Received: 31 October 2021 | Revised: 2 August 2022 | Accepted: 8 August 2022

DOI: 10.1111/gec3.12657

REVIEW ARTICLE

WILEY

Potential rebound effects of teleworking on residential and daily mobility

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Funding information
Swiss National Science Foundation, Grant/Award Number: 192304
Open access funding provided by Universitede Lausanne.

Abstract

The practice of teleworking has been growing steadily in recent years with the development of ICT and the flexibilisation of work. The Covid-19 pandemic and its stay-at-home restrictions have further accelerated this trend. As teleworking reduces the frequency of commuting, it also reduces CO_2 emissions and may be seen as a tool to regulate mobility. However, and especially since working from home enables more flexible working, teleworking may have various 'rebound' effects on daily and residential mobility practices. Rebound effects include possible increases in the frequency or distance of journeys, such as an increase in non-work-related travel on teleworking days, as well as effects such as residential relocation or multilocal dwelling. In this article we intend to introduce and categorize the existing literature on the potential rebound effects of teleworking on residential and daily mobility. By critically assessing the literature we have identified the major lessons, while also noticing the limits of the research and a scarcity of qualitative approaches to understand how and why people who telework reinvest their non-commuting time in other forms of mobility. Also missing in the literature is the longitudinal aspect, that is, the consideration of long-term changes. These gaps have led us to formulate our proposition of a research agenda, where the lifestyle and life course approaches have emerged as crucial tools to understanding

the motivations for teleworking and the respective rebound effects on residential and daily mobility.

KEYWORDS
daily mobility, life course, lifestyle, rebound effects, residential mobility, teleworking, working from home

1 | INTRODUCTION

Work imposes structure on people's lifestyles and their spatial and temporal dimensions. Generating many journeys and kilometres travelled, it plays an important role in greenhouse gas emissions, but also in local pollutions such as fine particle pollution, noise and so forth. It is therefore increasingly important to consider how work-related journeys may be reduced, and the new rise in teleworking appears to present the ideal opportunity.

Thanks to improvements in ICT, teleworking (in its various forms) is becoming increasingly popular, a trend accelerated by the Covid-19 crisis. In Switzerland, for example, while less than 25% of working people teleworked (occasionally or regularly) before the pandemic, this increased to almost 35% during the pandemic in 2020 (OFS, 2021). The Covid-19 crisis has accelerated talks on the future of teleworking and indicates the need to better understand the implications of this practice for spatial mobilities.

The transition towards teleworking sheds light on the question of substitution practices. This idea can be traced back to Zelinsky's model of a mobility transition. Zelinsky argued that the development of a means of transportation could lead to a decline in residential mobility, enabling longer commuting trips. And in a further step, technological improvements and their impact on the labour market and on working practices could also result in a mobility transition, leading to a possible reduction in daily mobility, in which people could 'use the flow of information rather than engage in a territorial shift' (Zelinsky, 1971, p. 222).

Although there is no doubt about the fact that teleworking allows people to avoid commuting, it may have some negative effects, often described as rebound effects, which are directly linked to how people appropriate travel time gains on teleworking days. This can involve residential relocation, as people may be willing to live further away from work if they are commuting less often, or multilocal dwelling. These rebound effects may counteract some or even all of the positive effects of teleworking in terms of the reduction in travel. Our focus is on the impact of teleworking on mobility practices, and not on other possible negative effects such as the dissolution of work–life boundaries.

To better understand the potential negative effects of teleworking, our article develops a critical overview of the links between teleworking practices and residential and daily mobilities, through a review of the existing international literature. We decided to assemble a systematic review which, as defined by Petticrew and Roberts (2006), minimizes excessive self-citations or citations of colleagues or already known articles. The database we have built includes peer-reviewed academic journals, conference proceedings and books. Studies from the last 20 years were searched (2000–2021), and those written in English were preferred. The research engines used were Scopus and Web of Science. We searched for key words that are synonyms for 'teleworking' and key words that relate to energy or travel.

In a second stage, we identified research gaps in the literature which enable us to propose a new agenda for research into the relationship between teleworking, mobility and rebound effects. To address the rebound effects of teleworking, we argue for an application of a lifestyle approach, so as to take into account all mobility practices rather than only commuting practices, and a life course approach, in order to acknowledge the importance of longitudinal and biographical factors.

2 | FORMS AND DEFINITION OF TELEWORKING

We must reflect first on work in general and how it has changed throughout the years. Work such as crafts, trades, agriculture and so on, has for a long time seen its workers working from or close to home. In the 18th century, however, the industrial revolution led to the centralisation of workplaces away from homes. This fundamentally transformed 'working' and 'living', as people now had 'to go to work' to centralized factories (Komlosy, 2018). This was the beginning of a new era in terms of how work influenced both daily and residential mobility.

The repercussions of this transition began to be apparent after 1900, when 'the conception of work to gainful employment outside the home finally become dominant on a global scale' (2018, p. 3). This led simultaneously to a centralisation of work in cities, and a process of suburbanisation and urban sprawl that in turn increased commuting distance and frequency. Then in the 1970s, along with other factors such as a shift to the tertiary sector, technological advances were beginning to change once again the notion of work and the way people work. Mobility practices and exchanges, particularly digital ones, increased in intensity. Under the combined effect of neoliberal economic dynamics and the globalisation of the economy (Boltanski & Chiapello, 2005), increasing flexibility was required of employees, with a strong injunction to mobility in particular, the effects of which varied according to the person and his/her social position (Ravalet et al., 2017; Sheller & Urry, 2006).

In 1973, Jack Nilles coined the terms 'telecommuting' and 'telework' within the context of the oil crisis. Whereas before, the workers had to go to the workplace, teleworking brought the work to the workers. The practice of teleworking thus became a screen projecting the hopes of a society that was coming to the end of the industrial age and venturing into the information age. This was based especially on the reduction or even eradication of the many ramifications of commuting, such as traffic congestion, pollution and so on. Teleworking questions the existence of dedicated and distinguished places for each activity. In the professional sphere, it therefore suggests working elsewhere than at the usual office (Melo & e Silva, 2017). 'The physical, place-bound world is increasingly shifting into digital and virtual space, leading to its dematerialisation and despatialisation, whether these changes are manifested in video-conferencing, home-offices, remote work on trains and in cafés or the rise of coworking spaces' (Ohnmacht et al., 2020, p. 103).

Teleworking covers a wide variety of situations (Aguilera et al., 2016), as it can be done in various places, sometimes far from the main home and outside of the conventional workplace (at a second home, for example). Three forms of teleworking are to be distinguished (Thomsin, 2002): (1) Teleworking at home, (2) Itinerant telework, and (3) Teleworking in third places (coworking spaces, cafés, etc.). Furthermore, in the definition of teleworking, the use of ICT is the first important point which is systematically present in the research on teleworking (Sullivan, 2003). The second point concerns the idea of a substitution which concerns the place where work is done (as shown by the expression 'telecommuting'). This dimension excludes from the definition those who are self-employed and work at home and those have a decentralized activity (as they would not commute to the workplace in any case).

Such a practice is not possible for all workers or employees and requires various conditions to be met. The possibility of teleworking is determined by the following elements:

- The nature of the job: Some jobs are not compatible with teleworking, in connection with the activity carried out, the links imposed by having to work on site that is, in a hospital, or the equipment used (Espinoza & Reznikova, 2020).
- Digital skills: Not all workers have the same ability to use digital tools in a professional context (Vendramin & Valenduc, 2020). These skills differ according to socio-economic and demographic characteristics such as age, gender and level of education (Robinson et al., 2020).
- Digital infrastructures: Remote work requires the use of hard and soft digital equipment. Computer hardware and a good internet connection are essential for working from home, and access to these varies greatly between and within countries (Katsabian, 2020).

- Company culture: Beyond any technical barriers, the non-recourse to teleworking can be explained by cultural barriers which mean that being at work in person is deemed necessary by colleagues or hierarchical superiors (de Kok, 2016).

These elements determine how possible teleworking is, and generate geographical disparities (e.g., urban/rural differences in the quality of internet connections), work inequalities (e.g., between those who have a teleworkable job and those who don't), differences in levels of responsibility and in how much time they already spend in the workplace, and gender inequalities where men and women are not considered in the same way by their hierarchical superiors (de Kok, 2016).

We now present the impact of telework on daily and residential mobilities, based on a systematic literature review. The 27 studies we selected are listed in Table 1.

3 | TELEWORK AND COMMUTING

One of the main questions that many studies have been concerned with is how telework affects commuting practices.

The first direct element concerns traffic congestion. In fact, teleworking reduces the number of commuting trips. Most teleworkers only go to their place of work three to four times a week, rather than five. Although the days teleworked are most often Monday, Wednesday and Friday, and thus a lot of teleworkers are still going in to work on Tuesdays and Thursdays, a positive effect of teleworking on peak-hour traffic is highlighted (van der Loop et al., 2019). Lachapelle et al. (2017) confirm that telecommuters may be more likely to avoid peak hours when they do commute. This is partly because teleworkers are more likely to have a flexible work schedule (and thus able to choose when they travel to work). According to Shabanpour et al. (2018), if 25% of workers had a flexible working schedule, this could result in a 1.06% reduction in the number of home–work journeys during peak hours, while 50% would lead to a 3.04% reduction. This highlights the potential of teleworking for decreasing network congestion, especially in dense urban areas (Shabanpour et al., 2018).

The second element discussed in the literature concerns the distances travelled by car, and the resultant air pollution (Choo et al., 2005; Giovanis, 2018; Lachapelle et al., 2017; Shabanpour et al., 2018). Choo et al. (2005) suggest that in the US, teleworking would lead to a 0.8% reduction in annual vehicle miles travelled on the order. Similar results are obtained by Helminen and Ristimäki (2007), who indicate that telework reduced the total distance travelled in Finland by 0.7%. And in Canada, Lachapelle et al. (2017) estimate that teleworking telecommuting can reduce total daily distances by up to 0.69% and overall travel time by 14 min. This has a direct positive effect on air pollution. Giovanis (2018) states that teleworking may lead to a reduction of pollution of 2.6%–4.1% in Switzerland, while in Chicago (US), telecommuting could have the potential to reduce Greenhouse gas (GHG) and Fine particular matter (PM2.5) emissions by 0.7%–1.14% (Shabanpour et al., 2018).

This first overview of the literature shows that teleworking has a positive effect on mobility and suggests interesting potential gains in terms of reducing car traffic and CO_2 emissions. However, these results are in contradiction with several other scientific articles, which highlight a much more nuanced assessment. For Zhu and Mason (2014) in the US, or e Silva and Melo (2018) in the UK, telecommuting is linked with an increase in distances travelled, while Cerqueira et al. (2020) highlight an increase in CO_2 emissions for teleworkers compared to non-teleworkers.

If some articles conclude that teleworking leads to a reduction in traffic, journey distances or pollution and others obtain contradictory results, this can be explained by the nature of the journeys undertaken. Articles that show a reduction in traffic often relate to commuting and peak-hour travel only (Helminen & Ristimäki, 2007; Lachapelle et al., 2017; Shabanpour et al., 2018), while those who conclude that there is an increase in traffic integrate all purposes and times of travel into their analyses. However, the differences between weekdays are not examined in these articles, even though the impacts of teleworking could be very different from day to day, depending on which days are teleworked and which are not.

TABLE 1 References from our systematic literature review of the impact of telework on mobility

Authors	Year of publication	Article title	Country location	Methodology	Scope of the study
Nilles	1991	Telecommuting and urban sprawl: Mitigator or inciter?	California (USA)	Quantitative approach (2 year test, surveys)	Effects of telecommuting on urban sprawl
Mokhtarian, Collantes, Gertz	2004	Telecommuting, residential location, and commute-distance travelled: Evidence from state of California employees	United States	Quantitative approach, but little size of the sample	Commuting distances and frequencies
Choo, Mokhtarian, Salomon	2005	Does telecommuting reduce vehicle-miles travelled? An aggregate time series analysis for the US transportation	United States	Quantitative approach	Impacts of teleworking on distances travelled
Ory, Mokhtarian	2006	Which came first, the telecommuting or the residential relocation? An empirical analysis of causality	United States	Quantitative approach	Relocation according teleworking possibilities
Helminen, Ristimäki	2007	Relationships between commuting distance, frequency and telework in Finland	Finland	Quantitative approach	Commuting travel
Muhammad, Ottens, Ettema, De Jong	2007	Telecommuting and residential locational preferences: A case study of the Netherlands	Netherlands	Quantitative approach	Telecommuting and residential preferences
Zhu, Mason	2014	The impact of telecommuting on personal vehicle usage and environmental sustainability	United States	Quantitative approach	Commuting and non-working trip distances
Kim, Choo, Mokhtarian	2015	Home-based telecommuting and intra-household interactions in work and non-work travel: A seemingly unrelated censored regression approach	United States	Quantitative approach	Distances travelled for both work and non-work purposes
Asgari, Jin, Du	2016	Examination of the impacts of telecommuting on the time use of non-mandatory activities	New York Metropolitan region (USA)	Quantitative approach	Time allocated to non-mandatory activities
Kim	2017	Is telecommuting sustainable? An alternative approach to estimating the impact of home-based telecommuting on household travel	Korea	Quantitative approach	Personal kilometres travelled by household members

(Continues)

TABLE 1 (Continued)

Authors	Year of publication	Article title	Country location	Methodology	Scope of the study
Moeckel	2017	Working from home: Modelling the impact of telework on transportation and land use	Munich Metropolitan Area (Germany)	Quantitative approach	Home—work distances and household relocation
Lachapelle, Tanguay, Neumark-Gaudet	2017	Telecommuting and sustainable travel: Reduction of overall travel time, increases in non-motorised travel and congestion relief?	Canada	Quantitative approach	Commuting and non-professional travel time
e Silva, Melo	2018	Does home-based telework reduce household total travel? A path analysis using single and two worker British households	Great Britain	Quantitative approach (path analysis models)	Total travel distances
Chakrabarti	2018	Does telecommuting promote sustainable travel and physical activity?	United States	Quantitative approach	Commuting and non-working trip distances
de Vos, Meijers, van Ham	2018	Working from home and the willingness to accept a longer commute	The Netherlands	Quantitative longitudinal data	Willingness to accept a longer commute
Jaff, Hamsa	2018	Estimating commute-travel implications of telecommuting by female employees in Kuala Lumpur, Malaysia	Malaysia	Quantitative approach	Vehicle and passenger kilometres travelled
Shabanpour, Golshani, Tayarani, Auld, Mohammadian	2018	Analysis of telecommuting behaviour and impacts on travel demand and the environment	Chicago region (USA)	Quantitative approach	Network congestion and vehicular emissions
Giovanis	2018	The relationship between teleworking, traffic and air pollution	Switzerland	Quantitative longitudinal approach	Air quality and traffic
Gubins, van Ommeren, de Graaff	2019	Does new information technology change commuting behaviour?	The Netherlands	Quantitative approach (data from 1996 to 2010)	Average commuting distance
Mitra, Saphores	2019	Why do they live so far from work? Determinants of long-distance commuting in California	California (USA)	Quantitative approach	Long-distance commuting and housing costs
Ravalet, Rérat	2019	Teleworking: Decreasing mobility or increasing tolerance of commuting distances?	Switzerland	Quantitative approach	Commuting and non-working trips

TABLE 1 (Continued)

Authors	Year of publication	Article title	Country location	Methodology	Scope of the study
Cerqueira, Motte-Baumvol, Belton Chevallier, Bonin	2020	Does working from home reduce CO_2 emissions? An analysis of travel patterns as dictated by workplaces	United Kingdom	Quantitative approach	Travel behavior, trade-off effects, and work and non-work trips
Wang, Ozbilen	2020	Synergistic and threshold effects of telework and residential location choice on travel time allocation	Puget Sound region of Washington State (USA)	Quantitative approach (GPS travel survey)	Effects of the duration of telework on travel
Guerin	2021	Policies to minimise environmental and rebound effects from telework: A study for Australia	Australia	Quantitative approach (comparative lifecycle assessment)	Commuting travel
Beck, Hensher	2021	What might the changing incidence of working from home (WFH) tell us about future transport and land use agendas	Australia	Quantitative approach	Impacts of teleworking on traffic
Caldarola, Sorrell	2022	Do teleworkers travel less? Evidence from the English National Travel Survey	United Kingdom	Quantitative approach	Impacts of teleworking on reducing travel

In whichever way this is approached, the fact is that if teleworking reduces the number of commuting trips, people who telework gain time by not commuting. And the question is, what exactly is done with this gained time?

4 | DOES TELEWORK HAVE REBOUND EFFECTS?

Numerous studies have found that teleworkers tend to live further away from work and therefore commute longer distances (Cerqueira et al., 2020; de Vos et al., 2018; Janelle, 1986; Muhammad et al., 2007; Nilles, 1991; Ravalet & Rérat, 2019). Thus, despite reducing the number of commuting trips, the distance travelled over the working week may still be greater due to the larger spatial distance between the home and the workplace (Ravalet & Rérat, 2019). In a similar vein, De Vos et al. (2018) observe that people who work from home are willing to accept 5% longer commuting times on average. Caldarola and Sorrell (2022) show that teleworkers travel much further each week in comparison to non-teleworkers, which results from a combination of longer commuting distances and additional non-work trips. Mokhtarian et al. (2004), point out, however, that it remains difficult to say whether the ability to telecommute is itself prompting individuals to move further away, or whether telecommuting is simply more attractive to people who already live further from work for other reasons.

The time gained from not commuting can be reinvested in additional work (Bosua et al., 2017; Mokhtarian & Bagley, 2000), family time (Hartig et al., 2007) or, importantly, additional journeys that would not have been possible on a regular commuting day. Indeed, an increase in non-work-related trips has been observed in serval case studies (Asgari et al., 2016; e Silva & Melo, 2018; Kim, 2017; Kim et al., 2015; Zhu & Mason, 2014). A case study in the USA showed that telecommuters and their household members take more non-work-related journeys than non-telecommuters and their household members (Kim et al., 2015), and according to e Silva and Melo (2018), for one-worker households, teleworking increases travel by all modes, particularly by car.

Our review of the research on telework and mobility suggests that, while teleworking allows workers to commute less, it also enables new/different mobility practices. Should we consider these to be rebound effects?

4.1 | Definition of rebound effects

In economics, a rebound effect can be defined as follows: 'if a good gets cheaper in terms of its price or any effort necessary to obtain it, the demand for this good usually increases' (Hilty et al., 2006). One of the most famous rebound effects concerns technical or technological improvements in fuel efficiency, which lead to a decrease in the cost of fuel and an increase in vehicle use (Hymel et al., 2010). In this article, we use the term 'rebound effect' with regard to (a) the possible increase in journey distance and frequency (on a weekly scale), and (b) the potential for residential relocation or multilocal dwelling in the context of a reduced requirement to commute. The first illustration of a rebound effect in the field of mobility was highlighted by Zahavi and Talvitie's report (1980) on transport time budgets. Their finding was that people reinvest time gains, allowed by an increase in travel speed in higher distances.

To better understand how people use the commuting time they save by teleworking, and how teleworking impacts their lifestyles as well as their housing and job choices, we now consider how people choose their places of residence, why they telework, and how they choose their transport modes.

4.2 | Is the possibility to engage in more personal or leisure activities a motivation to telework?

Several scholars have shown that migrations between regions (internal migration) have decreased during the last 50 years, due notably to improvements in transport infrastructures and the desire for local anchorage (Cooke, 2011;

Rérat, 2014). Telework could further reinforce this tendency, which started in the 1970s and concerns many countries throughout the world (Champion & Shuttleworth., 2017).

The impact of telework in regard to residential mobility have not yet been fully addressed. The move to teleworking could result from a negotiation with the employer (e.g., in order to take care of children, or for quality of life reasons) that took place after the residential choice. Teleworking could be seen as an incentive (1) to choose a home that is far away from the workplace, (2) not to relocate closer to the workplace, (3) to accept or stay in a job far away from home, or (4) to engage in multilocal dwelling.

The motivations behind teleworking can be approached from two points of view: that of the employer and that of the individual employee (Shin et al., 2000). We focus here on individual motivations, on which there is a great deal of literature. Laumer and Maier (2021) highlight six elements considered to play a role on individual choice to telework: increased autonomy, reduced distraction, reduced commuting, improved work–life balance, the telework experiences of their social network and negative office environments.

For this paper, we are most interested in motivations regarding reduced commuting and an improved work–life balance. When commuting is experienced as stressful, employees tend to highlight the reduction of commuting as a crucial motivation to telework. The greater the physical distance from home to office, the more positive employees' attitudes towards teleworking tends to be (Scott et al., 2012). Less travel means more time, and so saving travel time is also mentioned as a motivation to telework. This saved time in turn improves employees' work–life balance, as it may be reinvested in other ways.

Kim (2017) shows that non-work-related trips on teleworking days amount to 4 km on average. Perch-Nielsen et al. (2014) estimate that 7%–23% of the distance saved on travel due to teleworking is offset by compensation effects related to extra distances travelled for other purposes (e.g., leisure, childcare, shopping). According to Walls and Safirova (2004), however, the total distance travelled on teleworking days is between 53% and 77% lower than on non-teleworking days in the United States.

Belle et al. (2015) show that some employees want to telework because they desire the autonomy to choose where to work from. This appears to be particularly true of millennials, but not of employees with children (Laumer & Maier, 2021).

4.3 | Is the possibility to telework a criterion in the choice of residential location?

Residential location choices are complex and reveal trade-offs within households and between criteria and locations (Rérat, 2020). Mitra and Saphores (2019) explain that long-distance commuting practices are mainly linked to specific residential location choices that are taken without considering home–work distance as a prior criterion.

There is still no clear evidence or literature regarding the influence of telework on residential location. In a United States case study, Zhu (2013) shows that telework tended to increase household commuting distances from 2001 to 2009, and states that teleworking is a central factor in shaping household commuting patterns. Other studies, however, have argued that there is no evidence that teleworking leads to residential suburbanisation (Ellen & Hempstead, 2002; Ory & Mokhtarian, 2006), but rather that distant residential location motivates the decision to telework (Kim et al., 2012). Studying residential location preferences, Muhammad et al. (2007) confirm that 'telecommuters are not more likely to intend to change residence, suggesting that telecommuting is adopted as a rather permanent state, which allows one to overcome a longer commute and live in a more peripheral area with higher quality surroundings' (p. 356). They also add that the impact of telecommuting on choice of residential location might vary according to life stage (Muhammad et al., 2007). However, these studies are old and the health crisis calls for an update on these reflections.

From the first available data, it appears that Covid-19 has participated in a removal of populations from central areas to peri-urban or rural areas (Habib & Anik, 2021). But it remains difficult at this stage to know whether the dynamism of housing markets in sparsely populated areas is linked to relocation or to multilocal dwelling. Bachimon

et al. (2020) show that the pandemic encouraged owners who already had two homes to spend more time in their second home. The pandemic has also led to an increase in the number of digital nomads, which can be defined and are termed by Hannonen (2020) as people 'who work while traveling and travel while working'. Digital nomadism can be considered as a type of teleworking, and as a new way of working more generally (Thompson, 2019). However, assessing the proportion of these active people and the impact of their mobility practices on the environment remains extremely difficult. These first results regarding the impact of teleworking on residential relocation and multilocal dwelling militate for a consideration of travel time budgets on a weekly basis (Ravalet & Rérat, 2019). One of the hypotheses we can make is that people may be more willing to tolerate a greater home–work distance if they commute less frequently.

Teleworking can enable hypermobility or multi-mobility, such as digital nomadism, as mentioned above. Increasingly since the pandemic, we have seen that telework and the digitalisation of less connected regions have inspired new economic opportunities related to teleworking and tourism (Boscoboinik & Cretton, 2017; Bürgin & Mayer, 2020). Hotels in mountainous regions, for example, have offered rooms for teleworkers, including a good internet connection and other important necessities. For some, teleworking enables multilocal dwelling, that is, 'multilocal mooring points into workers' lives' (Gorman-Murray & Bissell, 2018, p. 233), including, for example, second homes or holiday homes. This multilocal dwelling then creates new forms of mobility practices, which have not yet been explored. However, as with every new shift, it also triggers change and controversies. We are faced with the challenge of what the future of work will involve and to what extent it will have an impact of our mobility practices.

Lastly, the lack of suitable workspaces at home is considered an important factor hindering the will of workers to telework (Laumer & Maier, 2021). Although we did not find any evidence for this in the scientific literature, the increase in teleworking could increase demand for larger homes, leading to greater tension in the housing market and to exurbanisation, as large homes are rarer in urban areas than in periurban or rural ones (Doling & Arundel, 2020).

At this stage, based on the studies conducted to date, it appears that there is no direct and measurable effect of telework on residential remoteness, but in theory, telework could lead to a relaxation of spatial constraints and have an impact on choice (residential, professional or related activities) in the medium or long term.

5 | TOWARDS A RESEARCH AGENDA ON THE EFFECTS OF TELEWORKING

Although the number of publications on the links between teleworking and mobility has increased in recent years, it appears that the majority of publications concentrate their research on commuting mobility. There is little consideration of the trade-offs made by teleworkers and their household members in terms of the activities and mobility practices that replace commuting. Previous research concerns the impact of telework either on daily mobility (for work and non-work purposes) or on residential mobility, but generally not both of them. This may result in part from the data used: articles often rely on secondary analyses of existing data, with only a few examples that aim to assess why people telework and the ways in which mobility practices evolve (e Silva & Melo, 2018 and Gubins et al., 2019 used cross-sectional analyses; Giovanis, 2018 used longitudinal data). This missing data is crucial in understanding how telework is linked to daily and residential mobility over a long period of time. The findings presented in this article reveal the need to analyse the effects of teleworking on mobility in the medium and long term, and to study the role of teleworking in residential location decision-making processes. To do this, a life course approach would be required.

Therefore, what needs more attention are the rebound effects and the possible ripple effects of teleworking, such as changes to commuting frequency or longer commuting distances and other changes in mobility practices that then cause other forms of mobility patterns. We thus advocate a more holistic study of teleworking that would involve analysing, for example, (a) the leisure mobilities that are enabled by the reduced requirement to commute, and (b) residential mobility, looking, for example, at the distance between the home and the workplace. We feel that qualitative methods would be a crucial complement to quantitative approaches, to help to better understand how

telework is appropriated and practised. A further scope is to recognize the temporal significance and to analyse how decisions are made about living arrangements and how these may change in the long term.

Another observation is that several articles have the explicit objective of reporting on the possible rebound effects of teleworking on mobility, but these are essentially assessed in terms of distances travelled. It remains unusual to approach the issue from an energy and/or climatic point of view (e.g. looking at CO_2 emissions). Thus, a final challenge would involve analysing CO_2 emissions in order to understand the environmental footprint, focussing not only on the reduction in commuting but also looking at rebound mobilities and effects.

These insights have led us to the formulation of a research agenda, which revolves around four purposes:

- Using the new mobilities paradigm and qualitative methods to better describe the ways in which time gained through teleworking is used
- Describing medium and long-term evolutions in daily and residential mobilities from a life course approach
- Considering telework through a lifestyle approach
- Assessing the impact of teleworking on CO_2 emissions in the mobility field

5.1 | Employing the new mobilities paradigm and qualitative methods to better describe the ways in which time gained through teleworking is used

The new mobilities paradigm coined by Mimi Sheller and John Urry (2006) has a major impact on the research of mobilities. According to Sheller, it should include and engage '[with] debates over globalization, cosmopolitanism, postcolonialism, and emerging forms (and histories) of urbanism, surveillance and global governance of various kinds of differentiated or uneven mobility, all of which should be central concerns of contemporary sociology' (2014, p. 49). In the context of telework, it is important to pay attention to the ways in which people adopt this mobility practice and how they are influenced by their lifestyle, life stage and social network.

Regarding mobility within fields (Bourdieu, 1993) and the potential to be mobile or immobile in various physical or non-physical spaces, this notion opens the question of how teleworking has an influence and changes the mobility of people who can telework. Similar to Tsing's (2005) notion of entanglements, or Latour's (2005) actor-network theory (ANT), Cresswell talks about, more specifically to the mobility research domain, the notion of 'constellations of mobility'. Which he describes as 'historically and geographically specific formations of movements, narratives about mobility and mobile practices; which reveal the importance of an historical perspective [...]' (Cresswell, 2010, p. 17). His notion of constellations of mobility also includes particular patterns or representations of movement, and the importance of practising movement in ways that make sense together. He describes the involvement of multiple scales and forms of mobility which are crucial to socio-spatial meanings (Cresswell, 2010). In the context of teleworking, the constellations of mobility are influenced not only by the practice of teleworking itself but also by personal motivations, obligations, the way the appropriate telework, their life course, culture or lifestyle.

As this article revolves around the connection between telework and various forms of mobility, it is important to approach this through a lens that can reveal 'the dynamic and multi-faceted relationality between workers' experiences and lives, on the one hand, and socio-geographical structures, institutions, and conditions of work, on the other' (Dorow et al., 2017, p. 2). Including the social sphere in the analysis of teleworking enables a more holistic perspective of all kind of mobilities and immobilities.

As rebound effects emerge in various ways, for example, in that telework might influence commuting, work-related mobilities, family time or leisure mobilities, focusing research on the motivations of teleworkers, will ensure a better

view of the trade-offs of individuals and households. Several studies are available, and the following lessons can be drawn from a transverse reading:

- Even if teleworking makes it possible to limit constraints on relocation, there is no consensus in scientific research as to the precise role of telework in residential relocation and multilocal dwelling. In-depth and longitudinal analyses would be necessary at this stage in order to better understand why people choose to live in peri-urban and rural areas (Beck & Hensher, 2021).
- The time saved by not commuting may be partially reinvested in other activities that may generate other journeys.

5.2 | Describing medium and long-term evolutions in daily and residential mobilities from a life course approach

According to Giele and Elder (1998), the life course can be defined as a series of events and roles that individuals experience or take on over their lifetime. Each individual path is immensely diverse and does not necessarily proceed in a predefined sequence but is a dynamic way of structuring a complex set of events that include decisions about occupation, life partners and residency (Coulter et al., 2016; Mulder & Clark, 2002). In the life course perspective, lives are seen as 'trajectories made up of multiple interlinked 'careers', for example, in the domains of employment, health and partnership' (Bailey, 2009). Several fundamental principles characterize the life course approach: (1) socio-historical and geographical location, (2) timing of lives, (3) heterogeneity or variability, (4) 'linked lives' and social ties to others, (5) human agency and personal control, and (6) how the past shapes the future (Mitchell, 2003, p. 1052). Bailey (2009) explains how individual lives are constituted by different events, comparing a life to a web which stretches over time and space.

The life course is a significant tool in helping us to understand the variety of teleworkers' biographies, life arrangements and appropriation of mobility. As teleworking could play a role in choosing where to live and work, and therefore in distances travelled, the question of the modes of transport used then arises, for both commuting and other journeys (e Silva & Melo, 2018; Zhu & Mason, 2014).

When combining the notion of the life course with the impact of teleworking on residential and daily mobility, it is important to see these movements as active practices that change over time and interlink with each other (Sheller & Urry, 2006). Applying the life course approach would contribute to an understanding of the intricacies which are involved in decision-making processes regarding where to live and work and would help especially with an understanding of long-term mobility transformations, which should be analysed through biographical interviews and longitudinal data. This would reveal the individual as well as the household motivations behind residential and daily mobility.

5.3 | Considering telework through a lifestyle approach

Aside from the life course, lifestyle choices are equally crucial in shaping mobility practices. Just as there are many diverse possibilities when it comes to life trajectories, there are equally diverse lifestyles. Axsen et al. (2012) define lifestyle as grouping together related social practices that give insights into the self-concept or identity of people. They further argue that these social practices are related to skills and access to technologies and activities. This argument is crucial to the context of teleworking since, as already discussed in the second section of this article, the possibility to telework depends on the individual's work activities, skills and access to technologies. We see that personal motivations are significant and can influence in a first step the start to telework and, by proxy then their respective residential and daily mobility.

Bourdieu's (1990) theory on habitus was pivotal in shifting the focus onto the embodied cultural representation which can be found in human habits and routines. As Ærø (2006) argues, when one looks at residential choice through a lifestyle lens, it becomes evident that it is connected to taste and to certain norms that exist within social groups. Residential choice is also linked with trends in which perceptions of the environment and the valorisation of certain areas play into lifestyle choices and, by proxy, residential choice, resulting in amenity-led or lifestyle migration (Boscoboinik & Cretton, 2017).

Both the lifestyle and the life course approaches militate for a detailed analysis of the discourses, motivations and experiences of people who telework, looking at such aspects as which mode of transport they use and why and where they choose to live. The key lies in studying telework as a practice with a broad range of potential impacts rather than studying teleworkers as a class of employees (Bailey & Kurland, 2002, p. 392).

5.4 | Assessing impacts of teleworking on CO_2 emissions in the mobility field

It is difficult to assess the impact of telework on CO_2 emissions because the effects are not always immediately evident, and it is sometimes impossible to make a comparison before/after or with/without teleworking. However, the climatic context imposes an enlightened vision of what can be expected from the development of teleworking in the years to come and a general CO_2 footprint assessment of teleworking.[1]

We are therefore advocating for an assessment of the CO_2 impact of telework that takes into account the multiplicity of potential rebound effects on daily and residential mobility.

6 | CONCLUSION

While the practice of teleworking raises many hopes in terms of reducing congestion, pollution and the over-use of infrastructures, and as it also aspires to enable an improved work–life balance, consulting the existing literature has shown that it is more complex than raising hope, as the research has found rebound effects in connection to telework. The research question motivating this article was to know to what extent telework practices lead to rebound effects on mobility. We have assembled an international review of the literature to better understand why this question is relevant and for which elements there is still research needed. Rebound effects impact in different ways on residential mobility (e.g., multilocal dwelling) and daily mobility (e.g., increase in non-work-related trips). We argue that it is necessary to consider the diversity of the population and social, geographical, professional, or familial situations to more fully assess the possible rebound effects of teleworkers. For example, gender differences and possible inequalities between men and women, not only in their possibility to telework, but also in the impact that teleworking has on their mobility practices, should be studied in depth.

In conclusion, we have seen a reorientation and a shift in work practices, a process which was accelerated by at least five to 10 years by the pandemic. It will be intriguing to follow these changes and see how the possibility of teleworking alters our notion of work, society, and spatial mobility. The perspective on telework will need to shift from one that sees it as an individual practice to one that views it as an influential territorial logic that may impact various behaviours and shape them. We have seen that the various rebound effects resulting from teleworking are linked in diverse ways in workers' lives; in order to understand this trend and to offer guidance regarding the politics of teleworking, these rebound effects should be studied in relation to each other. Through qualitative methods, we must focus research on the motivations of teleworkers, their behaviours and their mobility practices. This should include longitudinal changes in behaviour, by looking at the life courses and lifestyles of the teleworker. We hope that this research agenda for future research will assist to understand the interplay between telework and mobility.

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ENDNOTE

[1] We consider in this article the impacts of teleworking on travel, but an assessment of energy consumed at home and the energy saved in the workplace (e.g., through desk sharing), etc. is also needed to ensure a more comprehensive view.

ACKNOWLEDGMENTS

We would like to thank Prof. Heike Mayer, editor of Geography Compass, for the opportunity to write and publish this article. Furthermore, our gratitude goes to the anonymous reviewers for their time and inputs, which have helped to shape our article. SNF – Swiss National Science Foundation and our project number is: 192304.

Open access funding provided by Universite de Lausanne.

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How to cite this article: Hostettler Macias, L., Ravalet, E., & Rérat, P. (2022). Potential rebound effects of teleworking on residential and daily mobility. *Geography Compass*, *16*(9), e12657. https://doi.org/10.1111/gec3.12657