



ELSEVIER

Contents lists available at [ScienceDirect](http://www.sciencedirect.com)

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

Home-based telework in France: Characteristics, barriers and perspectives

Anne Aguilera ^{a,*}, Virginie Lethiais ^b, Alain Rallet ^c, Laurent Proulhac ^a^a IFSTTAR-LVMT, University of Paris-East, 6-8 avenue Blaise Pascal, 77455 Marne-la-Vallée cedex 2, France^b Marsouin, Telecom Bretagne, CS 83818, 29238 Brest Cedex 3, France^c RITM, Paris-Sud University, 54, Boulevard Desgranges, 92330 Sceaux, France

ARTICLE INFO

Article history:

Received 20 July 2015

Received in revised form 22 February 2016

Accepted 29 June 2016

Available online 26 July 2016

Keywords:

Home-based telework

Commuting

Barriers

Social expectations

ICT

France

ABSTRACT

The aim of this article is to explain the gap between high social expectations, particularly in terms of reducing commuting frequency, increasing productivity and improving work-life balance, and the reality of home-based telework. We use three French databases which give information about employers but also employees. We highlight that telework is not only a fairly restricted phenomenon but also one that lacks impetus; it is mainly an informal working arrangement. The main reasons raised by both employees and employers are the uncertain advantages coupled with immediate disadvantages. The conclusion examines different contextual factors that could alter this cost-benefits dilemma and foster the development of home-based telework.

© 2016 Elsevier Ltd. All rights reserved.

0. Introduction

Telework can broadly be defined as work conducted from a location other than the conventional work site whilst connected to the firm's computer systems by means of information and telecommunications technology (ICT). However in practical terms there is no common, clear-cut definition of telework and its measurement in that it covers a variety of different situations in terms of technology used, location, contractual arrangement and intensity in time (Allen et al., 2003; De Graaff and Rietveld, 2007; Feldman and Gainey, 1997; Haddon and Brynin, 2005; Shieh and Searle, 2013). This explains the gap between the figures reported by various surveys (Felstead and Jewson, 2000; Kraut, 1989).

Initially (from the 70s to the 90s) telework was primarily defined as home-based telework *i.e.* work performed by employees during paid hours in an alternative fixed worksite (primarily the homeplace or a satellite office generally located close to the homeplace) approved by the employer. The aim of such form of work is to decrease the individual (stress, fatigue, etc.) and collective (congestion, air pollution, etc.) burden of daily commuting: hence in this framework teleworking and telecommuting are almost synonyms. Self-employment is generally not taken into account because the idea is to define as teleworkers only the people who work (regularly or not) from a fixed location situated outside the premises of their employer.

For fifteen years the definition tends however to enlarge and telework encompasses two other categories: firstly nomadic work and secondly home-based work performed outside working hours (Qvortrup, 2002). Nomadic (or mobile) workers are

* Corresponding author.

E-mail addresses: anne.aguilera@ifsttar.fr (A. Aguilera), virginie.lethiais@telecom-bretagne.eu (V. Lethiais), alain.rallet@u-psud.fr (A. Rallet), laurent.proulhac@enpc.fr (L. Proulhac).

those working beyond home and office: on trains, at motorway service stations, in the departure lounge of the airports, in a temporary office space, in the premises of a client, etc. (Delaplace et al., 2014; Gareis, 2003; Hislop and Axtell, 2007; Lyons and Urry, 2005; Tremblay and Thomsin, 2012; Vilhelmson and Thulin, 2001) in relation with the development of mobile ICT, especially portable computers and mobile phones. However some studies include salaried employees working at customer sites in the category of nomadic teleworkers (Neirotti et al., 2013) despite the fact that off-site work is, and always has been, inherent to the occupations concerned (engineers, maintenance technicians, sales representatives...) and is then not necessarily related to ICT use. The third category of teleworkers can be named overtime teleworkers (Schweitzer and Duxbury, 2006) and is composed of the people who work from home outside the normal working hours (early in the morning, late at night, during the week-end, etc.). These different practices of teleworking are however still poorly measured especially because travel surveys only allow identifying home-based teleworkers and not the other categories.

These three categories of telework do not follow the same trends. In addition they do not meet the same social expectations. While nomadic work and overtime home-based telework are increasing (Noonan and Glass, 2012), home-based telework has become a never ending promise, its future always just around the next corner (Pliskin, 1997). Since the 1970s, numerous reports have predicted its rapid expansion. In 1971, AT&T thus asserted that in 1990 all Americans would be teleworkers (Huws, 1984). The widespread diffusion of home-based teleworking practices has, however, remained an unkept promise (Pliskin, 1997). Despite a stagnant growth rate, home-based telework nevertheless continues to be the object of periodic promotional campaigns that still promise its imminent 'take-off' due to the strong social expectations associated with it: it is expected to increase employee well-being by reducing travel-related fatigue, providing a less stressful work environment and a better balance between work and family life (Baines and Gelder, 2003; Di Martino and Wirth, 1990; Tremblay, 2002; Wheatley, 2012). It is also expected to allow companies to make considerable savings through lower real estate costs and productivity gains (Matthews and Williams, 2005). Finally, the public authorities expect home-based telework to reduce the social costs of commuting: a reduction in transport costs, pollution and urban congestion (Helminen and Ristimäki, 2007; Peters et al., 2004; Mokhtarian et al., 2004; Schwanen and Dijst, 2002). These expectations are reinforced by advances in remote communications technology and increasing environmental constraints.

The aim of this article is to analyze the current characteristics of home-based teleworking in France and the conditions and barriers to its future development as a formal or an informal practice (depending on whether it is formalized or not in the employment contract). The originality of this work is that it is based on three data sources: the first is the most recent national household travel survey (2008) which records home-based teleworkers and allows us to characterize them in terms of occupation, location and travel behaviour. The two other surveys have been made by the authors on a representative sample of 1294 SMEs and on a representative sample of 2000 employees in order to compare employers' and employees' attitudes toward teleworking as an actual or potential, formalized or not, working arrangement.

The paper is divided into four sections and a conclusion. The first section provides an international literature review on home-based teleworking. The second section presents the definition of home-based teleworking used in this research and the three data sources. Section three presents the results which concur in emphasising the low penetration rate of formal teleworking practices, the growth of informal teleworking arrangements, the characteristics of employee categories concerned and the concentration of teleworkers in Paris. Section four establishes that telework is not only a fairly restricted phenomenon but also one that lacks impetus and examines the reasons for this from the point of view of both employees and employers: uncertain advantages coupled with immediate disadvantages. The conclusion summarizes the main results and examines different contextual factors that could alter the choices made by the agents concerned.

1. Literature review

The aim of this literature review is to firstly provide an overview of the practice of home-based teleworking in Europe and in the USA, and secondly to identify the factors that are favourable or unfavourable to its practice and that will be tested in the French context in the empirical part of the paper.

1.1. A limited practice

Even if one considers only home-based teleworkers it is very difficult to gather precise statistics about telework in industrialized countries because on the one hand there is no common definition (De Graaff and Rietveld, 2007; Noonan and Glass, 2012), and on the other hand there is a clear lack of national data on the subject. The differences regarding the definition of home-based teleworking concerns especially the taking onto account of self-employed or not, of informal arrangements or only formal arrangements with the employer, of irregular telework *versus* only telework performed on a regular basis, of part-time telework *versus* only full-time telework and finally on including or not work performed during evenings and weekends.

However the different available studies suggest that home-based teleworking is a quite limited phenomenon which moreover seems to increase very slowly (Rasmussen and Corbett, 2008). Note that in most studies only formal teleworking (based on contractual agreements with the employer) is taken into account which is a clear limitation because some studies suggest that informal teleworking (*i.e.* informal arrangements between the employer and the employee which do not appear

in the labor contract) should not be neglected (Farrah and Dagen, 1993; Noonan and Glass, 2012; Nunes, 2005; Taskin and Devos, 2005).

In Europe (i.e. the 27 members of the European Union) 5% of workers were home-based teleworkers on a regular basis in 2000, and they were only 7% in 2007 (Welz and Wolf, 2010). There are however important differences between the countries according to cultural variations (Peters et al., 2009): in north-European countries telework is a better established practice than in south-European countries. For instance in France less than 6% of employed people are teleworkers. In Australia a recent study estimates that only 6% of the total workforce is involved in home-based telework in 2006 (Shieh and Searle, 2013). Finally in the USA 24% of the employed Americans work at least some hours at home each week, including the evenings and the weekends (Noonan and Glass, 2012). Another report also shows that about one-fourth of the Americans (including self-employed people) work remotely (from home or another location) at least one day a month during normal business hours but only 15% if one considers only employed people (WorldatWork, 2011).

1.2. Factors favourable and unfavourable to the practice of teleworking

According to the literature the factors favourable or at the contrary unfavourable to the adoption (and formalization) of home-based telecommuting relate primarily to three categories that concern (1) the work performed (nature of the tasks and organization); (2) the perception of the benefits (or disadvantages) of teleworking; and finally (3) compatibility with the work culture at a national level or within the organization.

Firstly, the nature and the organization of the work within the organization are influential factors (Nunes, 2005; Taskin and Edwards, 2007). On the one hand high skilled and autonomous workers are the more likely to telecommute: hence that sectors with a high proportion of these types of workers, like real estate, financial intermediation and education (Welz and Wolf, 2010), have in average a higher percentage of home-based telecommuters (De Graaff and Rietveld, 2007; Taskin and Edwards, 2007). In Europe a quarter of all teleworkers have an upper secondary education and more than a half have a third-level education. In the USA workers with a college degree or higher are also more likely to telecommute (Noonan and Glass, 2012). The influence of ICT usage is however debated insofar as there is a growing prevalence of ICT usage for work and as most people have a computer and Internet at home: hence ICT availability and usage should be less and less discriminating (Haddon and Brynin, 2005). One notable exception could be that the introduction of telework can be associated with a new form of employee control involving the implementation of technological means (Fairweather, 1999; Sewell and Taskin, 2015): therefore in some organizations the practice of home-based telework may depend on the possibility to implement such technologies, and on the associated costs. Moreover the adoption of teleworking practices often requires changes in the organization of work that can constitute a barrier (Illegems et al., 2001). Changes relate in particular to the surveillance and control of the teleworkers and more widely to the management of a remote workforce, especially the management of the psycho-sociological distance from the work environment (colleagues, common spaces, formal and informal exchanges, etc.) (Belanger, 1999; Harris, 2003; Illegems and Verbeke, 2004; Taskin and Devos, 2005; Thomsin and Tremblay, 2008; Wilton et al., 2011). From the employer's point of view, telework presents the disadvantage of removing employees from the physical control of their supervisors (Felstead et al., 2003) and might thus affect the surveillance of work especially in its two functions that are firstly evaluating contributions and secondly ensuring coordination (Sewell, 2012).

Secondly the way the managers or the employees perceive the benefits of teleworking contributes to explain the adoption of teleworking practices (Peters and Batenburg, 2015). The two main aspects are the productivity of work and the well-being of employees which are however subject to contradictory findings in the empirical studies. On the one hand telework is sometimes associated with an increase in productivity (Baruch and Nicholson, 1997; Apgar, 1998; Belanger, 1999; Pyöriä, 2011). In their literature review, Bailey and Kurland (2002) declare that in almost all empirical articles they examined, working at home was associated with a higher productivity by teleworkers. The productivity sometimes increases through less absenteeism related to the easier organization of private life (Kitou and Horvath, 2008). Conversely, other empirical studies are more nuanced and highlight a differential effect of telework on the productivity, depending especially on the quality of the social interaction with managers and family members (Neufeld and Fang, 2005) or on organisational and job related factors (Baker et al., 2007). On the other hand the relationship between teleworking and the well-being of employees is also subject to controversies. Teleworking is envisaged as a means of reducing the growing tensions between work and family life (Baines and Gelder, 2003; Di Martino and Wirth, 1990; Tremblay, 2002), underlined by numerous national and international surveys over the last few years. These tensions are particularly strong among women (Fagnani et al., 2004), managers (Guillaume and Pochic, 2009), employees commuting long distances (Sandow, 2014), or subject to long working hours or staggered shifts (Mac Innes, 2005). Empirical studies have nevertheless shown that one of the dangers of teleworking, and more particularly home-based telework, is the risk that work ends up invading family life (Maruyama et al., 2009; Tremblay et al., 2006). However employees with long commuting trips or living in the cities with the worst transport conditions seem to be more likely to telecommute. In the USA cities with the worst congestion or longest commutes, telework is more extended (Lister and Harnish, 2011). Similarly Peters et al. (2004) show that Dutch teleworkers have longer commutes in average. Hence it seems that teleworking practices are more likely to be implemented when workers have long commutes and probably in urban areas with problems of congestion. Finally managers can expect home or telecentre-based telework to reduce organizations' energy consumption due to the optimal use of premises. However the energy gains estimated by Matthews and Williams (2005) for the USA and Japan show marginal savings of less than 0.4% in the current situation. They estimate it would however remain below 1% under the hypothesis that teleworkers remain at home four days a week!

Thirdly cultural factors can favour or prevent the implementation of telecommuting (Peters and Batenburg, 2015). Peters et al. (2009) have thus shown how telework adoption among line managers in two locations of the same ICT-multinational company in France and the Netherlands varied according primarily to the differences regarding cultural values. In the Dutch context the managers viewed informal teleworking as a practice fitting cultural values whereas in France the valuation of power distance and uncertainty avoidance contributed to reduce the implementation of telework practices.

As we will explain now the empirical analysis has focused on the influence of the two first categories of factors (the work performed and the perception of the advantages or disadvantages) in the adoption of home-based telework practices in France. We did not test the influence of cultural factors because it was not possible through questionnaires and would have required face to face interviews.

2. Home-based teleworking in France: Definition, data sources and methodology

2.1. Definition

In this paper telework is defined as salaried employment (in other words, the teleworker is directly employed by the company implementing telework) where work that could have been conducted on the employer's premises is regularly conducted at home or from a satellite office. We name it home-based teleworking because satellite offices (like telecentres) are very rare in France. In addition limiting telework to salaried employment means that only the time spent teleworking during normal working hours will be taken into account. Moreover we think that telework implies regularity (weekly), but the number of regular work hours considered as telework varies according to surveys. In some surveys, the minimum number of hours worked off-site considered as telework is half a day whilst in others it is a full working day. We consider the half-day as the minimal acceptable condition from the moment it is regular. More often than not, teleworking is a part-time activity; employees divide their working time between the conventional workplace and the telework location. We nevertheless chose not to define telework in terms of frequency in the two surveys we conducted so as to collect information on all types of practice. This gave us two measurements of telework: one based on its strict definition as a regular practice conducted at least half a day per week, and a broader measurement including work conducted at home or in a telecentre in a more ad hoc manner. Finally we consider formal but also informal telework, *i.e.* tacitly allowed by the employer but not contractualized.

Our definition is very close to certain official definitions, for example the 2005 European framework agreement on teleworking subsequently adopted in several national industrial agreements. Moreover it has the advantage of not confusing forms of work based on differing principles and focuses on the social expectations associated with telework: the well-being of employees, costs and productivity gains for companies, and a reduction in the social costs of commuting for the public authorities.

2.2. Data sources

To measure and characterize this form of telework, we base our analysis on data from three surveys providing three complementary views of teleworking practices in France, both at national level and in a specific region (Brittany). Our aim is not to provide a direct comparison of survey results as the definition of telework and the sample bases used differ from one survey to the next but, in the absence of adequate data, to contribute to explaining the gap between societal expectations and teleworking practices from the point of view of both companies and employees. Moreover they have been questioned about not only the current situation about teleworking but also about the future of teleworking.

Our first data source is a survey on travel behaviour within the French population which includes questions on home-based teleworking practices. Conducted in 2008 by INSEE among a representative sample of the French population (20,200 French households), the National Survey on Transport and Travel (ENTD) comprehensively describes the French populations' short and long distance travel patterns relating to work, shopping, leisure activities, etc. Employees with a fixed place of work outside the home were also questioned on their teleworking practices. Information on whether an employee teleworked regularly or occasionally was also available even if frequency was not specified in the questionnaire. Individuals whose fixed place of work is the home were not counted among the population of home-based teleworkers.

However this kind of survey does not provide qualitative information about attitudes of both employees and employers toward teleworking as an actual or also potential working arrangement. Additionally we needed information about formal but also informal home-based teleworking which was not provided by the ENTD. Hence additional data were necessary.

Two other surveys were thus conducted by the GIS MARSOUIN¹ in 2012, through the OPSIS observatory (Regional Observatory of Digital Uses)² with the aim to measure the uses of ICT in the region. A section of specific questions on remote working was integrated by the authors of this article in each of the surveys. Both surveys focused on the specific region of Brittany. One was based on a representative sample of 1294 companies with between 10 and 250 employees in the industrial, commercial and service sectors (excluding the agricultural sector and public service sector) located in the Brittany region and the other

¹ Research centre on the information society and Internet uses based in Brittany (<http://www.marsouin.org>).

² The OPSIS observatory regularly conducts surveys on the use of digital technologies in the Brittany region, both among SMEs and individuals.

on a representative sample of 2000 residents of the region. For both surveys the quotas method has been used so as to provide a good final representativeness. The first sample is representative of the regional economic fabric in terms of location of the firm (corresponding to the seven Chambers of Commerce and Industry of the region to which firms are attached), size (three categories), and sector of activity (eight sectors). The second sample is representative of the population (older than 15 years) of each of the four *départements*³ of the region, in terms of age (five categories), occupation of the respondent and size of the urban area of residence (in seven categories). Among the 2000 respondents of this survey, 1096 are workers among which 156 live and work at the same place (farmers, entrepreneurs, ...). Then, we exploited the responses of 940 questionnaires: the active population whose principal workplace is not home.

2.3. Methodology

The ENT-D is used as the only national data source of home-based teleworking practices in France, defined here as working from home rather than the office with the employers' agreement (the questionnaire does not refer to a potential formalization in the employment contract). The survey conducted among SMEs took into account teleworking not only from home but also from a satellite office. Hence we consider that a company practices telework if it declares at least one worker working at home or in a satellite office at least half a day per week. In the residents regional survey, a teleworker is an employee who works from home several hours straight or more at least once a week (and whose principal workplace is not home). The respondents were explicitly asked whether telework was formalized in their employment contract (formal telework) or not (informal telework).

First, the three surveys provide recent statistics in order to characterize the practices of teleworking, in France and in a specific region within a more detailed way.

The two regional surveys also provide information about home-based teleworking in the Brittany region, especially the nature of teleworking (formal or informal), which is not specified in the national survey. Descriptive statistics are used to confirm the influence of factors related to the work performed (socio-professional category) and transport conditions: the commuting distance (and time) and the residential area.⁴

Second, the main objective of the questions we added on the two regional surveys was to provide information about attitudes toward teleworking as an actual or potential working arrangement. The comparison of the answers depending on whether the respondent has already experienced home-based telecommuting or not allow us to distinguish major obstacles to the diffusion of teleworking from simple reluctances.

Additionally the survey provides information about whether firms wish to implement, maintain, develop or even reduce home-based telework in the near future. The crossing of these intentions and the motivations and drawbacks of teleworking underlined by firms help us to better understand the potential of development of the practices and the way they have to be implemented. Finally, the main originality of data we use is that they allow us to combine employers' and employees' perceptions and attitudes toward home-based teleworking (benefits, constraints, barriers).

Tables 1 and 2 present the questions and modalities of responses included in the two regional surveys that have been used for describing the practices of teleworking and its potential development (Table 1) and for analyzing the barriers to this growth (Table 2).

3. Characteristics of home-based teleworking in France

Our analysis confirm that home-based teleworking remains a limited practice in France both at a national scale and in the Brittany Region. More interestingly we show that informal arrangements are the main model in the Brittany Region. Moreover the three data sources confirm that home-based telework is reserved not only for certain professions. . .but also Parisians probably because they are in average more educated and also because of the congestion of the transport network in the Paris Region. Finally our study suggests that home-based teleworking has a low potential for development, at least in SMEs located in the Brittany Region.

3.1. A limited practice

According to the ENT-D, regular or occasional home-based teleworkers concerned 6.8% of the French working population in 2008, which is low. If we only take into account the working population declaring a fixed place of work outside the home, it increases slightly to 8%, of which 5% are occasional teleworkers and 3% regular teleworkers. These figures are consistent with the results of the survey conducted among residents in Brittany: 7% of the working population (declaring a fixed place of work outside the home) reported teleworking from home at least one full day, of which 3% regularly (each week) and 4% occasionally. Including employees working at home several hours straight at least once a week in the regular teleworkers, brings the percentage of regular teleworkers up to 7.5%.

³ French *départements* are equivalent to counties.

⁴ The residential area was classified into the ten categories proposed by the ENT-D: one category encompasses the rural municipalities, and the other categories grouped the municipalities according to the size of the urban area and their spatial position (centre, suburbs).

Table 1

Questions and modalities of responses used to measure the practices and the perspective of teleworking (TW) in the two surveys on the Brittany region.

SMEs	Employees
<i>Practices</i>	
Frequency of TW (home or in a satellite office) if at least one teleworker Number of teleworker for each possible frequency	Frequency × duration of TW at home
<i>Formalization</i>	
Specified/planned to be specified in the labor contract	Specified/planned to be specified in the labor contract
<i>Selectivity of the practice</i>	
Categories of teleworkers (workman, employee staff, managerial staff, ...) Type of activity (R&D, supply, sales, production, ...)	Profession of the respondent Size of the urban area of residence Travel time from home to work
<i>Potential development</i>	
If no TW: intention to implement If TW: intention to extend/reduce and conditions for extension	

Table 2

Questions and modalities of responses used to measure the barriers of teleworking (TW) in the two surveys on the Brittany region.

SMEs	Employees
<i>Barriers</i>	
Reasons of no TW: <ul style="list-style-type: none"> Physical presence required on the site Employees' poor ability to use technological tools Lack of appropriate tools and no willingness to invest in No need for firm and no request from employees 	Reasons of no TW: <ul style="list-style-type: none"> No compatibility with the work Employer's opposition Desire to keep home life and work separate Lack of communication tools
Backwards (real or potential) of TW: <ul style="list-style-type: none"> Necessary work reorganisation Difficulty to control work Limitation of the interaction between teleworkers and colleagues Decreased productivity of teleworkers Need for specific equipment 	Reason of TW: <ul style="list-style-type: none"> Increased productivity Better work life balance Reduced commuting
Advantages (real or potential) of TW: <ul style="list-style-type: none"> Increased productivity of teleworkers 	Tools used in TW: <ul style="list-style-type: none"> Phone Mobile phone Smartphone PC Internet connection 3G dongle
Implication of TW: <ul style="list-style-type: none"> Work reorganisation by supervision methods Work reorganisation by greater autonomy of employees 	
Requirements to teleworkers: <ul style="list-style-type: none"> Connection to the company's network Prompt response to emails Reachability by phone 	

At company level, the INSEE (National Institute of Statistics and Economics Studies) estimated in 2009 that 22% of companies located in France counted at least one employee working off-site with access to company computer systems at least one half day per week; in other words a fairly broad definition of teleworking including nomadic work practices (INSEE, 2009). The survey conducted in Brittany showed that, without measuring frequency, 18% of SMEs reported at least one employee teleworking either from home or a satellite office. If the definition is limited to telework practiced at least half a day per week, the percentage drops to 12.4%. Furthermore, only a small percentage of employees are concerned: in 41% of the companies interviewed, only one employee can be defined as a teleworker in the strictest sense of the term and in 75% of cases, teleworking concerns less than four employees.

3.2. Informal telework as the main model

Several authors pointed the development of informal telework, a practice more often subject to a tacit non-formal agreement between the employer and the employee (Farrah and Dagen, 1993; Taskin and Devos, 2005). The two surveys conducted in Brittany confirm that today, telework is still a largely informal working arrangement. Among the companies implementing teleworking practices, only 41% had included the clause in their employees' employment contracts, 43% planned to do so, and almost 11% had not and did not intend to officialise the practice. However the higher the frequency of teleworking practices, the greater the tendency to officialise them. 62% of companies with employees working off-site throughout the week have officialised teleworking practices. Companies in which employees are sent to work from remote locations several times per week are 50% to have included teleworking in the employment contract. This figure drops to 25% for companies practicing telework at least one half day per week and drops to 23% for more occasional practices.

Finally, if we only take into account companies with at least one employee officially working off-site at least one half day a week, telework practices concern only 6.5% of the companies in our sample (a little less than 8% if we include companies who intend to officialise the practice). To resume, one can say that teleworking is an extremely limited practice essentially based on informal working arrangements.

Why teleworking is developing most informally? According to us, this is not the result of the absence of law but, rather, the result of the existence of a legal formalization. In France, teleworking has a legal framework (Act of 23 March 2012), as it is in many developed countries. The implementation of legal teleworking involves high transaction costs (need for a hierarchical agreement, change of employment contracts, provision of business equipment, Internet subscription, sometimes availability of a very-high-speed connection, converting a home room into a working area, imposing work schedules, authorization to have a professional activity within a residential building. . .). Informal telework enables firms and employees to bypass these costs while benefiting from flexible and tacit telework. This is the economic rationale for the development of informal telework.

3.3. A professional and spatial selectivity

The three surveys concur on the fact that teleworking is limited to specific professional categories and types of profession and moreover is more frequent in larger companies and when home-to-work travel is longer, confirming the findings of other studies (Daniels et al., 2001; Baruch and Nicholson, 1997; Peters et al., 2004; Helminen and Ristimäki, 2007; Mokhtarian et al., 2004).

If the national average of home-based teleworkers is 8% according to the ENTND, the (regular or occasional) teleworking population is most highly represented among company directors (41%), the liberal professions (32%), and executives in both the public and private sectors (22%). Among the SMEs practicing telework in Brittany, 73% declare that it concerns company managers, 25% the intermediate professions, 25% employees and only 13% workers. The same trend is observable among the employees of the Brittany region. This confirms previous research results: telework is essentially practiced by a few intellectual professions characterized by a considerable amount of job autonomy (Peters et al., 2004; Baruch and Nicholson, 1997).

A more singular result of our research is that Parisians are significantly over represented within the population of French teleworkers. Neither size nor urban, peri-urban or rural characteristics of the area of residence have little impact on the percentage of home-based teleworkers except in the municipality of Paris (but not the rest of the Paris region) where the proportion of teleworkers reaches 18%, more than double the national average. The concentration of highly skilled professions in Paris combined with difficult travel conditions in the Paris region are probably the two main reasons for this. Indeed the percentage of teleworkers increases with the time taken to travel from home to work and reaches 13% at over 60 min travel time compared to 8% home-based teleworkers among people which commuting time is less than 15 min. Previous studies (Mokhtarian et al., 2004; Peters et al., 2004; Helminen and Ristimäki, 2007; Zhu, 2013) highlight an increasing relation between the distance from home to work and telework practices. The same 'distance' effect is observed in the regional surveys: teleworking in the broadest sense of the term does not increase linearly with distance but teleworking practices are more frequent from the 30 min home-to-work travel threshold. In Peters et al. (2004), employees adopt teleworking when one way commuting time exceeds one hour. We did not, however, observe an effect of the firm's location⁵ on teleworking practices in the Brittany region probably because of low congestion.

3.4. A limited potential for development

Contrary to the particularly optimistic forecasts concerning the development of teleworking practices presented in successive ministerial reports, the results of our research do not indicate a significant increase in the practice which is in line with the recent trends observed in the USA (Noonan and Glass, 2012).

Our findings highlight that the potential for development in small and medium sized companies, at least the ones located outside the largest urban areas, appears relatively low. Firstly, among the Brittany companies not having implemented teleworking practices, only 2.4% intend to in the future. We can assume that as teleworking practices are fairly marginal in SMEs, those that have not yet implemented the practice are unable to perceive its future benefits. But the potential growth of teleworking among firms that have already implemented these practices remains low: 76.8% state they do not wish to develop the practice, 3.9% would prefer to reduce it, and only 15.9% of firms intend to extend the practice (11.2% to a greater number of employees and 4.7% to increase off-site working time without increasing the number of employees concerned).

We also show that the desire to expand teleworking practices neither depends on the number of employees concerned, nor on the frequency or regularity of off-site working practices. The implementation of teleworking practices does not appear to be driven by any particular force that would augur well for its future development.

⁵ The location is measured by the belonging to the seven Chambers of Commerce and Industry of the Brittany region, which are characterized by different level of urbanization.

4. Employer and employee barriers to teleworking in France

In this fourth and last part of the paper we explore the influence of the nature and organization of work and the perception of telecommuting on the actual and also future adoption of home-based teleworking practices among employers and employees in the Brittany Region. We point to strong reservations and poor motivation on the part of companies but also employees which would explain the low uptake of teleworking despite the availability of ICT.

4.1. The need to review work organization

Within the framework of the surveys conducted in the Brittany region, the main reason evoked by employees for not implementing teleworking practices is the non compatibility with their work (93%) and by companies the required physical presence of employees on site (88%). This requirement masks the organisational changes implied in the implementation of teleworking practices (Taskin and Edwards, 2007), which moreover constitutes a recurring argument (Pratt, 1997). Indeed, 58% of companies view the reorganisation of work as a major barrier to implementing teleworking practices.⁶ The characterization of the modalities of the variables associated with teleworking practices also emphasise the strength of this barrier. Indeed, companies considering that the reorganisation of work is not a major obstacle to implementing teleworking practices are over-represented among companies that have adopted the practice whereas companies estimating that work reorganisation is a major obstacle are over-represented among companies that have not. This result signifies that for a proportion of companies, teleworking would involve impossible organisational constraints. Inversely, only a small percentage of companies having implemented teleworking practices (7.8%) stated it has involved a reorganisation of work. This result can be justified by the fact that a high proportion of companies implementing teleworking practices also employ a nomadic workforce (sales representatives, delivery drivers. ...) meaning that off-site work is already an essential characteristic of their work organization.

4.2. A change in management practices

One of the reasons most frequently evoked by companies to justify the non-adoption of teleworking practices is that it is incompatible with the company's management methods (reason considered to be fairly or very important by 77% of companies concerned). Only half the companies (52%), however, directly refer to the problem of controlling the work performed by their employees as a very or fairly important disadvantage. The limitation of the interaction between employees and their colleagues is also often seen as a failing of teleworking (66% of firms believe it is a serious or fairly serious drawback), among both practicing and non-practicing companies. If, as we pointed out in the previous section, only a minority of companies declare that implementing telework practices resulted in the reorganisation of work, for a large majority (16 out of 19) this reorganisation resulted in greater job autonomy for the employees; the implementation of remote supervision methods remains marginal (3 out of 19 companies). Certain technological tools can be used to bridge the distance between the teleworker and the conventional workplace. If 43.2% of companies require their teleworkers to be permanently contactable by phone when they are working off-site, 27.6% that they answer their emails within a short deadline and 11.9% that they are permanently connected to the firms' computer network, almost half the companies concerned (49.8%) make no specific requirements. This confirms the fact that telework management is often accompanied by greater employee autonomy and is not necessarily based on very strict rules.

4.3. The influence on productivity

The regional survey conducted among SMEs shows that one of the major concerns for companies is employee performance. Firstly, it shows that companies that have not implemented telework are more likely to think that teleworking does not increase employees' productivity (80% of companies that have not introduced telework consider the advantage of increased employee productivity to be of little or no importance against only 43% of companies practicing telework). Telework is even associated with a decrease in employee productivity (44% of companies that have not implemented telework believe that a decrease in employee productivity is a serious or very serious disadvantage against 26% of companies that have adopted the practice). Moreover, companies' attitudes regarding the effects of teleworking on employee productivity is one of the discriminating factors, not only between companies practicing or not practicing telework, but also between companies intending to extend or reduce the practice. Indeed, the characterization of the modalities of the variable associated with maintaining telework practices reveals an opposition between companies wishing to extend the practice because they believe it increases employee productivity and those that do not because it implies the contrary.

Employees reveal the same divergence of opinions concerning the positive relationship between home-based telework and increased productivity. Only 22% of teleworkers consider they are more productive at home than in the office.

There does not appear to be a clear-cut relationship between telework and productivity, even among companies that have adopted the practice and the employees concerned.

⁶ The questions concerning the advantages and disadvantages of implementing teleworking practices were asked to all respondent companies so as to measure both actual and potential perceived effects. A large proportion of companies that have not implemented telework did not answer these questions. The statistics presented were calculated from companies having answered the questions (669 concerning the advantages and 696 concerning the disadvantages).

4.4. The technological dimension

The widespread use of ICT in both the home and work environment, has often been advanced as a factor that would boost the development of telework (Bayrak, 2012; Richardson and Benbunan-Fich, 2011). However in our sample, only 2% of individuals mention the lack of appropriate tools as an obstacle to working from home. The tools used by employees who work from home are mainly a desktop computer or laptop (for 94%), an Internet connection (for 81.4%), and a landline or mobile phone (53%). In addition few companies evoke the presence of technological tools and employees' ability to master them as a barrier to implementing telework. These findings confirm the work by Clear and Dickson (2005) on SMEs located in London showing that organisational factors are more critical than technological provision in facilitating successful implementation of teleworking. It also confirms the work by Haddon and Brynin (2005) which concluded that telework seems to reflect traditional occupational practices rather than a major technological shift.

However the majority of companies are aware that it implies investing in specific technologies. Only 9.8% of companies that have not implemented telework evoke employees' poor ability to use technological tools as a fairly or very important reason for their choice. 17.6% of these companies also evoke the lack of appropriate tools or not wishing to invest in them. At the same time, half the companies (51%) consider the need for specific technological equipment to be a fairly or very important obstacle. This opinion is moreover shared by all companies whether teleworking has been introduced or not.

This result can be interpreted in the following manner: the technological barrier to introducing telework is strong but not critical. To confirm this interpretation, we show that 51% of companies practicing telework declare having invested in specific technologies in the framework of teleworking implementation.

4.5. On balance: a practice with little support either from companies or employees

According to Bailey and Kurland (2002), employees' motivations concerning telework are not clear. The main argument advanced by employees to explain why they do not work remotely is that their jobs do not allow it (93% of the sample). Other possible barriers (employer opposition, lack of appropriate communication tools at home, desire to keep home life and work separate) are rarely evoked (2–4% of employees). Finally better work-life balance and reduced commuting do not appear to be favourable factors: the survey conducted in Brittany shows that only 12% of home-based teleworkers declare that it provides a better work-life balance. Moreover while 84% of home-based teleworkers estimate travelling less on days they work at home, against 8.5% for whom it remains the same and 7.5% who travel more, which confirms the results obtained by other surveys (Mokhtarian et al., 2004), only 2.5% evoke reducing home-to-work travel as an incentive.

At company level, we find reluctance on the part of managers, essentially on the grounds of investment costs, work organization and supervision reinforced by a low perceived need that limits its development. The parallel between the main barrier to implementing telework put forward by companies on the one hand (i.e. the necessary presence of employees on site) and on the other, the low response rate concerning questions on the potential advantages and disadvantages of teleworking from non-practicing companies (almost 47% on non-response) leads us to conclude that telework is just not considered as an opportunity by the majority of the SMEs interviewed.

The results of the two regional surveys lead to the following observation: a large proportion of companies (in particular SMEs) and employees automatically assume that teleworking is not accessible to them and therefore make no attempt to evaluate its potentialities.

5. Conclusion

We examined the reasons for the considerable gap between the high expectations concerning home-based teleworking and the low uptake observed. The three sources of data we used confirm not only the currently low penetration rate of teleworking but also the strong selectivity of the practice. Moreover, the regional surveys conducted in Brittany highlight the lack of real impetus. Particularly, the SMEs survey shows that a limited number of companies envisage introducing teleworking practices in the future. Worse, among the companies that have implemented teleworking, few wish to maintain it. Of course this latest result cannot be generalized as it concerns small and medium firms located in a particular region, but it reinforces the outcome of the strong selectivity of the practice.

What is striking in this situation is its recurrence. This is not a new problem, as if telework was structurally caught in a low level equilibrium trap. As a result, the arguments repeatedly used to glorify the improbable future of telework are no longer convincing. We have shown that the low level equilibrium is explained by the existence of strong barriers among both companies and employees. The costs of implementing teleworking programmes are clearly perceived by companies (in our survey, costs of organisational change and technological investments) whereas they have doubts as to gains in productivity. For the employees, teleworking is currently limited to certain categories of employee (those with high level of autonomy not requiring organisational or managerial changes) and is not necessarily perceived as providing a better balance between work and personal life or as a source of increased productivity. This twofold lack of attractiveness is even more penalising for telework in that the environmental benefits to be gained do not appear particularly convincing when examined closely, that is to say taking into account all forms of individuals' mobility.

What could break this deadlock?

First, it should be underlined that the potential growth of telework essentially concern large cities, as illustrated by the current over-representation of Parisians in the French population of teleworkers. This is explained by the time spent on travel which is higher in Paris than elsewhere for all types of travel (82 min on average per day in the Paris Region against 64 min outside) or for home-to-work commuting (over half an hour per day on average against 17 min). On average, the distances travelled are equivalent but the speed of travel is much slower. Over 22% of inhabitants in the Paris region spend over 2 h travelling per day against 12% elsewhere in France. This percentage increases significantly for inhabitants in the outer suburbs of Paris. Growing traffic congestion in the city can only increase travel time and associated costs.

The development of informal teleworking is a first solution. Surveys show that it has already developed though it is difficult to measure to what extent. Its success lies in its informal nature. Formal teleworking increases the costs of entry into teleworking, particularly for companies (new organisational procedures, the provision of legal guarantees, fitting out of new workstations...), which is dissuasive given the low intrinsic benefits perceived. As companies tacitly accept informal teleworking practices, it also benefits employees. They are not formally committing themselves to a new job status which can be risky during an economic crisis, but are able to occasionally work off-site. This possibility is obviously not open to all employees, but it would be interesting to be able to measure its development. It would show that informal telework is practiced as a flexible variable within a fixed situation.

The development of formal teleworking would imply different conditions that would alter the cost-benefits dilemma described previously. This would be the case if the public authorities introduced stronger policies transferring the social costs generated by urban congestion (fuel taxes, transport taxes, urban toll systems) onto private actors forcing them to review their current choices. A sharp rise in the cost of fuel would have a similar effect. The development of organized forms of telework would thus become a necessary alternative, especially for those already subject to long and costly travel times for whom it would further increase. Without an exogenous shock of this kind or a constraining law, telework is likely to remain as it is today.

References

- Allen, D.G., Renn, R.W., Griffeth, R.W., 2003. The impact of telecommuting design on social systems, self-regulation, and role boundaries. *Res. Personnel Human Resour. Manage.* 22, 125–163.
- Apgar, M.I., 1998. The alternative workplace: changing where and how people work. *Harvard Business Rev.* (May–June), 121–136.
- Bailey, D.E., Kurland, N.B., 2002. A review of telework research: findings, new directions, and lessons for the study of modern work. *J. Org. Behav.* 23 (4), 383–400.
- Baines, S., Gelder, U., 2003. What is family friendly about the workplace in the home? The case of self-employed parents and their children. *New Technol., Work Employment* 18 (3), 223–234.
- Baker, E., Avery, G.C., Crawford, J., 2007. Satisfaction and perceived productivity when professionals work from home. *Res. Pract. Human Resour. Manage.* 15 (1), 37–62.
- Baruch, Y., Nicholson, N., 1997. Home, sweet work: requirements for effective home working. *J. General Manage.* 23, 15–30.
- Bayrak, T., 2012. IT support for telecommuting workforce. *Telematics Inform.* 29, 286–293.
- Belanger, F., 1999. Workers' propensity to telecommute: an empirical study. *Inf. Manage.* 35, 139–153.
- Clear, F., Dickson, K., 2005. Teleworking practice in small and medium sized firms: management style and worker autonomy. *New Technol., Work Employment* 20 (3), 218–233.
- Daniels, K., Lamond, D., Standen, P., 2001. Teleworking: frameworks for organizational research. *J. Manage. Stud.* 38 (8), 1151–1185.
- De Graaff, T., Rietveld, P., 2007. Substitution between working at home and out-of-home: the role of ICT and commuting costs. *Transp. Res. Part A: Policy Pract.* 41 (2), 142–160.
- Delaplace, M., Pagliara, F., Aguilera, A., 2014. High-speed rail station, service innovations and temporary office space for mobile workers: a comparison France/Italy. In: *Transport Research Arena (TRA) 5th Conference: Transport Solutions from Research to Deployment*.
- Di Martino, V., Wirth, L., 1990. Telework: a new way of working and living. *Int. Labour Rev.* 129, 529–554.
- Fagnani, J., Giovannini, D., Højgaard, L., Clarke, H., 2004. Fathers and Mothers: Dilemmas of the Work-Life Balance: A Comparative Study in Four European Countries. Springer.
- Fairweather, N.B., 1999. Surveillance in employment: the case of teleworking. *J. Bus. Ethics* 22 (1), 39–49.
- Farrah, B.J., Dagen, C.D., 1993. Telecommuting policies that work. *Human Resour. Mag.* 38 (7), 64–71.
- Feldman, D.C., Gaine, T.W., 1997. Patterns of telecommuting and their consequences: framing the research agenda. *Human Resour. Manage. Rev.* 7, 369–388.
- Felstead, A., Jewson, N., 2000. In *Work, at Home: Towards an Understanding of Homeworking*. Routledge, London, UK.
- Felstead, A., Jewson, N., Walters, S., 2003. Managerial control of employees working at home. *Br. J. Ind. Relat.* 41 (2), 241–264.
- Gareis, K., 2003. Home-based vs. mobile telework: the interrelationship between different types of telework. In: *Organisation and Work Beyond 2000*. Physica-Verlag, Heidelberg, pp. 171–185.
- Guillaume, C., Pochic, S., 2009. What would you sacrifice? Access to top management and the work-life balance. *Gender, Work Org.* 16 (1), 14–36.
- Haddon, L., Brynin, M., 2005. The character of telework and the characteristics of teleworkers. *New Technol., Work Employment* 20 (1), 34–46.
- Harris, L., 2003. Home-based teleworking and the employment relationship, managerial challenges and dilemmas. *Personnel Rev.* 32 (4), 422–437.
- Helminen, V., Ristimäki, M., 2007. Relationships between commuting distance, frequency and telework in Finland. *J. Transp. Geogr.* 15 (5), 331–342.
- Hislop, D., Axtell, C., 2007. The neglect of spatial mobility in contemporary studies of work: the case of telework. *New Technol., Work Employment* 22 (1), 34–51.
- Huws, U., 1984. *The New Homeworkers: New Technology and the Changing Location of White-Collar Work*. Low Pay Unit, London.
- Illegems, V., Verbeke, A., 2004. Telework: what does it mean for management? *Long Range Plan.* 37 (4), 319–334.
- Illegems, V., Verbeke, A., S'Jegers, R., 2001. The organizational context of teleworking implementation. *Technol. Forecast. Soc. Chang.* 68 (3), 275–291.
- INSEE, 2009. E-administration, télétravail, logiciels libres: quelques usages de l'Internet dans les entreprises. *INSEE Première* 1228, 1–4.
- Kitou, E., Horvath, A., 2008. External air pollution costs of telework. *Int. J. Life Cycle Assess.* 13 (2), 155–165.
- Kraut, R.E., 1989. Telecommuting: the trade-offs of home work. *J. Commun.* 39 (3), 19–47.
- Lister, L., Harnish, T., 2011. The state of telework in the US. *Telework Research Network*, June.
- Lyons, G., Urry, J., 2005. Travel time use in the information age. *Transp. Res. Part A: Policy Pract.* 39 (2), 257–276.
- Mac Innes, J., 2005. Work-life balance and the demand for reduction in working hours: evidence from the British Social Attitudes Survey 2002. *Br. J. Ind. Relat.* 43 (2), 273–295.

- Maruyama, T., Hopkinson, P.G., James, P.W., 2009. A multivariate analysis of work–life balance outcomes from a large scale telework programme. *New Technol., Work Employment* 24 (1), 76–88.
- Matthews, H.S., Williams, E., 2005. Telework adoption and energy use in building and transport sectors in the United States and Japan. *J. Infrastruct. Syst.* 11 (1), 21–30.
- Mokhtarian, P.L., Collantes, G.O., Gertz, C., 2004. Telecommuting, residential location, and commute distance travelled: evidence from State of California employees. *Environ. Plan.* 36 (10), 1877–1897.
- Neirrotti, P., Paolucci, E., Raguseo, E., 2013. Mapping the antecedents of telework diffusion: firm level evidence from Italy. *New Technol., Work Employment* 28 (1), 16–36.
- Neufeld, D., Fang, Y., 2005. Individual, social and situational determinants of telecommuter productivity. *Inf. Manage.* 42 (7), 1037–1049.
- Noonan, M.C., Glass, J.L., 2012. The hard truth about telecommuting. *Monthly Labor Rev.* (June), 38–45.
- Nunes, F., 2005. Most relevant enablers and constraints influencing the spread of telework in Portugal. *New Technol., Work Employment* 20 (2), 133–149.
- Peters, P., Batenburg, R., 2015. Telework adoption and formalisation in organisations from a knowledge transfer perspective. *Int. J. Work Innovat.* 1 (3), 251–270.
- Peters, P., Bleijenbergh, I., Oldenkamp, E., 2009. Cultural sources of variance in telework adoption in two subsidiaries of an ICT-multinational. *Int. J. Employment Stud.* 17 (2), 66–101.
- Peters, P., Tijdens, K.G., Wetzels, C., 2004. Employees' opportunities, preferences, and practices in telecommuting adoption. *Inf. Manage.* 41, 469–482.
- Pliskin, N., 1997. The telecommuting paradox. *Inf. Technol. People* 10 (2), 164–172.
- Pratt, J., 1997. Why aren't more people telecommuting?: explanations from four studies. *Transp. Res. Rec.: J. Transp. Res. Board* 1607, 196–203.
- Pyöriä, P., 2011. Managing telework: risks, fears and rules. *Manage. Res. Rev.* 34 (4), 386–399.
- Qvortrup, L., 2002. From teleworking to networking. Definitions and trends. In: Jackson, P.L., Van der Wielen, J.M. (Eds.), *Teleworking: International Perspectives and Trends*. Routledge, London, pp. 21–39.
- Rasmussen, Erling, Corbett, G., 2008. Why isn't teleworking working? *New Zealand J. Employment Relat.* 33 (2), 20–32.
- Richardson, K., Benbunan-Fich, R., 2011. Examining the antecedents of work connectivity behavior during non-work time. *Inf. Org.* 21, 142–160.
- Sandow, E., 2014. Til work do us part: the social fallacy of long-distance commuting. *Urban Stud.* 51 (3), 526–543.
- Schwanen, T., Dijst, M., 2002. Travel-time ratios for visits to the workplace: the relationship between commuting time and work duration. *Transp. Res. Part A* 36, 573–592.
- Sewell, G., 2012. Employees, organizations and surveillance. In: Ball, K., Haggerty, K.D., Lyon, D. (Eds.), *The Handbook of Surveillance Studies*. Routledge, London, pp. 303–312.
- Sewell, G., Taskin, L., 2015. Out of sight, out of mind in a new world of work: autonomy, control and spatiotemporal scaling in telework. *Org. Stud.* 36 (11), 1507–1529.
- Schweitzer, L., Duxbury, L., 2006. Benchmarking the use of telework arrangements in Canada'. *Can. J. Admin. Sci./Rev. Can. Sci. l'Admin.* 23 (2), 105–117.
- Shieh, A., Searle, G., 2013. Telework and spatial trends in Australian cities: a critical review. In: *SOAC 2013: 6th State of Australian Cities Conference*. State of Australian Cities Research Network, pp. 1–8.
- Taskin, L., Edwards, P., 2007. The possibilities and limits of telework in a bureaucratic environment: lessons from the public sector. *New Technol., Work Employment* 22 (3), 195–207.
- Taskin, L., Devos, V., 2005. Paradoxes from the individualization of human resource management: the case of telework. *J. Bus. Ethics* 62, 13–24.
- Thomsin, L., Tremblay, D.G., 2008. Exploring the diversity of mobile working: a detailed examination on the sequences of workplaces and job satisfaction. *J. e-Working* 2 (2), 47–66.
- Tremblay, D.G., 2002. Balancing work and family with telework? Organizational issues and challenges for women and managers. *Women Manage.* 17 (3/4), 157–170.
- Tremblay, D.G., Paquet, R., Najem, E., 2006. Telework: a way to balance work and family or an increase in work-family conflict? *Can. J. Commun.* 31 (3), 715–731.
- Tremblay, D.G., Thomsin, L., 2012. Telework and mobile working: analysis of its benefits and drawbacks. *Int. J. Work Innovat.* 1 (1), 100–113.
- Vilhelmson, B., Thulin, E., 2001. Is regular work at fixed places fading away? The development of ICT-based and travel-based modes of work in Sweden. *Environ. Plan., A* 33 (6), 1015–1030.
- Welz, C., Wolf, F., 2010. *Telework in the European Union. Report for Eurofound*, 28 p.
- Wheatley, D., 2012. Good to be home? Time-use and satisfaction levels among home-based teleworkers. *New Technol., Work Employment* 27 (3), 224–241.
- Wilton, R.D., Páez, A., Scott, D.M., 2011. Why do you care what other people think? A qualitative investigation of social influence and telecommuting. *Transp. Res. Part A: Policy Pract.* 45 (4), 269–282.
- WorldatWork, 2011. *Telework 2011. A WorldatWork Special Report*.
- Zhu, P., 2013. Telecommuting, household commute and location choice. *Urban Stud.* 50 (12), 2441–2458.