Scuola universitaria professionale della Svizzera italiana
Dipartimento ambiente costruzioni e design

SUPSI

S2HOES – Safe and sustainable home-school mobility
A preliminary study

Final report

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1 Main aim

The proposed S2HOES model - *Safe and Sustainable Home School Mobility* - sought to break the cycle of negative mobility behaviour by implementing socially embedded motivational triggers and organizational changes to reduce car use and strengthen existing local Walking School Bus (WSB) initiatives and support active, safe and sustainable school mobility at the local level (www.s2hoes.ch). This goal was intended to be achieved with the support of two information technology (IT) solutions: 1) the "KidsGoGreen" game platform, and 2) the "Pedibus Smart" mobile application for WSB volunteers. The first solution exploits gamification to motivate children and families to improve their school mobility, the latter, aims to facilitate the daily operation of WSBs.

Against this background, the present S2HOES preliminary study tested these two IT solutions on the field involving three municipal schools (kindergarten and primary school) located in Canton Ticino, Switzerland during school year 2020/21: Balerna, Novazzano and Mendrisio. A set of three different intervention combinations were implemented and their impact analysed. The intent was to collect scientific knowledge on the efficacy of the two proposed tools in supporting lifestyle changes, as well as to collect bottom-up suggestions on how to improve future interventions.

2 The S2HOES Toolkit

2.1 Pedibus Smart – mobile application and proximity device

Participation in the "Pedibus Smart" scheme resided entirely in the parents' voluntary decision to enrol their child in the existing local Walking School Bus (WSB) initiative organised by the schools' official parent associations. Hence, a recruitment campaign was launched to enrol old and new WSB participants (children + adult WSB/PBS volunteers) in the proposed PBS scheme, with the only difference that the PBS scheme provides accompanying volunteering parents with the "Pedibus Smart" mobile application and participating children with a small proximity device to facilitate automatic registration to the WSB.

In this context, the S2HOES field study managed to involve ten local WSB/PBS routes. Routes are briefly described in the next section.

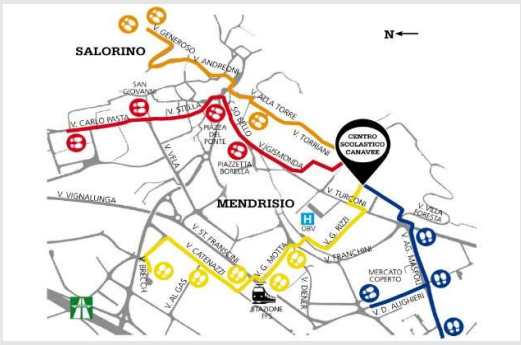
2.1.1 Linea Pedibus S2HOES – Istituto scolastico Balerna

Number of WSB/PBS lines: three routes (red, green and yellow)
Frequency: once every two weeks (on Fridays)
Number of children: 38
Number of WSB/PBS volunteers (parents): 6
Field study: Case study 1 (G1)

2.1.2 Linea Pedibus S2HOES – Istituto scolastico Novazzano

Number of WSB/PBS lines: three routes (blue, red and yellow)
Frequency: once every two weeks (on Tuesday)
Number of children: 29
Number of WSB/PBS volunteers (parents): 11
Field study: Case study 1 (G1)

2.1.3 Linea Pedibus S2HOES – Istituto scolastico Mendrisio-Canavée



Number of WSB/PBS lines: four (orange, red, blue and yellow)
Frequency: once every two weeks, at lunchtime (on Thursdays)
Number of children: 25
Number of WSB/PBS volunteers (parents): 14
Field study: Case study 2 (G2)

2.2 KidsGoGreen - a gamification approach

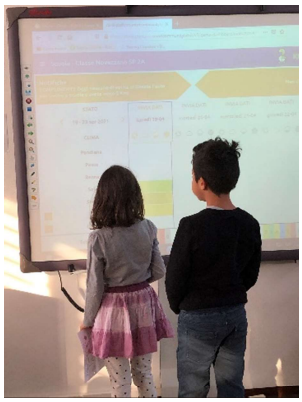
The kilometres travelled by each child using sustainable transportation (on foot, WSB/PBS, bike, kick scoter, school bus etc.), contribute to progress on a virtual, educational journey to places in the real word. Stops along the way allow the discovery of cities, countries, and places, conveying the value of the collective sustainable kilometres travelled to date. The game is supported by web platform that captures the sustainable kilometres of each child, managing progress in the game and displaying the achievements on a multimedia, interactive map.

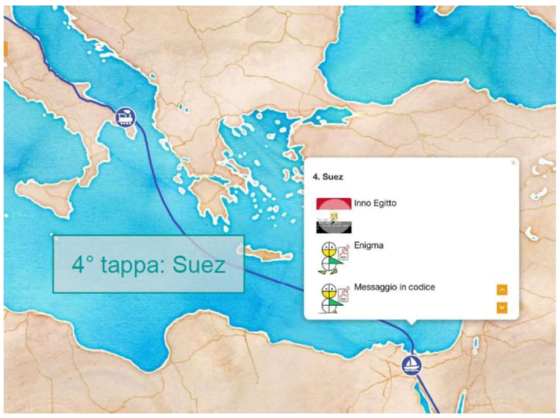
In the context of the S2HOES project, three KidsGoGreen journeys were developed and implemented: 1) Around the World in 80 Days; 2) Travelling with Azzurrra and Celestino"; 3) Traveling the Galaxy of Art. What follows is a brief description of these activities.

2.2.1 "Around the World in 80 Days" (47'075 km in 14 stopovers)

Number of participants: 356 children
School: Primary school and Kindergarten of Balerna and Novazzano
Duration: 18.01.21 until 31.05.2021
Field study: Case study 1 (G1); Case study 3 (G3)
Link: https://kidsgogreen.eu/en/routes/around-the-world-in-80-days/

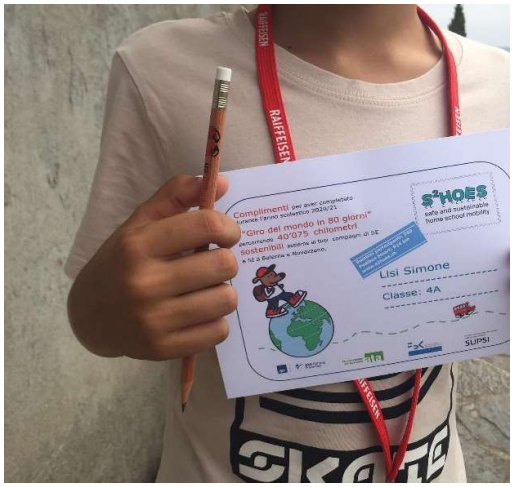
Based on Jules Vernes' famous novel "Around the World in 80 Days", participants joined the book's two main characters - Mr. Phileas Fogg and his French servant Passepartout - to travel the world, in an attempt to circumnavigate the globe in just 80 days to win a bet … of course, using sustainable transport modes to advance.





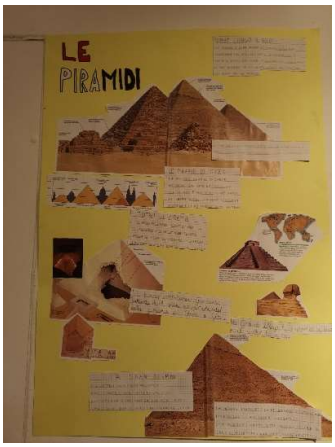
2.2.1.1 Final event

To reward the engagement shown by all participants, a final event was organized on the 16.06.2021. Penguin "Pango" - the official ATA Pedibus mascot – visited the involved schools and handed over to every child a S2HOES diploma, certifying the sustainable km travelled. Pango talked about the importance of going to school sustainably and safely, as well as its implications with climate protection.



2.2.1.2 Project exhibition

From 7.06 until 17.06.2021, a local exhibition of the project took place in the "Sala del Torchio" of the municipality of Balerna. The exhibition was organized in cooperation with the teachers and the parents' association and gave the opportunity to learn about the 14 stopovers the children reached and studied during their virtual journey around the world.



2.2.2 “Traveling with Azzurra and Celestino” (1’700 km in 3 stopovers)

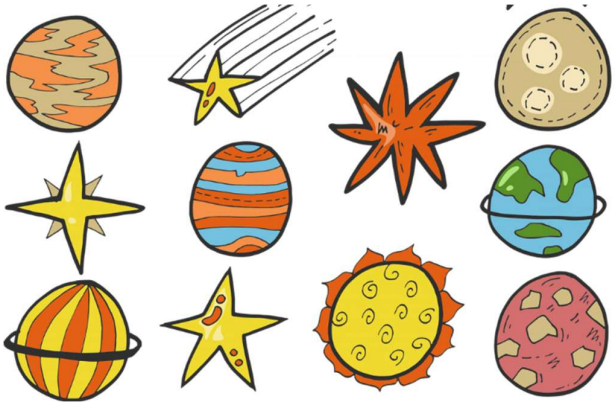
Number of participants: 18 children
School: Kindergarten of Mendrisio (Salorino)
Duration: 15.04.21 until 15.06.2021
Field study: Case study 3 (G3)
Link: https://kidsgogreen.eu/en/routes/traveling-with-azzurra-and-celestino/

Two little pirates are looking for a treasure: to reach it they have to land on islands but in each one there are problems to be solved. They ask for help from the children… for every help given, the children receive clues that will lead them to a treasure.

2.2.3 “Traveling the Galaxy of Art” (800 km in 8 stopovers)

Number of participants: 16 children
School: Kindergarten of Mendrisio (Capolago)
Duration: 15.04.21 until 15.06.2021
Field study: Case study 3 (G3)
Link: https://kidsgogreen.eu/en/routes/our-travel-to-the-galaxy-of-art/

The route is based on an itinerary that lasted the whole school year. An alien, who fell to Earth, tells us about the adventures he experienced on different planets: Puntinia, Lineapoli, the Planet of Forms, the Planet of Colours. This will lead us to get to know the world of art and, at the end of the journey, to create a classy exhibition.



3 Methodology

Between January and May 2021, the involved pilot schools engaged their entire school communities (teachers, pupils and their respective parents) in implementing either / or both the "KidsGoGreen" game in class and/or the "Pedibus Smart" initiative as a possible travel mode to school. This included the participation of both primary school classes (1st to 5th grade), as well as the kindergarten sections. Due to the COVID emergency, constantly menacing possible school lockdowns throughout the project period, the choice of S2HOES-tools to be tested in the field was left entirely to the discretion of each school board. This gave rise to a mixture of approaches and respective school levels being involved, creating three intervention groups G1, G2 and G3, as laid out in Table 1.

Table 1: Overview of the primary school and kindergarten classes involved in the S2HOES field study for the school year 2020/21

School	School level	No. of classes	No. of pupils	S2HOES tool to be tested	Intervention group
Balerna	Primary (1st - 5th grade)	8	131	KidsGoGreen + Pedibus Smart	G1
	Kindergarten	4	83	KidsGoGreen	G3
Novazzano	Primary (1st - 5th grade)	5	94	KidsGoGreen + Pedibus Smart	G1
	Kindergarten	3	48	KidsGoGreen	G3
Mendrisio	Primary (1st - 5th grade)	16	300	Pedibus Smart	G2
	Kindergarten	2	32	KidsGoGreen	G3
Total	**-**	**38**	**688**	**-**	**-**

Ultimately, all of the participating kindergartens opted to test the "KidsGoGreen" gamified solution by itself, leaving aside the implementation of the "Pedibus Smart" initiative (G3). This is because the involved kindergartens did not have yet a "traditional" WSB initiative in place at the starting time of the S2HOES project, to begin with. Instead, the primary school of Mendrisio, involving 300 pupils, enrolled for the testing of the "Pedibus Smart" tool only, with the intent to further strengthen the already existing WSB initiative, and opted out from testing the gamified "KidsGoGreen" solution, due to COVID time constraints of teachers (G2). Instead, the primary schools of Balerna and Novazzano, both ran by the same school board and jointly counting 225 pupils, opted for the complete S2HOES model, thus adhering to the implementation of both the "KidsGoGreen" approach and the "Pedibus Smart" option as a self-reinforcing model (G1).

While the testing of the "KidsGoGreen" scheme totally relied on the school board's decision to engage teaching staff in experimenting the tool at issue in class, participation in the "Pedibus Smart" scheme resided entirely in the parents' voluntary decision to enrol their child in the existing local WSB initiative organised by the schools' official parent associations. Hence, a recruitment campaign was launched to enrol old and new WSB participants in the proposed PBS scheme, with the only difference that the PBS scheme provides accompanying volunteering parents with the "Pedibus Smart" mobile application and participating children with a small proximity device to facilitate automatic registration to the WSB. In Balerna and Novazzano, primary school pupils joining the PBS scheme represent nearly one third of the total school population (Balerna = 29%; Novazzano = 31%). In Mendrisio, the segment of pupils joining the PBS scheme remained rather low (8%). Table 2 reports the number of pupils and volunteering parents that joined and experimented the PBS approach, in support to the traditional local WSB initiative.

Table 2: No. of pupils and volunteers enrolled in the PBS scheme in the primary schools of Balerna, Novazzano and Mendrisio

Primary school	Participation to the "Pedibus Smart" (PBS) scheme			
	No. of local PBS routes involved	No. of accompanying volunteers	No. of pupils joining PBS	% of PBS pupils / total school pupils
Balerna	3	6	38	29%
Novazzano	3	11	29	31%
Mendrisio	4	14	25	8%
Total	**10**	**31**	**92**	**18%**

3.1 Launch of a pre- and post-intervention survey

As set out in Table 1, participating pilot schools were subject to three different types of intervention (G1: the whole set of the S2HOES tools, namely KGG and PBS; G2: only PBS; G3: only KGG) . Any subsequent impact assessment of the S2HOES intervention thus entailed accounting for possible impacts and differences of these three intervention types. Considering that parents are the ultimate decision-makers about the travel mode used by their children to reach school, they also represented the main subject of investigation. However, collecting information about the S2HOES project also from a child's perspective could also be enriching. In order to gain a fairly robust feedback also from the children involved in the S2HOES experience and optimizing time resources, only school children participating in G1, experimenting the complete S2HOES solution (combining PBS + KGG) were involved.
In order to assess the impact and effectiveness of the two IT tools proposed to enhance active, safe and sustainable school mobility practices, a pre- and post-intervention survey was carried out (T1 and T2). Two different questionnaire formats were elaborated to collect information. One questionnaire addressed the parents of every single schoolchild involved in the S2HOES project, be it a primary school or kindergarten child, thus respondents represented respectively sample G1, G2 and G3. Another questionnaire was elaborated to address primary school children and was administered to G1 schoolchildren.

In order to be able to follow-up and correlate the information reported in the pre-intervention survey with the statements made in the post-intervention survey, all respondents received a pseudonymized identification code, which marked the questionnaires used for the two surveys, while safeguarding personal data protection.

Table 3 and Table 4 report the contents of the questionnaires used for parents and schoolchildren respectively in order to assess the impact and effectiveness of the S2HOES intervention. Data on variables unaffected by the intervention, such as mobility-related information about families, attitudes towards mobility, and environmental awareness was only collected in the pre-survey T1. Conversely, data about the evaluation of the PBS and KGG schemes was only collected in the post-survey T2.

Finally, the post-intervention survey included also an online questionnaire addressing teachers, in order to collect impressions from their side about the implementation of the KGG model in class. Table 5 reports respectively the contents of this questionnaire.

Table 3: Parents' questionnaire content used for assessing the impact and effectiveness of the S2HOES intervention.

Variables	Description	Pre-survey (T1)	Post-survey (T2)
General socio-demographic data - Family's car and bicycle ownership, access to the school bus service, distance and duration of their child's school trip	no. of cars, bicycles, length of school trip in kilometres and minutes	✔	
School mobility patterns - Child's prevalent travel mode to school and accompaniment level - Ideal travel mode, if parent could choose - WSB: level of organization, satisfaction and frequency	Options: on foot, bicycle/trotinette, school bus, by private car. 5-point Likert scale	✔	✔
Traffic and road safety perception - Parents' general attitude towards traffic congestion, air pollution, climate change and possible solutions	5-point Likert scale	✔	✔
Attitude towards mobility issues - Parents' personal attitude towards active transport (walking and cycling) and car use	5-point Likert scale	✔	
Environmental awareness - Parents' general attitude towards traffic congestion, air pollution, climate change and possible solutions	5-point Likert scale	✔	

Social factors - Encouragement by school, social norms and motivation to engage in sustainable school mobility	5-point Likert scale	✔	✔
Evaluation of the KGG scheme - Level of satisfaction and awareness about the S2HOES project - Level of educational stimulus of KGG	5-point Likert scale		✔
Evaluation of the PBS scheme - Opinion about proximity device + mobile application	5-point Likert scale		✔

Table 4: Schoolchildren's questionnaire content used for assessing the impact and effectiveness of the S2HOES intervention.

Variables	Description	Pre-survey (T1)	Post-survey (T2)
General socio-demographic data - Place of residence and school attendance (school and grade)	gender, place of residence, school grade	✔	
School mobility patterns - Child's prevalent travel mode to school - Ideal travel mode, if child could choose - WSB: level of satisfaction	Options: on foot, bicycle/trotinette, school bus, private car. 5-point Likert scale	✔	✔
Travel impact awareness - Impact of different school transport modes on the environment	5-point Likert scale	✔	✔
Evaluation of the KGG scheme - Level of satisfaction, motivation and educational stimulus of KGG;	5-point Likert scale		✔

Table 5: Teachers' questionnaire content used for assessing the impact and effectiveness of the S2HOES intervention.

Variables	Description	Pre-survey (T1)	Post-survey (T2)
Evaluation of the S2HOES project - Level of satisfaction	5-point Likert scale		✔
Evaluation of the KGG scheme - Motivation and educational stimulus; - Exchange/cooperation with colleagues; - Remarks/suggestions	5-point Likert scale, open-end comments		✔

3.2 Sample

The pre-survey questionnaire (T1) was paper-based and was administered to the parents of 688 schoolchildren involved in the S2HOES project (G1, G2 and G3) and to the 255 schoolchildren participating in G1, via class teacher. The response rate was extremely high (parents = 89.4%; schoolchildren = 96%). However, data acquisition from 943 paper-based questionnaires through an automatic reading system posed some limitations and entailed a long process to obtain clean data. Consequently, to facilitate data collection during the post-intervention survey (T2), researchers opted for the use of an online questionnaire for parents, while they kept the paper-based questionnaire for surveying schoolchildren,

considering the latter a more child-friendly option. The parents' online survey had a much lower response rate (30.4%), while the paper-based questionnaire remained rather high (82%).

The dual presence of a pseudonymized identification code in the two data series (T1 and T2) of those questionnaires that were respectively returned by G1, G2 and G3 parents and G1 schoolchildren, allowed to join data and to grant a comparative analysis. As for the survey addressing parents, responses collected at both T1 and T2 were 191 (= 28%) out of the 688 parents that received the S2HOES questionnaire. As for the survey addressing the participating schoolchildren, responses collected at both T1 and T2 were 181 out of 225 primary school pupils (80%) involved in the S2HOES project. Since they allow to compare responses before and after the S2HOES intervention, these two respondent samples (n= 191 parents and n = 181 schoolchildren) represent the base for the analysis and discussion of results in Chapter 4.

In order to be able to account for specific impacts and differences of the three intervention types (G1, G2, G3), responses by parents and schoolchildren were segmented and analysed according to this subdivision. Table 6 and Table 7 report the number of responses received from parents and schoolchildren respectively per intervention group for survey T1, survey T2 and survey T1 + T2 combined, the latter used ultimately for running a comparative analysis.

Table 6: Parents' response rate in numbers and percentages to the pre- and post-survey.

S2HOES Intervention type	Tot. no. of parents	T1		T2		T1 + T2	
		No. of responses	Response rate	No. of responses	Response rate	No. of responses	Response rate
G1 (KGG + PBS)	225	219	97%	110	49%	104	46%
G2 (only PBS)	300	283	94%	63	21%	60	20%
G3 (only KGG)	163	116	71%	31	19%	27	17%
Total	**688**	**618**	**90%**	**204**	**30%**	**191**	**28%**

Table 7: Schoolchildren's response rate in numbers and percentages to the pre- and post-survey.

S2HOES Intervention type	Tot. no. of pupils	T1		T2		T1 + T2	
		No. of responses	Response rate	No. of responses	Response rate	No. of responses	Response rate
G1 (KGG + PBS)	225	217	96%	185	82%	181	80%

As the end of the S2HOES intervention matched also the end of the school year - a very dense period for teachers - unfortunately, the online survey launched to evaluate the S2HOES field study from a teacher's perspective did not reach a reasonable response rate. Overall, only seven teachers replied to the post-survey. Considering these numbers and data not being representative, findings were not included in this final report. In future, instead of proposing an online survey, it could be advisable to organise a more personalised debriefing with participating teachers (e.g. focus group, workshop or interviews) as part of the school activities to better build on the experience made by teachers and collect bottom-up suggestions for improvement of the S2HOES model.

4 Results

4.1 General mobility-related information

Next to exploring gender distribution of participating schoolchildren, parents participating in the S2HOES survey were also asked to provide some general mobility-related information, such as the families' car and bicycle ownership, access to a school bus service, distance from school and school travel time, independently from the transport mode used. Results are reported in Figure 1.a to 1.f.

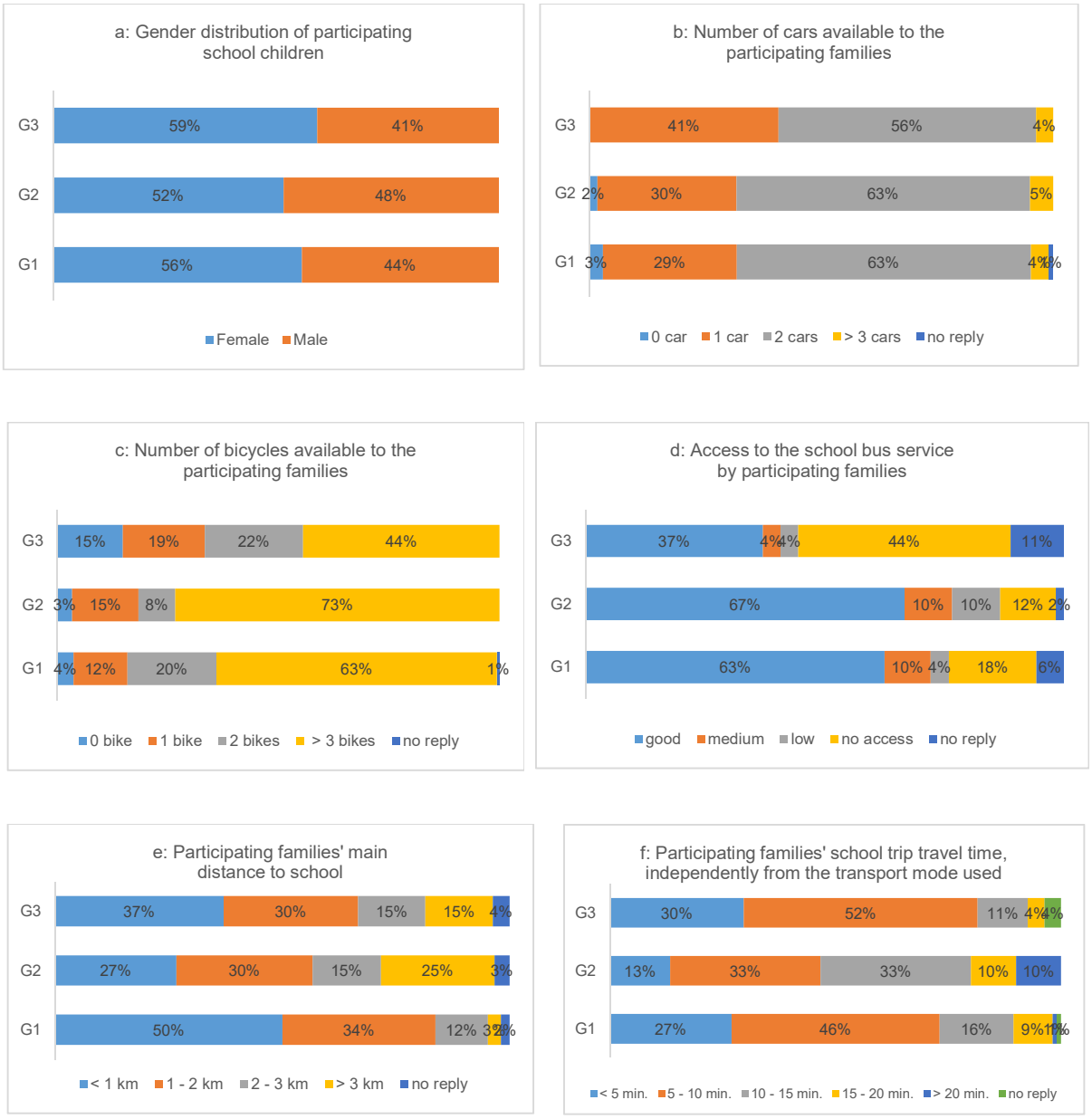
In all three samples (G1, G2, G3), gender distribution is fairly balanced, with females exceeding slightly male presence.

In each sample, most families own at least 2 cars (> 56%). As for the ownership of bicycles, it seems that its percentage grows, as the age of children rises and the family matures, i.e. sample G3, which represents those families with small

children attending kindergarten, has the lowest level of > 3 bicycle ownership compared to G1 and G2, which involve primary school children. The majority of parents from sample G1 and G2 rate their access to a school bus service as "good". However, data from sample G3 shows that nearly half of the respective families lack or have low access to a school bus service (48%). This might be related to the fact that school bus services are mainly designed to suit primary school pupils, instead of kindergarten ones.

In all three samples, the majority of families live below 2 km of distance from school. In sample G1, this segment represents 84% of participants. G2 reports the largest segment of families living > 3 km from school. Respectively, only G2 reports about families (10%) whose school trip travel time exceeds 20 minutes. For the majority of G1 and G3 families (73% and 82% respectively), the more rural samples, travel time to school remains below 10 minutes. In G2, this is the case for 46% of families, while another 33% takes 10 to 15 minutes from home to get to school.

Figure 1.a to 1.f: mobility-related information concerning G1, G2 and G3 participating families.



4.2 Parents' attitude towards mobility issues

To gain a better insight on parents' general attitude towards mobility issues, during the pre-intervention survey (T1), parents from G1, G2 and G3 were asked to rate their level of agreement with a series of statements related to "car mobility" (Table 8) and "active mobility" (Table 9). The survey used a 5-point Likert scale, where 1 = I strongly disagree and 5 = I strongly agree.

On average, G1, G2 and G3 parents "agree" on the fact that the car reduces the quality of life (all average scores are ≥ 4) and on the need to reduce the number of cars circulating on the road (all average scores are ≥ 3.96). However, the sample G3 scores slightly lower than its G1 and G2 counterparts. This finding seems, however, coherent with the fact that G3 represents also the one sample with the highest number of families stating to have no access to a school bus service in the previous paragraph (see Figure 1.d).
The slightly more favourable attitude towards car use by G3 emerges also in respect to the higher scores attributed to those statements asserting that people who do not own a car are at disadvantage (average score = 3.48), as well as with the respective drawback that travelling by car is more expensive (average score = 3.63), compared to sample G1 and G2.

Table 8: Agreement level of G1, G2 and G3 parents with statements related to "car mobility" during the pre-survey intervention (T1) using a 5-point Likert scale (1 = I strongly disagree; 5 = I strongly agree).

Parents' attitude towards car mobility	**G1**			**G2**			**G3**		
	n	**Mean**	**SD**	**n**	**Mean**	**SD**	**n**	**Mean**	**SD**
A car provides status and prestige	97	1.48	0.97	59	1.39	0.97	27	1.52	0.94
People should use the car as much as they like	100	2.93	1.32	59	2.54	1.18	27	2.81	1.3
It is important to reduce the no. of cars on the road	101	4.28	1.00	60	4.32	0.93	26	3.96	1.15
Car use reduces the quality of life in cities due to noise and pollution	99	4.32	0.98	60	4.23	0.96	27	4.00	1.04
A high level of car use leads to an unhealthy lifestyle	100	3.89	1.35	59	3.75	1.11	27	3.67	1.41
People who do not own a car are at a disadvantage	99	2.94	1.19	59	3.08	1.07	27	3.48	1.19
I would like to travel by car more often than I have done recently	100	1.48	0.73	59	1.54	0.77	27	1.56	0.89
Travelling by car is expensive	100	3.3	1.16	58	3.33	0.98	27	3.63	1.11
Travelling by car is stressful	100	3.25	1.26	58	3.22	1.23	27	3.3	1.35

Indeed, when running a Kruskal-Wallis test to detect possible differences between G1, G2 and G3 about their average attitude towards the statements listed in Table 9, a statistically significant difference (5% level; p value =0.04535) emerges between G1 and G3, when it comes to the specific statement "People who do not own a car are at a disadvantage". In this case, positions held by G1 and G3 are more distant and highlight a stronger perception by G3 than by G1 that the car represents often an "obvious (only) choice". This statistical significance is also confirmed by a post-hoc Dunn's test with Benjamini-Hockberg correction (adjusted p-value = 0.0387).
Parents of sample G1, G2 and G3 on average "agree" on the fact that active mobility is a healthy way to travel (all ratings are >4) and tend to agree that they should walk/cycle more to keep fit (all ratings are > 3.5). Compared to G1 and G3, G2 scores the highest on statements related to active mobility being possibly the quickest travel mode on short trips (average score = 4.22), offering more freedom and flexibility (average score = 3.85) and preferring to walk/cycle rather than taking the bus (3.88). This attitude seems to denote the more *urban* nature of sample G2. Nevertheless, G1 and G3, although scoring slightly lower than G2, are in line with these same statements. As for the statement that walking/cycling is dangerous, G1 and G3, the more *rural* samples, seem to be slightly more worried than G2.

Table 9: Agreement of G1, G2 and G3 parents with statements related to "active mobility" during the pre-survey intervention (T1) using a 5-point Likert scale (1 = I strongly disagree; 5 = I strongly agree).

Parents' attitude towards active mobility	G1			G2			G3		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
I don't like to walk or cycle a lot	102	1.95	1.23	59	1.88	1.19	27	1.93	1.3
I would rather walk/cycle than take the bus	101	3.53	1.25	59	3.88	1.1	27	3.59	1.15
Active mobility provides freedom and flexibility	100	3.77	1.08	60	3.85	0.95	27	3.67	1.14
I should walk/cycle more to keep fit	101	3.71	1.28	58	3.76	1.1	27	3.59	0.93
Active mobility can be the quickest travel mode for short trips	102	3.99	0.99	59	4.22	0.91	27	3.93	0.92
Active mobility is a healthy way to travel	101	4.34	0.93	59	4.39	0.83	27	4.41	0.75
I tend not to walk/cycle because I am not fit enough	101	1.78	1.13	58	1.72	0.93	27	1.74	0.98
Walking/cycling is dangerous	100	2.49	1.19	59	2.32	1.12	27	2.52	1.45
Walking/cycling is stressful	102	1.64	0.99	59	1.46	0.75	27	1.59	0.8

However, when running a Kriskall-Wallis test for all of the variables listed in Table 9, no statistically significant differences between G1, G2 and G3 were found concerning their average attitudes towards active mobility.

4.3 Parents' environmental awareness

On average, parents from sample G1, G2 and G3 "agree" (average rating in all samples is > 4.2) on the fact that being environmentally responsible is important to them as a person (see Table 10). At the same time, there is a tendency to agree on feeling a moral obligation towards reducing greenhouse gas emissions (ratings range between 3.78 and 4.03), followed by concerns about local traffic congestion (ratings range between 3.56 and 3.89) and sensing a moral obligation towards solving local traffic problems (ratings range between 3.22 and 3.73). Finally, parents of sample G1 and G2 tend towards being "undecided" about the impact of the WSB in favouring positively their mobility behaviour towards more sustainable choices (Mean = 3.13, respectively 3.15). In sample G3, where parents do not benefit from a WSB service, average response tends towards "I disagree" (2.58).

Table 10: Agreement level of G1, G2 and G3 parents with statements related to "environmental awareness" during the pre-survey intervention (T1) using a 5-point Likert scale (1 = I strongly disagree; 5 = I strongly agree).

Parents' environmental awareness	G1			G2			G3		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Traffic congestion is a problem in my local area	100	3.89	1.28	59	3.76	1.25	27	3.56	1.34
It is important to build more roads to reduce congestion	99	2.04	1.2	58	1.91	1.06	27	2.07	1.21
I feel a moral obligation to help solve my town/city's traffic problems	99	3.36	1.19	59	3.73	1.03	27	3.22	1.4
I feel a moral obligation to reduce the emission of greenhouse gases	100	3.87	1.22	60	4.03	0.99	27	3.78	1.09
There is not much parents can do to solve air pollution and climate change	99	2.55	1.15	59	2.08	1.02	27	2.30	1.27
Innovation technology will be enough to solve env. problems caused by cars	98	2.26	1.11	59	2.02	0.84	27	2.11	1.09
Being environmentally responsible is important to me as a person	100	4.27	0.95	60	4.53	0.6	27	4.22	0.89
I feel guilty when I use my car because it contributes to pollution and traffic	98	2.94	1.27	59	3.02	1.06	27	2.44	1.15
The WSB influences my mobility behaviour in favour of sustainable choices	94	3.13	1.34	52	3.15	1.41	26	2.58	1.42

When a Kruskal-Wallis test is ran for each of the listed statements on environmental awareness to identify a statistically significant difference between G1, G2 and G3, a slight distinction (5% significance level) can be made between G1 and G2 concerning the statement *"There is not much parents can do to solve air pollution and climate change"*. In this case, parents belonging to G2 seem more mindful than G1 about the fact that there is scope for action from their side in contributing to climate protection. In line with this attitude, G2 parents feel (moderately) more guilty than G1 and G3 parents when using their personal car, presumably aware of the fact that it contributes to pollution and traffic (Mean = 3.02). In fact, a statistical difference, with a 10% level of significance, emerges for the statement *"I feel guilty when I use my car because it contributes to pollution and traffic*" when G2 is compared to G1 and G3 via a Krusakl-Wallis test. These two findings somehow depict G2 as a group of parents well aware of the burden private car travel causes to the environment and of the (positive or negative) impact of personal mobility choices. However, this does not *per se* imply that G2 also leads a more environmentally friendly life, as this is easier said than done.

Overall, parents included in these three samples seem to sense climate change as a slightly more urgent environmental problem than local traffic congestion and acknowledge in general the importance of personal environmental responsibility, relating it more easily to actions against climate change (i.e. the need to reduce greenhouse gases) rather than to traffic congestion (i.e. solving local traffic problems). These attitudes are somehow in line with current public views on the urgency to act in favour of climate protection. Considering that people, in general, are inclined to conform personal attitudes and behaviour to perceived social norms (i.e. beliefs about what others think and do) and injunctive norms (i.e. what people typically approve or disapprove), present findings about parents' environmental awareness seem not to reflect a particularly sensitive and pro-active group of citizens. Rather, they report of a group of citizens mirroring current public perceptions about environmental challenges. Nevertheless, perceived social norms, as well as injunctive norms, can be a powerful driver for pro-environmental behaviour.

4.4 Schoolchildren's awareness about travel impact

Next to investigating parent's level of environmental awareness, the present field study also aimed to gain an insight on participating schoolchildren's awareness about the environmental impact of different travel modes. In this case, the impact of travel being also one of the main points at issue during the KGG game ran at school by G1 schoolchildren, this survey was not limited to the pre-intervention (T1), but was also carried out at the end of the intervention (T2) to see if the S2HOES project had some kind of impact.

G1 schoolchildren were asked to rate the impact of different travel modes on the environment, using a 5-point Likert scale, where: 1= very negative; 5 = very positive. A paired Wilcoxon test was run to identify possible changes between T1 and T2, as a possible result of the S2HOES intervention. Table 11 report main results.

Table 11: Average rating of environmental impact of different travel modes by schoolchildren in sample G1, before and after the S2HOES intervention, using a 5-point Likert scale, where: 1= very negative; 5 = very positive.

G1: Environmental impact evaluation of different travel modes	T1			T2			Difference		PAIRED Wilcoxon test	Statistical significance
	n	Mean	SD	n	Mean	SD	Mean	SD	p-value	
On foot	178	4.82	0.49	179	4.89	0.47	0.08	0.59	0.08	**10% ***
By bicycle	179	4.55	0.66	176	4.57	0.70	0.02	0.77	0.8346	No
By school bus	176	3.16	1.17	174	3.21	0.93	0.05	1.41	0.6172	No
By car	178	1.82	0.87	175	1.89	0.97	0.08	1.04	0.4109	No

Findings report a statistically significant and positive change (10% significance level) in the rating of walking as a travel mode between T1 and T2. At the end of the intervention period, travelling on foot is rated as the most positive mode (Mean = 4.89), followed by the bicycle (Mean = 4.57), and subsequently by the school bus (Mean = 3.21). The car is rated as the most negative mode (Mean = 1.89). As such, the combined S2HOES intervention in G1 seems to have positively affected schoolchildren in evaluating more positively the impact of walking as a travel mode on the environment.

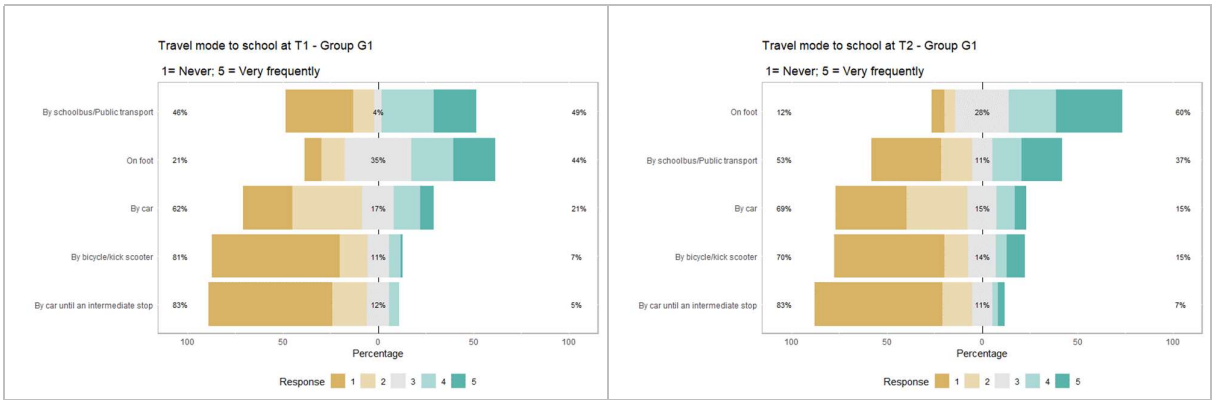
4.5 School mobility patterns

4.5.1 Prevalent school travel mode

As to gain an insight on the general mobility patterns of participants in the S2HOES field study and possible changes induced by the intervention, all parents (G1, G2 and G3) were asked to indicate the prevalent travel mode used by their child to reach school before (T1) and after (T2) the intervention. A frequency ranking scale, based on a 5-point Likert scale, was used to evaluate five different types of school travel modes: on foot; by bicycle/kick scooter, school bus/public transport; by car to school entrance; by car to pitch near the school. The ranking values ranged from "*1 = Never*" to "*5 = Very frequently*".

As reported in Figure 2.a and 2.b, sample G1 undergoes a change in the frequency with which schoolchildren travel to school by foot. In fact, before the S2HOES intervention (T1), around 44% of respondents indicated that their child went to school on foot "frequently" to "very frequently". After the intervention (T2), this percentage rises to 60%. Also the frequency with which children reach school by bicycle/kick scooter changes. Before the intervention, only 7% of parents stated that their child used this kind of transport mode "frequently" to "very frequently". At the end of the S2HOES project (T2), percentages double in this category, reaching 15% of responses. The percentage of schoolchildren reaching school by car "frequently" to "very frequently" diminishes from 21% at T1, to 15% at T2. Even the use of the school bus undergoes a decline, passing from 49% of schoolchildren using it "frequently" to "very frequently" at T1, to 37% at T2.

Figure 2.a und 2.b: G1 parents' responses in percentage concerning the frequency with which their child used each of five different travel modes to get to school before (T1) and after (T2) the S2HOES intervention, based on a 5-point Likert scale (1 = Never; 5 = Very frequently).



As to determine whether the above-described changes are statistically significant, a paired Wilcoxon test was ran (data showed in fact no normal distribution). Table 12 reports the results obtained. Indeed, a slight statistically significant increment in frequency occurs within sample G1 in regards to both walking and cycling to school (1% significance level). As for the use of the private car to reach school, too, a statistically significant change occurs (5% significance level) and children tend to use the car less as a transport mode on their school journey.

Ultimately, findings show that the S2HOES intervention adopted in sample G1, consisting in implementing the combined KGG and PBS approach, has positively affected school mobility behaviour of G1 participants, increasing the frequency of active mobility (walking/cycling), as well as decreasing motorized travel, i.e. the use of the private car.

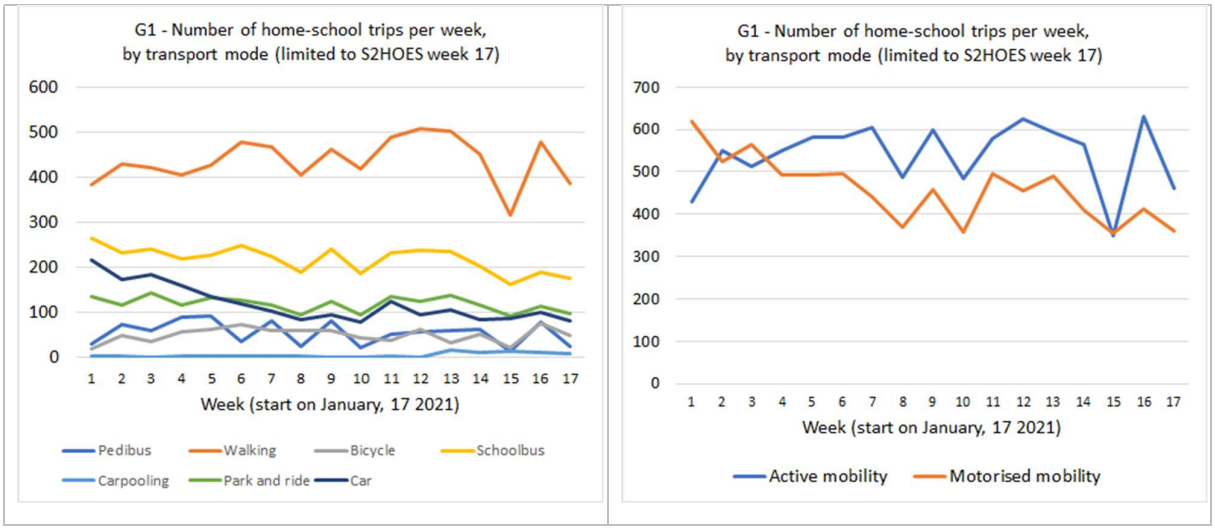
Table 12: Prevalent travel mode frequency to school used by their child, indicated by parents of sample G1 before (T1) and after (T2) the S2HOES intervention, using a 5-point Likert scale, where: 1= Never; 5 = Very frequently.

G1: Prevalent school travel mode	**T1**			**T2**			**Difference**		**PAIRED Wilcoxon test**	**Statistical significance**
	n	**Mean**	**SD**	**n**	**Mean**	**SD**	**Mean**	**SD**	**p-value**	
On foot	100	3.36	1.21	104	3.75	1.19	0.45	0.94	0.00001017	**1% *****
By bicycle/ kick scooter	97	1.6	0.99	104	1.97	1.35	0.42	0.99	0.00008888	**1% *****
By schoolbus/ public transport	99	2.9	1.64	104	2.68	1.6	-0.13	0.99	0.1279	No

By car up to school entrance	101	2.4	1.21	104	2.14	1.19	-0.23	0.94	0.01564	**5% ****
By car to close by parking area	94	1.57	0.9	104	1.61	1.05	0.01	1.32	0.9569	No

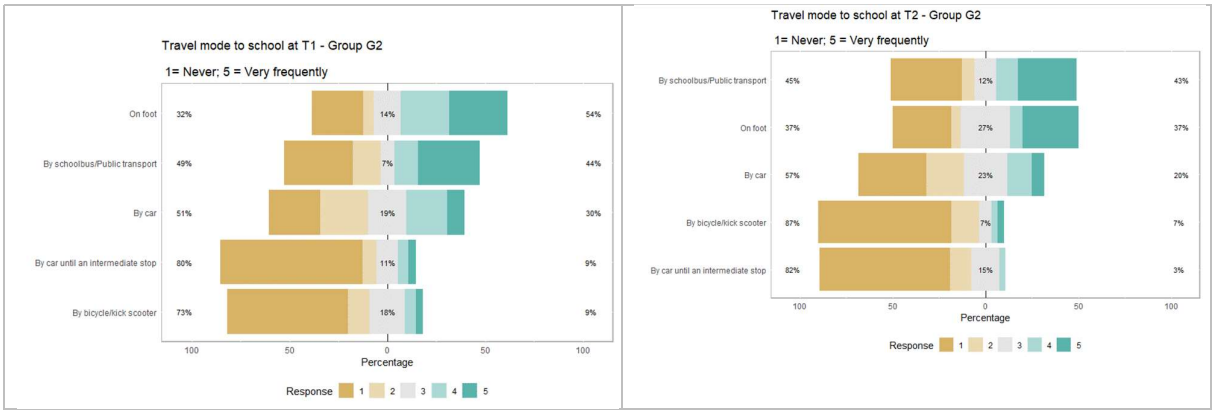
This very finding is also confirmed by the analysis of the school travel mode data recorded by G1 schoolchildren in class by means of the KidsGoGreen web platform (using the mobility logbook). Data visualized on a weekly base, shows clearly how active mobility increased over the intervention period, while motorized mobility decreased (Figure 3.a and 3.b).

Figure 3.a and 3.b: Evolution of the weekly number of home-school trips, by transport mode. Week 1 started on January, 18 2021 (start of the S2HOES intervention in group G1). Weeks 18 and 19 are not represented here, since they were close to the end of the school year and information on the transport mode to school was not systematically collected in all classes.



Looking at G2 data, the sample registers a decrease in the numbers of respondents indicating walking as a “frequent/ very frequent” school travel mode (see Figure 4.a and 4.b). Here, percentages shift from 54% at T1 to 37% at T2. Lost percentages, however, are gained in the intermediate area. Here, the number of respondents indicating “sometimes” increases from 14% at T1 to 27% at T2. When considering cycling, sample G2 reports a clear decrease in its frequency, shifting from an intermediate segment of 18% of schoolchildren using this mode “sometimes” at T1, to 7% at the end of the intervention (T2). At the same time, also a drop in the frequency with which G2 schoolchildren reach school by private car can be detected. In this case, a high frequency level of 30% during T1 drops to 20% at the end of the intervention period (T2). In G2, the school bus remains a more stable travel mode for children to reach school. During T1, about 44% of respondents indicated it as a “very frequently” to “frequently” used transport mode. This proportion remains stable at T2, representing 43% of respondents. G2 representing the more *urban* sample compared to its G1 and G3 counterparts, this very sample denotes a tendency by schoolchildren to use the school bus in a rather regular manner. This finding seems in line with the fact that in G2, nevertheless 25% of families live more than 3 km of distance from school.

Figure 4.a and 4.b: G2 parents' responses in percentage concerning the frequency with which their child used five different travel modes to get to school before (T1) and after the S2HOES intervention (T2), based on a 5-point Likert scale (1 = Never; 5 = Very frequently).



Again, as to determine whether these changes are statistically significant, a Wilcoxon test was ran (see Table 13). While the drop in the walking frequency is nevertheless of no statistical significance, the registered decline in the frequency with which schoolchildren used a bicycle/kick scooter to reach school is significant (5% significance level). At the same time, also the declared drop in car mobility is statistically significant (10% significance level).

It must be highlighted that participants in G2 had the opportunity to join the proposed PBS scheme only once every two weeks, at lunchtime. With the PBS frequency being so marginal, in this case, the G2 intervention seems not to have contributed much to consolidating active mobility practices over time, after initial promotion efforts. At the same time, however, the drop in the travel mode frequency reported in G2 for both active *and* motorized mobility, somehow denotes a general inconsistency of the sample. As such, it remains an open question whether the frequency levels indicated by parents are more perceived than factual. In the absence of more solid, daily and verifiable data on travel modes actually used to reach school, interpretation becomes difficult. Could, for instance, the perceived presence of injunctive norms (i.e. what people typically approve or disapprove) related to sustainable school mobility determine parents' responses concerning private car use? Could the registered decline in active mobility be the result of harsh weather conditions during the testing period? Or else, the absence of a strong motivational trigger to surmount these circumstances?

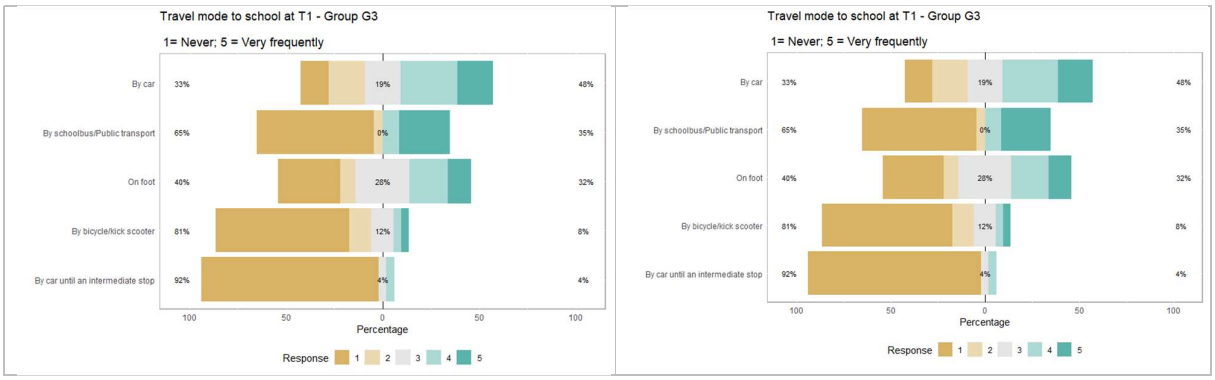
Table 13: Prevalent travel mode frequency to school used by their child, indicated by parents of sample G2 before and after the S2HOES intervention, using a 5-point Likert scale, where: 1= Never; 5 = Very frequently.

G2: Prevalent school travel mode (frequency)	**T1**			**T2**			**Difference**		**PAIRED Wilcoxon test**	**Statistical significance**
	n	**Mean**	**SD**	**n**	**Mean**	**SD**	**Mean**	**SD**	**p-value**	
On foot	57	3.26	1.59	60	2.98	1.62	-0.18	1.24	0.27	No
By bicycle/ kick scooter	55	1.78	1.15	60	1.52	1	-0.22	0.74	0.03	**5% ****
By school bus/ public transport	57	2.91	1.72	60	2.92	1.74	0.04	1.02	0.72	No
By car to school entrance	57	2.61	1.32	60	2.33	1.28	-0.25	1.15	0.08	**10% ***
By car to close by parking area	55	1.6	1.12	60	1.52	0.87	-0.04	0.96	0.86	No

In sample G3, which refers only to kindergarten children and the implementation of the KGG scheme without the presence of a PBS initiative, the frequency with which children reach kindergarten by car seems to drop: at T1, 48% of respondents indicated to use the car "frequently/very frequently". This percentage drops to 37% at T2 (Figure 5.a and 5.b). As for active mobility transport modes, a drop in the walking frequency is registered, accompanied by an increase in the use of a bicycle/kick scooter. While in T1, 8% of parents indicated bicycle/kick scooter as a "frequently/very frequently" used transport mode, at T2, this percentage rises to 15%. However, "frequently/very frequently" walking to kindergarten drops from 32% at T1 to 26% in T2. The school bus is used "frequently/very frequently" by 35% of kindergarten children at T1 and by 41% at T2. Overall, families taking at the end of the S2HOES intervention "frequently/very frequently" children to

school by bus represent a large segment (ca. 40%), as do also those families taking “frequently/very frequently” children to school by car (37%).

Figure 5.a and 5.b: G3 parents’ responses in percentage concerning the frequency with which their child used five different travel modes to get to school before (T1) and after (T2) the S2HOES intervention, based on a 5-point Likert scale (1 = Never; 5 = Very frequently).



Running a Wilcoxon test also for sample G3 to check whether the emerging changes between T1 and T2 are statistically significant, it emerges that differences are of no statistical significance (Table 14).

Table 14: Prevalent travel mode frequency to school used by their child, indicated by parents of sample G3 before and after the S2HOES intervention, using a 5-point Likert scale, where: 1 = Never; 5 = Very frequently.

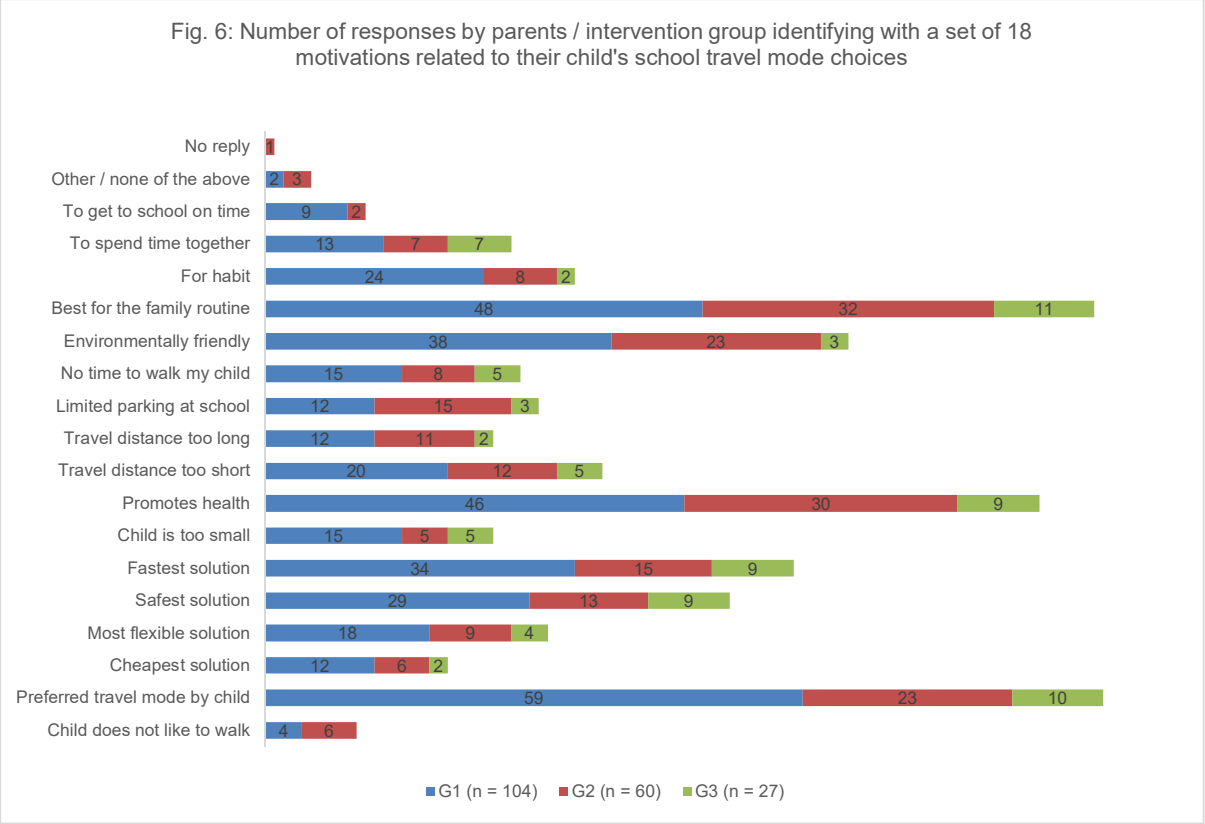
G3: Prevalent school travel mode (frequency)	**T1**			**T2**			**Difference**		**PAIRED Wilcoxon test**	**Statistical significance**
	n	**Mean**	**SD**	**n**	**Mean**	**SD**	**Mean**	**SD**	**p-value**	
On foot	25	2.72	1.43	27	2.67	1.47	-0.16	1.34	0.5938	No
By bicycle/ kick scooter	26	1.62	1.1	27	1.74	1.32	0.15	1.71	0.7777	No
By school bus/ public transport	23	2.35	1.82	27	2.59	1.97	0.35	1.72	0.3889	No
By car up to school entrance	27	3.19	1.36	27	2.81	1.71	-0.37	1.39	0.1827	No
By car to a close by parking area	25	1.2	0.71	27	1.44	1.01	0.28	1.34	0.3592	No

4.5.2 Parent’s motivations related to the prevalent travel mode choices

In relation to the pre-intervention survey (T1), G1, G2 and G3 parents were also asked to motivate their prevalent school travel mode choices, by providing them with a list of 18 multiple, close-ended options. Figure 6 reports findings. Percentages reported are above 100, because respondents were allowed to allocate more than one answer.

Findings reported allow for a first, rough insight into parents’ general perceptions about why they chose the prevalent travel mode for their child’s school journey. In fact, the most popular reason reported by all three samples (G1, G2 and G3) was “*Best for the family routine*”, followed by “*Preferred travel mode by child*” and “*Promotes health*”. This latter motivation, which undoubtedly links to active mobility travel modes, prevails over the statement “*Travel distance too short*”. As such, although active mobility might be actually triggered by the fact that the school is close to home, parents prioritize the health benefit of walking/cycling. The “Fastest solution” seems to gain slightly more points over the “*Safest solution”. “To spend time together”* is a reason comprehensively felt more strongly by G3 parents than G1 and G2 parents, as it refers in particular to kindergarten children. For those parents indicating “*Other/ none of the above*” options, no particular comments were provided, except for one family comprehensively tracing back their school travel mode choice to important health issues involving their child.

Figure 6: Number of responses provided by parents / intervention group identifying with a set of 18 motivations related to their child's school travel mode choices



4.5.3 Parent's ideal school travel mode

Before (T1) and after (T2) the S2HOES intervention, parents were also asked to indicate what they considered the ideal travel mode for their child, if given the choice. Options considered the following travel modes: on foot, by car, bicycle/kick scooter and school bus. In order to be able to identify whether variations between T1 and T2 are of statistical significance, a McNemar test, based on categorical variables, was ran. Since this test only works with dichotomized variables, data gathered was subdivided in two categories: active mobility (comprising on foot, bicycle/kick scooter) and motorized mobility (school bus/public transport, car). Dichotomization was applied to all samples (G1, G2 and G3) before (T1) and after (T2) the S2HOES intervention and is reported in Table 15 and Figure 7.

Table 15: Ideal travel mode to school indicated by G1, G2 and G3 parents, if given the choice, before (T1) and after (T2) the S2HOES intervention, dichotomized into "active" and "motorized" mobility.

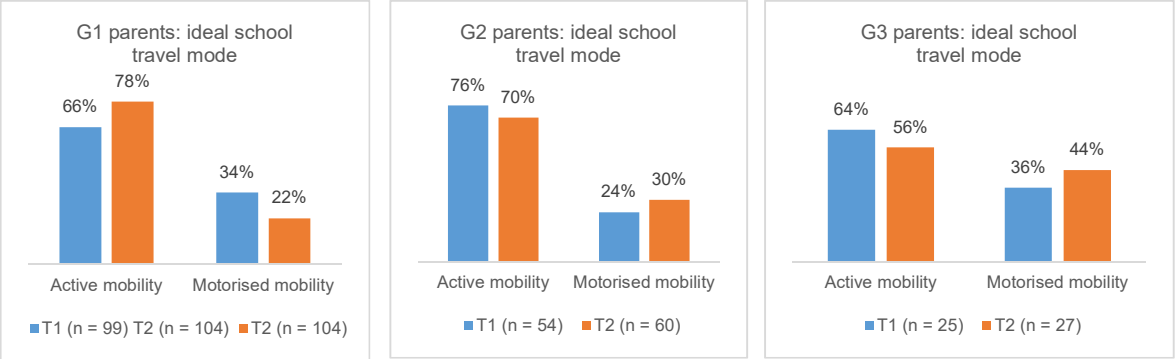
Parents' ideal school travel mode	T1					T2					McNemar test	
	n	Active mobility		Motorized mobility		n	Active mobility		Motorized mobility		p-value	Statistical significance
		No.	%	No.	%		No.	%	No.	%		
G1	99	65	66%	34	34%	104	81	78%	23	22%	0.0455	**5% ****
G2	54	41	76%	13	24%	60	42	70%	18	30%	0.4533	No
G3	25	16	64%	9	36%	27	15	56%	12	44%	0.7237	No

Dichotomized data for sample G1 shows an increase (+ 12%) in parents considering active mobility the preferred travel mode for their child, shifting from 66% to 78%. At the same time, the McNemar test detected a statistically significant change at the 5% level. Findings thus imply that the S2HOES intervention implemented in sample G1 (a combined approach of PBS and KGG) positively affected parents' ideal wish to use active transport modes for their child's school

mobility. This finding is also in line with the statistically significant increase in active mobility as a prevalent travel mode reported for G1 in section 2.2.1

Instead, dichotomized data for both sample G2 and G3 show a decrease in active mobility, dropping from 76% to 70% in G2 (-6%), and respectively from 64% to 56% in G3 (-8%). However, these variations are not statistically significant. This implies that the single PBS approach in G2, and the single KGG approach in G3 have been of no influence in shifting parents' perceptions on the ideal school travel mode for their child.

Figure 7: Parents' ideal school travel mode, if given the choice: dichotomized data for sample G1, G2 and G3 before (T1) and after (T2) the S2HOES intervention



4.5.4 Schoolchildren's ideal school travel mode

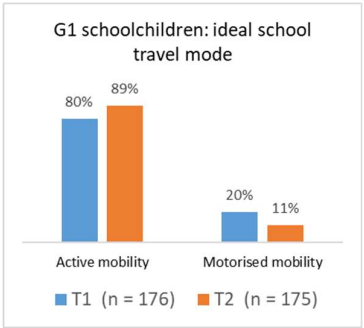
Before (T1) and after (T2) the S2HOES intervention, G1 schoolchildren were also asked to indicate what they considered their ideal school travel mode, if given the choice. Options considered the following travel modes: on foot, WSB, by car, bicycle/kick scooter and school bus. Again, in order to be able to identify whether variations between T1 and T2 were of statistical significance, a McNemar test, based on categorical variables, was ran and implied dichotomizing data into two main categories: active mobility (on foot, bicycle/kick scooter, WSB) and motorized mobility (school bus/public transport, car). Findings are reported in Table 16 and Figure 8.

Table 16: Ideal travel mode to school indicated by G1 schoolchildren, if given the choice, before (T1) and after (T2) the S2HOES intervention, dichotomized into "active" and "motorized" mobility.

Children's ideal school travel mode	T1					T2					McNemar test	
	n	Active mobility		Motorized mobility		n	Active mobility		Motorized mobility		p-value	Statistical significance
		No.	%	No.	%		No.	%	No.	%		
G1	176	141	80%	35	20%	175	155	89%	20	11%	0.01481	5% **

From data gathered, the G1 sample reports a 9% increase in children considering active mobility their ideal school travel mode at the end of the intervention, shifting thus from an already high percentage (80%) at T1 to 89% at T2 (Fig. X). A McNemar test confirmed that the observed difference between T1 and T2 is statistically significant at the 5% level. This shows that, also for schoolchildren, the whole set of the S2HOES tools tested by G1 can positively affect the wish to use active mobility on the route to school.

Figure 8: Schoolchildren's ideal school travel mode, if given the choice: dichotomized data for sample G1 before (T1) and after (T2) the S2HOES intervention.



4.6 Traffic and road safety perception

Parents are ultimately the decision-makers about the travel mode used by their children to reach school. Consequently, the survey ran before (T1) and after (T2) the S2HOES intervention had the aim to explore parent's traffic and road safety perceptions with the aim to identify possible barriers to active mobility, as well as to detect possible changes due to the promotion of safe and sustainable school mobility approaches, such as S2HOES.

Based on a 5-point Likert scale, ranging from "1 = I strongly disagree" to "5 = I strongly agree", parents had to evaluate a closed-ended list of nine statements about traffic and road safety, before (T1) and after (T2) the S2HOES intervention. As to identify statistically significant changes in perception between T1 and T2, a Wilcoxon paired test was ran, since the distribution of the responses was non-normal. Table 17, Table 18,Table 19 summarize respectively findings from sample G1, G2 and G3.

In sample G1, the statement on traffic and road safety perception receiving the highest overall score at T1 (Mean = 4.06) is *Where possible children should not be accompanied to school by car* ("I agree"). This attitude is maintained also after T2 (Mean = 4.13). However, the two statements denoting a statistically significant variation (10% significance level) between T1 and T2 are *Pedestrian crossings on the route to school are safe for my child* and *I am afraid that my child may become a victim of bullying by other children*. On one hand, this indicates that the implementation of the S2HOES intervention (PBS scheme in combination with KGG) has reinsured to a certain extent G1 parents on the safety of crossing roads during their child's trip to school, with a positive increment of the mean value of the respective statement (+ 0.26). At the same time, findings seem to denote an increase in parents' concern about possible bullying events during the school trip (+ 0.23). As active mobility (walking/cycling) increases in the G1 sample during the field experiment, somehow many parents sense their child being more exposed to such kind of social dynamics in the absence of adult supervision. Hence, to overcome such fears and prevent possible bullying episodes, in the future, school mobility solutions should focus on prevention measures targeting this phenomenon, as well as find possible means to promote non-invasive forms of adult supervision, such as provided for instance by the WSB/PBS scheme, and correctly advertise them.

Table 17: G1 parents' responses concerning their level of agreement with nine statement about traffic and road safety before (T1) and after (T2) the S2HOES intervention, based on a 5-point Likert scale (1 = I strongly disagree; 5 = I strongly agree).

G1: Traffic and road safety perception	T1			T2			Difference		Paired Wilcoxon test	Statistical significance
	n	Mean	SD	n	Mean	SD	Mean	SD	p-value	
Thee route to school is dangerous	100	3.57	1.17	104	3.45	1.19	-0.14	1.19	0.253	No
Motorized traffic in front of school is dangerous	102	3.02	1.24	104	3.19	1.16	0.18	1.31	0.1849	No
Pedestrian crossings on the route to school are safe	97	2.78	1.18	104	3.04	1.08	0.26	1.33	0.06417	**10% ***
Child should not be taken to school by car, if possible	99	4.06	1.28	104	4.13	1.32	0.16	1.40	0.2377	No
Car is the safest travel mode for school journey	102	2.04	1.11	104	1.90	1.08	-0.12	1.12	0.2524	No
Afraid of strangers	102	3.31	1.33	104	3.35	1.27	0.00	1.39	0.9086	No
Child not yet skilled enough/self-sufficient	102	2.21	1.09	104	2.20	1.04	-0.02	1.01	0.8347	No
Afraid of bullying	102	2.06	1.08	104	2.29	1.11	0.22	1.22	0.05863	**10% ***
WSB/PBS improves road safety	97	3.71	1.14	104	3.81	1.09	0.18	1.18	0.1743	No

In sample G2, again, the statement on traffic and road safety perception receiving the highest overall score at T1 (Mean = 4.29) is *Where possible children should not be accompanied to school by car* ("I agree"). This tends to decrease slightly after T2, yet, variations are of no statistical significance. A statistically significant variation (5% level) can be detected in relation to parents' perception about the statement *Motorized traffic in front of the school is dangerous*, which slightly decreases after T2. At the same time, sample G2 denotes a statistically significant increase (10%level) in the perception that *the car corresponds to the safest travel mode for accompanying children to school,* as well as a statistically significant increase (10% level) in the perception that *my child does not have the skills/ability for independent and safe mobility*. Considering that G2 denoted a statistically significant decrease in the use of the bicycle/kick scooter to reach school, as well as a slight drop in walking (section 4.5.1), the two statements related to parents' safety perception ("the car being the

safest transport mode" and "children not being yet skilled enough to travel independently and safe") seem in line. At this point, the fact that "the perception about the dangers of motorized traffic in front of the school" also drops, somehow reflects a dissociation made by G2 parents between the increase/decrease of active mobility and respective decrease/increase of motorized traffic and road safety in front of school. Again, could the increased safety perception reported by G2 parents in front of school be more perceived than factual? Also worthwhile to remember is that sample G2 also denoted a statistically significant drop in car mobility (see section 4.5.1). However, a contemporary drop in active and motorized mobility is not possible. This inconsistency would need further investigation. So far, variations identified in G2 cannot be directly linked to the rather "weak" S2HOES intervention, which involved the implementation of only the PBS scheme, once every two weeks. At T2, G2 parents still remain in the "undecided" domain, but with a tendency towards "I agree" (Mean = 3.75) in regards to considering the WSB/PBS scheme a way to "increase road safety".

Table 18: G2 parents' responses concerning their level of agreement with nine statement about traffic and road safety before (T1) and after (T2) the S2HOES intervention, based on a 5-point Likert scale (1 = I strongly disagree; 5 = I strongly agree).

G2: Traffic and road safety perception	T1			T2			Difference		PAIRED t-test Wilcoxon test	Statistical significance
	n	Mean	SD	n	Mean	SD	Mean	SD	p-value	
Thee route to school is dangerous	56	3.59	1.33	60	3.35	1.27	-0.20	1.07	0.1658	No
Motorized traffic in front of school is dangerous	57	3.65	1.06	60	3.30	1.21	-0.33	1.27	0.04088	5% **
Pedestrian crossings on the route to school are safe	56	2.8	1.29	60	2.93	1.04	0.11	1.37	0.5338	No
Child should not be taken to school by car, if possible	58	4.29	1.11	60	4.07	1.25	-0.22	1.50	0.2283	No
Car is the safest travel mode for school journey	57	1.84	0.94	60	2.07	1.07	0.25	1.06	0.08723	**10% ***
Afraid of strangers	58	2.88	1.13	60	3.17	1.33	0.24	1.34	0.2091	No
Child not yet skilled enough for self sufficiency	57	2.07	1.1	60	2.30	1.08	0.30	1.09	0.05513	**10% ***
Afraid of bullying	56	2.21	1.2	60	2.37	1.09	0.14	1.09	0.3987	No
WSB/PBS improves road safety	50	3.64	1.22	60	3.75	1.16	0.16	1.45	0.4728	No

In sample G3, it is interesting to note that the statement *Where possible children should not be brought to school by car* has received the highest overall score at T1 (Mean = 4.63), even compared to sample G1 and G3. However, at the end of the intervention period (T2) a statistically significant (10% level) drop in this perception occurs, even though the score remains high (Mean = 4.04) implying an overall "I agree". According to findings emerging in section 4.5.1, sample G3 includes many families using at the end of the S2HOES intervention "frequently/very frequently" either the school bus (41%) as a prevalent transport mode or the car (ca. 37%). As such, proposing only the KGG scheme to change school mobility behaviour in such a highly motorized school context might not be enough. Despite the ongoing S2HOES intervention, which aims to raise parents' awareness about the importance of safe and sustainable school mobility by means of the KGG scheme, G3 parents increasingly perceive the car as a viable solution. This result may imply two things: either a lack of communication about the project's scope and unity of intent between the school and the parents, or the lack of a valid and safe alternative to motorized mobility for parents to explore (i.e. the WSB/PBS scheme), especially considering that G3 involves small kindergarten children that are not yet self-sufficient. This latter possibility would also be in line with findings reported in section 4.7.

Table 19: G3 parents' responses concerning their level of agreement with nine statement about traffic and road safety before (T1) and after (T2) the S2HOES intervention, based on a 5-point Likert scale (1 = I strongly disagree; 5 = I strongly agree).

G3: Traffic and road safety perception	T1			T2			Difference		PAIRED t-test Wilcoxon test	Statistical significance
	n	Mean	SD	n	Mean	SD	Mean	SD	p-value	
Thee route to school is dangerous	27	3.48	1.37	27	3.70	1.32	0.22	1.55	0.504	No
Motorized traffic in front of school is dangerous	27	2.74	1.4	27	3.07	1.33	0.33	1.64	0.3184	No
Pedestrian crossings on the route to school are safe	27	2.7	1.38	27	2.59	1.15	-0.11	1.69	0.8251	No

Child should not be taken to school by car, if possible	27	4.63	0.88	27	4.04	1.37	-0.59	1.39	0.05147	**10% ***
Car is the safest travel mode for school journey	27	2.19	1.3	27	2.15	1.35	-0.04	1.48	0.9467	No
Afraid of strangers	27	3.48	1.12	27	3.41	1.22	-0.07	1.62	0.6023	No
Child not yet skilled enough for self sufficiency	25	2.88	1.24	27	2.93	1.24	0.08	1.32	0.73	No
Afraid of bullying	26	2.31	1.12	27	2.59	1.12	0.27	1.28	0.2654	No
WSB/PBS improves road safety	25	3.52	1.05	27	3.26	1.48	-0.08	1.26	0.8196	No

4.7 Mobility-related social factors

The section that follows aims to detect possible social factors/support that may have affected parents in their mobility behaviour during the S2HOES field study. Before (T1) and after (T2) the intervention, parents of sample G1, G2 and G3 had to indicate their level of agreement with three statements concerning mobility-related behaviour promoted by the school to incentivize sustainable mobility, using a 5-point Likert scale, where "1 = I strongly disagree" and "5 = I strongly agree". To test for any statistically significant variance between T1 and T2, a paired Wilcoxon test was run.

Table 20 reports findings for sample G1, G2 and G3. In G1 and G2, parents perceive no significant change in regards to how the school promotes mobility-related sustainable behaviour. Even though not statistically significant, G1 parents, however, experience a slight, positive increase in the expectations perceived from school in playing an active part in making sustainable mobility choices.

Sample G3 is the only sample that experiences a statistically significant decrease in the perception that the school encourages children to walk to school (10% significance level). This finding somehow reflects an incongruity between the scope of the proposed S2HOES intervention (encourage children to walk to school) and the perception held by G3 parents, highlighting a possible lack in communication between the two parts. However, considering that G3 aims to promote safe and sustainable school mobility within a kindergarten context, were children are prevalently not yet self-sufficient for their age, the fact of not backing up parents with a valid and safe alternative to car mobility, i.e. the possibility to join a WSB/PBS initiative, might also work against this statement. In that case, this perception may confirm the dynamic hypothesized in section 4.6 related to traffic and road safety perception, which experiences a drop in G3 parent's perception that children should not be brought to school by car, where possible.

Table 20: G1, G2 and G3 parents' responses (Mean) concerning their level of agreement with three statements about mobility-related social support provided by the school before (T1) and after (T2) the S2HOES intervention, based on a 5-point Likert scale, where 1= I strongly disagree; 5 = I strongly agree

G1: Social factors	**T1**			**T2**			**Difference**		**Wilcoxon test**	**Statistical significance**
	n	**Mean**	**SD**	**n**	**Mean**	**SD**	**Mean**	**SD**	**p-value**	
Encourages children to walk to school	104	4.16	0.97	99	4.09	0.99	-0.09	1.23	0.3926	No
Expects me to do my part in sustainable school travel	104	3.42	1.2	95	3.67	1.2	0.22	1.48	0.142	No
Motivates me to do my part in sustainable school travel	102	3.87	1.26	101	4.1	1.05	0.26	1.27	0.1014	No
G2: Social factors	**T1**			**T2**			**Difference**		**Wilcoxon test**	**Statistical significance**
	n	**Mean**	**SD**	**n**	**Mean**	**SD**	**Mean**	**SD**	**p-value**	
Encourages children to walk to school	60	3.42	1.31	52	3.4	1.14	-0.06	1.45	0.6605	No
Expects me to do my part in sustainable school travel	60	3.17	1.25	50	3.34	1.3	0.08	1.52	0.6427	No
Motivates me to do my part in sustainable school travel	60	3.93	1.04	53	3.68	1.27	-0.15	1.46	0.4295	No
G3: Social factors	**T1**			**T2**			**Difference**		**Wilcoxon test**	**Statistical significance**

	n	Mean	SD	n	Mean	SD	Mean	SD	p-value	
Encourages children to walk to school	27	4.04	1.09	24	3.62	1.24	-0.58	1.59	0.09078	10% *
Expects me to do my part in sustainable school travel	27	3.37	1.31	25	3.48	1.08	0	1.63	0.9368	No
Motivates me to do my part in sustainable school travel	27	3.85	1.46	25	3.92	1.29	0.12	1.74	1	No

4.8 Assessment of the "KidsGoGreen" (KGG) scheme

4.8.1 Parents' evaluation of the KGG scheme

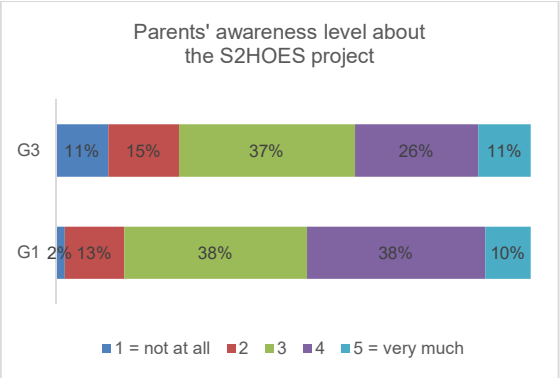
The aim of the post-intervention survey (T2) was to explore a possible appraisal by parents of the proposed KGG solution as a tool for promoting safe and sustainable mobility at school. As such, the questionnaire addressed only G1 and G3 parents (G2 did not experiment KGG) and, to begin with, enquired their awareness level concerning the S2HOES project implemented at school, and respectively their level of satisfaction. Evaluation was based on a 5-point Likert scale, where "1 = not at all" and "5 = very much". Table 21 reports findings.

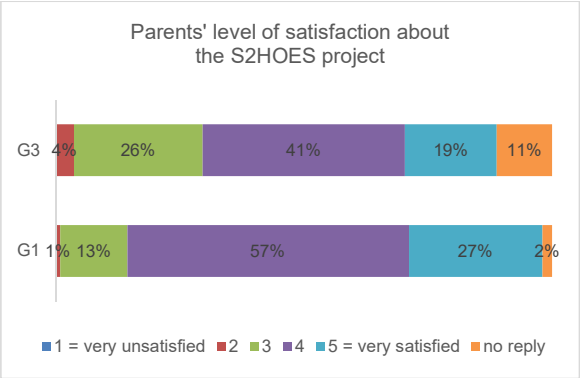
Table 21: G1 and G3 parents' responses (Mean) concerning their awareness and satisfaction level about the S2HOES project at the end of the intervention (T2), based on a 5-point Likert scale (1 = not at all; 5 = very much).

Parents' evaluation of the S2HOES project in general	G1			G3		
	N	Mean	SD	N	Mean	SD
How much do you know about the S2HOES project (awareness level)	104	3.40	0.90	27	3.11	1.15
How much satisfied are you with S2HOES in approaching sust.+ safe mobility issues	102	4.12	0.66	24	3.83	0.82

In both cases (G1 and G3), the mean value concerning the level of awareness about the S2HOES project ranges between 3.11 and 3.40, thus it remains in a more "moderate" domain. However, if we look at the level of satisfaction recorded in the two samples, G1 parents are on average "satisfied" (Mean = 4.12) of the project, while G2 parents are less (mean = 3.83) and remain in the "neither satisfied, nor unsatisfied" domain. Considering that G1 experienced the complete version of the S2HOES intervention (KGG + PBS approach), while G3 just a partial one (only the KGG approach), a combination of the two proposed technology tools may be more effective. Indeed, in Figure 9, which reports parents' responses about the S2HOES project evaluation in percentage, the "satisfied/very satisfied" segment (84%) is well recognizable, compared to the 60% of the "satisfied/very satisfied" segment of sample G3.

Figure 9: parents' responses in percentage concerning the awareness and satisfaction level concerning the S2HOES project at the end of the S2HOESi intervention (T2), based on a 5-point Likert scale (1 = not at all; 5 = very much).





Next, parents were asked to evaluate the playful approach used in the KGG solution implemented at school by indicating their level of agreement of statements about KGG educational impact, based on a 5-point Likert scale ("1 = I strongly

disagree" and "I strongly agree"). Table 22 reports findings. Parents in both samples G1 and G3 seem to acknowledge above all the potential of KGG in raising *mobility-related awareness about sustainability*.

Table 22: G1 and G3 parents' responses (Mean) concerning the educational impact of KGG's playful approach at the end of the intervention (T2), based on a 5-point Likert scale (1 = I strongly disagree; 5 = I strongly agree).

Parents' evaluation of the KGG playful approach	G1			G3		
	n	Mean	SD	n	Mean	SD
It is an innovative teaching method	99	3.78	0.79	20	3.60	0.88
It stimulates pupils' curiosity	101	3.92	0.83	22	3.59	0.85
It promotes relationships	100	3.70	0.88	20	3.65	0.93
It promotes shared values	102	3.77	0.89	18	3.50	0.92
Raises awareness about sustainability	102	4.02	0.77	21	3.86	0.85
It affects school mobility habits	101	3.79	1.06	21	3.52	0.87
It affects mobility habits for leisure activities	99	3.52	1.02	22	3.23	1.02

When asked to specify the frequency with which their child shared thoughts about the KGG virtual journey undertaken during the S2HOES field study (see Table 23), G1 reports a value in the "sometimes" domain (Mean = 3.20), while G3 in the "rarely" domain (Mean = 2.04). For sure, it has to be taken into account that the age of children involved in G3 ranges from 3 to 6 years, and thus have intrinsically less narrative skills than primary school children.

Table 23: G1 and G3 parents' responses concerning the frequency with which their child shared thoughts about the KGG virtual journey at home (T2), based on a 5-point Likert scale (1 = never; 5 = very frequently).

Parents' evaluation of child sharing thoughts about KGG	G1			G3		
	n	Mean	SD	n	Mean	SD
Frequency	101	3.20	1.05	24	2.04	1.00

As for reporting important aspects that could be possibly improved about the KGG scheme proposed within the S2HOES project, interestingly, comments made were mainly about improving communication between the school and the parents as to become a more active part in the initiative (see Table 24).

Table 24: Open-ended comments/suggestions made by parents from sample G1 and G3 on how to improve the KidsGoGreen (KGG) solution experienced at the end of the S2HOES intervention (T2).

Parents' comments on how to improve the KidsGoGreen (KGG) solution experienced	No. of resp.	
	G1	G3
Improve communication / involvement of parents	7	1
Provide a general presentation of the project aims	1	
I consider what has been done in the S2HOES project very good	1	
Introduce more safety contents about mobility (cars, bicycles, etc.)	1	
Organize an awareness-raising campaign on the dangers of strangers/smoke/drugs	1	
Introduce a WSB/PBS service for the kindergarten		1
Reward more those who use sustainable travel modes to reach school		1

4.8.2 School children's evaluation of the KGG scheme

At the end of the S2HOES intervention phase (T2), G1 schoolchildren were asked to evaluate their experience of KGG in class. In particular, they were asked to indicate their level of agreement in relation to seven close-ended statements about the KGG team game on safe and sustainable mobility using a 5-point Likert scale, where "1 = I strongly disagree" and 5 = I strongly agree". Table 25 reports findings.

From the data gathered, schoolchildren evaluate the KGG experience as mainly positive. On average, children "agree" to have enjoyed participating (Mean = 4.24), increased their knowledge about the impact of mobility on the environment (Mean = 4.11) and found lessons interesting (Mean = 4.03). Discovering the importance of sustainable mobility is, however, less felt (Mean = 3.91). This finding seems to reflect on one hand a high environmental awareness of schoolchildren at the end of the S2HOES intervention. On the other, it also seems to express modern society's common difficulty of transforming positive principles (the protection of the environment) into daily practical actions, such as mobility-related sustainability. This latter aspect could be promoted more proactively in future.

Table 25: G1 schoolchildren responses (Mean) concerning the playful approach of KGG and its impact at the end of the S2HOES intervention (T2), based

on a 5-point Likert scale (1 = I strongly disagree; 5 = I strongly agree).

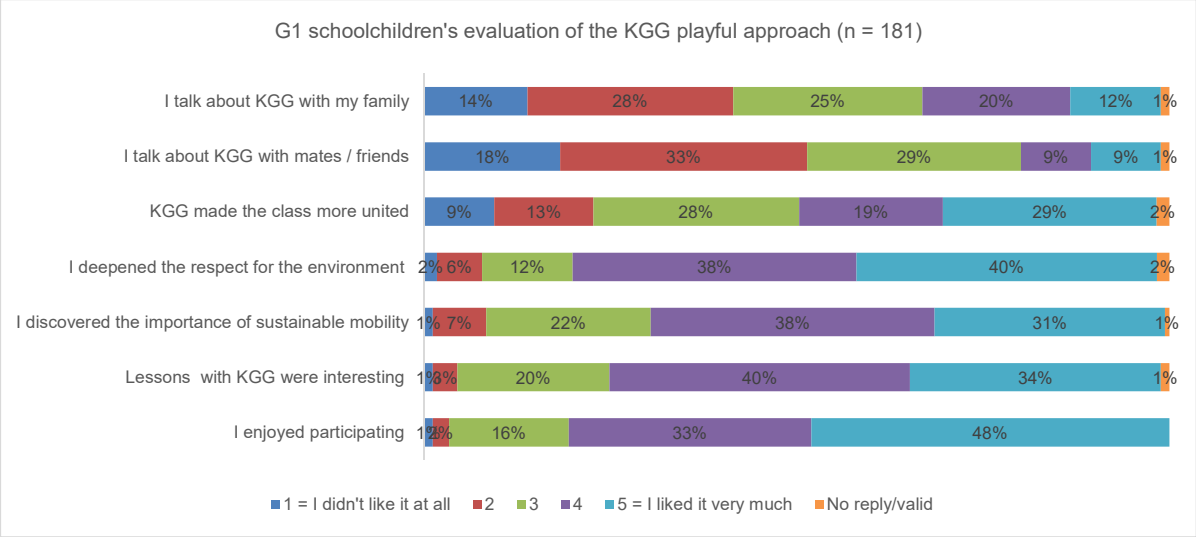
Evaluation of KGG's playful approach (T2)	n	Mean	SD
I enjoyed participating	180	4.24	0.88
Lessons with KGG were interesting	179	4.03	0.89
I discovered the importance of sustainable mobility	180	3.91	0.96
I deepened the respect for the environment	178	4.11	0.96
KGG made the class more united	178	3.46	1.30
I talk about KGG with mates / friends	179	2.58	1.17
I talk about KGG with my family	179	2.89	1.24

Finally, schoolchildren were asked to evaluate each of the single tasks laid down by the KGG playful approach. Also in this case, the evaluation based on a list of 5 closed-ended statements, using a 5-point Likert scale, where "1 = I did not like it at all" and "5 = I liked it very much" (Table 26).The one activity receiving the highest overall score is *reaching stopovers to discover their contents* (Mean = 4.44) with 89% of respondents stating to "like/like very much". Filling in the "mobility logbook" is a topic of discordance, where 49% state to "like/like very much" and another 42% state to be "undecided" or "not to like". However, 74% "liked/liked very much" to having enjoyed using sustainable travel modes to reach school (Figure 10).

Table 26: G1 schoolchildren responses (Mean) concerning the specific activities of KGG at the end of the S2HOES intervention (T2), based on a 5-point Likert scale (1 = I did not like it at all; 5 = I liked it very much).

Evaluation of KGG's specific activities	n	Mean	SD
Fill in the "mobility logbook"	1	3.69	1.00
Advance along the itinerary in steps	178	4.21	0.95
Use sustainable travel modes to advance the game	179	4.13	0.99
Reach stopovers to discover their contents	179	4.44	0.77
Use of multimedia contents during lessons	181	4.00	0.96

Figure 10: G1 schoolchildren's evaluation of single KGG activities undertaken.



4.9 Assessment of the PBS scheme

4.9.1 Parents' evaluation of the PBS scheme

Within the S2HOES field study, the PBS scheme was only experimented at primary school level, respectively involving sample G1 and G2. Sample G3, which involved only kindergarten sections, did not take part in the PBS experimentation.

What follows is a data analysis built on the responses provided by G1 and G2 parents that actually responded to both the pre- (T1) and post-intervention survey (T2). Respondents to the T1 and T2 surveys were differentiated between those parents who had only their child joining the WSB/PBS service and those, who had their child joining and themselves serving as volunteers. Table 27 reports findings.

Prior to the intervention start (T1), sample G1 included 47 school children already participating in the WSB service since the beginning of the 2020/21 school year. 13 of these children had their parents directly involved in the WSB service as accompanying volunteers. At T2, the number of participants using the WSB/PBS scheme in G1 increased to 57, welcoming ten new schoolchildren. Of these newcomers, 3 had their parents joining as WSB/PBS volunteers. Ultimately, G1, which implemented the complete S2HOES approach (PBS scheme and KGG scheme combined), experienced an increment in WSB/PBS participation of 10% during the S2HOES field study.

Sample G2 instead, involved 17 WSB participants. Of these nine parents had only their child joining the WSB service and eight of them had their child joining and themselves serving as volunteers. At T2, however, two participants were lost (one including a volunteering parent. While this kind of loss may well be the result of circumstances, in the case of sample G1, the 10% increment of WSB/PBS participants suggests a more proactive adhesion due to the combined S2HOES intervention (KGG + PBS scheme). The single PBS scheme experienced by G2, instead, seems not to be of particular impact on raising participation in the WSB initiative.

Table 27: Number of participants (schoolchildren + volunteers) included in sample G1 and G2 joining the WSB before the onset of the S2HOES project (T1), and those who joined the WSB/PBS initiative over the 5-month period of the S2HOES field study (T2).

Joining the WSB/PBS service	**G1**			**G2**		
	T1	**T2**	**Dif.**	**T1**	**T2**	**Dif.**
No	57	47	-10%	43	45	+ 3%
Yes	34	41	+7%	9	8	- 1.5%
Yes, as a WSB/PBS volunteer	13	16	+3%	8	7	- 1.5%
Total	**104**	**104**	**-**	**60**	**60**	**-**

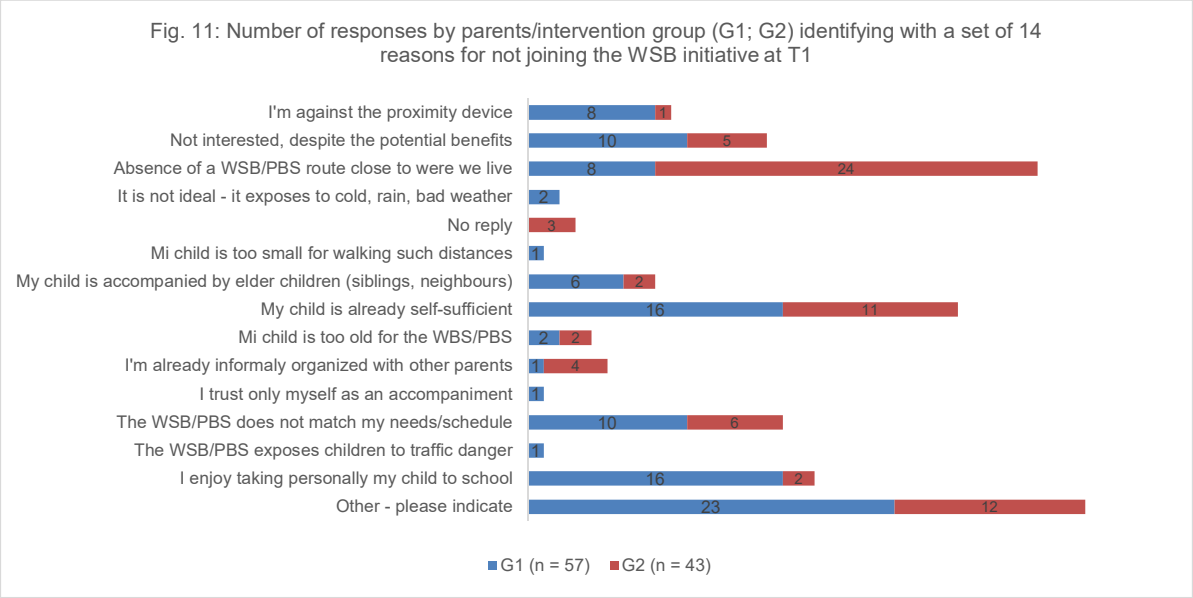
4.9.2 Position of non-adhering parents

In the pre-survey questionnaire (T1), parents *not* adhering to the proposed PBS scheme, were asked to indicate, out of a list of 14 options, possible reasons for not joining. Providing multiple answers was possible.

Figure 11 reports the percentage of parents from both G1 and G2 identifying with this set of 14 reasons for not joining the proposed PBS scheme at T1.

In this context, nearly 50% of G2 parents indicate the absence of a WSB/PBS route close to where they live. In the G1 sample, this is the case for only 13% of parents. In both G1 and G2, 26% and 22% of parents respectively, indicate that their child is already able to go to school on his/her own, and are similar in this respect. This, however, reflects more an overall evaluation of the self-sufficiency of the child in reaching school, indistinctly of the travel mode used, whether active or motorized. Again, 26% of G1 parents point out that they enjoy taking their child personally to school. In G2, this is the case for only 4% of parents. Between 10% to 16% of parents in both G1 and G2 are not interested in joining PBS, despite the potential benefits. Accordingly, 12% to 16% of parents report that the PBS does not match with their working needs/schedule. While in G2 the adoption of a sensor and mobile application was hardly an issue for not joining (2%), in G1, approximately 13% highlighted they disagreed with the use of it. In both samples, factors such as trust, age-related ability, traffic safety issues and harsh weather conditions represent a minority of reasons (or not a reason at all) for not joining the PBS scheme.

Figure 11: Number of responses by parents/intervention group (G1; G2) identifying with a set of 14 reasons for not joining the WSB initiative at T1.



Yet, in reference to the main reasons indicated by parents in not joining the PBS scheme, 37% of respondents in G1, and 24% in G2, indicate “Other reasons” for not joining the PBS scheme. Respondents could further specify their reasons by entering a free text in the questionnaire. Table 28 reports the number of “Other reasons” stated by parents, grouped into six main categories, according to the free, personalised contents indicated by respondents.

Table 28: Number of “Other reasons” given by parents for not joining the proposed PBS scheme.

“Other reasons” for not joining the PBS scheme (T1)	**G1 (n = 22)**	**G2 (n = 10)**
Child does not like / does not want to participate	7	3
Distance to school is too short	4	3
Lack of information / communication	4	1
For work reasons and / or other commitments	3	1
Distance to school too long	3	1
Against mobile app and proximity device	1	1

These “Other reasons” actually highlight aspects such as the fact that home is either “too far” or “too close” to school for utilizing the PBS scheme, or that the PBS does not combine with the parents’ working needs/schedule or other duties. An additional aspect considered by parents for not joining is that their child does not wish to join the PBS scheme, or does not like to walk. An additional insight emerging from these comments is that for some parents, lack of information about the existence of the PBS scheme, purpose or registration stopped them from joining.

4.9.3 Position of adhering parents

Parents whose children actually joined the PBS scheme were asked to evaluate it at the end of the S2HOES intervention (T2). The respective evaluation used values on a 5-point Likert scale, ranging from “1= I strongly disagree” to “5 = I strongly agree”, and the analysis differentiated responses by G1 and G2.

In both G1 and G2, all evaluation criteria that were used to assess the proposed PBS scheme (see Table 29), receive a high score (> 4.00). Thus, the level of organisation and satisfaction of the WSB are rated as good, and the wish to increase the frequency of the service is well present. Overall, G2 seems to attribute slightly higher scores than its counterpart G1. A more in-depth qualitative analysis (interviews, focus groups) could be helpful to better understand possible future needs and expectations of parents in regard to a possible increase in WSB/PBS journeys, especially when taking into account

that the WSB/PBS services under study were run only once every two weeks. Consequently, a possible future increase in the weekly frequency, inevitably will pose new challenges and considerations.

Table 29: Average mean attributed to the PBS scheme by G1 and G2 parents at the end of the S2HOES intervention period (T2), based on a 5-point Likert scale, where "1 = strongly disagree" and "5 = I strongly agree".

Parents' evaluation of the PBS scheme at T2	G1			G2		
	n	Mean	SD	n	Mean	SD
The initiative is well organised	57	4.35	0.83	15	4.53	0.74
I am satisfied with the current initiative	57	4.30	0.84	15	4.60	0.63
I hope the frequency of the service offered will increase	57	4.05	1.08	15	4.60	0.63

At the end of the intervention (T2), after testing the PBS "smart" approach, parents, whose children had joined the WSB/PBS-scheme during the S2HOES field study, were asked more specifically to indicate whether they approved or disapproved the use of a proximity device for their children and a mobile application for the accompanying volunteers as part of the WSB initiative. Of those parents, who responded, far the majority in both G1 and G2 asserted that the mobile application and the proximity device for children, which allows the automatic registration of children joining the WSB, represents an added value (see Table 30).

Table 30: Responses provided at the end of the intervention (T2) by those parents, whose children either joined the WSB or PBS scheme during the S2HOES field study.

I approve / disapprove of the PBS scheme (T2)	G1 (n = 57)		G2 (n = 15)	
	No. of replies	Percentage	No. of replies	Percentage
Yes, it is an added value	42	74%	12	80%
No, I am against its use (proximity device + mobile app)	15	26%	3	20%

The same sample of G1 and G2 parents was thereafter asked to motivate their statements about their approval/disapproval of the "smart" version of the WSB, i.e. the PBS scheme. Table 31 reports the main arguments brought in favour or against the PBS scheme. Twenty parents reasoned in favour of the proposed PBS technology. Comments point out to the motivational trigger of the proximity device for children, the fact of facilitating and/or speeding up the children's registration by volunteers or to being simply a useful/nice solution in general. Some parents see the safety of children increased thanks to the automated registration of children joining the WSB, others simply underline the advantage of promoting sustainable school mobility habits in children. Arguments against the use of a proximity device and mobile app involved terms such as "useless", "unneeded", "exaggerated" in relation to the proposed PBS tracking technology. These comments were provided by ten parents. However, it must be highlighted at this point, that the mobile app has, so far, been exclusively designed to facilitate WSB volunteers in the registration of children joining the WSB/PBS. As such, parents do not benefit in any direct way from the PBS app, nor from the proximity device. These very insights could however, turn into a starting point for future improvement of the mobile app, involving also parents in the evaluation and enhancement of possible functionalities of interest to them (e.g. possible notifications? Other aspects?). Ultimately, also the size and frequency of the WSB/PBS initiatives plays an important role in the weighing of potential benefits of the PBS approach: the automated registration of children is very advantageous especially in those cases where supervision is difficult (high numbers of participants and WSB lines, volunteers not knowing personally the children, etc.). Or else, where automated data can be useful for statistical purposes, mobility plans, etc. At this point, one parent also questioned the management of personal data protection, another one drew the attention to the fact that proximity devices are not very environmentally friendly (become waste), next to being needless, since their WSB WhatsApp chat works well. These latter comments, all denote again lack of communication or some kind of misunderstanding about the functioning and purpose of the mobile app: not only is personal data safeguarded and dealt correctly, also PBS app functionalities provide more than what a WhatsApp chat can offer. However, in general, all of these remarks point to ways of improving communication of the PBS initiative to parents.

Table 31: Parents' open comments to motivate their approval/disapproval of the proposed PBS technology solution (proximity device + mobile app for volunteers).

"The PBS scheme (proximity device + mobile app) represents an added value"	No. of resp.	"I am against using the proximity device"	No. of resp.
It motivates children / more appealing	3	It is useless / tracking is unneeded	6
It facilitates volunteers	2	This tracking technology is exaggerated	4
It is useful / a nice solution	3	I prefer using my own device	1

It speeds up the registration of children joining the WSB	3	Proximity devices become waste one day	1
It increases children's safety	2	We have a WhatsApp chat that works well	1
It adapts to modern times	2	What about personal data protection?	1
The use of a proximity device is indifferent to me, as long as it promotes sustainable mobility habits	2		
It is a healthy way of traveling	1		

Finally, the post-intervention survey (T2) provided an open-ended, optional section where parents could indicate areas of improvement for the WSB/PBS approach. Those parents, whose children did not join the WSB/PBS initiative, could also provide comments. In this case, respondents were instead asked to provide comments and suggestions/measures for improvement of safe and sustainable school mobility in general. No parent delivered comments or suggestions on how to improve the WSB/PBS scheme. However, some comments on how to improve safe and sustainable mobility at school did arrive. These comments/suggestions are summarised in Table 32.

Interesting to note, repeatedly parents from G1 indicated the need to improve surveillance around school when children cross the road. A problem of road safety clearly emerges and concerns mainly the primary school of Novazzano. Here, parents indicate that the Cantonal crossroad is rather dangerous and that there is a need for traffic supervision. As such, these bottom-up comments represent a precious source for the school and municipality of Novazzano, as it would allow the implementation of local road safety measures, based on citizens' actual needs.

Table 32: Open-ended comments/suggestions made by parents from sample G1 and G2 who did not join the WSB/PBS scheme on how to improve safe and sustainable school mobility at the end of the S2HOES intervention (T2).

Comments on how to improve safe and sustainable school mobility	**No. of responses**		
	G1	**G2**	**G3**
Increase surveillance when children cross the road	14	2	
Act on road traffic / implement road safety measures	2	2	
A parking space for bicycles and kick scooters at school	2		
The school bus is a great option for parents who can't accompany their child for work reasons	2		
Improve communication with parents / proactive support / information campaign	2	1	
Strengthen the WSB/PBS service	1	1	
Promote children cycling to school		1	
Provide more cycling paths		1	
Provide less parking spaces near school			1
Promote active mobility in general where possible		1	
Due to work reasons, we are forced to use the car			2
A change in mentality and culture is needed (e.g. promote active mobility independently from weather conditions)			1
Kindergarten children might be too small for WSB route			1

4.9.4 Evaluation of the mobile application by WSB volunteers

The PBS mobile application aims to facilitate the automatic registration of children joining the WSB. Being a tool used exclusively by WSB accompanying volunteers, at the end of the intervention (T2), those 23 parents that actively supported the WSB/PBS initiatives as accompanying volunteers were asked to evaluate the app. They were given a list of seven closed-ended statements and were asked to indicate their level of agreement, based on a 5-point Likert scale (1 = I strongly disagree; 5 = I strongly agree). Table 33 reports findings.

Table 33: WSB accompanying volunteers' evaluation of the PBS mobile application, using a 5-point Likert scale, where "1 = I strongly disagree" and "5 = I strongly agree".

Volunteers' evaluation of the PBS mobile application (T2)	**n**	**Mean**	**SD**
Easy to install	23	4.04	1.15
Easy to use	23	3.87	1.06
Attractive in design	23	3.09	1.00
It is useful	23	3.00	1.00
It is an added value for the traditional WSB	23	2.87	0.97
It is time efficient	23	3.30	1.06
Pleasant to use	23	3.13	0.87

On average, parents who joined the WSB/PBS initiative as volunteers, “agree” on the fact that the PBS mobile application is easy to install (Mean = 4.04) and rather easy to use (Mean = 3.87). However, for the rest of the listed items, most positions remain in the “moderate” domain. Here the statement that the PBS app is “time efficient” receives the highest score (Mean = 3.30) and “Pleasant to use”, while the statement “It is an added value for the traditional WSB”, the lowest. Again, considering that the present field study run its WSB/PBS initiatives only one every two weeks, the added value may not easily emerge: the automated registration of children becomes advantageous especially in those cases where supervision involves high numbers of participants and WSB/PBS routes, etc. Ten volunteers provided additional open-ended comments to explain their approval/disapproval of the proposed PBS technological solution (see Table 34). Most comments were in favour of the PBS scheme. However, a debriefing of the experience made, could provide more in-depth information about the advantages and disadvantages in using the proposed PBS application and find more tailored solutions.

Table 34: WSB Volunteers' open comments to motivate their approval/disapproval of the proposed PBS technology solution (proximity device + mobile app for volunteers).

“The PBS scheme (proximity device + mobile app) represents an added value”	**No. of resp.**	**“I am against using the proximity device”**	**No. of resp.**
It facilitates volunteers	2	It is useless	1
It motivates children / more appealing	1	Too demanding	1
It is useful / a nice solution	1		
It speeds up the registration of children joining the WSB	1		
Children’s registration was more handy at the WSB stops	1		
The proximity sensor is useful, but not essential (the mobile app can also be used without proximity device)	1		
I would like to investigate the mobile app further	1		

As for general suggestions for improvement of the PBS solution, only one volunteer provided a comment. This entailed the use of the PBS mobile application *only at bus stops (not during the journey!), since it is not nice to see accompanying volunteers crossing the road with their eyes focused on the mobile application*. Considering that the mobile app was meant to be used by volunteers exclusively at bus stops, this improper use denotes that future communication towards the participating volunteers needs improvement and will have to be more explicit about its proper use from the beginning.

4.9.5 School children’s evaluation of the PBS scheme

Another aim of the S2HOES survey was to understand the level of participation of schoolchildren in the WSB/PBS initiative and to gain an insight on the strengths and weaknesses of this approach from a child’s perspective. Thus, G1 schoolchildren were first asked to indicate their participation (or not) to the WSB/PBS initiative before (T1) and at the end (T2) of the S2HOES intervention. In both occasions, for those children joining the WSB/PBS, they were asked to evaluate their experience, using a 5-point Likert scale”. G1 schoolchildren had also the possibility to openly comment their evaluation choices in regards to the WSB initiative in the pre-intervention survey (T1).

Table 35 reports the number of G1 schoolchildren joining the WSB before (T1) and at the end of the S2HOES field experiment (T2). A 9% increase in the adhesion to the WSB/PBS initiative emerges in response to the S2HOES project.

Table 35: Number of schoolchildren that joined the WSB before the onset of the S2HOES project (T1), and those who joined the WSB/PBS initiative over the 5-month period of the S2HOES field study (T2).

Joined the WSB/PBS initiative (n = 181)	**T1**	**T2**	**Diff.**
No	113	98	-8.3%
Yes	65	81	+8.9%
No reply	3	2	-0.6%

G1 schoolchildren, who joined the WSB initiative before the onset of the S2HOES intervention, had the possibility to comment openly about their experience in the pre-survey (T1). Table 36 reports findings, summarized in positive and negative aspects and catalogued into a series of main topics/common denominators. Apart from the fact that positive comments outweigh negative ones, the social aspect of the WSB (24 responses), coupled with the enjoyment of physical activity (16 responses) seem to emerge as the strongest motivational trigger for joining or liking the WSB. Negative

comments are disparate. However, a trait that emerged several times is that the WSB can be physically tiring for some children (4 responses), for others it has a tiring tempo and is too slow (3 responses).

Table 36: Schoolchildren's open comments about the WSB (T1)

Schoolchildren's open comments about the WSB (T1)			
Positive aspects – categories	**No. of resp.**	**Negative aspects – categories**	**No. of resp.**
I can stay with friends	24	It is tiring	4
I like walking / I like walking together with friends	16	The WSB is too slow, boring	3
It does not pollute	7	I use the WSB too little	2
It is fun, nice etc.	6	It is not fun, nice, etc.	3
I build muscles and train	3	I prefer the bus	1
I can stay outdoor	2	It is like walking or using the kick scooter	1
I can watch the landscape	1	The WSB line does not pass where I live	1
It is a change to routine	1	I don't like the WSB when it is cold	1
		Cars on the road drive too fast	1
		I feel uncomfortable, because the other kids are older	1

Finally, all of those schoolchildren who had participated in the WSB/PBS scheme until the end of the S2HOES intervention (T2) were asked to evaluate their experience, based on a 5-point Likert scale (1 = did not like at all; 5= liked very much). The ratings resulted positive (Mean = 4.02) and is reported in Table 37.

Table 37: Average mean attributed to the WSB/PBS scheme by respondents of sample G1, subdivided in different categories according to their different combinations of involvement in the WSB/PBS scheme, before (T1) and after the intervention (T2)

Schoolchildren's evaluation of the PBS scheme at T2	**G1**		
	n	**Mean**	**SD**
Overall evaluation	81	4.02	1.06

5 Lessons learned and future prospects

5.1 Summary of intervention G1: Combined version of PBS and KGG

The G1 intervention, which implemented the combined approach of KGG and PBS, **seems to have experienced the most successful impact.**

G1 involved jointly the primary schools of Balerna and Novazzano, two municipalities of the Mendrisio district that count respectively 3'321 and 2'380 inhabitants and are part of the urban agglomeration of Mendrisio-Chiasso.

In general, families participating in G1 rate their access to a school bus service as "good", 84% of them live close to their school (> 2 km of distance), and as such, travel times to school, independently from the transport mode used, remain below 10 minutes in the majority of cases (73%). Exploring parents' attitudes towards car mobility, on average they perceive cars as a factor reducing the quality of life in cities due to noise and air pollution (Mean = 4.28), and agree on the importance of reducing cars on the road (Mean = 4.28). At the same time, compared to their counterpart in intervention group G3 (located mainly at the outskirts of the city of Mendrisio and involving kindergarten children), they perceive less the private car as their only obvious mobility choice. When it comes to exploring their general attitude towards active mobility, they agree that active mobility is a healthy way to travel.

Findings show that **the combined S2HOES intervention (PBS + KGG) adopted in sample G1 has positively affected school mobility behaviour of G1 participants, incrementing** in a statistically significant way the frequency of **active mobility** (1% significance level) to reach school, **as well as decreasing motorized travel**, mainly the use of the private car (5% significance level). In line with this finding, at the end of the field trial, even **parents' ideal wish to use active transport modes for their child's school mobility, if given the choice, undergoes a positive change** (5% significance).

At the **level of traffic and road safety perception, again, the combined S2HOES intervention (PBS + KGG) has reinsured to a certain extent parents on the safety of crossing roads during their child's trip to school**, with a positive increment (10% statistical significance level). At the same time, findings seem to denote also an increase in parents' concern about possible bullying events during the school trip, even though not statistically significant. In conclusion, as active mobility (walking/cycling) increases during the field trial, many G1 parents seem to sense their child being increasingly exposed to such kind of social dynamics in the absence of adult supervision. To overcome such fears and prevent possible bullying episodes, in future, school mobility solutions proposed by schools/parents associations, could focus more on prevention measures targeting this phenomenon, as well as actively promote the advantages of WSB/PBS initiatives in providing non-invasive adult supervision. Another interesting note, which emerged unexpectedly during the evaluation of parents' traffic and road safety perception, is a specific safety concern felt and repeatedly highlighted by some parents from Novazzano about a rather dangerous cantonal crossroad in proximity of the primary school, which needs improved traffic supervision/surveillance of children crossing. These latter suggestions demonstrate that **participative projects like S2HOES provide the possibility/potential to convey actual needs of stakeholders** and represent a precious source and opportunity for schools and municipalities for **implementing more targeted and effective road safety measures at the local level**.

As to understand whether the combined S2HOES intervention launched by the school triggered some kind of **socially embedded change in mobility-related behaviour of parents (in favour of more sustainable travel choices), no statistically significant change was reported**. Closely linked to this result is the finding that G1 parents rated their knowledge about the S2HOES project as "intermediate" (Mean = 3.40). Overall, this seems to reflect a weak communication aspect in the set-up of the intervention approach contemplated. In fact, when parents were asked to provide bottom-up suggestions about how to possibly improve the S2HOES project, and in particular the KGG scheme – representing the main crossing point between the school and the parents - comments made were mainly about **improving communication between the school and the parent, as to become a more active part in the initiative**. Hence, the G1 intervention actually did manage to nurture the curiosity and awareness of parents, though it could have done more to inform them sufficiently/proactively about the purpose and intent.

The combined S2HOES intervention (KGG + PBS) **successfully contributed to a 10% increment of WSB/PBS participants in G1**. Findings from the evaluations carried out by those parents who had their child joining the WSB/PBS initiative or additionally, had also served as WSB/PBS volunteers during the field trial, report that the service was well organized, that participants were satisfied and hoped to increase the frequency in future. 74% of these parents asserted that the mobile application and the proximity device for children, which allows the automatic registration of children joining

the WSB, represented to them an added value. Instead, 13% out of the G1 subsample *not* joining the WSB/PBS initiative indicated the proximity device as the reason for not adhering. However, in the G2 counterpart sample, the adoption of a sensor and mobile application was hardly an issue for not joining the PBS (2%). It would be advisable to ensure that, again, information and communication about IT technologies arrives correctly to parents.

Overall, **84% of parents indicated to be "very/very much satisfied" about the S2HOES project**. On average, they agreed on the fact that the combined S2HOES intervention, and in particular the KGG scheme, raised awareness about sustainability and mobility, stimulated schoolchildren's curiosity, affected positively school travel modes and represented an innovative teaching method.

Finally, also **from a perspective of the schoolchildren** taking part in the G1 field trial, the combined S2HOES intervention **has positively affected their mobility-related awareness**. In fact, at the end of the field trial (T2), findings report a statistically significant increase (10% significance level) in their impact rating of walking as a positive travel mode for the protection of the environment. In addition, **the wish to use active mobility (walking/cycling) as the main school travel mode** undergoes a statistically significant increase (5% significance level). At the end of the intervention period, those schoolchildren who joined, **rate the WSB/PBS experience, on average, as positive** (Mean = 4.02).

As for the KGG experience, 74% of schoolchildren "agree/strongly agree" to have enjoyed using sustainable travel modes to reach school, presumably as a result of schoolchildren's most liked KGG-related activity: reaching stopovers to discover their contents (Mean = 4.44). On average G1 schoolchildren enjoyed participating (Mean = 4.24), increased their knowledge about the impact of mobility on the environment (Mean = 4.11) and found lessons interesting (Mean = 4.03). Discovering the importance of sustainable mobility was slightly less felt (Mean = 3.91). This latter aspect could be subject for future improvement, strengthening the problem-solving approach of the intervention, possibly with the proactive help of teachers. To some extent, this finding reflects also a rather typical trait of modern society: on one hand, we find an increased environmental awareness of individuals, on the other, society's common difficulty of transforming positive principles (the protection of the environment) into daily practical actions, such as safe, active and sustainable mobility.

5.2 Summary of intervention G2: Single version of PBS

The G2 intervention, which implemented the single version of the PBS scheme, **seems to have experienced a less successful impact.**

G2 involved the primary school of Mendrisio city centre (Canavée), which counts 15'509 inhabitants.

Compared to the other two case studies (G1 and G3), G2 reports the largest segment of families living > 3 km from school (25%) and is the only case study reporting about families, whose school trip travel time exceeds 20 minutes (10%).

Findings depict G2 as a group of parents well aware of the burden private car travel causes to the environment and of the (positive or negative) impact of personal mobility choices. In fact, a statistically significant difference emerges when comparing G2 to G1 and G3 about the statement *"I feel guilty when I use my car because it contributes to pollution and traffic*" (10% significance level). However, this does not *per se* imply that G2 also leads a more environmentally friendly life, as this is easier said than done. G2 also scores the highest, compared to its G1 and G3 counterparts, when it comes to statements related to active mobility being possibly the quickest travel mode on short trips, offering more freedom and flexibility and preferring to walk/cycle rather than taking the bus. This attitude seems to denote the more *urban* nature of sample G2.

After initial promotion efforts, **the single S2HOES (only PBS) adopted in sample G2 did not contribute in consolidating active mobility practices over time.** Neither has the **single S2HOES intervention (only PBS) been of impact in shifting parent's perceptions on the ideal school travel mode towards active mobility**. However, it has to be taken into account that **participants in G2 joined/run the proposed WSB/PBS scheme only once every two weeks, at lunchtime**. Whilst the WSB/PBS frequency offered was marginal, G2 experienced a general drop in active mobility. Whereas the drop in walking was of no statistical significance, the reported decline in the use of a bicycle/kick scooter to reach school was significant (5% significance level). However, **also a statistically significant drop in car mobility was recorded** (10% significance level), thus **denoting a general lack of consistency over time in the responses**. Could, for instance, the perceived presence of **injunctive norms (i.e. what people typically approve or disapprove)** related to sustainable school mobility **determine parents' responses concerning private car use?**

In the context of traffic and road safety perception, at the end of the field trial (T2), **parents' fears undergo a statistically significant drop** in relation to the statement *Motorized traffic in front of the school is dangerous* (5% significance level). However, it is rather doubtful that this occurred because of the single S2HOES intervention (only PBS) implemented on the field. In fact, data reports **in parallel also a statistically significant increase** in the perception that *The car corresponds to the safest travel mode for accompanying children to school* (10% significance level) and in the perception that *My child does not have the skills/ability for independent and safe mobility* (10% significance level). This somehow **depicts again a strong incongruence within G2.** Presumably, the applied single S2HOES intervention model **did not manage to break the so-called "vicious circle" of motorized school mobility:** as motorized traffic within school surroundings rises, parents' risk perception increases and there is a lower likelihood of other children using active travel modes to school. With increasing numbers of children being driven to school, **car trips become socially acceptable and a self-reinforcing social norm**. As a result, the increased safety perception reported by G2 parents in front of school, could be more perceived than factual, justifying their motorized mobility choice.

Finally**, the single SHOES intervention (only PBS) did not experience an increment in WSB/PBS participation, but maintained it rather steady** over time. However, 80% of G3 parents, whose children joined the WSB/PBS scheme, asserted that **the mobile application and the proximity device for children**, which allows the automatic registration of children joining the WSB, **represented an added value**. Out of the **G2 subsample of parents *not* joining the WSB/PBS, nearly 50% indicated the absence of a WSB/PBS route close to where they live, as a main reason**. This finding indicates that there might be **a potential for improvement in the extension of WSB routes in the more urban setting of Mendrisio.** Instead, the adoption of a sensor and mobile application was hardly an issue for not joining the PBS (2%). In general, comments in favour of the PBS scheme pointed out to the motivational trigger of the proximity device for children, the fact of facilitating and/or speeding up the children's registration by volunteers or to being simply a useful/nice solution in general. Some parents see the safety of children increased thanks to the automated registration of children joining the WSB, others simply underline the advantage of promoting sustainable school mobility habits in children.

5.3 Summary of intervention G3: Single version of KGG

The G3 intervention, which implemented the single KGG version, **seems to have experienced a less successful impact.**

G3 involved children attending kindergarten in Balerna, Novazzano and Mendrisio-Salorino. While Balerna and Novazzano represent two municipalities of the Mendrisio district that count respectively 3'321 and 2'380 inhabitants and are part of the urban agglomeration of Mendrisio-Chiasso, Salorino is a residential district of the city of Mendrisio, located in the green outskirts, close to Monte Generoso, which counts 490 inhabitants.

Data shows that nearly half of the respective families in G3 lack or have low access to a school bus service (48%). This might be related to the fact that school bus services are mainly designed to suit primary school pupils, instead of kindergarten ones. Consequently, G3 nourishes a slightly more favourable attitude towards car mobility compared to its counterparts G1 and G2, and perceives less the *"need to reduce the number of cars circulating on the road"*. On average, G3 seems to hold the position that car mobility represents in many cases an "obvious and only choice". In fact, a statistically significant difference between G3 and G1 was detected concerning the statement that "*people who do not own a car are at disadvantage*", with G3 attributing it a higher score, while acknowledging at the same time car mobility's drawback of being *"more expensive"*. When it comes to exploring their general attitude towards active mobility, they agree that active mobility is a healthy way to travel. Looking at environmental awareness issues, G3 parents, like their counterpart G1 and G2, do not seem to reflect a particularly sensitive and proactive group of citizens.

The mobility-related behaviour does not shift substantially towards active mobility: G3 families taking at the end of the S2HOES intervention "frequently/very frequently" children to school by bus represent a large segment (ca. 40%), as do also those families taking "frequently/very frequently" children to school by car (37%). **Nor did the single S2HOES intervention (only KGG) shift parent's wish about the ideal school travel mode for their child, if given the choice, in favour of active mobility.**

As for **traffic and road safety perception, during the single S2HOES intervention (only KGG)**, **parents' view that *Children should not be taken to school by car, if possible* drops in a statistically significant way** (10% significance level). This statistically significant drop could **imply a lack of communication about the project's scope and unity of intent between the school and the parents**. Or else, it could also possibly be the result of G3 parents being made aware of the importance of safe and sustainable school mobility thanks to the KGG scheme on one hand, and on the other, of **not being offered a valid alternative to motorized mobility (i.e. the WSB/PBS scheme). Unintendedly, this urges**

parents to see the car as a feasible (only?) solution. Though not statistically significant, G3 parents also report the highest concerns, compared to G1 and G2, about *the route to school being dangerous* (Mean = 3.70) at the end of the field trial. In this case, the fact that G3 involves kindergarten children that are often not yet self-sufficient for their age to travel on their own surely influences parents' attitudes.

G3 is also the only case study that **experiences a statistically significant decrease in the socially related perception that the school encourages children to walk to school** (10% significance level). This finding somehow seems to reflect an **incongruity between the scope of the proposed S2HOES intervention and parents' perception**, highlighting a possible lack of communication between the two parts. However, reconsidering the highly motorized context of G3, **the fact of not backing up parents with a valid alternative to car mobility, i.e. the possibility to join a WSB/PBS initiative, might also work against the school's effort**. Additionally, it has to be taken into account that the KGG approach leverages much on participation and engagement (family-peers-school-network) to promote safe and sustainable school mobility. However, applied **in a kindergarten context, where children still have limited narrative skills, *action for change* (e.g. joining a WSB/PBS initiative) may be of greater impact for both children and families as an experience.**

A positive result: in response to the S2HOES experience made, at the end of the school year, **the parents association of Balerna expressed the will to create a new, specific WSB/PBS initiative for its kindergarten children, starting September 2021**. Unlike all other locally existing WSB initiatives, **this one aims to run on a daily basis**. As the school year 2021/22 has just started, the Pedibus line has not yet been endorsed and ATA Pedibus Ticino is currently waiting for a confirmation.

5.4 General recommendations for future interventions

- Considering that one of the main aims of the S2HOES model is to leverage on social and community interactions (family-peers-school-network) to trigger mobility-related lifestyle changes, an effective communication and unity of purpose between parents and the school becomes pivotal and needs a proactive drive and could be subject for future improvement;
- Participative projects like S2HOES provide the possibility/potential to convey actual needs of stakeholders and represent a precious source and opportunity for schools and municipalities for implementing more targeted and effective road safety measures at the local level;
- As schools gradually experience an increment in active mobility and parents' concerns about possible bullying events during the school trip increase, schools & parents associations could target this phenomenon by promoting prevention measures, as well as actively communicate the advantages of WSB/PBS initiatives in providing non-invasive adult supervision.

5.5 Recommendations for Pedibus Smart (PBS)

- Currently the PBS mobile app is more useful for larger and/or more frequent WSB initiatives, where it is more challenging to supervise participation - this was not really the case in S2HOES field study (here initiatives run only once every two weeks). Perhaps the current PBS app could be customized to address the challenges faced by smaller WSB/PBS initiatives (Ticino Pedibus), by providing, for example, support for the expansion in terms of the number of days active with volunteer scheduling, or communications;
- The PBS mobile app having been, so far, exclusively designed to facilitate WSB volunteers in the registration of children joining the WSB/PBS, parents currently do not benefit in any direct way from the PBS app, nor from the proximity device. A starting point for future improvement of the mobile app could be to involve also parents in the evaluation and enhancement of possible functionalities of the PBS mobile app, as to fit also parents' needs and interests (e.g. possible notifications? Other aspects?);

- Improve the communication with parents and WSB/PBS volunteers, as to clarify and avoid possible misunderstandings about the functioning and purpose of the mobile app and the proximity device: not only is personal data safeguarded and dealt correctly, also PBS app functionalities provide more than what a WhatsApp chat can offer;

- Underline the benefits of collecting automated data for local school mobility management (municipalities, schools, associations, etc.) - why is it useful to have the statistics? Who benefits from the statistics? What more could be done with the statistics.

5.6 Recommendations for KidsGoGreen (KGG)

- A re-design of the "mobility logbook", emerging as the less engaging activity for children, might be worth to improve the user experience;

- Finding new ways of making parents and families more involved in KGG (e.g., through sustainable mobility challenges in weekends/holidays) might be useful to increase their engagement and extend the positive impact also on free time and leisure trips;

- Supporting teachers in the preparation of KGG educational journeys and monitoring of the on-going journeys require considerable staff effort. To enable a wider adoption of KGG, an improvement of the existing digital tools is needed, with the aim of making teachers more autonomous in the various preparatory and conduction activities;

- Strengthening the problem-solving approach of the proposed S2HOES model with the proactive help of teachers to overcome the rather common difficulty of modern society in transforming increased environmental awareness of individuals, (positive, theoretical principles) into daily practical actions - such as safe, active and sustainable mobility;

- As a result of the experience made with kindergarten children, that are prevalently not yet self-sufficient to travel alone, and have limited narrative abilities for reporting to their parents about school activities, implementing KGG may need to be coupled with *action for change* (e.g. joining a WSB/PBS initiative), in order to impact families' mobility-related behaviour.