

Research Project for the Mobile Lives Forum

When new lifestyles disrupt daily mobility in England

Analysis of data from the UK National Travel Survey

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Context

In recent decades, the world of work has seen several key developments : the increase of women in the workforce, the transformation of employer-employee relations and the growing importance of Information and Communication Technologies (ICTs). These changes modify the workers' typical day, in terms of schedules and workplaces, but also with regards to their mobility, as well as the mobility of those who travel with or for them. Indeed, due to how work significantly structures people's schedules, it affects other activities of daily life that are often coupled or synchronized with the beginning or end of the workday. Or it even overlaps with them because of the increasing intertwining of work and other activities due to ICTs.

The results of this study are based on data relating to England from the UK National Travel Survey. This data predates the COVID-19 health crisis, which is still ongoing at the time of writing this summary note (January 28, 2021). However, we believe that these findings can inform or question the changes in mobility practices that this crisis may give rise to or consolidate.

The central problem

The purpose of this research is to understand how working conditions and their evolution cause adaptations in daily travel and how it is organised within the household.

The study focused on three main topics:

- The first was on recent developments in information and communication technologies that **have eroded the spatial fixity of the workplace**, allowing more people to work from home, either permanently or several times a week. Telework has benefited from these technological developments and is seen as a potential tool to reduce the travel demand and, as a result, congestion and greenhouse gas (GHG) emissions. Telework also has significant potential effects on non-work-related travel, such as shopping, leisure, and health-related trips (Aguilera *et al.*, 2007). On the one hand, a large proportion of these non-work-related trips are made in conjunction with work-related trips. On the other hand, the development of ICTs blurs the boundaries between work-related and non-work-related activities, creating more complex travel patterns (Schieman and Young, 2010). Does the evolution of workplaces (teleworking, homeworking, multiple workplaces) contribute to the restructuring of travel patterns as well as to a reduction in CO2 emissions (Cerqueira *et al.*, 2020)?
- The second research topic relates to **the effects of online shopping on the mobility of workers**, in line with works on how ICTs affect the mobility of households (Mokhtarian, 2002; Schwanen *et al.*, 2006). Is e-shopping substituting, complementing, modifying, or having no effect on household travel practices, whether for shopping or any other reason (Cao, 2009; Mokhtarian *et al.*, 2009)? Given that people in employment constitute the largest share of online buyers (UK NTS, 2017), the underlying question is whether e-shopping is a tool that can ease their scheduling constraints and give them time and organizational flexibility to manage their workdays and activities outside work.
- The third research topic focuses on the task of **taking the children to their activities**, the performance of which is organized around the contingencies of parents' workdays when they have a job (Motte-Baumvol *et al.*, 2017b). In a context where increasing numbers of women are working, where work is increasingly performed in several locations and where working hours are evolving, the task of taking the children to their activities is likely to undergo major changes. However, it appears that this particular task maintains and reproduces significant gender inequalities (Pfefferkorn, 2011). The increasing participation of women in the labor market suggested a decline in the supposedly dominant model of the *male breadwinner*, by which men bring back wages and women take care of the household and children (Crompton, 1999; Lewis, 2001), in favor of a new, fairer ideal of task sharing: the *dual earner/dual carer* model, in which men and women participate equally in household activities. The underlying question of this third research topic is whether changes in women's working conditions are helping to redistribute household tasks such as taking the children to their activities.

The method

Data

In order to thoroughly investigate the different temporalities of work and the mobilities that relate to it either directly (home-work commutes, work trips, etc.) or indirectly (taking children to their activities or household shopping), it is necessary to move beyond the “traditional” analytical timescale for mobility, i.e. the day. Given the various temporalities generated by the changes mentioned above, other, broader timescales are needed. To do this, our work is based on data relating to England from the UK National Travel Survey, which has an observation period of one full week. It has been conducted every year since 1995 and covers a representative sample of the country's population. It surveys almost 7.000 households and 17.000 individuals every year. It is common in studies using data from the UK National Travel Survey (NTS) to aggregate several years and analyze them together, making it possible to work from very large samples.

The data from the NTS offers observational opportunities which are lacking in existing French or European surveys, given that they focus on a “typical day” as representative of weekly practices. The UK's data allows us to consider variations in working days between different days of the week. This makes the UK NTS one of the few available sources of data that examines, in a disaggregated manner, the relationship between workdays and other out-of-home activities.

Statistical analysis

The use of travel data that spans a one-week observation period, such as the data from the UK NTS, involves adding an extra dimension to the analysis: the temporal dimension. Additionally, to meet the goals of this research, we must combine the analysis of several travel motives and account for their interactions. Finally, in order to study e-shopping and the task of taking children to their activities, we must be able to consider the interactions between different members of the household.

For all these reasons, we turned to Structural Equation Modeling (SEM) as a statistical method to address the different research questions. Indeed, “structural equation methods are designed to analyze multiple and simultaneous causal relationships” (Roussel *et al.*, 2002, p.1). Furthermore, SEMs are a particularly flexible statistical tool that can be easily adapted both to the research questions and to the available data (Scheiner and Holz-Rau, 2015). SEMs therefore allow for more comprehensive analyses that are better suited to social science approaches such as ours.

Results

Does working from home reduce mobility and CO2 emissions?

Our study developed a structural equation modelling approach using data at the individual and household levels from the UK National Travel Survey (NTS) in order to highlight the relationship between workplace diversification, travel habits and CO2 emissions in England. The methodological approach introduces a comprehensive study of the travel habits of employed workers, distinguishing between work-related trips (commutes and business) and non-work-related trips (taking children to their activities, shopping, leisure, etc.). In this study, we compare the movements of five different groups of workers characterized by their specific workplace configurations:

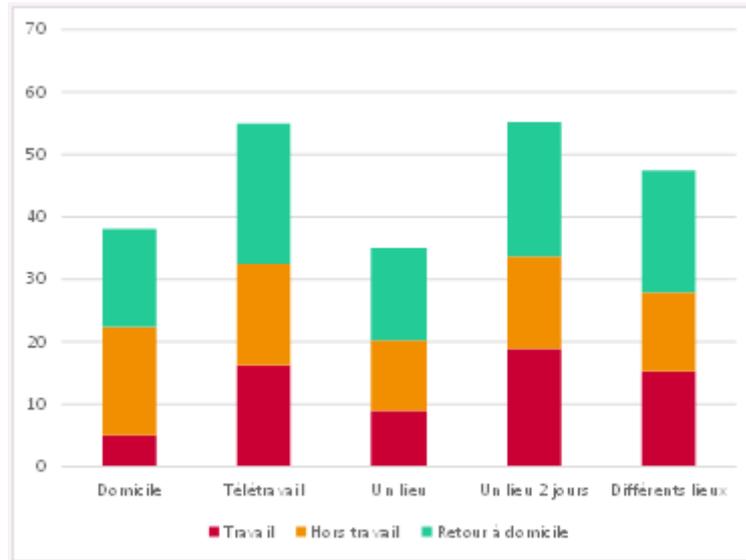
- 1- workers who work in a fixed location (outside the home) during the whole week ("1 Place");
- 2- workers who work in a fixed location (outside the home) at least two days a week ("1 place 2 days");
- 3- workers who have multiple workplaces ("Different places");
- 4- workers who are working fulltime from home ("Home");
- 5- teleworkers who report working remotely at least 1 day a week and work in the same place at least 2 days a week ("Telework").

The starting point for this study was the assumption that with the continuous decline over the past two decades in the proportion of individuals with a fixed workplace, it is important to understand the recent changes in travel modes, as well as their environmental impact. As such, we hypothesize that the development of ICTs and the consequent increase in the share of homeworkers and teleworkers do not necessarily lead to a decrease in GHG emissions due to possible rebound effects.

First, the results (Figure 1) show that CO2 emission levels are significantly higher for individuals with multiple workplaces (Telework, 1 place 2 days, and Different locations). Statistical modelling confirms the results, all other things being equal. These higher levels of emissions for workers with multiple locations (+11%) are mainly linked to the total number of kilometers travelled per week (+10%) and total travel times (+5%) but also to direct effects such as the higher modal share of cars. The results show that, overall, the diversification of workplaces translates into longer average distances, particularly for work-related trips which are often connected to more distant places of residence. For teleworkers, CO2 emissions are more strongly related to distances travelled to get to work: they tend to live further away from work than others and have longer travel distances. As such, with an equivalent number of weekly trips (18 per week) and fewer work-related trips (-15%), teleworkers have weekly time budgets for travel that are 25% bigger, they travel 50% more kilometers and emit 50% more CO₂ than workers with a single outside-the-home workplace. These effects are greater for teleworkers who spend only one day at home and lower for those who stay there more than two days a week.

To a lesser extent, the trade-off between work and non-work activities also affects the total CO₂ emissions of people who telework or work from home. For these workers, workdays at home involve more non-work-related trips, especially for taking children to their activities and shopping. With a lower time budget (-2%), homeworkers have higher levels of CO₂ emissions than workers with a single workplace (-12%), as the lack of regular commutes to work (-65%) is offset by non-work-related trips that contribute to making them travel significant weekly distances (+6%).

**FIGURE 1: WEEKLY CO2 EMISSIONS (KG)
BY TRAVEL MOTIVE AND BY WORKPLACE**



*Data: National Travel Survey 2013-2017 (UK)
Chart and calculations by the authors*

Our results also show that part-time workers have lower rates of CO2 emissions because they travel shorter distances for work-related travel, which indicates that they live closer to their workplace. Additionally, the model confirms some expected conclusions: men, high-income individuals and skilled workers have higher levels of CO2 emissions because they tend to travel longer distances, particularly for work-related trips. Men, in particular, have greater direct effects, perhaps because they use cars more often than women.

The original contribution of the study is to highlight the effects of non-work-related trips on total weekly travel. Contrary to the commonly accepted view that work trips have a greater environmental impact because they are mostly done by car, on a daily basis and over much greater distances than other kinds of trips, this study shows that non-work-related trips account for an equally important share of CO2 emissions for all worker profiles. The other original contribution is to highlight that fixed-location work (outside the home) remains the least-emitting form of work. Having a single place of work in England is correlated with greater use of urban public transport, walking or cycling. Meanwhile, teleworking is the form of work for which the modal share of cars is the greatest, with an equivalent level for workers with multiple workplaces and homeworkers. Teleworkers and workers with multiple workplaces have average emission levels that are much higher (+50%) than those with a fixed workplace (outside the home).

It should be noted that the above results, showing that teleworking or even homeworking do not contribute to reducing CO2 emission levels, only account for emissions generated by a worker's weekly travels. Emissions related to a worker's housing and its configuration (heating, electricity, Internet connection), as well as those related to the employer's workplaces or to digital and remote working practices (videoconferencing, etc.) are not taken into account. In addition, unlike other studies such as those by ADEME based on scenarios and foresight (Greenworking and ADEME, 2020), our results are based on actual travel practices and allow comparisons between different workplace configurations, including telework. This is all the more important because it sheds light on what could happen in France and elsewhere if telework became widespread following the ,COVID-19 pandemic when people will be able to

move around freely again. In this instance, by focusing only on travel, we would see a significant increase in distances travelled due to a residential rebound effect, especially if it occurs in remote or less densely populated areas that require travelling longer distances to access shops and services, as well as a significant shift to motorized modes, and thus to higher emission levels. While telework may be associated with fewer trips, there is no saying that these trips will be shorter or less motorized, as the English survey shows.

Does e-shopping reduce travel?

The UK is a country where online shopping is very popular - both in terms of volume and money spent - which makes it one of the European leaders for online sales. Working households make up the bulk of online shoppers. The question is whether this practice is related to the constraints of work-related journeys and whether it has an impact on travel, whether for purchases or for any other reason. Here, we investigated four types of effects, in connection with the existing literature. The first effect, substitution, corresponds to a decrease in the number of trips performed to make purchases, replaced by e-shopping. In the second, complementarity, e-shopping generates an increasing number of in-store trips. The third effect, modification, implies there is no change in the number of shopping-related trips, but changes in terms of schedules, destinations or modes. Finally, neutrality signals that there are no changes to shopping-related trips.

The results reveal two types of relationship between online shopping and workers' travel habits:

- The first is akin to substitution for online food shopping. Indeed, households that buy their groceries online perform fewer trips for this purpose (-0.4 trips per week - see Box A in Table 1 below), which represents 42% fewer trips compared to households that don't buy online. We were able to estimate that a household that shops for food online emits an average of 2.2 kg per week compared to 3.5 kg per week for a household that doesn't shop online, which corresponds to a 39% reduction in household emissions for grocery shopping. The effects of online food shopping vary depending on the type of living space. In rural areas, there is a 38% reduction compared to 56% in London. If the percentage reduction is lower in rural areas, in terms of absolute values, the reduction is significant since it is 2.2 kg per household compared to only 1 kg in London. For the general population, e-shopping leads to a reduction of approximately 6.5% of all kilometers travelled for food shopping and about as much in terms of CO2 emissions.

However, these amounts must be put into perspective with those estimated for deliveries made by supermarkets: an average basket emits an estimated 1.4 kg of CO2 (based on the work of van Loon *et al*, 2015). The potential to reduce emissions through e-shopping therefore appears to be low. However, in addition to route optimization for deliveries, we can assume that it is easier to compel supermarkets than households to adopt "clean" or low-emitting vehicles, and that doing so would therefore be more likely to reduce delivery-related emissions.

- The second relationship is akin to complementarity and additivity between e-shopping and in-store trips, concerning non-food products. Households that frequently buy online tend to make a higher number of trips for this purpose (see Box B in Table 1). These households perform almost 10% more trips and more kilometers for non-food shopping. The overall impact is small as there are few such households. It appears that they would contribute to a 1% increase in the total mileage travelled by all households for non-food purchases, and about as much in terms of CO2 emissions.

Outside of food shopping, e-shopping has no substitution effect on the frequency of shopping-related trips: e-shopping is done in addition to in-store shopping. There are several possible reasons for this effect. The main assumption would be that e-

shopping is an additional channel that encourages individuals to buy more, which is consistent with the observation that the growth in online sales revenue has not led to a decrease in in-store sales (in the pre-COVID-19 period). A second hypothesis is related to how in-store trips performed to make a purchase are turning into in-store trips performed to browse, exchange or return products. This would mean that e-shopping is giving rise to new travel practices that cannot properly be captured in travel surveys, due to the low level of information for travel motives, which regroup all these different trips under the same motive: “shopping.”

TABLE 1: NUMBER OF TRIPS PER WORKERS’ MOTIVE BASED ON THE HOUSEHOLD’S E-SHOPPING PRACTICES

	Online food shopping		Frequency of e-shopping			Together
	No	Yes	≤ 2/year	> 2/year & < 3/week	≥ 3/week	
No. Trips WD Food purchases A	0,56	0,32	0,56	0,53	0,55	0,53
No. Trips WE Food Shopping	0,34	0,20	0,34	0,33	0,29	0,33
No. Trips WD Non-Food Purchases	0,49	0,40	0,41	0,49	0,53	0,48
No. Trips WE Non-Food Purchases	0,36	0,33	0,33	0,36	0,38	B 0,36
No. Trips WD Work	3,17	3,18	3,11	3,19	2,84	3,17
No. Trips WE Work	0,28	0,19	0,33	0,26	0,23	0,27
No. Trips WD Other motives	3,49	3,40	3,00	3,51	3,59	3,48
No. Trips WE Other motives	1,61	1,55	1,37	1,63	1,62	1,61

Data: National Travel Survey (UK), Chart and calculations by authors

How to read this chart:

In the lines

- No Trips WD: the total number of trips made on weekdays (Monday to Friday)
- No Trips WE: the total number of trips made on the weekend (Saturday and Sunday)

In the columns

- The first two columns differentiate workers according to whether or not they do their food shopping online
- The following three columns differentiate workers by frequency of e-shopping for all types of products (food shopping, other food products or non-food products)

Besides for studying the shopping travel, the UK NTS can also be used to estimate the time spent in-store. Here, too, e-shopping has an effect, as the average time spent in-store to buy food is 46 minutes for households that do not shop online and only 28 minutes for those that do. The substitution effect is clear on the temporal level. Conversely, the average time spent in-store for non-food purchases increases with the frequency of e-shopping, from 48 minutes for those who very rarely buy online to 63 minutes for those who shop online several times a week. The additivity effect is clear here for non-food purchases and the statistical model shows that this effect is also observed when all other things remain equal. Thus, this effect isn’t influenced by income, household composition or residential location, the effects of which are controlled for in the model.

Regarding food shopping, one could conclude from these results that buying online saves time. But the survey does not measure the time spent at home or in other fixed places (for example, at work during a break) to order the same basket of products online. Similarly, home delivery mechanically immobilizes individuals who may no longer be able to travel at those times (delivery timeframes may be 2 to 4 hours long depending on the provider). This period of time, which is likely to be reinvested in other home activities, will not be considered as shopping-related time, even within a Time Use survey. Substitution therefore does not necessarily translate into time saved or less travel, but it does show that these "avoided" trips are not reinvested into other trips.



How do dual-income families share the task of taking children to their activities ?

The final part of this research focuses on how dual-earning families organize the task of taking the children to school and activities. We examine the inequalities between spouses based on two working hypotheses:

- The first hypothesis postulates an intrinsic inequality between men and women in taking children to their activities, all other things being equal. For an equal workday, with identical working hours, women have a greater probability of taking the children to their activities performing this task
- The second hypothesis postulates interactions between spouses despite gender inequality. As such, each spouse's commitment to taking children to their activities depends on their own workday as well as on the workday and commitment of their partner.

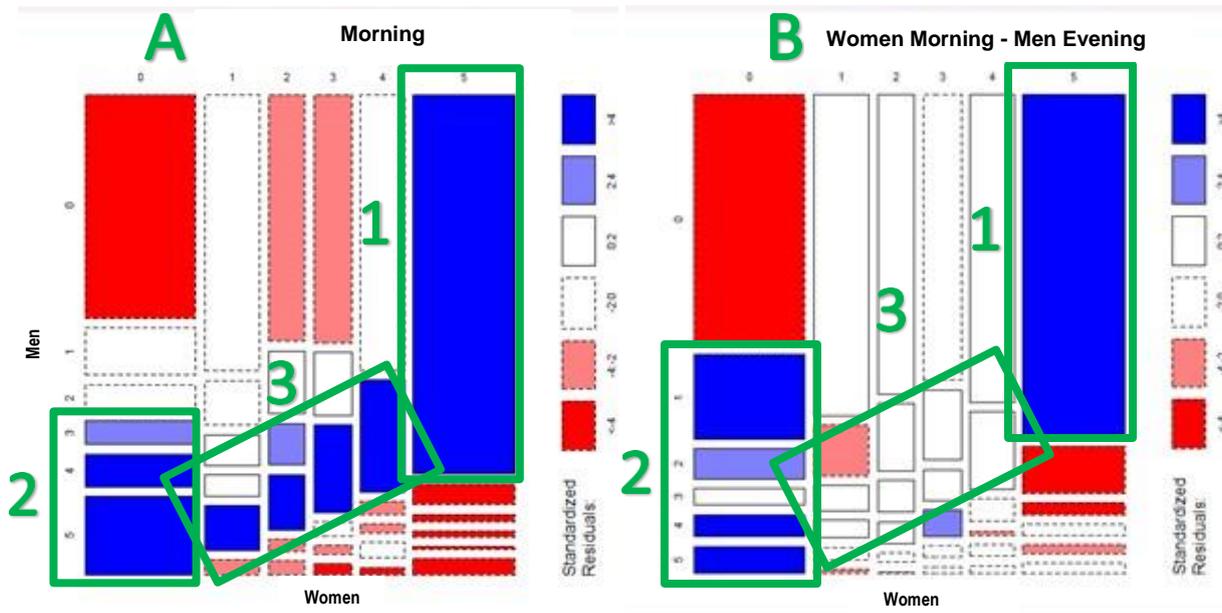
Among the observed families, 50% of couples take their children to their activities, and those with young children do so more than those with older children. Among spouses, women chauffeur them twice as often as men, performing two-thirds of the trips. Fathers usually chauffeur children less often than their spouses (24%), which means that only 11% of men accompany their children as often or more than their wife. Moreover, this inequality is compounded by the fact that 35% of women perform this task both in the morning and the afternoon, as opposed to less than 5% of men.

Our work shows that these differences between women and men in terms of chauffeuring children are not explained by the different effects of each spouse's job characteristics (in terms of location, working hours, etc.). Indeed, working part-time, holding a less skilled job, or driving a car to work are characteristics that have the same effect regardless of gender: they all increase the probability that the worker will perform a greater number of trips to accompany their children. Consequently, all things being equal, there are no differences between men and women in terms of taking children to their activities: our first hypothesis is incorrect. However, we know that in terms of gender and the sharing of household activities, spouses are rarely equal. While there is parity between the partners studied here in terms of activity (they are all employed workers) and place of residence, many inequalities remain in terms of employment (work time, location, etc.) and modes of transport, etc. These differences necessarily affect the structure of the population and, ultimately, how children are taken to their activities.

The results then focus on the second hypothesis: the forms of interaction between spouses. Our findings show an adaptation of schedules in both directions. Men adapt how often they take their children to their activities in function of their spouse's work day. As such, despite the strong inequalities between spouses performing this task, the interaction between how the spouses organize their days occurs in both directions and in an egalitarian way. The inequality in terms of practices was created earlier, probably around the birth of the child, with a choice being made regarding the mother's work situation.

Then, the second level of interaction between spouses relates to how they organize the transport of their children on different weekdays or in the mornings and evenings. At this level, we were able to find that parents are more likely to split the task taking to school between the different days of the week (A in Figure 2), rather than splitting it between mornings and evenings (B in Figure 2).

FIGURE 2: INTERACTIONS BETWEEN DIFFERENT TYPES OF TRIPS TO TAKE THE CHILDREN TO THEIR ACTIVITIES (MORNING, EVENING, WOMEN, MEN) OVER 5 BUSINESS DAYS



Data: National Travel Survey (UK), Chart and calculations by the authors

How to Read These Charts:

- In both charts: The boxes have a surface area proportional to the number of households in the sample affected by a situation. Blue indicates that a situation is over-represented relative to the average. Conversely, red indicates the under-representation of a situation relative to the average.
- In Chart A, the horizontal axis shows the number of weekdays where the women drove the children in the morning and the vertical axis shows the number of weekdays where the men took the the children to school in the morning. Thus, we can see in the top right (1) an overrepresentation of women who take their children to school and activities 5 days a week without their spouse doing so at all. This is the most common situation in the chart since this box has the greatest surface area. At the bottom left (2), we can see an overrepresentation, compared to the average, of men who take their children to their activities 5 days a week while their spouse does not do so at all. Finally, there is an overrepresentation of situations where one spouse takes the children to school and their activities only part of the week and the other spouse does so the rest of the week (3). These are the blue boxes in the middle of the chart. This shows that the task of taking children to their activities is split between spouses among different days of the week.
- In Chart B, the horizontal axis shows the number of weekdays where women performed the task in the morning and the vertical axis shows the number of weekdays where men did so in the evening. At the top right (1), we can see an overrepresentation of women who take the children to their activities every day in the morning while their spouse does not do so in the evening. This is the most frequent situation. Also, there is an overrepresentation of men who take the children to their activities 1 to 5 times a week (except no. 3) in the evening (2) while their spouse does not do so in the morning. Finally, the absence of blue in the center of the chart (3) shows the low probability that spouses will split the task n during the same day.

In the end, the gender differences seen in relation to the task of taking children to their activities are not surprising or new, considering that other surveys such as the Time Use Survey clearly show that in England, as well as in France for that matter, domestic activities, including those relating to children, remain very unevenly shared between women and men, despite an increase in men’s participation rates. However, it is worth pointing out that the models of interaction reveal that spouses tend to split the task of chauffeuring children according to the different days of the week. Indeed, the spouse or parent who takes them to their activities in the morning will do so throughout the day. This finding calls into question the interaction model based on one spouse performing this task in the morning and the

other doing so in the evening (Schwanen 2007). The results presented can be explained by a structural effect related both to the condition in which our subsample was selected and to the inherent and persistent gendered differences observed in daily activities and travel.

Conclusion

Our results on the cross-effects between workdays and non-work-related travel highlight several types of situations, in relation to evolving forms of work, online shopping practices and taking children to their activities. The analyzed situations take into account both the magnitude of the studied evolution, its effect on overall mobility and the structuring role of work-related trips. In the end, the three core research topics we pursued led to three types of findings.

The significant evolution of workplaces, with the growing importance of teleworking and homeworking, is leading to considerable changes in the entire travel schedule of those concerned. In fact, workers who work all or part of the week from home perform far more non-work-related trips. We are therefore faced with a marked change in work-related travel that has a strong impact on overall mobility.

Another, more important development among workers is the increase of online shopping, the effects of which are limited: trips avoided thanks to online shopping are not reinvested for other motives. While it may have been expected that e-shopping would be favored by those with long and constraining workdays and/or who live far from work, this is not the case and shopping-related trips do not appear to be very structuring in the workers' overall mobility.

Finally, the task of taking children to school and their activities has evolved in a way that has very limited scope and shows only complex and tenuous links to all other trips, including work-related ones. Habits have evolved very little and changes in how workdays are organized have had relatively little impact on them: among dual-income families, women almost exclusively shoulder the burden of performing this task, with very small variations depending on their work constraints and those of their male partners. As a result, we can say that the issue of taking the children to their activities and its place in couples' travel schedules is subject to a very strong conservatism.

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