INTERNET: Investigating New Technology's Evolving Role, Nature and Effects for Transport

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REVIEW REPORT

Background

Two thirds of the UK adult population are now Internet users (ONS, 2005a). More than half of all homes in the UK are connected to the Internet (ibid), almost half of which now have permanent connections (ONS, 2005b); and, with the expansion of community online centres, the extension of Internet access to all schools and public libraries (Teachernet, nd; People's Network, nd) and growing use in the workplace, almost all members of the UK population are said to have ready access to a place from which they can access the Internet[1]. In the words of Haythornthwaite and Wellman (2002), Internet use 'is being pervasively incorporated into people's lives'. Everyday activities, from education and employment to shopping and participation in social networks, increasingly have the potential to be carried out (at least in part) online, without recourse to physical mobility by the individual undertaking the activity. As Internet use weakens the traditionally strong links between activity, place and time, questions regarding the impacts of Internet use for accessibility and thus activity participation and travel have been raised.

Internet use has potentially important consequences for travel behaviour. Internet enabled accessibility, or 'virtual mobility', provides an alternative to reaching opportunities, goods, services and social networks, providing access without physical travel. In so doing, Internet use may also enable (or enhance opportunities for) the simultaneous conduct of activities, which may further reduce the need for travel. Thus it is that Internet use may reduce congestion and other negative externalities of transport, including aspects of mobility-related exclusion. Equally, however, it has been suggested that virtual mobility will increase physical mobility, as a result of widened travel horizons, an increase in time available for travel, the productive use of travel time and the intrinsic value of travel as an activity in itself; and that Internet use may have negative social effects, including the worsening of social isolation, an increase in deception and the decline of community. Should these be the case, virtual mobility has the potential to worsen mobility-related exclusion and social exclusion in general. A third school of thought questions whether or not there will be *any* observable effect (on travel, see Mokhtarian and Salomon, 2002).

Whilst there has been debate about the impacts of ICTs for travel for some time (for example, Salomon identifies more than thirty papers on this subject in his 1986 review), the rapid growth in access to and use of the Internet in the late 1990s has provided added stimulus to this debate. For the first time, with the Internet, there is a technology truly capable of providing access to everyday activities, without recourse to physical mobility by the individual undertaking the activity; and the Internet is truly popular and universally available (or, at least, statistics suggest that it is becoming so). Whichever of the relationships outlined above is correct, it is clear that Internet use could have important implications for transport policy, including policies to tackle mobility-related exclusion.

The INTERNET project has sought to explore the impacts of Internet use for travel behaviour and the extent to which virtual mobility can provide a viable alternative to physical mobility in providing access to activity participation. To do so, virtual mobility must provide the same function as physical mobility, or, at the least, fill the gap that a lack of physical mobility leaves; and it must not have any negative mobility or social effects that might worsen social exclusion, thereby reducing the benefits of virtual mobility for mobility-related exclusion. This study aimed to consider each of these factors, providing conceptual, empirical and methodological investigation and analysis, to this end.

Objectives

The objectives of this project have been as follows:

1. <u>To develop recommendations concerning the role of the Internet in an integrated transport policy:</u>
   - To identify relationships between personal travel and Internet use, based on quantitative evidence;
   - To demonstrate the potential impact of the Internet upon transport policy, assessing the extent to which Internet use can substitute for and supplement both existing and future travel demand amongst key groups at the heart of current transport policy; and
   - To assess the role of an increase in virtual accessibility in developing a more inclusive society.
2. <u>To produce and make available for wider consultation a data set regarding travel and Internet use:</u>
   - To conduct two national surveys to develop a traveller/Internet profile and map current attitudes towards the Internet, travel and an interaction between the two; and
   - To conduct six-monthly activity diaries to monitor developments in Internet behaviour alongside traveller behaviour, identifying correlation between the two.
3. <u>To enhance current methodologies to enable more effective monitoring of travel/Internet interactions:</u>

[1] 99.5% of households are within 10km of an public internet access point, 95% within 5km and 89% within 3km (Office of the e-Envoy, 2003). Furthermore, 96% of the UK population are aware of a place where they could go online (OII, 2003).

- To integrate quantitative and qualitative approaches, following a novel multidisciplinary approach;
- To incorporate telecommunications into activity diaries, pioneering the incorporation of technologies into studies of traveller behaviour and travel patterns, providing methodological advance in academia; and
- To revisit definitions of accessibility in light of Internet use, examining the appropriateness of conceptualisation of activities as being a function of time and space and the individual's ability to overcome these constraints, an assumed relation in existing traveller behaviour methodologies.

Methodology

Reflecting objective (3), above, this research has employed both qualitative and quantitative methodologies, taking a multidisciplinary, mixed methods approach. The research focused upon two national questionnaire surveys, distributed three years apart; and a longitudinal, panel-based diary study, which incorporated interviews, focus groups and an email survey. The richness and depth of the data gained from these methods led to the decision to forgo the scenario exercises discussed in the proposal.

National Survey. Two national, self-completion, online questionnaire surveys were conducted, three years apart, in March, 2003 and February, 2006. The surveys were designed and analysed by the project team and fieldwork was conducted by GfK NOP, using their proprietary online panel of c. 200,000 GB Internet users aged 16+ and within an online template that has been extensively usability tested.

The first survey was distributed as part of the NOP e-omnibus, at the outset of the research. The survey aimed to:

- gather information from a representative sample of Internet users in GB;
- establish the sample's travel behaviour in terms of mode use and activities outside the home;
- elicit attitudes to personal travel;
- establish the nature of Internet use in terms of forms of access and online activities undertaken;
- elicit attitudes to Internet use;
- assess views concerning the interaction (or not) between Internet use and personal travel; and
- provide insights and guidance for the diary study.

An online survey was implemented, to maximise time and cost effectiveness, with a guaranteed response rate of 1,000. 5,700 members of a panel received emails, asking them to complete this survey. Survey response rates were monitored by GfK NOP and distribution was staged, according to response rates, to ensure that the final sample was representative of GB Internet users aged 16+ (based on the NOP Internet User Profile Survey data). In effect, therefore, stratified random sampling was employed. 1028 responses were received.

The second survey was distributed as a bespoke survey. Questions from the 2003 survey were repeated, allowing the assessment of the change in behaviour and attitudes between the survey waves. Additional questions, reflecting the findings from the diary study (including more detailed examination of the relationships between offline and online activity participation, plus questions regarding multitasking and sociability) were also included. Therefore, in addition to those listed above, the survey had the following aims:

- to examine selected findings from the diary study amongst a larger, nationally-representative sample, allowing analysis of the national applicability of results; and
- to assess changes in attitudes and behaviour, over time.

The questionnaire was initially distributed to those participants who had previously completed a questionnaire within this study, to allow longitudinal panel analysis. 220 of 909 still in the online panel replied. A second mailing was distributed one week later to other online panel members securing the target of 1,000 respondents. Analysis is of panel, cross-sectional and, where appropriate, unique wave 2 data.

Considering the sample, the data suggest that the samples for waves 1 and 2 are broadly representative of *weekly Internet users*, at the time of each wave, in terms of: age; gender; household income; location; and transport mode use. However, detailed examination of representativeness points to a need for caution in drawing conclusions for the national population. *All data will be freely available on the project website*.

Diary study. Authors including Doherty and Miller (2000), Golob (2001) and McCray et al (2003) have highlighted a 'methodological gap', which has frustrated research into the implications of Internet use. The results from the focus groups studies, conducted as part of the feasibility study that preceded this research, alongside a multidisciplinary literature review, complemented such suggestions, such that a key aim of this study was not only to collect empirical data to contribute towards theoretical advance in this area, but also to contribute towards methodological advance through the development and testing of an original methodological design. The accessibility diary was developed, to this end.

In light of the aims and objectives, it was necessary for the methodology to meet the following requirements:

- to provide quantitative data on activity, Internet and travel behaviour, as both primary and secondary activities;

- to gather evidence of change in the above, to allow assessment of the effects of virtual mobility (specifically, its substituting and/or supplementing effects within key activities); and
- to allow appraisal of the influence of key characteristics upon behaviour and behavioural change.

In light of the methodological difficulties that emerged during the focus groups study (including: problems of behavioural awareness and awareness of change; difficulties with retrospective recall; conflict between revealed and stated behaviour, particularly where there is a perceived socially desirable response) and those highlighted in the literature review (including: the complexity of behavioural interactions, therefore the need for a complex dataset; reliability issues with stated preference data; ethical, financial and reliability issues with experimental data; and the exploratory nature of this research, such that an element of inductivism is necessary), a longitudinal, panel-based diary study was selected as the principal methodological approach. A comprehensive, multidisciplinary review of diaries from each of these traditions revealed that none recorded activities, communications, travel and the complexities of time use, including polychronic time use (multitasking), to the level of detail required for this study of the impacts of Internet use upon the same. In consequence, the *accessibility diary* was developed. So called to reflect the emphasis upon all forms of access to activities, the accessibility diary draws together aspects from each of the above methods to allow recording, at the individual level, of personal travel, activity participation, time use and communications use, in one survey instrument. By recording access in terms of both physical travel and communications use, the diary recognises that time and space no longer pose the principal barriers to participation. Recording activity participation alongside modes of access, the accessibility diary allows assessment of the influence of both physical and virtual mobility upon the individual's patterns of participation in activities.

Axhausen (1998) and Stopher et al (nd) debate the difficulties of gathering all of the data that we wish to have, in a single survey, whilst maintaining response rates, particularly in a longitudinal studies. The accessibility diary was designed to balance researcher needs for comprehensive data with participant needs for a diary that is quick and easy to use. Therefore, users are asked for just six basic pieces of information: (1) what they did; (2) the start and (3) end times of the activity; (4) the participation or (5) presence of others; and (6) what else they were doing at the time. Activities are pre-coded. The activity codes are the key to the simplicity of the diary for users, whilst simultaneously providing rich and complex data. In addition, the use of activity codes allows the combination of a number of measured variables into one recorded variable, including the mode (Internet or travel) of access to the activity. All aspects of the diary were piloted and one-to-one training was provided. Focus groups were conducted to discuss the usability of the diary after the first wave. An intensive anti-attrition strategy included payment (£25 for diaries 1 and 2, £35 for diary 3) and regular personal contact, including holiday cards and project updates.

Initial analysis revealed no longitudinal effect, for any key activity, considering the whole sample and demographic subgroups. Therefore, the analysis turned to consider a different analytical approach, exploring difference by (1) total weekly Internet use (sample divided into quartiles) and (2) total and offline participation rates for those participating offline only and those participating online, within each activity. This necessitated the creation of a composite database, integrating the three diary waves into a single database by summing each individual's data, across all three waves, to create a single database. Findings below are from this composite analysis.

During the analysis of the diary study, it became apparent that further qualitative research was necessary to uncover the nature of the relationship between Internet use and activity participation, including travel. Therefore, an email survey was distributed to all those participating in wave 3 of the study (n=80), with the aim of uncovering the likely effects of online participation. 43 participants replied to the survey, representing a 54 percent response rate. The questionnaire asked participants if participating in key activities online has made them spend more time, less time, or had no effect upon their participation in the activity offline. Space was provided for additional comments.

Considering the sample, Glaser and Strauss (1967) discuss 'theoretical sampling': sampling from (researcher-constructed) groups, with the purpose of furthering theoretical and methodological development. This approach has been adopted in transport research by authors including Behrens (2003) and Thomsen (2004), in their investigations of relatively novel research topics; and is recommended by Stopher (1997) as a key method to be adopted for the advancement of understanding of travel behaviour. Random sampling may disguise patterns of behaviour exhibited by key populations, where their number within the population (and therefore the sample) is small. This may, in turn, inhibit theoretical development. In light of the novelty of the research question and of the proposed methodology, this sampling strategy was chosen for this study. The literature review and the feasibility study highlighted a number of variables, which were seen to influence needs from, access to and uses of physical and virtual mobility, plus responses to and effects of the same upon activity participation. Of these, four were selected to inform recruitment. They are: income; Internet experience; mode of travel; and residential location. A mix of age, educational attainment, employment profiles, gender and household structure was sought, in addition to the above key variables. However, it was not the aim to gain a representative or equal mix of these variables and priority was given to sampling adequately within the four key variables. The study aimed to recruit 96 participants, to allow adequate

representation from each of the variables whilst maintaining a sample size manageable for a lone researcher, in light of the intensive anti-attrition strategy implemented. A number of recruitment strategies were employed, the principal being snowballing from key contacts within the community. Press coverage was also effective in recruitment. 92 participants were recruited for the first wave. Of these, 87 participants returned their diary. 85 were complete and usable. 69 participants (79 percent of initial participants) completed and returned complete and usable diaries for all three waves. A further 9 participants were recruited prior to the second wave. A total of 96 participants completed and returned at least one diary. 7 completed only one and 20 completed two diaries. Analysis of the sample population for each wave suggests that attrition was random and was not selective by any key or demographic variable. *All data will be freely available on the project website*.

Findings – diary study

There is no evidence in this research to support a link between physical mobility and virtual mobility. The time use data finds no evidence of a link between physical mobility and virtual mobility, in terms of both substitution and generation, for both the longitudinal and composite analyses. This suggests that the principal effect of virtual mobility for physical mobility is in substituting for an increase in physical mobility, stemming future traffic growth.

There is no evidence in this research to suggest a negative effect of virtual mobility for sociability. The diary data highlight an increase in participation in social networks with increasing time online, considering the analysis of difference by Internet use quartiles; and that those who participate in social networks online spend more time participating in social networks in total than those who do not participate online. Furthermore, the email survey reveals an increase, not a decline, in sociability, as a result of online communications.

This research supports the hypothesis that virtual mobility can provide a viable alternative to physical mobility in reducing aspects of mobility-related exclusion. The results show that those participating online exhibit significantly different behaviour to those who do not participate online. Online participation is associated with significantly more total activity participation for the majority of activities. For education activities, online participation is also associated with significantly more offline activity participation. It was not possible, with these data and this analysis, to categorically state a causal relationship between online and offline behaviour. However, further research in the form of an email survey demonstrates that, for the majority of participants and the majority of activities, online activities are supplementary to their offline counterparts, fulfilling a latent demand for participation.

This research confirms the importance of multitasking for the understanding of travel behaviour, Internet use and activity participation. The findings support the theoretical and (limited) empirical evidence in the existing literature. Multitasking is highly prevalent, occurring on the majority of days and 'adding' 45 percent more time to every working day; and it is important, affecting our perception of, amongst other things, the sociability of activities, the amount of time that we spend online and the amount of time that we spend travelling. The data demonstrate the distorted picture of time use and activity participation that emerges when only primary activities are considered, highlighting that the activities in which time use is most underreported when primary activities alone are considered are those that are fundamental to the travel substitution/sociability debates. Whilst the inclusion of secondary activities did not affect the overall findings in relation to the hypotheses, the importance of multitasking for the understanding of behaviour and change therein is proven.

Methodological findings. There is a dilemma in research in this area: how to balance researcher needs for increasingly complex data and user needs for a survey instrument that is quick and easy to use. The accessibility diary represents an attempt to simplify data collection for a complex subject area, by combining recorded variables, or by accepting less precise data. A number of compromises were made in the design of the accessibility diary, which reduced the number of different *types* of data collected and, as such, restricted the analysis, in a number of ways. However, these compromises acted to increase the *volume* and *quality* of data available, because of the consequent usability of the survey instrument. It is relatively easy to produce a more complex survey instrument in response to the observed data gaps. It is less easy to recruit and retain participants willing to bear the burden of such surveys; and less easy to input, process and analyse such complex datasets. Reflecting upon the above, it becomes clear that we cannot collect all of the data that we wish to have, in a single survey. The results from this research suggest that it is appropriate for further research in this area to consider the following methodological options. *Firstly*, to be more restrictive in the subject under investigation. It may be that a diary with fewer variables, but greater detail in selected variables, would be more effective in enhancing understanding of specific, micro-level aspects of behaviour. Such incremental advance in understanding could lead to greater progress in the field of research, with individual studies drawn together in the development of wider theory. *Secondly*, to take a mixed methods approach. This research suggests that different methods are appropriate for different research questions and different stages of understanding/stages of theoretical development. The methodological solution may lie as much in better understanding of the benefits of combining studies and methods, rather than in seeking

to expand single studies and/or methodologies. *Thirdly*, to reconsider the use of longitudinal methods or to critically examine their capacity to uncover change, particular that which wishes to attribute change to a particular (set of) variable(s). These results suggest that there are phenomena that can*not* be observed using panel data. As such, Goodwin's (1987) observations on the utility of panel data should be revisited.

Findings – questionnaire

Internet use, over time. There is a clear trend towards greater use of the Internet between the waves, considering both hours per week and frequency of use; and a substantial and significant increase in participation in selected online activities, which is not matched by parallel change in offline activity participation. Finally, considering attitudes towards travel, analysis of responses to attitudinal statements highlights a noticeable shift towards greater acceptance of the technology. The greater fluidity of opinions is likely to reflect the still novel status of the Internet. This remains true today, but was particularly so in 2003. There is thus evidence of a changing acceptance of the Internet with its increased (cultural) prevalence and (individual) use over time.

The influence of Internet use upon travel. This was probed in a number of ways. *First*, longitudinal analysis considered the influence of frequency of Internet use upon transport mode and found no links between the two. *Second*, whilst changes in the frequency of car, bicycle, bus and train use are correlated with changes in the frequency of home web, work email, home web and home email, respectively, in the main, there was a lack of a clear direction of change and change was statistically insignificant, or could not be computed. *Third*, participants were asked if their use of the Internet for certain activities had affected their travel to these activities. Whilst the majority of participants, for the majority of activities, suggest that there has been no effect, a substantial minority suggest that their travel has decreased as a result of Internet use. Therefore, considering the wave 2 data, one-fifth of the sample suggest that they spend less time travelling for paid work, as a result of the online paid work; a third spend less time travelling for grocery shopping; two-thirds travel less to communicate with family and friends; a third travel less for education-related activities. Considering other shopping and searching for information, 57 percent and 59 percent spend less time travelling, respectively. There is a significant increase in the percentage of participants suggesting a negative effect of Internet use upon travel time between the 2003 and 2006 waves, for all activities. The data suggest that, with increasing time online and as the Internet is incorporated more fully into daily life (at the individual and societal levels), its impact is changing. *Fourth*, participants were asked to guesstimate how much travel time they save. Notwithstanding caveats regarding the reliability of retrospective recall, the travel time that is being saved through online participation is not insignificant. Considering the mean, more than two hours of work-related and education-related travel is saved, per week; almost an hour and a half of information search-related travel is saved, per week; over an hour of communications-related travel; and almost an hour of shopping-related travel. Should these travel time savings be aggregated to all Internet users and assuming that the time saved is not reinvested in additional travel, the impact upon the transport system would be substantial and significant. The impact upon individual quality of life, through the increased availability of time, would be expected to be similarly substantial and significant. *Fifth*, questions (wave 2 only) explored the effects of online activities upon offline activities, in terms of when, how often and where the offline activity takes place, confirming the complexity of Internet-travel interactions. Whether or not the online activity is in addition to and/or instead of the offline activity and the role of the Internet in providing additional access to activities that were previously inaccessible was also explored. The data highlight a role for Internet use in providing supplementary, rather than substitutive, access, for the majority of participants, to the majority of activities. This said, a substantial minority – up to a quarter of the sample, depending upon the activity – report substitutive effects. *Sixth*, there is no evidence of change over time in participants' stated preferred travel time to key activities. *Finally*, considering attitudes towards travel. The most striking finding from the above analysis is that there has been little change in attitudes towards travel, over time. Where change is observed, in the main, change is in the direction of a greater affinity with travel.

The influence of travel upon Internet use. Between a third and a half of the sample, depending upon the activity, suggest that travel-related factors, including saving time, money, reducing inconvenience or overcoming travel difficulties, influences their decision to participate in activities online, rather than offline. For the majority of activities, travel issues were amongst the most important factors, of those listed, influencing this decision. The research points to a key opportunity in highlighting the convenience of the online, vis-à-vis the offline, activity in persuading substitution and travel reduction.

The influence of Internet use upon sociability. The 2006 survey asked participants about the effect that using the Internet has had upon the *number* of people that the respondent feels very close to, the number that they are somewhat close to and the number of casual acquaintances in their lives; and the time spent *communicating with* and *in the company of* the same. The data fail to support concerns for a decrease in sociability as a result of Internet use. Rather, the majority suggest that Internet use has had no effect upon sociability, with a substantial minority reporting positive effects, in respect of each of the above.

Multitasking. Following the diary study findings, which confirmed the importance of multitasking, the 2006 survey asked participants about the influence of multitasking upon their choice to do activities online, rather

than offline. Between a third and half of the sample suggest that the ability to multitask influences their decision to activities online, rather than offline (dependent upon the activity). Multitasking is the third most important factor in the decision to do an activity online, rather than offline, for communications, education and information search activities. Participants were also asked if it was easier to multitask online, than offline. Results confirm that participants can multitask more when they conduct activities online, than when they conduct the same activities offline. Qualitative text responses support this finding. These results support the hypothesis that Internet use enables multitasking, therefore enabling greater activity participation.

Dissemination Activities

In light of the multi-disciplinary nature of this research, a conscious effort has been made to disseminate to the social policy, time use and transport studies communities in terms of conference and journal papers. Dissemination has been concerned with the conceptual, empirical and methodological advances made in this research; and has reported results from both the national questionnaire survey and the diary study. One conference paper, two journal papers and two book chapters are focused primarily upon conceptual advance. Four conference papers and two journal papers (with two in process) report empirical results from the diary study, of which one is concerned with methodological discussion, drawing upon evidence from the same. Three conference papers (and two journal papers in process) report empirical results from and conceptual advance as a result of the national survey. Two papers integrate the two studies and results from both studies will be integrated in further journal papers. The project team have also spoken at numerous academic seminars and CPD events. In addition to the above academic dissemination, two project web sites disseminate information about the project to participants and the wider community, the latter including access to working papers, presentations and full datasets from the diary study and national questionnaire survey. Finally, results have been disseminated to participants in the form of a project newsletter; and a national press strategy will be implemented in August.

Further Research

This research has highlighted the following principal areas of further research: opportunities for further analysis with this dataset; further research into the importance of secondary activities for travel behaviour research; and future methodological development. Considering *further analysis of the existing dataset*, objective (2) details that a key aim of this research was 'to produce and make available for wider consultation a data set regarding travel and Internet use'. As such, the accessibility diary collected detailed data on daily activity participation; and the national survey, detailed information about attitudes and behaviour with regard to the interactions between travel, activity participation and Internet use. Reflecting objective (2), it was not the aim of this research to review all of the data collected. Therefore, there are considerable opportunities for further analysis of the dataset. With regard to the diary study, this can include: the incorporation of the unused variables; the use of activities not included in this analysis; the recombination of activities into different categories; and the application of alternative statistical techniques. Considering *secondary activities*, the analysis has highlighted the importance of secondary activities to travel behaviour research, with implications not only for the understanding of change in travel behaviour as a result of Internet use, but for all research and policy that considers travel behaviour and/or promotes behavioural change. Further research into multitasking is planned, seeking to understand the importance of multitasking at present; the importance of multitasking for behavioural change, both natural and policy-driven and both positive and negative; and reflecting upon previous research and existing theory, to consider how much of our understanding of travel behaviour is compromised by the failure to take account of multitasking. Finally, considering *methodological development*. Considerable methodological advance (objective (3)) has been made in this research, as discussed above. This has highlighted a number of avenues for further research, including: the exploration of the benefits (or otherwise) of shorter, simpler surveys, perhaps activity-specific, the results from which can then be combined; the efficacy of mixed methods in enabling the collection of greater volumes of data, which can then be triangulated; and research into the attributes of surveys which increase response rates and minimise attrition, which is essential if we are to increase the volume and quality of data that we collect.

Explanation of Expenditure

Some variation in expenditure has occurred. The researcher suffered a traffic accident in the course of the research at an early stage. This resulted in a project extension and her paid absence from work for 6 weeks. The move of the PI and researcher from Southampton to UWE before the start of the project resulted in a salary increase; added to subsequent inflationary increases and further increments, coupled with some increase in staff time worked to manage the complexity of the project has resulted in an overspend on staff costs. The intensity of the diary study resulted in a decision to conduct three rather than four waves. This resulted in an underspend on consumables. Meanwhile, supervision and support of the c100 diary study participants and the increased level of dissemination activity to reach different disciplinary audiences has resulted in an overspend on travel and subsistence. Overall, however, the project resources have been managed and consumed appropriately and effectively.

Note: for reasons of space, the list of references has been excluded.