HAL
open science

Flexible work arrangements and household-related journeys. Who takes the lead in dual-earner heterosexual couples?

Eugênia Viana Cerqueira, Benjamin Motte-Baumvol

To cite this version:

Eugênia Viana Cerqueira, Benjamin Motte-Baumvol. Flexible work arrangements and household-related journeys. Who takes the lead in dual-earner heterosexual couples?. Travel Behaviour and Society, 2022, 26, pp.240-249. 10.1016/j.tbs.2021.11.003 . hal-03434197

HAL Id: hal-03434197

https://hal.science/hal-03434197v1

Submitted on 29 Nov 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Flexible work arrangements and household-related journeys. Who takes the lead in dual-earner heterosexual couples?

Eugênia Viana Cerqueira [1], BenjaminMotte-Baumvol[2]

[1] Universidade Federal de Minas Gerais, Av. Antônio Carlos, 6.627, Belo Horizonte 31270-901, Brazil

[2] Laboratoire ThéMA Université de Bourgogne Franche-Comté, 4 boulevard Gabriel, 21000 Dijon, France

Abstract

This research provides an exploration of the relationship between flexible work arrangements (FWA), CO2 emissions, and household travel allocation among dual-earner couples. Using data from the United Kingdom National Travel Survey for the period between 2002 and 2017, we develop a path analysis approach based on SEM that allows for a comprehensive study of travel behavior and trade-off effects. Results suggest that, although the partner who benefits from FWAs tends to carry out domestic provision and maintenance activities, the allocation of tasks within the household is still asymmetrical. Results also outline that the presence of children will intensely affect the allocation of activities and household arrangements, increasing gender inequalities.

Keywords: flexible work arrangements, travel behavior, telework, dual-earner couples, sustainable transport

---

This is a postprint version, the definitive version of this paper is :

Cerqueira, E. V., & Motte-Baumvol, B. (2022). Flexible work arrangements and household-related journeys. Who takes the lead in dual-earner heterosexual couples? Travel Behaviour and Society, 26, 240-249. https://doi.org/10.1016/j.tbs.2021.11.003

Introduction

Flexible work arrangements (FWAs) (Allen et al., 2013) or alternative work designs (Brewer, 1998) such as teleworking, working from home, part-time working, or self-employment have become a hot topic during the COVID-19 outbreak, accelerating the debate about the way we work and its implications for commuting and travel. For example, home-based work has become the "new normal" for millions of workers the world over during lockdowns and scholars have promptly sought to assess not only the current shifts in people's daily activities (Hensher et al., 2021; Nguyen and Armoogum, 2021) but also the main impacts of a potential extended remote-working routine in the post-COVID era (Jesus et al., 2020; Schur et al., 2020; Nguyen, 2021).

FWAs are receiving attention in the field of transport for their capacity to transform many aspects of commuting, such as the number of trips, distances traveled, modal share, congestion at peak times, and pollutant emissions. The potential issues surrounding FWAs, in the event of their marked development after the COVID-19 outbreak, are therefore very significant. The energy and climate impacts of some forms of FWA such as teleworking were investigated in the pre-crisis period and have since been the subject of many studies. Findings demonstrate that the reduced distance travelled for commuting could positively impact in energy consumption, traffic congestion and CO2 emissions (Shabanpour et al., 2018). Nonetheless, many points of the capacity of FWAs to reduce commuting and CO2 emissions remain disputed, as the more rigorous studies that include non-work trips or home energy use find smaller savings or even an absence of reduction of GHG emissions (Cerqueira et al., 2020). Hook et al. (2020) emphasize that despite the positive forecast on the climate impacts of FWA, there are still numerous uncertainties about its actual benefits, as they could lead to unpredictable increases in non-work travel.

Thus, although the relationship between FWA and the existence of rebound effects for non-work trips has been analyzed in the academic literature for entire households (Cerqueira et al., 2020), few studies have focused on the intra-household level. This issue must be considered in the light of the role of flexible work in dual-income couples who are the main ones concerned by these types of employment (Chung et al., 2020a). Studies show that FWAs are used in particular by workers who want to better balance work and family life, with a high prevalence of women. Household responsibilities and the travel that goes with them (such as children escorting trips, for example) tend to weigh more heavily on the spouse with flexible work, freeing up the other spouse and adjusting the couple's non-work mobility and the associated

CO2 emissions. These arrangements could thus entail some intra-couple rebound effects, which would counterpoint the commonly established notion that FWA would reduce traveling and climate impacts. In the event of a surge in FWAs in a post-COVID period, it is important to analyze intra couple travel trade-offs and their impacts on CO2 emissions.

Thus, this research focuses on the how FWAs will affect household travel allocation among dual-income couples and consequently, its CO2 emissions. We argue that it is capital to grasp the trade-offs that operate in couples with one member who benefits from FWAs and their impacts on overall household CO2 emissions. Does FWA allows minimizing CO2 emissions at the couple scale or does it rather increase them? The data used were obtained from the United Kingdom National Travel Survey, which collects data from trip diaries for a seven-day observation period, between 2002 and 2017. The case is made for focusing exclusively on non-work trips, as previous investigations demonstrate that FWAs can entail substantial trade-offs between work and non-work trips and that the latter account for a significant share of CO2 emissions (Ravalet and Rérat, 2019).

We use Structural Equation Modeling (SEM) implementing path analysis and notably highlight the implications of FWAs for household travel patterns. The results show that, although the partner who benefits from FWAs tends to carry out domestic provision and maintenance activities, the allocation of tasks within the household still involves gender inequalities. We also find that the presence of children, combined with FWAs, implies more escorting and caregiving-related trips, particularly for women.

The article is structured as follows. First, the literature review section summarizes previous findings on the effects of telework on intra-household arrangements and the influence of those arrangements on travel patterns and activity choices. The data and methods section presents the travel survey data and explains the SEM developed. The results are presented in Section 4 and the final section summarizes the main findings and highlights lessons that can be drawn for future studies.

2-Literature review

2.1-Flexible Work Arrangements

There is no established and widely used definition of FWAs in the literature. However, the literature points to two main dimensions by which this flexibility can be characterized: the temporal and spatial dimensions (Burkinshaw, 2018; Moen et al., 2016). For temporal flexibility, multiple characteristics can be taken into account, such as the possibility of arriving late or leaving early on certain occasions, of being able to change one's schedule depending on the day and/or week, or even of having control of the schedule (Schieman and Young, 2010). Flexible working can also include control over the number of hours worked, as with part-time jobs. Of course, all of these characteristics are understood to determine the actual level of work flexibility in different degrees. Spatial flexibility means allowing work outside the usual place of work (Schieman and Glavin, 2008). The definition of the usual place of work is open to debate. In general, what is covered is telework at home or in any other third place within the framework allowed by the employer and the legislation.

Despite more favorable legislation, particularly in the UK, the number of workers adopting FWAs increased moderately in the pre-COVID-19 period, at least in the early 2010s (Tipping et al., 2012). One reason is the prevalence of flexibility stigma, i.e., the perception that workers who use FWAs for care purposes are less productive and less committed to the workplace (Williams et al., 2013). Finally studies have also shown that as flexible working becomes more widespread, it is less stigmatized (Moen et al., 2016) and the COVID-19 crisis may have contributed to reducing the stigma of flexibility (Chung et al., 2020b).

2.2- FWAs, work-life balance and gender inequalities

In the transportation field, the effects on commuting have only been investigated for some FWAs, in particular those related to spatial flexibility: teleworking and working from home. The effects of temporal flexibility have not been studied directly, but may appear among other determinants in studies on commuting and/or non-work trips. For example, the highly developed part-time jobs for women in the Netherlands are associated with more shopping and escorting trips (Schwanen et al., 2007). In addition, part-time jobs are associated with shorter commuting distances, but these effects appear to be largely endogenous with those related to gender (McQuaid and Chen, 2012). The effects of potentially flexible working hours for escorting children in the morning can also be observed particularly for women (Motte-Baumvol et al., 2017).

From the perspective of spatial flexibility, the development of ICT has enabled more individuals to work from home either permanently or several times a week. Telework has gained significant attention as a potential way of reducing travel demand and its negative effects, such as congestion and CO2 emissions (Hook et al., 2020). Over the past two decades, numerous investigations have analyzed the effects of home-based work from different viewpoints, illustrating the profile of individuals who adopt these arrangements as well as showing its environmental, social, and economic implications (Ory and Mokhtarian, 2006 ; Zhu and Mason, 2014; De Abreu e Silva and Melo, 2018). While some of these studies highlight the positive effects of telework, such as the reduction in the number of trips and kilometers traveled (Choo et al., 2005; Helminen and Ristimäki, 2007) and the increase in free time for activity allocation (Hilbrecht et al., 2008), findings also emphasize that working from home often entails significant rebound effects, since time saved on commuting trips may be converted into additional non-work trips or longer commutes (Zhu, 2012; He and Hu, 2015; Author et al., 2020).

In terms of its contribution to the work–life balance, teleworking seems to be an attractive arrangement for time-pressured working couples seeking to avoid often long daily commutes to work. Home-based work may lead to a greater sense of control over time and allocation of household responsibilities, increasing individuals' satisfaction with their work–life balance. Although flexible work could be a useful tool for promoting gender equality (Chung and van der Lippe, 2018), a notable body of research demonstrates that the temporal flexibility created by home-based work arrangements is used differently by male and female teleworkers and it could potentially reinforce gender roles in the labor market and in domestic tasks (Lott and Chung, 2016).

The literature is almost unequivocal in depicting that, when it is women who telework, teleworking contributes to the reproduction of gender inequality by reinforcing their responsibility for caregiving and the management of domestic tasks, especially when there are children in the family (Stier et al., 2012; Chung and van der Lippe, 2018). Hilbrecht et al. (2008) investigate the impacts of teleworking on the work–life balance among married women with children in Canada, demonstrating that time saved on commuting trips is mostly reallocated to childcare, domestic work, or work-related tasks, rather than to time for personal leisure. Moreover, the "stay-at-home mother" role contributes to the close association of personal work schedules with the rhythms of children's activities, which include escort trips to school and

leisure activities. Thus, for some mothers, the combination of working from home and childcare responsibilities may result in increased stress, as time spent during the day with their children often involves the trade-off of their evening leisure time (Hilbrecht et al., 2013).

On the other hand, evidence suggests that although male teleworkers may sometimes undertake a significant share of housework, they tend to maintain a greater degree of separation between the work and family spheres. They often follow conventional industrial working time patterns and also increase their working intensity when working from home (Sullivan and Lewis, 2001; Chung and van der Lippe, 2018). Men also appeared to convert the time saved on commuting into increased leisure opportunities more often than women (Hilbrecht et al., 2013). When comparing teleworking impacts on family management in Poland and Sweden, Kurowska (2020) shows that, in Poland, men are able to avoid the trap of the double burden of paid and domestic work, while in Sweden the negative effects of home-based work on the ability to balance work with non-work activities affects both men and women.

More recently, scholars have emphasized that dramatic changes in work arrangements brought about by the COVID-19 pandemic contribute to a greater disproportion in the allocation of household responsibilities between males and females (Nguyen and Armoogum, 2021). Most of the negative effects of teleworking are reported among couples with children, particularly among mothers with young children (Andrew et al., 2020 ; Seiz, 2021). Nonetheless, higher rates of females compared with their male counterparts had a positive perception of telework within the lockdown period and a desire to continue with this type of work arrangement post-COVID-19 (Bachelet et al., 2021; Nguyen and Armoogum, 2021). This confirms previous findings showing that women consider teleworking as beneficial for achieving a better work–life balance (Hilbrecht et al., 2008).

It is also important to note that telework does not in itself transform the gendered allocation of domestic tasks and caregiving (Sullivan and Lewis, 2001). Despite the overlap of the family and work spheres, the association between telework and work–life balance seems to be positively perceived in many cases (Maruyama et al., 2009). Increased time for leisure activities is considered to be a valued outcome of telework, as well as an opportunity to take advantage of non-peak periods at recreation facilities (Hilbrecht et al., 2013). As working from home directly impacts time management and the allocation of tasks within the household, it will also have significant consequences for travel behavior and choices.

2.3- Intra-household arrangements and travel-behavior

In transport research the individual has conventionally been regarded as the basic decision-making agent. However, it is well known that individual daily activity and travel patterns are often influenced by other household members and, in some cases, choices may involve a group of people (Zhang et al., 2009). Thus, a growing avenue of research has integrated intra-household interactions on modeling activity and travel-related decisions, as evidence demonstrates that household resource allocation (such as car use) and task and time allocation all involve close coordination among household members at different levels in order to meet group needs under social, spatial, and resource constraints (Ho and Mulley, 2015). For instance, a family member may opt to use public transport in order to free the family car; household members may design joint travel arrangements to save time or reduce the number of trips. Thus, choices of activity and travel patterns are closely associated with household and individual characteristics such as the presence of children, car ownership, income, working hours, and travel patterns.

A set of studies examines the way individual choices of activity and travel patterns are substantially impacted by household decisions, particularly from a couple's perspective. Schwanen et al. (2007) demonstrate that, across a sample of over 700 couples in the Netherlands, individuals' participation in out-of-home activities is significantly influenced by their partner's travel behavior. Srinivasan and Bhat (2006) make the point that women who undertake serve-child trips, such as escorting children to and from school, are less likely to carry out discretionary activities. In these households, child escort responsibilities also decrease the possibility of parents pursuing joint activities. In that sense, investigations also provide evidence that men often have greater influence than their spouses on joint task allocation and household travel decisions (Zhang et al., 2005; Zhang and Fujiwara, 2006).

The literature often distinguishes mandatory from non-mandatory activities (Vovsha et al., 2004; Bradley and Vovsha, 2005; Srinivasan and Bhat, 2006). Despite being of an individual nature, mandatory activities such as attending work, school, university, and escorting children often orchestrate household travel decisions, entailing travel cooperation in the form of pick-ups and drop-offs on the way (Vovsha et al., 2003). Similarly, although many of the domestic provision and maintenance activities (such as grocery shopping, trips to the post

office, etc.) are carried out individually, their allocation to a specific household member is an active part of the joint decision-making process. Thus maintenance activities are "characterized by a significant degree of intrahousehold coordination, substitution, and possibly sharing" (Vovsha et al., 2004, p. 171). In that sense, decisions behind the allocation of maintenance activities may not be completely assessed within a single one-day framework, which is why it is ideal to work with longer data cycles to analyze non-mandatory and less regular activities (Bradley and Vovsha, 2005).

Finally, Vovsha et al. (2004) investigate the allocation of domestic maintenance activities among household members according to their employment status, demonstrating that household travel patterns and activity choices are closely associated with personal characteristics, time availability, and residential location. Srinivasan and Bhat (2006) find that individuals who work from home for fewer than 4 hours a day are most likely to travel for non-mandatory activities, suggesting that home-based telework could impact the allocation of discretionary activity within the household. They also find that couples are less likely to undertake non-mandatory activities jointly if one or both of them work outside the home. Moreover, individual changes in travel behavior due to flexible working hours or earlier school hours reportedly also directly affect the travel patterns of other household members (Ho and Mulley, 2015). Therefore, we argue that the temporal flexibility resulting from telework arrangements impacts not only individual travel patterns, but also household activity patterns.

3. Data and methods

3.1. Data

The data used were obtained from the United Kingdom National Travel Survey (NTS) for the period between 2002 and 2017 in order to ensure a healthy sample size for FWAs, which are relatively rare. The data used refer to the travel of English residents within Great Britain. In the NTS, we selected heterosexual couples with two workers, allowing us to observe trade-offs between spouses and gender differences. In total, 25,658 couples were included in our analysis, 44% of whom have children. In order to calculate GHG emissions, the NTS provides CO2 emission factors (derived from the Driver & Vehicle Licensing Agency data set). Where the

CO2 emission factor was missing, we applied the conversion factors from DECC & DEFRA[1] (2020). We also assigned CO2 coefficients to public transport trips based on the type of transport mode used (bus, light rail). No coefficients were assigned to cycling and walking.

Table 1. *Description of the variables used in the model*

			No Child	Child	All
Women	Work place (% in column)	Same place	79.2	76.3	77.9
		Two places	5.0	4.5	4.8
		Different places	6.3	6.4	6.3
		Home	4.6	5.9	5.2
		Telework	5.0	6.8	5.8
	Working status (% in column)	Employee	91.5	90.1	90.9
		Self-employed	8.5	9.9	9.1
	Working time (% in column)	Full time	69.1	44.4	58.2
		Part time	30.9	55.6	41.8
	Individual income (% in column)	< £25,000	73.7	78.1	75.7
		£25,000 to £49,999	22.1	17.7	20.1
		£50,000 and over	4.2	4.2	4.2
	Weekly trips by purpose at destination (number)	Work	4.2	3.4	3.8
		Shopping	2.0	2.2	2.1
		Personal & Leisure	2.8	2.8	2.8
		Escort	0.8	4.5	2.5
		All (previous + other + home)	18.1	22.8	20.2
Men	Work place (% in column)	Same place	64.8	63.1	64.0
		Two places	7.1	8.3	7.6
		Different places	16.2	17.6	16.8
		Home	4.7	3.3	4.1
		Telework	7.2	7.8	7.4
	Working status (% in column)	Employee	81.9	83.1	82.4
		Self-employed	18.1	16.9	17.6
	Working time (% in column)	Full time	92.6	96.4	94.3
		Part time	7.4	3.6	5.7
	Individual income (% in column)	< £25,000	48.4	44.1	46.5
		£25,000 to £49,999	39.2	40.9	40.0
		£50,000 and over	12.4	15.0	13.5
	Weekly number of trips by purpose at destination (Number)	Work	4.7	4.8	4.7
		Shopping	1.5	1.4	1.5
		Personal & Leisure	2.5	2.3	2.4
		Escort	1.0	2.3	1.6
		All (previous + other + home)	18.1	19.6	18.8
Household	Residential Area Type (% in column)	London Boroughs	11.6	10.3	11.0
		Other urban	72.3	74.6	73.3
		Rural	16.1	15.1	15.7
	Couple CO2 emissions by purpose at	Work	26.4	23.6	25.2
		Shopping	5.7	5.9	5.8
		Personal & Leisure	13.5	16.3	14.8
		Escort	3.6	10.9	6.9

[1] Available from https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020 (accessed 20 March 2021).

destination (Kilogram)	All (previous + other + home)	93.6	109.6	100.7
Number of households		14 298	11 359	25 658

Data: National Travel Survey 2002–2017

Four categories of workplaces used in the analysis are pre-defined in the NTS survey on the basis of a main criterion which is the "usual" place of work (same place, two places, different places and homeworkers). However, to further explore the issue of FWAs, we also opted to create an additional "teleworkers" category. The referred category was created from the variable "How often do you work from home?" We selected individuals who do not fall into the "homeworkers" category and who declared they worked from home "three or more times a week" or "once or twice a week". Thus, the definition of teleworker adopted in this work is relatively restrictive compared to the definitions that can be found in the literature and includes only individuals with a usual place of work outside of home, i.e., whose teleworking does not exceed three days a week. Nonetheless, it is important to note that few variables in the National Travel Survey account for work flexibility.

To address the effects of FWAs on travel behavior, the number of available variables is limited in the UK NTS. For spatial flexibility, we used the place of work variable with the addition of a telework category for individuals declaring at least one day of telework per week. Thus we have two categories assimilated to FWAs: work-at-home and telework. These categories are more frequent for women with children (Table 1). Conversely, the different places category is a type of workplace with strong constraints, both in terms of time and space, since it involves, for example, a home care nurse making her rounds or an employee of a cleaning company working in different places. This place of work appears less frequently for women with children and to a lesser extent for men with children.

In order to address the temporal dimension of FWAs, only one variable relating to working time—part-time or full-time—is used. Part-time jobs are much more frequent for women with children, but not for men, on the contrary. The NTS data does not include any other variable indicating the flexibility of workers' schedules. Finally, we used the variable distinguishing employees from self-employed on the assumption that the latter potentially have greater spatial and temporal flexibility.

The travel indicators, i.e., the number of trips for a given reason, are calculated over a whole week, corresponding to the UK TS observation period. Women and men with children make more trips than their counterparts without children, with 4.7 and 1.5 more trips per week respectively. This corresponds almost exclusively to an increase in escort travel. As a result,

the CO2 emissions of couples with children are higher than those of couples without children due to the greater number of escort trips. Non-work trips account for more than half of the emissions of couples (excluding the return home) and 63% for couples with children.

3.2. Model Framework

Although many studies focusing on CO2 emissions analyze the effects of commuting trips, in this paper we choose to focus exclusively on non-work trips, as we seek to understand the trade-off effects that operate between dual-earner couples in terms of travel arrangements and its potential impacts. As previous investigations have demonstrated, with the same dataset, the relationship between FWA and the compensations between work and non-work trips (Cerqueira et al., 2020), our goal is to explore this subject further at the intra-household level. We argue that these trade-offs pertain exclusively to non-work-related travel, as couples would tend to reallocate household responsibilities to the partner benefiting from FWA, potentially generating additional trips and GHG emissions.

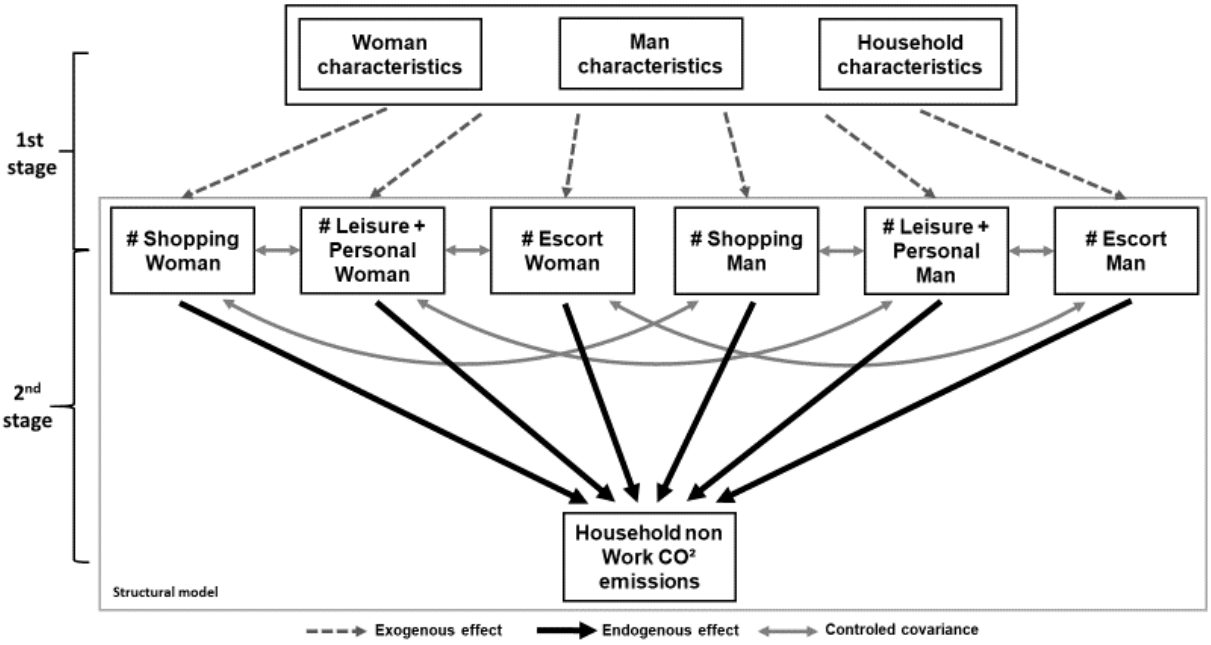
The model developed in this research aims to establish two points. First, certain characteristics of spouses' activity such as telework, working from home, and part-time work are linked to an increase in non-work activities (in particular escort and shopping) for the spouse concerned. Second, the increase in escort and shopping trips by one spouse, linked to his or her activity, results in a trade-off with the other spouse, who then reduces his or her participation in escorting and shopping.

To determine this, SEM allows us to test several hypotheses simultaneously by analyzing independent variables one by one while controlling for the others as covariates and also to evaluate mediation effects. The model (Figure 1) is structured in two stages:

- In the first stage, the model is built around six dependent variables that we seek to explain on the basis of women's employment characteristics, men's employment characteristics, and finally household characteristics. These variables correspond to the number of non-work trips made by women and men for three types of motives: shopping, leisure/personal, and escorting. At this stage, it is already possible to highlight cross-effects between the employment characteristics of one spouse and the travel of the other spouse. These six variables are then used as independent variables in the structural model to explain CO2 emissions.
- In the second stage of the model, in the structural model, the contribution of each travel motive for women and men to the CO2 emissions (of non-work travel) of the couple is studied. The choice of a CO2 indicator to represent the couple's total non-work mobility has the advantage of addressing the environmental issue of teleworking and working from home, which are

intensively scrutinized. This second step makes it possible to measure the overall effect on emissions of the different employment characteristics of one or other of the spouses. But also, by considering the trade-offs between men and women we are able to measure CO2 emissions.

Figure 1. Conceptual Framework



The exogenous variables are the same for all six regressions and consider the characteristics of the household and both partners. Finally, the model is applied to a population divided into two different groups, couples with children and those without. This distinction corresponds to very different levels of escorting depending on whether there are children in the household. Discrimination between the two groups provides very good general indicators of model quality, while in a test conducted, the comparative fit index (CFI) of the model drops to 0.900 without discrimination between couples in terms of whether or not they have children.

4.Results

The model obtained is considered a good model with respect to the indicators generally used (Golob, 2003). The root mean square error of approximation (RMSEA) is less than 0.05 and the standardized root mean square residual (SRMR) less than 0.02, which is judged satisfactory. Moreover, the comparative fit index (CFI), which compares the proposed model with an unrestricted base model, exhibits a value of 0.97 (a good model should have a value of more than 0.90).

4.1-Couples with children

4.1.1-The effects of women's employment characteristics

For couples with children (Table 2), women's FWAs, part-time work, work from home, self-employment, or telework, have positive effects on non-work trips. There are also positive effects of car access as the main driver of a vehicle. Conversely a low-earner and a high-earner (compared to an average earner) are associated with a lower level of shopping and escorting.
In terms of cross-effects, there are negative effects of FWAs for women on their spouse's non-work trips. This is consistent with the trade-off hypothesis that FWAs are associated with increased out-of-work travel for the spouse who benefits from them and restricted travel for the other spouse. This trade-off effect is, however, limited in terms of the levels and reasons for travel involved. It is observed for escorting in the case of working from home, and for shopping and escorting in the case of part-time work. A trade-off is also observed for shopping and escorting in the case of the woman being the main driver of a vehicle. For income, this trade-off is only observed for escorting.

Concerning the CO2 emissions of the couple as a whole linked to non-work trips, we observe that the FWAs for the woman lead to an increased level of emissions for the couple. This means that the trade-off, when there is one, is not sufficient to balance the emissions between women and men. Therefore, part-time work, working from home, self-employment, and finally telework, in decreasing order of effect, lead to higher levels of emissions for the couple's non-work trips. The decomposition of the effects between men's and women's trips shows that the positive effects for women are only very partially offset by negative effects for men. The break-down by purpose shows that it is the increase in escorting that contributes most to these higher levels of CO2 emissions, followed by leisure/personal and shopping trips.

4.1.2- The effects of men's employment characteristics

For couples with children (Table 2), men's FWAs have similar effects to those observed for women. Part-time work, working from home, and telework have positive effects on their non-work trips. However, it should be mentioned that these positive effects are not as pronounced for escorting, reflecting the lower propensity of men to escort in general. Thus, self-employment for men does not lead them to escort more as is the case for women, but on

the contrary to escort less. For men, this activity status is therefore not a way of freeing up time to escort children. Working in different places decreases men's out-of-work travel.

As for the cross-effects of men's job characteristics on women's off-work travel, we observe trade-off effects similar to those described for women's job characteristics. Thus, men's part-time work and working from home are associated with a lower probability for women to engage in escorting and shopping. Conversely, the lower propensity of men who are self-employed or work in different places to make non-work trips does not lead to a trade-off with their spouse. The same is true for men's telework, which allows them more escorting and leisure/personal trips, but does not result in fewer trips for these motives for their spouses.

In the end, FWAs for men lead to more CO2 emissions for the couple's non-work mobility. This is simply because men's excess travel in these situations does not correspond to an equivalent trade-off or no trade-off at all on the part of their spouse. This is similar to what was observed for women. However, it should be noted that the effects of the characteristics of telework, working from home, and part-time work are much lower than for the characteristics of women. This corresponds to the fact that these employment situations for women are linked to a greater investment in non-work activities, which is not equivalent for men in the same situations.

Table 2. *Results of the model for the household with child*

With Child			Effects on individual # trips per motive						Effects on household non work CO2 emissions					
			Women			Men			Indirect effects by motives (Women + Men)			Indirect effects by gender (All motives)		All effects
			Shopping	Leisure/ Personal	Escort	Shopping	Leisure/ Personal	Escort	Shopping	Leisure/ Personal	Escort	Women	Men	Total CO2 Non Work
Women	Work place (ref: Same place)	Different places				-0.017 .							-0.008 *	
		Home	0.037 ***	0.048 ***	0.057 ***			-0.042 ***	0.006 *	0.014 ***	0.018 *	0.049 ***	-0.011 *	0.038 ***
		Telework		0.016 .	0.026 **	-0.017 .					0.013 *	0.017 **		0.015 .
	Working status	Self Employed (dummy)		0.035 **	0.039 ***					0.008 *	0.020 **	0.030 ***		0.028 **
		Part Time Job (dummy)	0.091 ***	0.097 ***	0.123 ***	-0.020 *	0.038 ***	-0.047 ***	0.012 ***	0.030 ***	0.052 ***	0.106 ***	-0.011 *	0.095 ***
	Car access	Driver (dummy)	0.136 ***	0.175 ***	0.280 ***	-0.041 ***	0.049 ***	-0.090 ***	0.017 ***	0.051 ***	0.125 ***	0.218 ***	-0.025 ***	0.194 ***
	Individual income (ref: <£25,000)	£25,000 to £49,999	-0.042 ***		-0.022 *		0.024 *	0.053 ***	-0.008 **			-0.018 **	0.021 ***	
		£50,000 and over	-0.061 ***		-0.028 **	-0.036 ***		0.055 ***	-0.014 ***			-0.028 ***	0.015 ***	
Men	Work place (ref: Same place)	Different places				-0.068 ***	-0.040 ***	-0.044 ***	-0.008 ***	-0.010 **	-0.016 *		-0.029 ***	-0.034 ***
		Home	-0.016 .		-0.028 **	0.021 *	0.043 ***	0.082 ***		0.006 .	0.011 .	-0.020 **	0.037 ***	0.017 *
		Telework					0.023 *	0.035 ***		0.007 *	0.012 .		0.016 ***	0.017 *
	Working status	Self Employed (dummy)		-0.019 .		-0.052 ***	-0.018 .		-0.007 **	-0.008 *				
		Part Time Job (dummy)	-0.021 *	-0.028 **	-0.030 **	0.050 ***	0.033 **	0.090 ***			0.013 *	-0.027 ***	0.041 ***	0.015 .
	Car access	Driver (dummy)	0.022 *	0.033 ***		0.111 ***	0.088 ***	0.143 ***	0.016 ***	0.024 ***	0.050 ***	0.015 *	0.076 ***	0.091 ***
	Individual income (ref: <£25,000)	£25,000 to £49,999			0.026 *	0.031 **	0.034 **		0.006 **	0.010 *	0.014 *	0.020 **	0.010 *	0.030 ***
		£50,000 and over		0.037 **	0.077 ***		0.037 **			0.016 ***	0.039 ***	0.053 ***		0.054 ***
Household	Residential Area Type (ref: other)	London	-0.113 ***	-0.071 ***	-0.049 ***	-0.074 ***	-0.058 ***	-0.047 ***	-0.027 ***	-0.028 ***	-0.042 ***	-0.062 ***	-0.035 ***	-0.097 ***
		Rural	-0.020 *					-0.021 *					-0.008 *	

Data: National Travel Survey 2002-2017, Tools: R with the Lavaan package
*Signif. codes: 0 "***" 0.001 "**" 0.01 "*" 0.05 "." 0.1*
All values of the estimates are standardized and allow comparisons between reasons, between women and men, and between couples with and without children.
The missing coefficients correspond to non-significant values, $p < 0.1$, and the categories/variables were removed from the final computation.

Table 3. *Results of the model for the household without child*

Without Child			Effects on individual # trips per motive						Effects on household non work CO2 emissions					
			Women			Men			Indirect effects by motives (Women + Men)			Indirect effects by gender (All motives)		All effects
			Shopping	Leisure/ Personal	Escort	Shopping	Leisure/ Personal	Escort	Shopping	Leisure/ Personal	Escort	Women	Men	Total CO2 Non Work
Women	Work place (ref: Same place)	Different places						-0.018 *						
		Home	0.041 ***	0.073 ***	0.030 **			-0.029 **	0.007 *	0.021 ***		0.038 ***	-0.008 .	0.030 ***
		Telework		0.039 ***						0.013 **		0.010 *		
	Working status	Self Employed (dummy)												
		Part Time Job (dummy)	0.115 ***	0.079 ***	0.076 ***	-0.017 .		-0.031 **	0.023 ***	0.022 ***	0.014 ***	0.070 ***	-0.011 **	0.059 ***
	Car access	Driver (dummy)	0.149 ***	0.197 ***	0.166 ***	-0.035 ***	0.073 ***	-0.205 ***	0.027 ***	0.072 ***		0.136 ***	-0.042 ***	0.094 ***
	Individual income (ref: <£25,000)	£25,000 to £49,999	-0.044 ***		-0.018 *		0.024 **	-0.032 ***	-0.012 ***	0.009 *	-0.014 ***	-0.012 **		-0.017 *
		£50,000 and over	-0.037 ***		-0.022 *			-0.023 *	-0.011 ***		-0.013 **	-0.016 ***	-0.008 .	-0.024 ***
Men	Work place (ref: Same place)	Different places	-0.021 *	-0.023 *	-0.025 **	-0.046 ***	-0.044 ***		-0.013 ***	-0.018 ***	-0.007 .	-0.019 ***	-0.019 ***	-0.037 ***
		Home	-0.019 *		-0.022 *	0.062 ***	0.064 ***	0.043 ***	0.006 .	0.013 **		-0.014 **	0.039 ***	0.025 **
		Telework	-0.022 *		-0.020 *		0.017 .		-0.006 *			-0.011 *	0.007 .	
	Working status	Self Employed (dummy)				-0.042 ***	-0.021 *		-0.006 .				-0.011 *	
		Part Time Job (dummy)		0.043 ***		0.097 ***	0.107 ***	0.037 ***	0.018 ***	0.039 ***	0.008 *	0.011 *	0.054 ***	0.065 ***
	Car access	Driver (dummy)	0.042 ***	0.04 ***	-0.084 ***	0.124 ***	0.106 ***	0.113 ***	0.031 ***	0.038 ***			0.079 ***	0.074 ***
	Individual income (ref: <£25,000)	£25,000 to £49,999		0.038 ***		0.035 ***	0.047 ***		0.009 **	0.022 ***		0.011 *	0.020 ***	0.030 ***
		£50,000 and over		0.020 *	0.020 *		0.018 .			0.010 *		0.013 **		0.017 *
Household	Residential Area Type (ref: other)	London	-0.080 ***	-0.015 .	-0.068 ***	-0.088 ***		-0.085 ***	-0.033 ***		-0.043 ***	-0.042 ***	-0.041 ***	-0.083 ***
		Rural	-0.020 *		-0.032 ***		-0.025 **	-0.043 ***		-0.010 *	-0.021 ***	-0.018 ***	-0.018 ***	-0.036 ***

Data: National Travel Survey 2002-2017, Tools: R with the Lavaan package
*Signif. codes: 0 "***" 0.001 "**" 0.01 "*" 0.05 "." 0.1*
All values of the estimates are standardized and allow comparisons between reasons, between women and men and between couples with and without children.
The missing coefficients correspond to non-significant values, p < 0.1, and the categories/variables were removed from the final computation.

4.2-Couples without children

For couples without children (Table 3), the effects of women's characteristics on women's and men's travel are not very different from those observed for couples with children. Two types of differences can be highlighted. First, we notice the weaker effects on escorting, which are much less numerous for couples without children. Second, there is no significant effect of self-employment. This activity status seems to allow women with children to be more flexible in terms of mobility outside of work, in particular for support. This is therefore not the same for women without children.

The same type of effect of women's characteristics can be observed for the CO2 emissions of the couple linked to non-work travel as for couples with children. That is, part-time jobs and working from home lead to higher levels of emissions for non-work trips. The higher number of women's trips is only partially offset by the lower number of men's trips. Also, there is no effect of telework and self-employment, which are not used by women without children to increase their non-work mobility, unlike women with children.

Regarding the effects of men's characteristics on trips, there is first of all a relative similarity in the mobility of men without children and men with children. Part-time jobs and working from home allow for greater mobility out of work. However, this greater mobility only concerns leisure/personal and shopping trips rather than escorting. Conversely, and similarly to men with children, working in different places and being self-employed lead to a lower number of out-of-work trips. As for the cross-spouse effects, these are more systematic for couples without children. Thus, all types of men's workplaces have effects on women's shopping and escort trips. In particular, the effect of men's telework is significant here and leads to a reduction in women's shopping and escort trips. Conversely the effect of working in different places for men is linked to a lower number of out-of-work trips by women. There is therefore no trade-off here and, conversely, the lower off-work mobility of a man is accompanied by a lower off-work mobility of his wife. This lack of trade-off can also be observed in the case of a man with a part-time job whose spouse also makes more leisure/personal trips.

As a result, the effects of men's characteristics on the couple's CO2 emissions for non-work trips are not very different between couples with and without children. However, these

similar results are the outcome of slightly different trade-offs between men and women. In fact, beyond the partial balancing effects, we can observe here the effects of a shift towards fewer trips for couples in which the men work in different places and towards more trips for couples in which the men have a part-time job.

5-Discussion

This study developed a SEM approach using individual and household level data from the UK National Travel Survey (NTS) to shed light on the impacts of FWAs on travel behavior and CO2 emissions. While the impacts of FWAs on individual activities have been widely discussed in the academic literature, their effects on household joint decisions and overall travel behavior, such as potential trade-offs, have come in for little debate to date. Thus, with the increase in FWAs over the past decades, it is important to capture their impacts on travel arrangements not only at an individual level but also at household level.

The case is made for focusing exclusively on non-work trips, as previous investigations demonstrate that FWAs can entail substantial trade-offs between work and non-work trips and that the latter account for a significant share of CO2 emissions (Cerqueira et al., 2020). In fact, non-work trips are often disregarded in travel-behavior studies and current urban travel policies because most travel surveys use a one-day trip diary and so fail to capture the full scope of these trips. Thus, the seven-day observation period provided in the United Kingdom NTS allows a better understanding of the full-array of non-work trips, including potential trade-offs within the household.

This study also contributes to the debates on the gendered allocation of activities within dual-income households. The main findings demonstrate that although the partner who benefits from FWAs tends to carry out domestic provision and maintenance activities, the allocation of tasks within the household is still asymmetrical. Thus, flexible work arrangements result in a greater allocation of domestic and maintenance activities to women than their male counterparts. Conversely, men with alternative work patterns tend to convert their free-time into leisure and personal trips, while still allocating a significant share of domestic-related trips to their partners. These results echo previous investigations that demonstrate that telework does not in itself transform the gendered allocation of domestic tasks and caregiving (Sullivan and Lewis, 2001).

Results also outline that the presence of children will intensely affect the allocation of activities and household arrangements, increasing gender inequalities. FWAs involve more escorting and caregiving-related trips, particularly for women. Although men also tend to increase the number of escorting trips when they benefit from alternative work patterns, the allocation of chauffeuring trips is significantly higher for their female counterparts, which increases the overall CO2 emissions for the household. These findings confirm results from previous investigations that outline marked gender inequalities in the allocation of escorting tasks within households (Motte-Baumvol et al., 2017).

The trade-off effects observed are significantly different for dual-income couples without children. For women, FWAs have a less significant impact on non-work trips, particularly escorting trips, when compared to women with children. On the other hand, travel patterns of men without children tend to be similar to those of men with children, but escorting trips are less significant, while the number of personal and shopping trips is higher with FWAs. Trade-off effects between partners is significant for couples without children, as men with FWAs tend to reduce their partner's shopping and escorting trips.

6-Conclusion

While, over the past two decades, flexible work arrangements, such as teleworking, have received attention in the field of transport for their capacity to transform many aspects of commuting, the current COVID-19 outbreak has brought about dramatic changes in work arrangements, intensifying the debate about the increase of alternative work patterns in the post-crisis era. Thus, this paper presents an original exploration of the relationship between FWAs, CO2 emissions, and household travel allocation among dual-earner couples. We present a comprehensive analysis that extends traditional investigations by observing the impacts of alternative working patterns not only on individuals but also on households.

The interpretation of the findings should consider some key limitations, particularly regarding the database used. It is important to note that few variables in the National Travel Survey account for work flexibility. Therefore, the investigation could have benefited from a more detailed exploration if variables such as working hours were provided. Moreover, non-work trip purposes are not specific enough, limiting the analysis, particularly in terms of trade-off effects for

maintenance and domestic-related activities. For example, it is well known that personal and domestic provision shopping will entail completely different travel patterns and, consequently, household arrangements.

From a policy analysis perspective, the findings of this study imply that demand-management solutions directly impacting one adult could also result in changes to their partner's travel behavior and the household arrangements as a whole. Thus, travel demand management policies that influence individual work location and duration, such as telework, can also impact non-work activity participation choices of their partner, resulting in changes to the overall travel patterns of both adults in the household, and consequently, GHG emissions. The implications of the empirical results described in this paper are noteworthy because current travel and environmental policies often ignore non-work trips and potential trade-offs within household travel patterns. Such omissions could potentially reduce the effectiveness of such policies. In the event of an intense development of FWAs in a post-COVID period, this could lead to an increase in overall CO2 emissions by workers. In view of the results reported here and the potential increase in FWAs in the post COVID-19 era, the scope of travel-behavior analysis needs to be extended in order to come up with more effective policymaking on sustainability and travel.

References

Allen, T.D., Johnson, R.C., Kiburz, K.M., Shockley, K.M., 2013. Work–Family Conflict and Flexible Work Arrangements: Deconstructing Flexibility. Personnel Psychology 66, 345–376. https://doi.org/10.1111/peps.12012

Andrew, A., Cattan, S., Dias, M.C., Farquharson, C., Kraftman, L., Krutikova, S., Phimister, A., Sevilla, A., 2020. How are mothers and fathers balancing work and family under lockdown? [WWW Document]. https://doi.org/10.1920/BN.IFS.2020.BN0290

Bachelet, M., Kalkuhl, M., Koch, N., 2021. What If Working from Home Will Stick? Distributional and Climate Impacts for Germany [WWW Document]. URL https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3908857 (accessed 9.8.21).

Bradley, M., Vovsha, P., 2005. A model for joint choice of daily activity pattern types of household members. Transportation 32, 545–571. https://doi.org/10.1007/s11116-005-5761-0

Brewer, A.M., 1998. Work design, flexible work arrangements and travel behaviour: policy implications. Transport Policy 5, 93–101. https://doi.org/10.1016/S0967-070X(98)00003-1

Burkinshaw, J., 2018. The Tenuous and Complex Relationship Between Flexible Working Practices and Travel Demand Reduction, in: Hui, A., Day, R., Walker, G. (Eds.), Demanding Energy: Space, Time and Change. Springer International Publishing, Cham, pp. 165–181. https://doi.org/10.1007/978-3-319-61991-0_8

Cerqueira, E.D.V., Motte-Baumvol, B., Chevallier, L.B., Bonin, O., 2020. Does working from home reduce CO2 emissions? An analysis of travel patterns as dictated by workplaces. Transportation Research Part D: Transport and Environment 83, 102338. https://doi.org/10.1016/j.trd.2020.102338

Choo, S., Mokhtarian, P.L., Salomon, I., 2005. Does telecommuting reduce vehicle-miles traveled? An aggregate time series analysis for the U.S. Transportation 32, 37–64. https://doi.org/10.1007/s11116-004-3046-7

Chung, H., Birkett, H., Forbes, S., Seo, H., 2020a. Working From Home and the Division of Housework and Childcare Among Dual Earner Couples During the Pandemic in the UK. https://doi.org/10.31235/osf.io/4esf7

Chung, H., Seo, H., Forbes, S., Birkett, H., 2020b. Working from home during the COVID-19 lockdown: Changing preferences and the future of work.

Chung, H., van der Lippe, T., 2018. Flexible Working, Work–Life Balance, and Gender Equality: Introduction. Soc Indic Res 151, 365–381. https://doi.org/10.1007/s11205-018-2025-x

De Abreu e Silva, J., Melo, P.C., 2018. Home telework, travel behavior, and land-use patterns: A path analysis of British single-worker households. JTLU 11. https://doi.org/10.5198/jtlu.2018.1134

Golob, T.F., 2003. Structural equation modeling for travel behavior research. Transportation Research Part B: Methodological 37, 1–25.

He, S.Y., Hu, L., 2015. Telecommuting, income, and out-of-home activities. Travel Behaviour and Society 2.

Helminen, V., Ristimäki, M., 2007. Relationships between commuting distance, frequency and telework in Finland. Journal of Transport Geography 15, 331–342. https://doi.org/10.1016/j.jtrangeo.2006.12.004

Hensher, D.A., Beck, M.J., Wei, E., 2021. Working from Home and its implications for Strategic Transport Modelling based on the early days of the COVID-19 pandemic. Transportation Research Part A: Policy and Practice. https://doi.org/10.1016/j.tra.2021.03.027

Hilbrecht, M., Shaw, S.M., Johnson, L.C., Andrey, J., 2013. Remixing work, family and leisure: teleworkers' experiences of everyday life: Remixing work, family and leisure. New Technology, Work and Employment 28, 130–144. https://doi.org/10.1111/ntwe.12010

Hilbrecht, M., Shaw, S.M., Johnson, L.C., Andrey, J., 2008. 'I'm Home for the Kids': Contradictory Implications for Work-Life Balance of Teleworking Mothers. Gender, Work & Organization 15, 454–476. https://doi.org/10.1111/j.1468-0432.2008.00413.x

Ho, C., Mulley, C., 2015. Intra-household interactions in transport research: a review. Transport Reviews 35, 33–55. https://doi.org/10.1080/01441647.2014.993745

Hook, A., Court, V., Sovacool, B.K., Sorrell, S., 2020. A systematic review of the energy and climate impacts of teleworking. Environ. Res. Lett. 15, 093003. https://doi.org/10.1088/1748-9326/ab8a84

Jesus, T.S., Landry, M.D., Jacobs, K., 2020. A 'new normal' following COVID-19 and the economic crisis: Using systems thinking to identify challenges and opportunities in

disability, telework, and rehabilitation. WOR 67, 37–46. https://doi.org/10.3233/WOR-203250
Kurowska, A., 2020. Gendered Effects of Home-Based Work on Parents' Capability to Balance Work with Non-work: Two Countries with Different Models of Division of Labour Compared. Social Indicators Research 151, 405–425.
Lott, Y., Chung, H., 2016. Gender Discrepancies in the Outcomes of Schedule Control on Overtime Hours and Income in Germany. Eur Sociol Rev 32, 752–765. https://doi.org/10.1093/esr/jcw032
Maruyama, T., Hopkinson, P.G., James, P.W., 2009. A multivariate analysis of work–life balance outcomes from a large-scale telework programme. New Technology, Work and Employment 24, 76–88. https://doi.org/10.1111/j.1468-005X.2008.00219.x
McQuaid, R.W., Chen, T., 2012. Commuting times – The role of gender, children and part-time work. Research in Transportation Economics, Gender and transport: Transaction costs, competing claims and transport policy gaps 34, 66–73. https://doi.org/10.1016/j.retrec.2011.12.001
Moen, P., Kelly, E.L., Fan, W., Lee, S.-R., Almeida, D., Kossek, E.E., Buxton, O.M., 2016. Does a flexibility/support organizational initiative improve high-tech employees' well-being? Evidence from the work, family, and health network. American Sociological Review 81, 134–164.
Motte-Baumvol, B., Bonin, O., Belton-Chevallier, L., 2017. Who escort children: mum or dad? Exploring gender differences in escorting mobility among parisian dual-earner couples. Transportation 44, 139–157. https://doi.org/10.1007/s11116-015-9630-1
Nguyen, M.H., 2021. Factors influencing home-based telework in Hanoi (Vietnam) during and after the COVID-19 era. Transportation 32.
Nguyen, M.H., Armoogum, J., 2021. Perception and Preference for Home-Based Telework in the COVID-19 Era: A Gender-Based Analysis in Hanoi, Vietnam, Sustainability. https://doi.org/10.3390/su13063179
Ory, D.T., Mokhtarian, P.L., 2006. Which Came First, the Telecommuting or the Residential Relocation? An Empirical Analysis of Causality. Urban Geography 27, 590–609. https://doi.org/10.2747/0272-3638.27.7.590
Ravalet, E., Rérat, P. (Eds.), 2019. Teleworking: Decreasing Mobility or Increasing Tolerance of Commuting Distances? Built Environment 45, 582–602. https://doi.org/10.2148/benv.45.4.582
Schieman, S., Glavin, P., 2008. Trouble at the border?: Gender, flexibility at work, and the work-home interface. Social Problems 55, 590–611.
Schieman, S., Young, M., 2010. Is there a downside to schedule control for the work-family interface? Journal of Family Issues 31, 1391–1414. https://doi.org/10/frtpqn
Schur, L.A., Ameri, M., Kruse, D., 2020. Telework After COVID: A "Silver Lining" for Workers with Disabilities? J Occup Rehabil 30, 521–536. https://doi.org/10.1007/s10926-020-09936-5
Schwanen, T., Ettema, D., Timmermans, H., 2007. If You Pick up the Children, I'll Do the Groceries: Spatial Differences in between-Partner Interactions in out-of-Home Household Activities. Environ Plan A 39, 2754–2773. https://doi.org/10.1068/a38491
Seiz, M., 2021. Equality in Confinement: Nonnormative Divisions of Labor in Spanish Dual-Earner Families During the Covid-19 Lockdown. Feminist Economics 27, 345–361. https://doi.org/10.1080/13545701.2020.1829674

Shabanpour, R., Golshani, N., Tayarani, M., Auld, J., Mohammadian, A.K., 2018. Analysis of telecommuting behavior and impacts on travel demand and the environment. Transportation Research Part D: Transport and Environment 62, 563–576.

Srinivasan, S., Bhat, C.R., 2006. A multiple discrete-continuous model for independent- and joint-discretionary-activity participation decisions. Transportation 33, 497–515. https://doi.org/10.1007/s11116-006-8078-8

Stier, H., Lewin-Epstein, N., Braun, M., 2012. Work-family conflict in comparative perspective: The role of social policies. Research in Social Stratification and Mobility 30, 265–279. https://doi.org/10.1016/j.rssm.2012.02.001

Sullivan, C., Lewis, S., 2001. Home-based Telework, Gender, and the Synchronization of Work and Family: Perspectives of Teleworkers and their Co-residents. Gender, Work & Organization 8, 123–145. https://doi.org/10.1111/1468-0432.00125

Tipping, S., Chanfreau, J., Perry, J., Tait, C., 2012. The fourth work-life balance employee survey, Employment Relations Research Series 122. Department for Business and Innovation, London.

Vovsha, P., Petersen, E., Donnelly, R., 2004. Model for Allocation of Maintenance Activities to Household Members. Transportation Research Record 1894, 170–179. https://doi.org/10.3141/1894-18

Vovsha, P., Petersen, E., Donnelly, R., 2003. Explicit Modeling of Joint Travel by Household Members: Statistical Evidence and Applied Approach. Transportation Research Record 1831, 1–10. https://doi.org/10.3141/1831-01

Williams, J.C., Blair-Loy, M., Berdahl, J.L., 2013. Cultural schemas, social class, and the flexibility stigma. Wiley Online Library.

Zhang, J., Fujiwara, A., 2006. Representing household time allocation behavior by endogenously incorporating diverse intra-household interactions: A case study in the context of elderly couples. Transportation Research Part B: Methodological 40, 54–74. https://doi.org/10.1016/j.trb.2005.01.004

Zhang, J., Kuwano, M., Lee, B., Fujiwara, A., 2009. Modeling household discrete choice behavior incorporating heterogeneous group decision-making mechanisms. Transportation Research Part B: Methodological 43, 230–250. https://doi.org/10.1016/j.trb.2008.05.002

Zhang, J., Timmermans, H.J.P., Borgers, A., 2005. A model of household task allocation and time use. Transportation Research Part B: Methodological 39, 81–95. https://doi.org/10.1016/j.trb.2004.03.001

Zhu, P., 2012. Are telecommuting and personal travel complements or substitutes? Ann Reg Sci 48, 619–639. https://doi.org/10.1007/s00168-011-0460-6

Zhu, P., Mason, S.G., 2014. The impact of telecommuting on personal vehicle usage and environmental sustainability. Int. J. Environ. Sci. Technol. 11, 2185–2200. https://doi.org/10.1007/s13762-014-0556-5