-12 years old. There are significant group differences for children and adolescents and a decrease across the waves for the use of cars for leisure trips only in both age groups. This can be seen in figure 20.

Additionally, differences can be found in the use of PT between the age groups for school trips as visualized in figure 23.
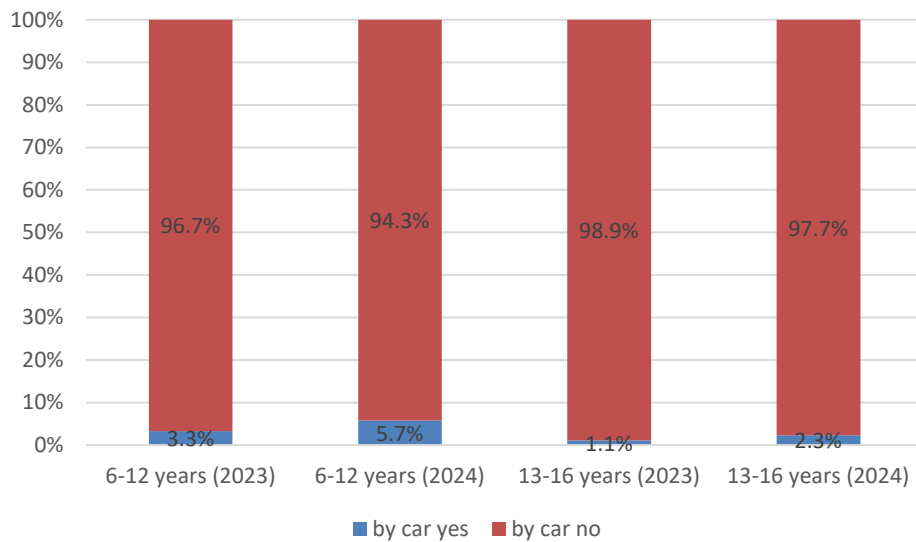
Figure 23: School trips with PT by people who plan to cash-in the voucher (used usually)

Source: own graph.

Children aged 13-16 years old use public transport significantly ($p<0.5$) more often for school trips than children 6-12 years old.

Figure 24: School trips by car by people who plan to cash-in the voucher (used usually)
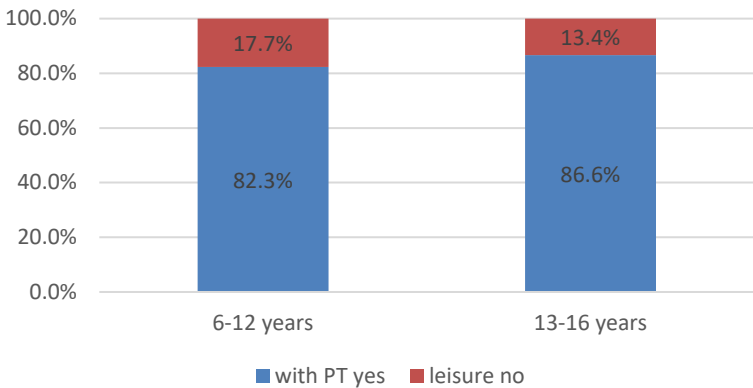

Source: own graph.

Children aged 13-16 years old use the car more often for school trips than children 6-12 years old.

Furthermore, significant group differences at the p<5%-level can be found in the mean value comparison of all people who cash-in the voucher (second wave): There are significant group differences for children and adolescents for the use of car for leisure trips in both age groups as well as for children and adolescents for the use of public transport for school trips in both age groups.

Initial indications are emerging for people who cash-in the voucher stemming from survey wave 2 in 2024.

Figure 25: Leisure trips with PT by people who cash-in the voucher (used usually)
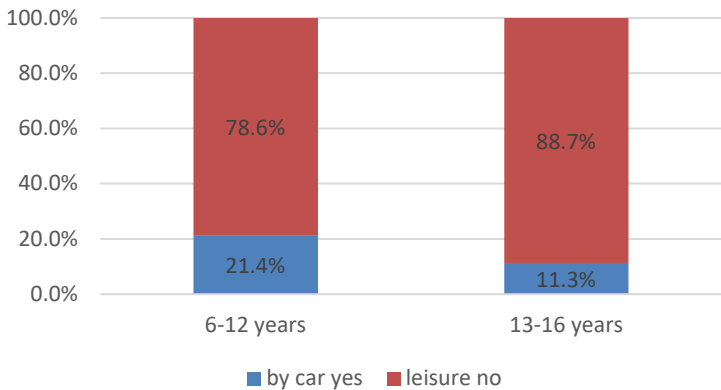

Source: own graph.

For people who cash-in, figure 25 shows, that adolescents tend to make more leisure trips by PT than children.

However, figure 26 shows significant (p<0.5) group differences for children and adolescents for the use of car for leisure trips in both age groups

Figure 26: Leisure trips with car by people who cash-in the voucher (used usually)

For people who cash-in, figure 24 shows, that adolescents tend to make significantly ($p<0.5$) fewer leisure trips by car than children.

Additionally, figure 27 shows significant ($p<0.5$) group differences for children and adolescents for the use of public transport for school trips in both age groups

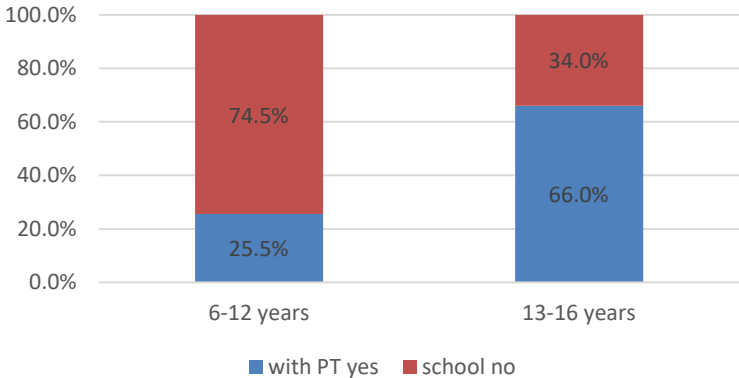Figure 27: School trips with PT by people who cash-in the voucher (used usually)
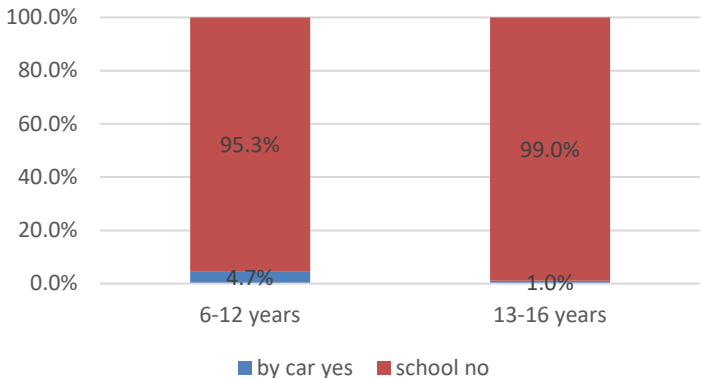
For people who cash-in, figure 28 shows, that adolescents tend to make significantly ($p<0.5$) more school trips by PT than children.

Figure 28: School trips by car by people who cash-in the voucher (used usually)

For people who cash-in, figure 28 shows, that adolescents tend to make less school trips by car than children.

6 Discussion

The public transport voucher intervention of the City of Lucerne, which is carried out using the living lab methodology. Survey wave 1 and 2 have produced initial data indicating that the voucher is being successfully accepted and used by the pupils and their families.

With regard to the methodology, the cluster sampling processes reveals a comparable sample structure. Comparability and measuring of effects is possible, since results of questions of MoT used usually and mobility diary are aligned. The questionnaire allows for specification of target group. Particularly important effects can be achieved for adolescents.

The difference in intention and behavior shows that the willingness to cash-in is aligned with voucher redemptions as stated in the survey. The comparison of the first and second survey wave allow a first descriptive trend analysis. The intention stated in survey wave 1 can therefore be compared with behaviour stated in wave 2. Moreover, it can be investigated whether the voucher has led to higher shares of public transportation use and less car use in different domains of travel (school and leisure trips).

Survey results show, that more people heard of the voucher. Hence, the likeliness to cash-in the voucher is decreasing. In 2024, 93.1% of the requested households reported having received the voucher and 79.9% reported having cashed-in the voucher. Thereafter, voucher chashed-in don't lead to behavior change automatically. In terms of behavior, it shows that modal split shifts can be achieved: The use of PT can be increased and the use of private cars can be reduced. Both the time series comparisons of the main modes of transportation for school and leisure trips as a first indication and the mobility diary as an important information source confirm this trend. The increased sole use of routes also indicates that public transport is being used more widely. There are also differences between travel purposes, especially for school and leisure trips. However, based on bivariate statistics, no significant effects can be found so far. But descriptive results show timely changes in the survey waves of the cross-sectonal trend study.

The analysis shows that the intervention targets the adolescents mainly for leisure trips, since the analysis of cashed-in vouchers shows that families who have cashed-in the voucher use public transport more frequently for school and leisure trips and car less for leisure trips than those who have not. Overall, the data shows that the voucher has a positive influence, particularly through the increased use of public transport for school and leisure trips.

The results confirm the findings of Sauter (2019), who recognizes that the whole development is mutually supported by various factors that are essential for the change in mobility behaviour of adolescents and young adults. On the one hand, these are improved public transport services,

whether in the form of an expanded network, timetable (tighter intervals, night buses and trains) and new travel passes. The increased use of public transport may promoted by the positive attitude of young people towards this modes of transport. On public transport, one can talk to others, surf the internet or simply 'be' (see Sauter & Wyss 2014).

7 Outlook

Survey wave 1 and 2 provide first hints of the PT-voucher use. The data of wave 1 serves as a baseline and provides initial indications of our research questions. Furthermore, it clarifies the intention to cash-in the voucher and shows the *status-quo*. Wave 2 shows first changes in modal split.

The comparison of survey wave 1, conducted before the introduction and wave 2, after the first intervention of the voucher clarifies the intention to implement a planned use of the public transport voucher. In addition, a future wave will be included, which will make it possible to compare the first and second survey wave with the feedback after the introduction of the first two waves of interventions. This allows for a more sophisticated trend analysis.

In the analysis of the public transportation voucher and comparison of the 2023 and 2024 surveys, we plan to conduct a logit analysis as well as a trend analysis and a multi-group comparison for multivariate modelling. This will allow to examine the likelihood of pupils using public transportation based on the year of the survey (2023 or 2024) and other relevant variables such as the presence of the voucher or the age group. To do this, we will first formulate a model that describes the relationship between these variables. Then, we estimate the coefficients of the model to quantify the influence of each variable on public transportation usage. Finally, we interpret the results to understand how the voucher and the year of the survey influence the likelihood of using public transportation.

Furthermore, more data sources will be used for the evaluation: Data of voucher redemption as well as ticket sells in the City of Lucerne and revenues in the Canton of Lucerne will be investigated for further analysis of behavior-change.

The developments described are taking place against the background of structural and social changes, such as the increase in distances to places of education and the expansion of public transport, which is complemented by a positive attitude towards this mode of transport on the part of children and young people. This may changing the choice of modes of transport in the long run, not only for educational purposes, but also for leisure time.

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