Studying disruptive events: innovations in behaviour, opportunities for lower carbon transport policy?

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Abstract

The continued failure to put transport on a robust low carbon transition pathway calls for new approaches in policy and research. In studies of transport systems and patterns of mobility, established approaches to data collection, analysis and subsequent policy design have focused on capturing 'typical' conditions rather than identifying the potential for substantive change. This focus on the apparent aggregate stability of the transport regime has reproduced a belief in policy circles that our current travel patterns are largely fixed and therefore very difficult to alter, which in turn has resulted in an over reliance on implausible assumptions about the carbon reductions that can be achieved through technological improvements such as low emission vehicles.

This paper argues that there is potentially much greater adaptive capacity in the mobility system than currently allowed for. It illustrates this potential through the investigation of actual adaptations made during a set of specific 'disruptive' events. The paper concludes by suggesting that we can go further in reducing the demand for travel if we broaden the scope of intervention to take a wider view of when and how mobility matters to participation in activities across the population. This could enable an acceleration of existing trends which suggest the potential for less mobility and therefore less carbon intensive lives.

1 Introduction

There is now growing consensus that rapid and radical change is required in the energy systems and patterns of mobility of developed countries if current targets for decarbonisation are to be achieved. In the UK, ambitious and 'legally binding' targets for the reduction of greenhouse gas emissions to 80% of their 1990 levels by 2050 underline the scale of change required. However, as the *Stern Review on the Economics of Climate Change* (Stern *et al.*, 2006) set out, such a transformation will require almost total decarbonisation of the energy sector, major infrastructural adaptations in all sectors, and significant changes to systems of provision and patterns of consumption (Docherty and Mackie, 2010; HMG, 2011; Schwanen *et al.*, 2011).

Transport and the mobility of people and goods are central to any decarbonisation agenda, contributing 25.8% of EU-28 greenhouse gas emissions in 2015, 23% above 1990 levels (European Environment Agency, 2018). Crucially, it is unlikely that technological innovations, such as the widespread electrification of the vehicle fleet, will be enough in themselves to meet decarbonisation targets within the timescales required (see Holtsmark and Skonhoft, 2014), and so further adjustments including substantial travel behaviour change will also be necessary (CCC, 2016; Oxley et al., 2012). Yet, transport has traditionally been conceptualised as "more difficult" to change (Stern, Peters et al., 2006, xiii), at least in the short-medium term, than other energy- and carbon-intensive sectors. This is due to a variety of factors including: the scale and (perceived) stability of major transport flows; the fixed nature of transport infrastructure in space and the long planning horizons of major investments; complex

interdependencies with lifestyle choices and often entrenched public and political attitudes about the very notion of behaviour change and the extent to which it is legitimate for the state to intervene in individual decision making (Marsden et al., 2014; Docherty and Shaw, 2011; Banister *et al.*, 2007). If, as Brand et al. (2018) argue, it is necessary to couple technological change with substantial social or lifestyle change to achieve deep cuts in carbon, the reticence to shift behaviour must be addressed.

This paper seeks to challenge the pervading mindset that transport is 'too difficult to change' substantively, by exploring two key contentions. First, whilst the 'transport system' is perceived to be stable and durable, underlying patterns of *mobility* are in fact subject to considerable on-going change (Heinen and Chatterjee, 2015). Although we measure (and even seek out) stability at the aggregate level (e.g. total vehicle kilometres travelled from one year to the next), as Cohen (2012: 380) suggests (drawing on the work of Phil Goodwin (2010)), "when seeking to identify nascent transport tendencies there is little value in focusing on global or national averages". Indeed, at the same time that behaviour change has been labelled as difficult to achieve, over the past twenty five years in the UK there has been:

- A reduction in commute trips of 20% per person and despite longer trips, a net reduction in distance travelled per capita
- A move to 15% of goods being purchased on line and a 30% decline in shopping trips and 15% decline in distance travelled per capita

- A major shift in licence holding rates with delayed licence take up, ownership and use and 50% reduction in distance travelled by males aged 18-30 (Marsden et al., 2018)

These trends are not unique to the UK although they vary in their strength in different contexts (Kuhnimhof, 2012; Polzin et al., 2014; McDonald, 2015; Maltha et al., 2017). The reasons for this extend well beyond transport to changes in the economy, in education and parenting (Chatterjee et al., 2018). However, the trends suggest that society can reconfigure to less car dependent lifestyles. We need to understand better how to cultivate and positively support such trends so that they can occur whilst simultaneously achieving welfare gains or at least avoiding welfare losses.

Second, if we contend that some of the changes required to reduce the carbon intensity of mobility are already apparent, then learning from them might make it possible to steer the socio-technical system to a more sustainable state overall (Watson, 2012). However, the changes set out above have happened slowly over time and it is not always possible for people to be explicit about how the changes were brought about (Schwanan et al. 2012). It is therefore necessary to explore sites where change happens to allow more conscious exploration of what is necessary to achieve change. Graham and Thrift (2007: 5) suggest that some of the answers might be found through a focus on breakdown, maintenance and repair within systems: “when things break down, new solutions may be invented. Indeed, there is some evidence to suggest that this kind of piece-by-piece adaptation is a leading cause of innovation, acting as a continuous feedback loop of experimentation which, through many small increments in practical knowledge, can produce large changes”.

We therefore suggest that a key site of learning and innovation about change within the complex mobility system will be at sites of breakdown, repair and reconfiguration of mobility (Guell et al., 2012).

The overarching hypotheses which this paper explores are that, through the study of 'disruptive events' we will find:

i) A greater range of behavioural adaptations than commonly assumed; and

ii) Insights into some of the mechanisms necessary to unlock more behavioural change

The paper proceeds as follows. First, we expand upon the research framework for our proposition that 'disruptions' represent critical episodes from which it is possible to learn more about what social adaptations occur and how. We then review the evidence from previous studies related to transport disruptions to underline the potential for such events to deliver insight. Our data is then introduced, comprising a large sample survey of residents in six sites to explore adaptive capacity at a personal scale and three distinct data collection exercises conducted during disruptive events. This is particularly novel as most of the literature reports on post-hoc recall of events and actions. Our argument is not that the responses observed during disruptions will take us on a more sustainable transition pathway *per se*, but rather that the learning from adaptation during disruption could be the basis for designing new interventions that reconfigure the mobility system in more sustainable and welfare enhancing ways. Our analysis focuses on these insights across a range of contexts which we use to reflect on our hypotheses. The paper concludes by

suggesting that we can go further in reducing the demand for travel if we broaden the scope of where to intervene to take a wider view of when and how mobility matters to participation in activities across the population.

2 Conceptualising 'Disruption'

Graham (2010: 3) suggests that "studying moments when infrastructures cease to work as they normally do is perhaps the most powerful way of really penetrating and problematising those very normalities of flow and circulation to an extent where they can be subjected to critical scrutiny". Drawing on Heidegger, Graham and Thrift (2007) contend that when things break or become inoperable then their relevance comes to the fore as, without this ability to adapt and reconfigure or repair, things cannot continue. They suggest both that "repair and maintenance is rather more significant than the practical models of the onflow of everyday life that have now become so significant in the social sciences and humanities" (p3) and that recovery is the means by which society "produces learning, adaptation and improvisation." (p5). This thinking aligns strongly with our call to both accept change as a part *of* the everyday and to study change *in* the everyday. Whilst the study of 'breakdown' or what we refer to as 'disruption' holds appeal we need to be clear what sorts of 'breakdowns' and 'disruptions' are in focus. This section sets out our approach to understanding what disruption to the mobility system means.

First, we argue that the focus should be around disruption to the system of activities which the transport system supports (see Mattson and Jenelius, 2015). It is straightforward to conceptualise breakdown or disruption to a physical system such

as a bridge which might be closed for repairs or a railway washed away in flooding (Zhu and Levinson, 2010). A recent systematic review of transportation resilience concluded that “most of the definitions of transportation resilience are given either from a system perspective or a network perspective” (Wan et al., 2017) Operational resilience, and objectives to maximise the availability of infrastructure and put back infrastructure to the agreed level of service as quickly as possible in the event of any incident, for understandable reasons, dominate (e.g. Quarmby, 2010). However, the impacts of infrastructure or service provision failures are on people and businesses and so a wider mobility system perspective means focussing on what happens to the activities of everyday life when transport is disrupted.

Our research framework draws on Vollmer (2013: 2), who focuses his insights (although not specifically considering travel) around a key notion that what is ‘disrupted’ is the “coordination of activities and expectations” within a collective entity. It is not just the potential impact of disruption on an individual making a journey, but on the wider social systems of coordination that we need to explore and understand. This directly ties in with both Urry’s and Hägerstrand’s recognition of the importance of the complexity of the coordination task associated with mobility (Hägerstrand, 1970; Urry, 2004), and strands of the resilience literature which foreground social adaptation (see Davoudi, 2012 and Nelson et al., 2007). Schwanen also calls for much greater attention to be paid to the intertwined social and environmental context within which change, and stability, occurs (Schwanen, 2016).

Vollmer's (2013) inclusion of expectations brings to the fore common assumptions around which the complex patterns of coordination are constructed. These include firms' decisions to hold limited inventories and rely on just-in-time delivery, organisational rules and norms that workers must be physically co-present in order to work with each other, the tolerance of lateness in society, or expectations about the time it should take to get between places. Social norms are understood to be an important influence on people's behavioural attentions (Anderson, 2000 and Wall et al., 2008) and Vollmer's work suggests paying greater attention to how these norms change and through disruption. Studying disruption to the mobility system means understanding the responses of individuals but recognising that these happen in a context.

There is an existing literature studying the impacts of disruptive events on travel patterns. The literature is limited in size, relative to the full body of literature on behavioural adaptations in transport, and scope (drawing predominantly from post-hoc reflections. This we suggest is the result of the often unanticipated nature of some of the events (timing, location or both) and the difficulties of mobilising resources to understand such events when the institutional focus is on response and repair. Van Exel and Rietveld (2001; 2009) have studied the impacts of industrial disputes on public transport use. Complete system shutdowns are sometimes observed, although more commonly only a part of the system closes or there is a limited service provided across a whole network. They provide a period of uncertainty in terms of the network that will operate and require a reaction, particularly from regular users of the network or those that had pre-planned to use the network in the

affected period. Their 2009 study of a pre-planned rail strike found that “Forty-four percent of the people who had anticipated to travel by train on the day of the strike abandoned their trip, 24% switched to car as driver, 14% switched to another mode (as passenger), 18% stayed with the train and rescheduled the planned activity to another day” (p526). Earlier work (Van Exel and Rietveld, 2001) identify a strong differential impact on participation in different types of activities during such strikes, with sizeable reductions in cultural and entertainment activities and smaller but still important reductions in shopping and church attendance. In the short run at least, there is capacity to change mode and to postpone travel. This is likely to vary with context, with a recent stated intention survey of reactions to a hypothetical one day complete transit system shutdown in Melbourne anticipating a more car based response (Nguyen-Phuoc et al., 2018).

A study of the London 2012 Olympics provides further insight into behavioural response preferences, albeit in an environment where there are a range of transport options for most journeys. Here, advice was given to travellers to avoid specific stations or routes and to avoid travelling on particular days where the combination of baseline and visitor traffic would have caused severe overcrowding. Interestingly the study found that 40% of people did not intend to make any changes when asked before the games but, of these, 40% did make changes. Of the 60% intending to change 76% went on to make a change (Parkes et al., 2016). The most common behavioural responses were retiming and reducing journeys (33% and 32% of respondents respectively) compared with 19% re-routing and 14% changing mode.

213 6% of people had sustained their change two to three months after the Games had
214 finished (Parkes et al., 2016).
215
216 Cairns et al. (2002) and Zhu and Levinson (2010) review over 100 studies of the
217 temporary or permanent loss of road capacity (e.g. bridge closures and roadspace
218 reallocations to non car modes). Some of these interventions are planned, consulted
219 on and communicated to the affected public (such as pedestrianising streets or
220 closing a bridge for maintenance). Others are unplanned disruptions typically as a
221 result of significant external factors (earthquakes, bridge collapse, flooding or
222 damage to bridges). They all had significant durations and therefore required more
223 than just an adaptation of actions from one day to the next. Cairns et al. (2002) found
224 that in half of the cases they studied, 11% of vehicular traffic could not be found in
225 the study areas after the reduction in capacity. In some cases this was attributed to
226 traffic finding routes in other areas or people changing the mode of travel or
227 destination. However, they also found adaptations that go well beyond those
228 imagined purely from considerations of network availability and journey time costs.
229 These included “consolidating trips for different purposes, altering the allocation of
230 tasks within a household to enable more efficient trip-making, car-sharing, or no
231 longer making journeys (e.g. by working from home occasionally). Longer-term
232 responses included changes in job location, changes in household location and
233 changes in developers’ choice of location for new development.” (p18). More
234 recently, examination of the impacts of Hurricane Sandy, Kontou et al. (2017) found
235 that wealthier commuters were more likely to continue teleworking for longer.
236 Kaufman et al. (2012) reported the necessity of substantial workplace reorganisation

as a result of power outages as well as reduced transport options. This echoes Guiver's qualitative research of a bridge collapse which severed a town in a national park in England where substantial institutional and organisational reconfiguration happened to reduce the significant transport impacts (Guiver, 2011).

The existing literature provides some support for the notion that both the scale and variety of behavioural adaptations during disruption is larger than that considered in traditional transport interventions. It also suggests that, after such events some of the adaptations persist, even where no intentional strategy to support that was present. These events are therefore interesting sites of learning about how bigger adaptations are made possible, the conditions necessary to extend those adaptations or the practical limits to doing so.

However, much of the existing literature relies on recall to capture the behavioural adaptations and this has significant limitations in terms of forgetting, confounding or providing narrative reinterpretations of why certain changes were made (Behrens and Mistro, 2010). The next section introduces our novel data sets which enabled us to overcome some of those limitations and study behavioural adaptions during disruptions.

3 Case Study Methodology

Our empirical evidence is drawn from a set of surveys investigating changes in traveller behaviour in response to disruption in the UK, namely:

1 x baseline six-site household questionnaire survey:

- *Everyday survey:* A large sample online survey, N = 2,700, of six areas of the UK[1] seeking to understand adaptive capacity amongst travellers when faced with a variety of everyday disruptions.

3 x responsive mixed method surveys:

- *Winter*: a major snow and ice weather event in January 2013 affecting most of the country for over two weeks which led to the closure of motorways and airports as well as many minor roads and delays and cancellations to rail services. Online survey focusing on the heavily affected areas of Yorkshire, East Anglia, the southern Home Counties and South Wales, N = 2,417;

- *Flooding*: a major flooding event in 2014 across southern England which closed numerous roads and rail lines for several days, N = 520. This is augmented by in-depth qualitative research of flooding in the historic city of York (2012) in the north of England based on face-to-face interviews with households, N = 75;

- *Forth Road Bridge (FRB)*: The closure of a major estuarial road crossing on the main route north out of Edinburgh, Scotland to all traffic for 3 weeks in December 2015. A large sample questionnaire survey of travellers, N = 1,364, alongside data from traffic count sites and a smaller survey of affected businesses.

[1] Aberdeen (*n=436);* Liverpool *(n=410);* London (*n=632);* Reading & Bracknell (*n=410);* Yeovil & Chard (*n*=405); York (*n*=407)

There are three important aspects to note about these data sets. First, for the *Everyday survey*, a questionnaire was administered in six different 'Travel to Work Areas (TTWA)' in the UK in September 2013. This survey was administered to enable benchmarking of experience of disruption (the frequency and type of adaptive response) in a variety of types of location across the UK (a capital city (London), a post-industrial city region (Liverpool), a historic city (York), a large regional employment centre with rural hinterland (Aberdeen), a commuter town (Reading) and a rural county (Yoevil and Chard). The design of the survey was preceded by a set of four focus groups, as well as an extensive literature review, to inform the types of disruption, adaptive response options and associated vocabulary used on the survey. A market research company (YouGov) was used to provide an online sample and age and gender quotas were applied to ensure a representative sample with additional corrective weights applied among the 2,700 final respondents. The sample under-represents those with limited computing skills or access.

Second, for the three data sets collected on actual disruptions (*Winter*, *Flooding* and *Forth Road Bridge – the 'Responsive' surveys*), these were all collected during the period of the disruption itself. A core survey instrument was developed and passed through ethical approval which considered what should be asked in the event of a 'generic' disruption and this was quickly tailored for each circumstance. Data collection for the *Winter* and *Flooding* surveys took the form of online panel surveys (in this case Research Now). Specific geographical and socio-economic quotas were put in place to ensure that both surveys were statistically representative for the

regions being surveyed. Once again, the sample under-represents those with limited computing skills or access to ICT. The *Forth Road Bridge* closure survey used a mixed-method approach: (1) An online survey promoted via Twitter yielding few responses; (2) A postal survey mailed directly to 9,500 households in areas affected by the disruption; and (3) The distribution of self-completion paper surveys to passengers boarding train services operating across the River Forth and to passengers boarding direct coach services at a Park and Ride site travelling to Edinburgh via an alternative bridge (with a significant detour of 40 minutes (66% extra journey time)). Full details of the closure, data and analysis are provided by Shires et al. (2016).

Third, the responsive data covers a range of circumstances in a range of contexts within the UK. The *Forth Road Bridge* (FRB) closure was a clearly defined infrastructure failure where there was a government agency tasked with managing that failure and implementing a response plan. The *Flooding* research covered a large area of southern England where a large number of road and rail routes in the area were affected for, in some cases, several weeks. However, there were also parts of the network which were not affected and so re-routing options existed for many people. The *Winter* survey was conducted over several of the worst affected areas of England and Scotland during a period of snow ice and heavy rain. The impacts varied day to day with the weather but the freezing temperatures meant that large areas were impacted for one or two weeks with much less clarity over exactly where in the network impacts would occur. Taken together, these datasets provide a diverse set of behavioural responses from which it is possible to identify a range of

commonalities as well as distinctive reactions to each type of incident. There is no such thing as a representative disruption as each will be highly contextual in time and space. It is also, in circumstances like this, not possible to know what the target population is nor to be able to meaningfully interpret metrics such as response rates. For the online panel surveys, conducted by YouGov (Everyday survey) and Research Now (Winter and Flooding surveys) every effort was made to match the socio-economic characteristics of the population in the areas we requested the survey company to sample in. This was not the case with the FRB which distributed questionnaires in a random manner to rail users and through a household postal survey, the distribution of which was weighted to reflect population densities by postcodes (though still random within each post code).

The survey instruments which were used to gather data are all available to download from
http://www.its.leeds.ac.uk/fileadmin/documents/research/disruption/disruption.zip.
The characteristics of the samples from the Everyday Survey and the FRB Survey are available as Annex 1.

From an employment perspective the FRB survey sample is replicative of the census statistics. This does not appear to be the case with regards driving licence and car availability, with the survey sample reporting much higher incidences of both (23% and 16% respectively). This suggests that those responding are more likely to have been directly affected by the FRB closure, namely car drivers or car passengers. It also reflects that our sample is skewed towards commuters (68%). Whilst care is

356 required in interpretation of the results, it is both likely and desirable, from a learning
357 perspective, that those affected by these events are most likely to respond to surveys
358 about the effects. Overall then, we do not claim that the scale of response is
359 therefore transferable but we instead identify responses which could be expected to
360 be evident in a range of places.
361
362 **4 Case Study Findings**
363 The various data collection exercises described above differed with respect to their
364 timings, precise methods and geographical contexts. Nevertheless, each was
365 formulated and administered with the common objective of capturing perceptions and
366 behavioural responses to disruption utilising, as far as was practicable, core survey
367 questions relating to aspects such as adaptive behaviours. We structure the findings
368 as follows. First, results from the *Everyday* survey are presented. This provides a
369 complementary 'benchmarking exercise' to the Responsive survey results which
370 follow by reflecting a 'base' level of potential flexibility upon which behavioural
371 responses during disruptions are built across different types of disruption, place and
372 socio-economic circumstance. Second, the adaptive behaviours are examined from
373 the Responsive surveys, looking firstly at work and business travel and secondly at
374 non-work related activities, reflecting Cass and Faulconbridge's (2016) call to look at
375 travel in the context of particular purposes. Thirdly, these results are brought together
376 through a categorisation of adaptive responses to disruption. Through this, we
377 discuss what the implications could be for a reimagination of the broader 'travel
378 behaviour change' policy agenda in response to our first hypothesis.
379

4.1 Benchmarking adaptive responses using the Everyday survey

The six-city questionnaire survey investigated the capacity for people to adapt their travel patterns in the context of everyday journey making. To explore flexibility, standardised categories of adaptive behaviours were offered as response options on the survey. Such categories had been used previously (for example by Transport for London in their management of the London Olympics in 2012 (Parkes et al., 2016)). These comprised of *remoding* (using a different form of transport for at least a main leg of the trip, including working at home or shopping on the internet), *retiming* (modifying the time at which the trip starts) and *rescheduling/cancelling* (cancelling the activity on that day and potentially undertaking it on a different day).

In Figure 1 we see self-reported assessments of the relative ease or difficulty of *remoding*, *retiming* and *rescheduling*/*cancelling* for five different journey purposes. The question relates to everyday life, specifically asking people to recall the last time they undertook a journey for each of these purposes[2], where relevant. This data provides a means of broadly capturing the degree and the type of flexibility (or inflexibility) for different types of trips in the absence of a disruptive event.

Insert Figure 1 about here

[2] Specifically: "*Think about the last time you undertook each of the activities listed below. How easy/difficult would it have been for you to have (i) travelled to these activities at a different time that day? (ii) used a different mode of transport (e.g. car, bus, walk, train or even the internet at home) from the one you used? (iii) cancelled/postponed this activity?* This was asked on a 5-point scale*: Very easy, somewhat easy, neither easy nor difficult, somewhat difficult, very difficult.*

As may be expected, food shopping is perceived to be the most flexible, with many more people saying that it would be 'very easy' or 'somewhat easy' (combined into one category 'easy') to *retime* or *reschedule/cancel* these trips than said it would be 'very difficult' or 'somewhat difficult' (= 'difficult'). Smaller but equal numbers of respondents claim it would be easy or difficult to *remode* despite the fact that remoding could include using the internet in this case. By contrast, school trips are the least flexible with respect to *retiming* and *rescheduling/cancelling*, but almost twice as many suggested they would find it easy to *remode* as said it would be difficult. Therefore these two journey purposes directly contrast with each other in terms of the type of adaptation that is deemed possible.

Interestingly, *remoding* was found to be almost equally as easy or difficult as *retiming* for the journey to work, with just over 40% of employed respondents suggesting they would find it easy to have responded in each of these ways on their last journey. In this case, participants were asked to include working at home as a form of *remoding*. Voluntary work and caring for an adult outside the home appear to have a split profile across each of the three adaptation responses in that almost as many people recorded that it would be easy or difficult for each option. Voluntary work is slightly more flexible than caring with respect to both *remoding* and *rescheduling*, than caring duties.

In summary, looking across all journey purposes, *rescheduling/cancelling* is reported to be the most difficult adaptation, particularly with respect to the journey to school and work, as would be expected, but also for caring responsibilities outside the

home. *Retiming* is the most popular adaptation for shopping and caring, both *remoding* and *retiming* are equally popular for work but *remoding* is the only meaningful option for the school run.

The Everyday survey allowed us to examine how this perceived flexibility varied spatially. The availability of a range of transport services in an area (and the infrastructure they rely on) has long been associated with a lower propensity to travel by car (e.g. Santos et al., 2013). The findings from the Everyday survey corroborates this by showing a clear positive relationship between the level of public transport use in general (i.e. the average proportion of all trips per person per week undertaken by public transport) among commuters in each location and their stated ease of *remoding* for the journey to work (Figure 2). Yeovil & Chard, a predominantly rural location in the south west of the UK shows high car dependence and low reported *remoding* capability, with London the reverse on both counts. While the contrasting results for these two locations might be expected, this analysis reveals that there nevertheless exists some capacity to adapt in all locations.

Insert Figure 2 about here

On an individual level, our data supports this positive relationship, finding that many people are multi-modal and therefore are already skilled in remoding and these skills could be applied to other circumstances. The Everyday survey enables an examination of a broad set of socio-demographic characteristics associated with perceived flexibility across different journey purposes including its association with a

number of attitudinal constructs. There are too many variables to include here (see Anable and Budd, 2014 for further details), but Table 1 provides an overview of the relationship between self-perceptions of ease/ difficulty of remoding for the journey to work and a selection of typical socio-demographic characteristics. Where the socio-demographic characteristic is a categorical variable, the relationship with the categorical 'perceived ease of remoding for the journey to work' variable was examined with chi-square analysis. Where the socio-demographic variable is a continuous variable, a one-way Anova was performed. The sample has been restricted to those who claim to use the car for their main mode to work and do not have any disability that could impair choice of alternative travel mode (N=792).

Insert Table 1 about here

This analysis reveals that individual perceived ability to adapt varies according to a range of characteristics, some of which can be assumed to clearly constrain flexibility in more or less predictable ways. For instance, shorter distance to work, greater multi-modality, ability to work flexibly, ability to work at home and fewer fixed commitments outside of work are all associated with a lower perceived difficulty to remode away from the car for the commute journey. On the other hand, this analysis did not reveal income, tendency to undertake business trips, possession of a bicycle for own use, the length of time living at the same address or having children at home/ dropping them off on the way to work (unless a lone parent where this is more difficult) as being related to this perceived capacity to change.

4.2 Findings from the responsive surveys: work and business travel

Commuting and business trips represent 20% and 9% of all person miles travelled in England respectively, and are therefore an important source of carbon emissions (DfT, 2016). The journey to work is traditionally identified by transport planners as *the* critical trip in economic and infrastructure investment terms, so our surveys undertaken during the disruption events focused first on these journeys.

The response options given in the responsive surveys differed due to the ability of participants to be more specific about whether activities had really been rescheduled or cancelled and because remoding for the winter and flood results would be difficult to interpret given the lack of data on alternative service provision and quality. Retiming has the same meaning across Sections 4.1 and 4.2, rescheduling is the same but we have separated out cancelling from rescheduling and classed them as activities not conducted at any point. Relocating includes activities done elsewhere or from home. The Forth Road Bridge survey allowed re-routing and remoding to be captured.

During the *Forth Road Bridge* disruption there was a headline reduction in the number of days people travelled to work of 0.4 days per person per week, with 14% of respondents reported reducing the frequency of work trips. The largest reduction was in people travelling to work five days a week which decreased from 63% to 51% of commuters with three-quarters of this reduction in mobility achieved instead by working from home instead of commuting to an office or other regular place of work (relocation). The remainder may be explained by *cancellation* or by greater use of

flexible working arrangements such as formal flexi-time arrangements (rescheduling) to work more intensively on days when travel (which often had significantly longer journey times due to the diversion) was made.

Similar adaptations were revealed during the *Winter* and *Flooding* disruptions studied. Table 2 shows the range of temporal and spatial adaptive responses for the commute and in-work business travel during the *Winter* survey period and on the first day following flooding from the *Flooding* survey. The winter weather event had the greater impact on work and business travel due to its impact on many routes on a regional scale. Both events led to a large amount of *retiming*, especially during the winter events and for commuting journeys, but *rescheduling* was also a key response for business trips. Rescheduling was a comparatively small response with respondents more likely to work from home or somewhere other than their usual place of work than to reorganise on which days they would work.

Insert Table 2 about here

As part of the Flooding survey respondents were asked how many times they had experienced flooding. Those that had been affected 7 or more times by flooding were more than twice as likely to work from home as a response than those never previously affected (12% to 5%) and more likely to reallocate tasks to other people (4% to 1%) reinforcing the importance of learning over time and within social groups.

During the FRB closure additional rail services were put on and, because of the length of the diversionary routes for cars (although 31% of respondents indicated they did travel on a different route), *remoding* was a major response with 42% of car users and 46% of bus/coach users shifting to rail which is consistent with the estimated ease of remoding from the Everyday survey. In addition, in the Everyday survey the *remoding* category included working from home whereas this was measured separately in the FRB study. There was a 46%[3] increase in the number of days working from home. This was largest for car users (58%) and lowest for bus/coach (8%) with rail and 'other' similar at 28% and 27% respectively.

Working from home is not an option for everyone, although 84% of respondents in our sample reported it being possible. Of these 84%, 38% of employers were supportive of home working (a great deal or quite a bit) but 42% were not supportive. 90% of respondents reported flexible working being possible (e.g. longer hours on some days). 57% of employers were supportive of flexible working (a great deal or quite a bit) and 18% were not supportive of flexible working. It is worth noting that in the Everyday survey, only just under half of all working respondents agreed that their working hours were flexible. 22% of respondents currently in work agreed that 'the attitudes of my work colleagues about start/finish times make coping with disruption more difficult' and 26% believed 'employers could be more sympathetic when travel disruptions happen'. Nevertheless, in the FRB survey, even for those with no ability to work from home, different shift arrangements were sometimes implemented during the disruption to increase the intensity (hours worked) of each work trip and therefore

[3] Albeit it from a small base of 0.5 days before the disruption.

542 reduce the total trip volume. This is reflective of a more general shift to fewer
543 commutes and longer working days across the UK (Le Vine et al., 2017).
544
545 Taken together, the Everyday and Responsive surveys suggest significant
546 proportions of the population capable of remoding, retiming and relocating their work
547 activities at least some of the time. Some sectors of the population find this more
548 challenging due to non-transport factors (nature of employment, parenting
549 responsibilities limiting flexibility) although factors such as long distances and more
550 limited options also reduce the scope for remoding.
551
552 **4.2 Findings from the responsive surveys: non work trips**
553 Although given less attention in transport policy, non-work trips comprise 71% of all
554 distance travelled domestically in England (19% visiting friends, 13% personal
555 business and other escort, 11% shopping, 5% educational escort and 22% other
556 leisure (DfT, 2016)). It is not unusual to classify leisure and personal business trips
557 as discretionary within transport and to presume that this is where most flexibility may
558 lie (e.g. Chu, 2010). However, as hinted at in the Everyday survey with respect to the
559 differential perceived abilities to reschedule shopping, caring and voluntary work
560 trips, we observe that this assumption belies important differences between different
561 'discretionary' activities.
562
563 Figure 3 shows the % of respondents from each of the Responsive surveys reporting
564 retiming, rescheduling, cancelling and relocating each of the activity types which
565 gives an indication of how likely different activity types were to be affected. Table 3

566 shows the median % of respondents recording a response by disruption (flood, winter
567 and FRB) and organised first by joining all responses across each activity type and
568 then by type of adaptation. This allows some more generic but important summary
569 findings to be made. First, each disruption had quite a different scale of response
570 showing the importance of context such as the scale of network impacted and the
571 anticipated duration of impact. Second, whilst noting differences in magnitude and
572 sometimes order of responses across disruptions, some activity types (shopping,
573 leisure and visiting friends and family) seem much more amenable to change than
574 others (health and sport). Third, rescheduling to another time period and cancelling
575 seem more likely to be undertaken more limited retiming and relocating of activities,
576 although context again matters here with relocation being the most important
577 adaption during flooding.
578
579 *Insert Figure 3 about here*
580 *Insert Table 3 about here*
581
582 The qualitative work during the York flooding case study enriched the understanding
583 of which adaptation behaviours are likely to be applied to discretionary activities.
584 Household interviews revealed that many people shopped more locally, were able to
585 make do with food stocks for a little longer or did small top-up shops en-route to
586 activities when they did manage to travel during this period. Some replaced a
587 physical shopping trip with a home-shopping activity which they sometimes did
588 anyway. In the flooding surveys, where only some areas were affected, relocation of

activities was a more important response and this was true across all activity types other than health where there is limited scope to relocate where this occurs.

Leisure activities were cancelled most often and for a range of reasons. For example, in the FRB study, extended journey times for work reduced the amount of leisure time available. In the winter and flooding studies some leisure activities were unsafe or difficult to access and so cancelled. Across all activity types, rescheduling activities within a week was still commonplace. The responses for sporting activities are dictated by the nature of the facilities affected and the degree of formalisation of participation. Team or individual league related sports have to be rescheduled whereas hobby related sport can be cancelled.

We contrast the findings in Figure 3 and Table 3 to those from the Everyday survey on Friends and Family (Figure 1), which suggested that *rescheduling* and *cancelling* are reported to be the most difficult adaptations overall, but in particular for caring responsibilities outside the home when compared to other discretionary activities measured. Here, rescheduling and cancelling are most prevalent except in the flood survey where relocation features strongly. This is potentially important methodologically as it may be that rescheduling and cancelling are less desirable responses to remoding or retiming on paper but not in practice when the realities of the trade-offs are faced. We are unable to test this further as the respondents to the Everyday survey were different to those in the disruptions.

612 The household interviews during the York study revealed great efforts being made to
613 reach certain events such as birthdays and christenings which had a high degree of
614 synchronisation between many participants and sometimes no temporal flexibility.
615 Therefore, such events came across as very rigid. Caring trips for elder relatives
616 (often classified as a discretionary activity) were also described as a high priority as
617 routines for care recipients were seen to be very important although they could
618 sometimes be reallocated to other people who were less affected. Within household
619 and within workplace task reallocation was commonly discussed.
620
621 Overall, the results therefore suggest greater attention needs to be paid to where
622 flexibility may lie and what sort of flexibility might be possible at a more disaggregate
623 level than a simple typology of work versus discretionary travel. More attention also
624 needs to be paid to the nature of the activity beneath such aggregate headings as
625 'friends and family' if we are to understand where flexibility may lie and where it does
626 not. There is however evidence of some flexibility for some people in all of the
627 different activities. The flexibility does not just lie with the individual but depends on
628 colleagues, family members, wider social networks and the norms which
629 predominate during the disruptions.
630
631 **4.3 A categorisation of adaptive behaviours**
632 The *Everyday* survey adopted a tried and tested limited categorisation of potential
633 adaptive behaviours (*remoding, retiming, rescheduling/ cancelling*) which was
634 expanded and tested further in the responsive surveys. Indeed the mixed method
635 opportunities offered by the responsive surveys found these initial three categories to

squash quite different types of response together which oversimplifies or, potentially, overlooks, how best to understand how people behave. Consequently, in response to our first hypothesis we expand this list to seven behavioural adaptations that could be a goal of policy as set out in Table 4.[4] Each category in the table relates to a unique combination of spatial, temporal and material reconfigurations involved in the adaptation. If what we are seeking to do is reconfigure the patterns of societal co-ordination as Vollmer suggests, then we need to be broader in our inclusion of temporal, technological and locational adaptation (see also Lyons and Davidson (2016) for discussion of the Triple Access System) as well as thinking about modes and routes.

Insert Table 4 about here

In setting out these behavioural responses, we also note that the second order effects of such responses need to be considered. For example, reallocation of tasks does not save carbon unless the person or group to whom the task is reallocated is closer or will use a less carbon intensive mode to conduct the task. Similarly, shifting an trip to a bank to an on-line transaction is different in carbon benefits to replacing a trip to a store with a home delivery.

We also suggest that the nature of an individual set of capacities needs to be framed even more broadly than the seven categories included here to include, as discussed above, what Vollmer (2013) refers to as 'expectations'. As such, we also identify '*renorming'* as a new category of adaptive strategy and response. The *renorming*

[4] Cancellation is removed from the list as this is not a policy strategy but an emergency response and we acknowledge that not changing is also a possible response, but it is not classed as an adaptive behavior.

concept emerged in particular from the qualitative components of our studies. The interview data suggested in a variety of ways that the boundaries of norms are renegotiated or reinterpreted during moments of disruption (see also Parkes et al., 2016 during the London 2012 Olympics). There was clearly an intensification of flexible working and home working for example and whilst there is still some way to go to match the potential degree of flexibility to attitudes and expectations of employers and colleagues these boundaries shift during disruptions. This is more an acceleration of existing trends than the creation of a new norm. Recent research has shown that for the past twenty years the UK labour market has had an increase in working from home, working from multiple sites and reduced commute frequencies per capita (LeVine et al., 2017). Similarly, the degree of comfort in home delivery of goods has increased and intensifying home shopping is now a more normal part of everyday life for many people (77% of adults in Great Britain shopped on-line in 2016, up from 53% in 2008, DfT 2017) and therefore a more normal response to it being more difficult to physically reach a store for many people.

5 Discussion and Conclusions

This paper opened with two important contentions about the shape of the current debate on the potential to reduce transport emissions. First, we described why one of the reasons for a cautious policy approach to intervening in travel demand is a wide ranging perception that mobility patterns are stable, durable and difficult to change. This mindset emerges from the longstanding framing of transport policy around analyses that focus on travel patterns at the aggregate level which do indeed change slowly, rather than alternative sites of analysis that might reveal considerable churn and/or adaptation that is already apparent. Using novel data sets, we have been able

683 to provide a range of evidence to demonstrate that there is a greater range of
684 behavioural adaptations than commonly assumed and that these adaptations are
685 applicable across a wide range of places, people and journey purposes. In our
686 analysis of what may support (or prevent) adaptive capacity, the importance of
687 disaggregation across detailed journey purposes, locations and prior experience of
688 disruption were revealed. Assumptions typically made relating to the flexibility of
689 discretionary journeys as contrasted to the inflexibility of work-related journeys were
690 exposed as somewhat misguided. Certain classes of activity generally permit a range
691 of destinations and timings (e.g. shopping), others such as healthcare facilities are
692 more fixed. Significant flexibility in accessing work was seen for many. However,
693 caring responsibilities and family special occasions were found to be especially
694 'rigid', exposing the complexity of coordinating activities and expectations as vital
695 components of the mobility system.
696
697 In reflecting on the findings of the discovered set of behavioural adaptations, we see
698 what Graham and Thrift (2007) suggest, which is innovation at sites of breakdown
699 and recovery. The behaviours observed in some senses represent those which
700 would in any case be deployed in the normal run of daily life (remoding, retiming,
701 rescheduling, reallocating) but the disruptive events generated greater need to
702 deploy alternative strategies and revealed more about what flexibilities could be
703 available. Although these flexibilities are not entirely new, they are less considered,
704 understood and visible in the normal framing of travel behaviour.[5]

[5] We acknowledge that activity-based modelling attempts to take account of role allocation within households and of activity chaining across periods longer than a day. These approaches have yet to see widespread application however and the policy implications remain muted.

Our second contention was that by developing insights from research on cities as systems (Graham and Thrift, 2007) and combining it with Vollmer's work on the sociologies of disruption (Vollmer, 2013), it might be possible to demonstrate how mobility (and thus emissions) might be reduced in future by applying the lessons implied by our evidence. Evidence now suggests that, in England, per capita trip making and trip distances have declined over the past ten to twenty years in almost every activity class (DfT, 2017) even in the absence of a policy to support this. To enable this change, many of the adaptations found in this research seem likely to be at play. It is surely, therefore, legitimate to consider using the insights from this research to accelerate these trends such that active participation in society is less mobility dependent.

Recent research has shown that many people are in fact multi-modal when their total mobility choices are considered across even a week (Heinen and Chatterjee, 2015). The Everyday survey was able to test this at the individual level and spatially, showing that the places and people with the greatest multi-modal capacity and experience are most likely to self-report as being adaptable. Whilst our work reinforces the potential to see existing multi-modality as an important marker of capacity for change (see also Cass and Faulconbridge (2016) on the importance of competencies to use modes), it also demonstrates that experiences of doing things differently builds a set of adaptive capacities which goes well beyond remoding to relocating, reducing and reallocating, all of which could potentially contribute to less travel and lower emissions. Whilst it may not be possible for most people to reduce

car use all of the time, it is clearly possible for the majority of drivers to do so some of the time. This requires a change in the planning mindset however from the current approach of seeing people as 'modal users' (e.g. car drivers or bus users) undertaking a regular set of journeys. The incentives we have in place reinforce this with many season ticket offers on public transport making sense only for very regular users and workplace parking fees often being monthly or yearly tariffs. The advent of more integrated ticketing and payment across modes through Mobility as a Service could offer the potential to change the system of incentives to reinforce more flexible and less mobility intensive lifestyles and thus reinforce what appear to be changing underlying societal norms.

As well as designing systems which encourage a broader set of travel behaviours, our research also suggests that there is greater potential for people to adapt than they may indicate if asked in surveys. An approach of adopting temporary or seasonal closures or adaptations to infrastructure offers the potential to experiment (as with the New York City experiments in Sadik-Khan and Solomonow, 2016). Some of this is inevitable in any case given the scale of urban maintenance programmes, but more thought should be given as to whether things need to be put back the way they were or can be part of changing pathway. Our work suggests that there is greater potential for societal adaptation if we can explain why it is necessary and what the benefits might be.

It is important to note that individual capacity to adapt varies across individuals for a range of reasons (Murray and Doughty, 2016). Some of this relates to the availability

753 of different transport options, physical or mental capacity or financial ability to access
754 alternatives as studied in the literature on uneven distributions of transport access
755 (Lucas, 2012). Some relates to broader social conditions such as the presence of
756 children in the household, single parenthood and the nature of employment (Cass
757 and Falconbridge, 2016). It is also clear from our results that very coarse activity
758 headings also mask important differences in the degree to which different activities
759 are flexible and in what ways they might be flexible to different groups.
760
761 In conclusion then, our findings suggest the dominant framing of stability in transport
762 policy seems incorrect and likely to miss opportunities that exist to learn from and
763 capitalise on innovation and change in the everyday. This matters because if current
764 targets for decarbonisation are to be achieved, then radical change is required in the
765 energy systems and patterns of mobility of developed countries at a wholly different
766 scale and pace to that currently achieved. The focus on change and reconfiguration
767 during disruption could help to reveal more about the nature of societal adaptations,
768 many of which are happening in everyday life, and which could be stimulated further
769 to accelerate progress on a lower carbon transition pathway.

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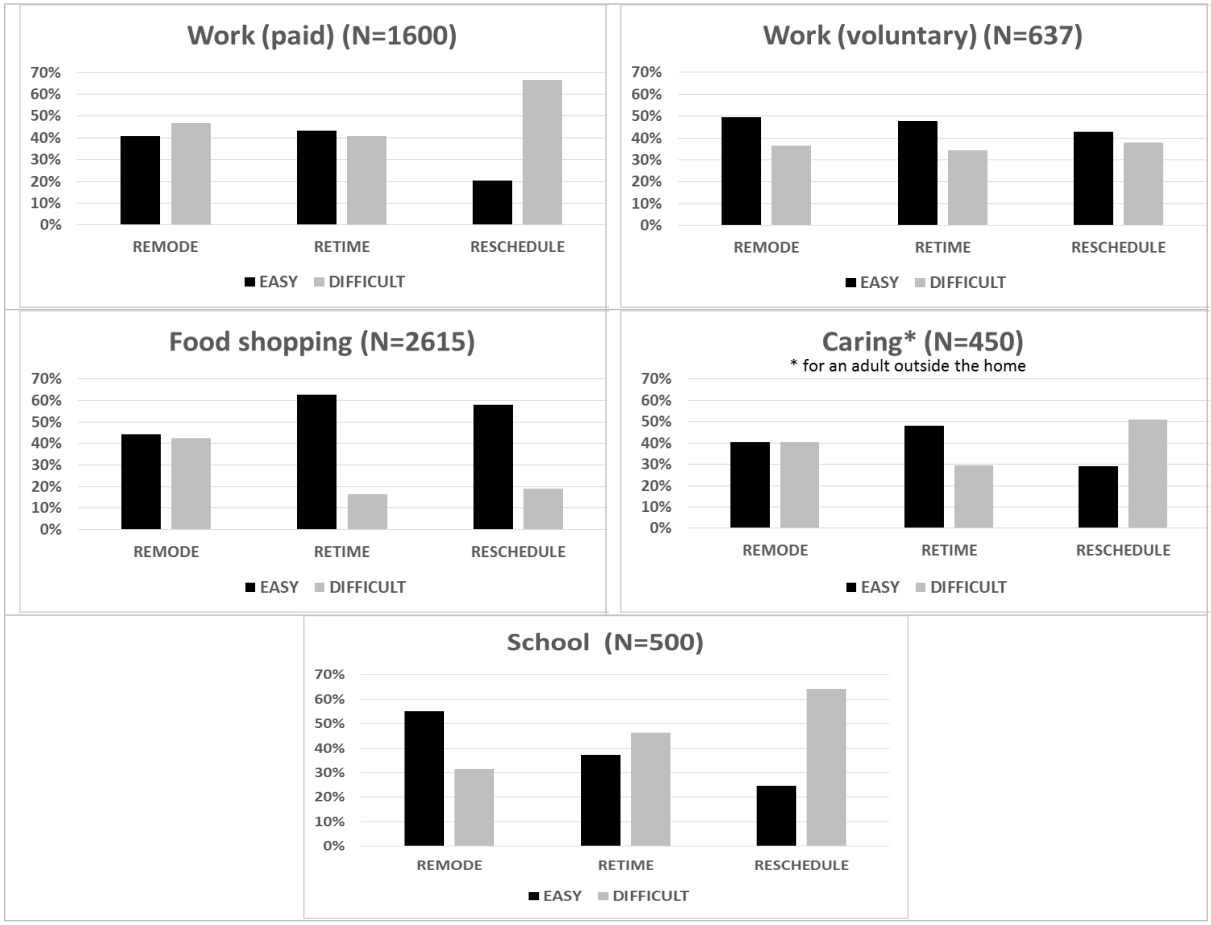
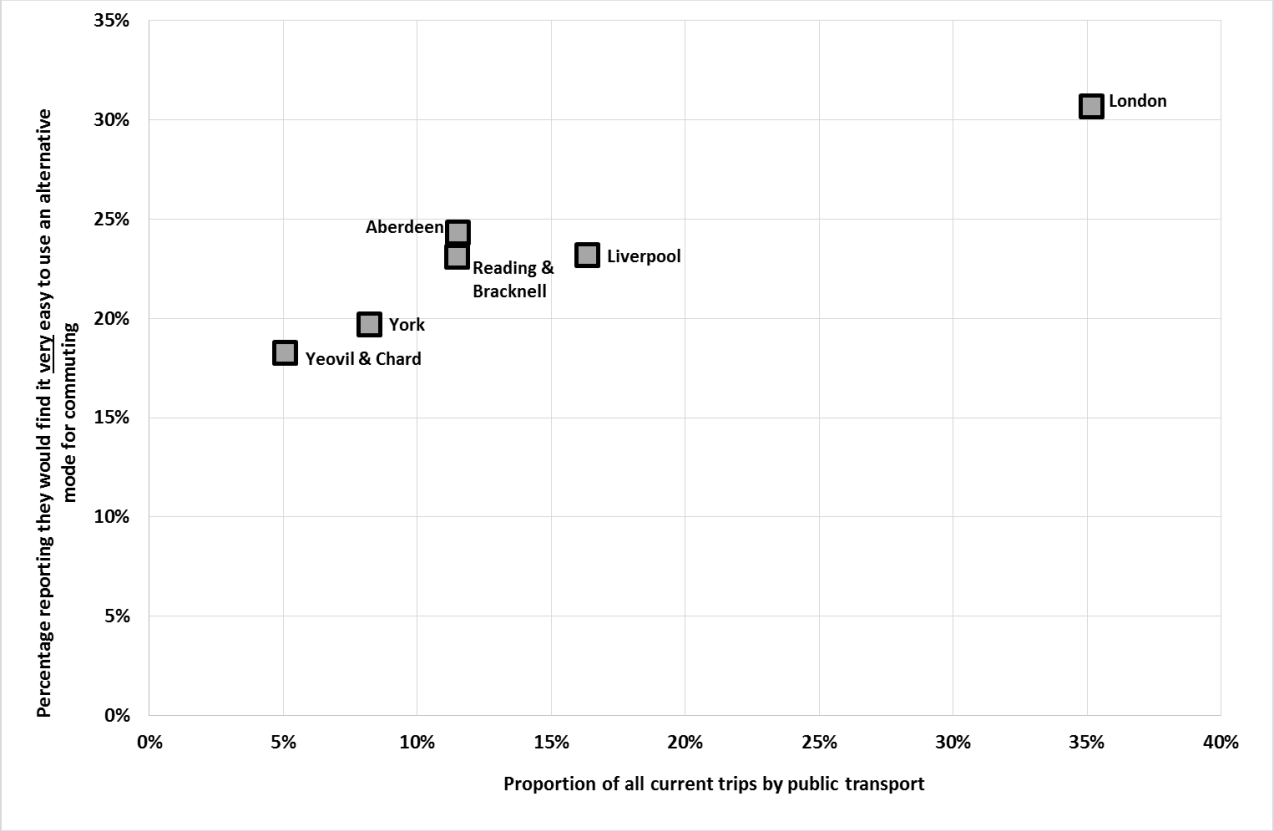
To be added after review

Figure 1: Percentage of respondents indicating whether an adaptive response would be easy/difficult for each journey purpose (based on their last experience)



Source: Everyday survey (N=2700); Note (i) that response rates for individual questions varied as respondents only answered if they undertook such a journey (i.e. if they have a voluntary job, drop children off at school) (ii) 'Easy' is the combined proportion of 'very easy' + 'somewhat easy' and 'difficult' = 'very difficult' + 'somewhat difficult'.

Figure 2: Relationship between stated ease of remoding for commuting and average proportion of all trips per capital per annum undertaken by public transport



Source: Everyday survey (N=1611 - those in full-time or part-time work only)

Figure 3. Non-work trip responses (by trip purpose) to winter weather, flooding and FRB disruptions (Sample N FRB=1,364, Winter=2,417 and Flooding=520)

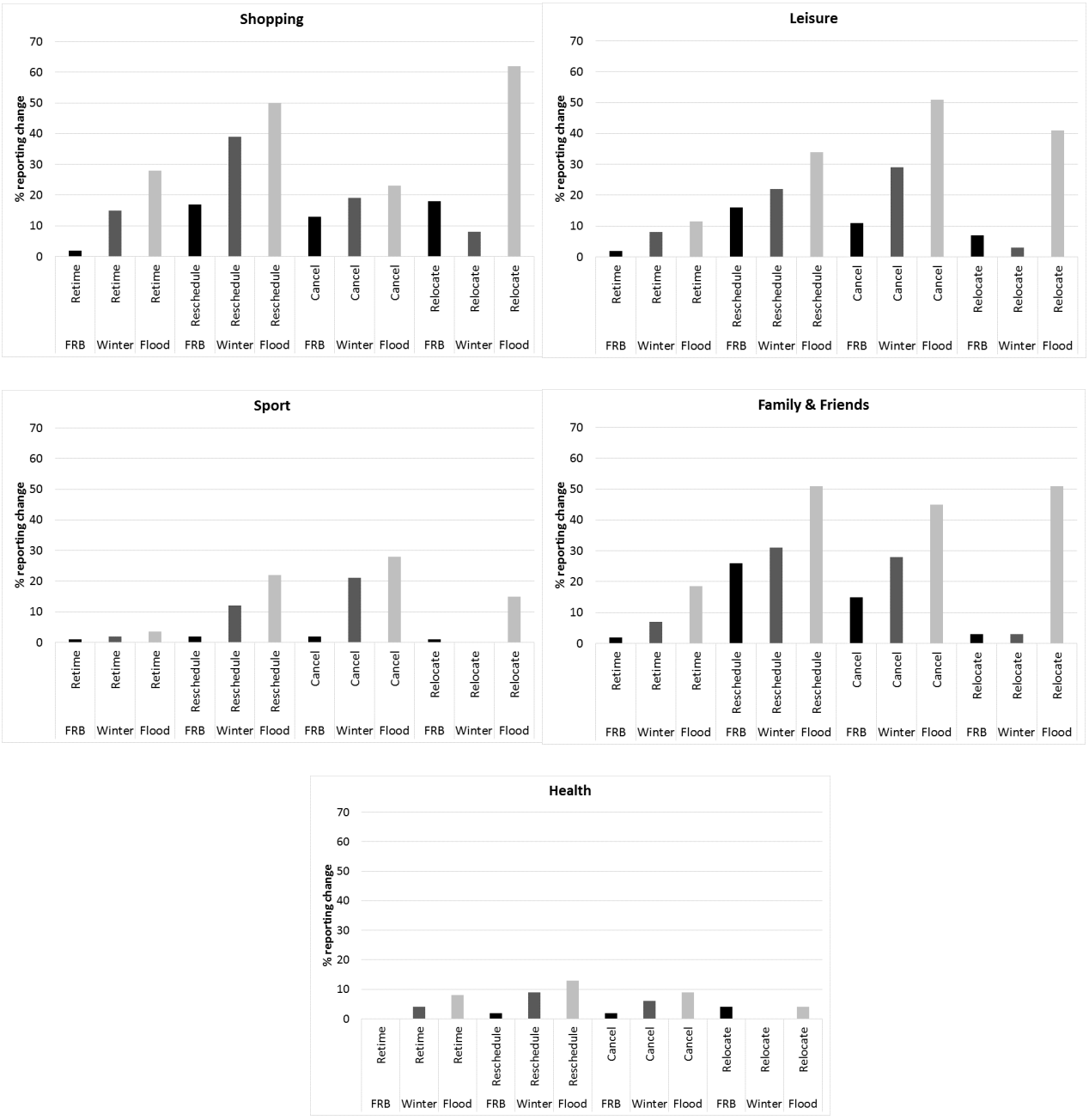


Table 1: Key socio-demographic characteristics and their relationship with the 'perceived ease of use of remoding for journey to work' variable

Characteristic	Relationship with perceived ease of remoding for journey to work (5 pt scale)	
SIGNIFICANT RELATIONSHIP		
		Pearson Chi Square (X^2 (df) p-value)
Age (6 bands)	Youngest and oldest perceive less difficulty	37.406 (20), p<0.01
Education (5 bands)	Higher educated perceive greater difficulty	53.684 (16), p<0.001
Household structure (6 bands)	Lone parents, single adults, childless couples perceive most difficulty; Single seniors, adult house sharers and couples with children perceive less difficulty	61.861 (24), p<0.001
Presence of children in the household (Y/N)	Those with children perceive less difficulty	45.748 (4), p<0.001
Number of cars in the household (4 bands)	The fewer the number of cars, the less difficulty perceived	75.363 (16), p<0.001
Agree/disagree working hours are flexible (5 bands)	Flexible working hours is associated with lower perceived difficulty	48.895 (16), p<0.001
Agree/disagree can work from home (5 bands)	The ability to work at home is associated with lower perceived difficulty	55.476, (16), p<0.001
Additional travel responsibilities (3 bands)	Fewer fixed commitments outside work is associated with lower perceived difficulty	23.130, (8), p<0.01
		ANOVA (*F* (df) p-value)
Proportion of all journeys undertaken by car per week	Lower car dependency is associated with lower perceived difficulty	F=5.028 (4), p<0.001
Proportion of all journeys undertaken by public transport per week	Greater public transport use is associated with lower perceived difficulty	F=9.854 (4), p<0.001
Distance to work (derived from mid-point of 8 distance bands)	Shorter commute distance is associated with lower perceived difficulty	F=21.553 (4), p<0.001
NO EFFECT (NOT SIGNIFICANT (NS)		
Gender (M/F)	NS	--
Annual household income (4 bands)	NS	--
Time at current address (4 bands)	NS	--
Bicycle available for personal use (Y/N)	NS	--
Commute involves dropping child at school	NS	--
Job involves travelling on business (Y/N)	NS	--

Source: Everyday survey (N=792 - those using car as main mode to work and without disability)

Table 2: Temporal and spatial adaptations on work and business journeys.

	Response				
Activity	**1 Retimed**	**2 Rescheduled**	**3 Cancelled**	**4 Relocated**	**N[a]**
Commute Trips					
Winter	49%	8%	41%	14%	974
Flood Day 1	29%	5%	9%	6%	627
Business Trips					
Winter	21%	41%	41%	7%	126
Flood Day 1	10%	8%	6%	4%	567

[a] Note respondents could indicate more than one response, for example they might have retimed one work trip and cancelled another. As a result % do not sum to 100% in rows.
Source: Winter Weather and Flooding (Responsive) Surveys

Table 3: Response Differences across disruption, activity type and response type

	Flood	Winter	Forth Road Bridge	Median across disruption
Family and Friends	48	17.5	9	17.5
Sport	18.5	7	1.5	7
Leisure	37.5	15	9	15
Health	8.5	5	2	5
Shopping	39	17	15	17
Median across activities	37.5	15	9	
Retime	11.5	7	2	7
Reschedule	34	22	16	22
Cancel	28	21	11	21
Relocate	41	3	4	4
Median across response types	31	14	7.5	

Table 4: Expanded Categorization of Adaptive Behaviours

Adaptation	Description
Remoding	Using a different form of transport for at least the main leg of the trip
Rerouting	Taking a different route from that which was planned or would typically be taken
Retiming	Modifying the time at which a trip starts by either bringing it forward or pushing it back without altering where in the sequence of activities it occurs
Rescheduling	Changing when in the week a trip is made. This is distinct from retiming as the trip is seen to be moved in a sequence of activities
Relocating	Changing the destination of a journey such as shopping somewhere else.
Reallocating	Passing over the responsibility for a journey to someone else (e.g. childcare pick up or caring trip)
Reducing	Not conducting a trip at all but conducting the activity through ICT

Annex 1 ***Representativeness of the FRB Survey Sample***

Table A.1 outlines some key descriptors which indicate how representative the data is and whether there are any inbuilt biases that should be considered when interpreting results. Where possible, comparative measures, as taken from the Scottish Census (Scottish Census, 2011) for the Fife region, have been reported (inside brackets) alongside the survey data.

From a gender perspective the survey sample contains slightly more males than females (2% more) and is not quite reflective of the Fife population as a whole (4% more females). This may reflect a bias towards commuters within the survey which are likely to have higher numbers of males.

The age profile of the survey sample is over representative towards the older age categories (40+ years) and underweighted towards the youngest age categories, especially 16-19. This pattern is a familiar one and highlights higher response rates amongst older segments of society vs lower response rates amongst younger segments. The contrast is particularly marked for the youngest cohort (16-19 years) and reflects the likelihood that this age group was not reached particularly well by the train/coach surveys or household survey. In the case of the latter it is likely that a parent will have completed the survey, whilst for the former the flows will have been dominated by older groups making commuting/business/leisure trips as opposed to educational trips.

From an employment perspective the survey sample is replicative of the census statistics. This does not appear to be the case with regards driving license and car availability, with the survey sample reporting much higher incidences of both (23% and 16% respectively). This suggests that those responding are more likely to have been directly affected by the FRB closure, namely car drivers or car passengers. It also reflects that our sample is skewed towards commuters (68%). Care is therefore required in the conclusions to ensure that the views of non-car users are also represented

Table A.1: Descriptive Data Statistics by Survey & Census Forth Road Bridge Survey

Descriptor	*Male*	*Female*					*Obs*
Gender[1]	51% (48%)	49% (52%)					1,309
	16-29 yrs[2]	*30-39 yrs*	*40-49 yrs*	*50-59 yrs*	*60-69 yrs*	*70+ yrs*	
Age Group[3]	7% (21%)	14% (15%)	20% (18%)	23% (16%)	24% (15%)	12% (15%)	1,316
	Employed	*Not Employed*					

[1] http://www.scotlandscensus.gov.uk/ods-analyser/jsf/tableView/tableView.xhtml
[2] Note that the response for 16-19 was 1% and 20-29 was 7%. The comparative census figures for these two groups is 6% and 15%
[3] http://www.scotlandscensus.gov.uk/ods-analyser/jsf/tableView/tableView.xhtml

Employment[4]	70% (72%)	30% (28%)					1,313
	Yes	*No*					
Driving license[5]	91% (68%)	9% (32%					1,317
	Yes	*No*					
Car Availability[6]	86% (70%)	14% (30%)					1,221
	Children <6 yrs - Yes	*Children <6 yrs - No*	*Children 6-16 yrs – Yes*	*Chidren 6-16 yrs – No*			
Household Composition	*14%*	*86%*	22%	78%			*1,157* 1,220
	Edinburgh	*Non-Edinburgh*					
Home Location	12%	*88%*					1,364

[4] http://www.scotlandscensus.gov.uk/ods-analyser/jsf/tableView/tableView.xhtml
[5] http://www.gov.scot/Publications/2015/08/3720/7
[6] http://www.gov.scot/Publications/2015/08/3720/7

Representativeness of the Everyday Survey Sample

The questionnaire was administered by a market research company (YouGov) in six 'Travel to Work Areas (TTWA) in the UK using an on-line market research panel provider (YouGov) in September 2013. TTWA are statistically derived geographical regions based on UK Census data that describe self-contained labour markets where at least 75% of the area's resident workforce also work in the area and at least 75% of the people who work in the area also live in the area. They were chosen to represent statistically defined boundaries based on revealed choices for travel related research, rather than using traditional electoral or other administrative boundaries. The questionnaire underwent pre cognitive testing (n=27) and a pilot (n=100). It took an average of 20 minutes to complete.

Age and gender quotas were applied to ensure a representative sample. In addition, before undertaking the analysis, survey data samples were weighted to correct for non-response bias in the achieved sample as far as possible. This bias occurs because some subsets of the population may be more willing or able to respond to surveys than others. The corrective weights were derived by comparing the age and gender of the achieved samples with population figures (from ONS mid-year population estimates) for each of the six travel to work areas. Weighting by age/gender combination is a commonly used approach in many national surveys.

Table A.2 shows key demographic characteristics of the sample in each area, contrasting the weighted with the unweighted results. Looking at the gender and age profiles of the different locations, we can see the largest corrections were applied to the Aberdeen and Reading and Bracknell samples where males had been over represented, and Liverpool where they had been underrepresented. The greatest age corrections were necessary for the very youngest age group (17-29 years) which had been underrepresented in all locations. The tendency for younger age groups to be less well represented is a typical finding in social surveys. Overall, London required the greatest amount of corrective weighting across all the parameters and especially with regards to the lowest age groups, middle income and households with children, all of which had been underrepresented in the sample.

In conclusion, the age and gender corrections proved to be useful, despite attempts to apply quota sampling. However, correcting a sample based on these two parameters does not account for additional biases which related to characteristics which are entirely unrelated to age and gender. These may include attitudinal biases and personality traits which may determine how or whether a person will fill out a questionnaire survey in the first place.

Table A.2 Unweighted and Weighted Descriptive Statistics for the Everyday Survey

		UNWEIGHTED (WEIGHTED)						
		Aberdeen	Liverpool	London	Reading & Bracknell	Yeovil & Chard	York	***Total***
N=		436	410	632	410	405	407	***2700***
Gender	Male	55.5 (49.1)	45.6 (49.0)	45.1 (47.6)	54.1 (49.5)	51.1 (48.1)	49.9 (48.2)	***49.9 (48.5)***
Age Group	17-29 yrs	18.3 (27.3)	12.2 (25.6)	12.5 (24.2)	17.1 (21.9)	6.2 (16.0)	14.3 (24.8)	***13.4 (23.4)***
	30-39 yrs	17.2 (18.1)	19.0 (19.5)	19.0 (23.4)	24.6 (23.8)	7.2 (10.8)	17.7 (16.5)	***17.6 (19.1)***
	40-49 yrs	14.2 (15.1)	21.0 (15.1)	19.1 (17.7)	20.7 (17.3)	12.6 (13.8)	18.4 (14.7)	***17.8 (15.8)***
	50-59 yrs	17.4 (16.1)	22.2 (17.3)	17.4 (12.3)	17.8 (16.8)	22.5 (21.9)	21.4 (18.9)	***19.6 (16.8)***
	60-69 yrs	25.7 (18.6)	19.0 (17.1)	23.9 (17.7)	13.7 (13.9)	36.0 (26.8)	18.9 (17.2)	***23.0 (18.5)***
	70+ yrs	7.1 (4.8)	6.6 (5.4)	8.1 (4.6)	6.1 (6.3)	15.6 (10.6)	9.3 (7.9)	***8.7 (6.4)***
Income	< £20,000	20.0 (22.3)	32.4 (32.4)	22.1 (20.9)	16.4 (22.2)	28.4 (28.9)	22.7 (30.4)	***23.5 (25.8)***
	£20-49,999	47.1 (47.8)	48.1 (48.6)	43.1 (52.6)	51.3 (49.8)	51.0 (49.3)	55.5 (50.9)	***48.9 (50.0)***
	£50-74,999	18.0 (16.1)	14.2 (14.0)	17.4 (12.4)	17.0 (15.1)	12.7 (14.1)	13.7 (12.0)	***15.7 (13.9)***
	£75,000 +	14.9 (13.8)	5.2 (5.1)	17.4 (14.1)	15.2 (12.9)	7.8 (7.6)	8.1 (6.6)	***11.9 (10.3)***
Employment (FT or PT)	Yes	62.6 (63.4)	60.2 (59.6)	59.5 (60.8)	69.8 (64.1)	47.7 (50.9)	61.9 (57.5)	***60.3 (59.6)***
Driving Licence	Yes	79.1 (73.5)	82.0 (78.8)	76.4 (74.9)	87.8 (83)	93.8 (89.4)	82.8 (74)	***83.0 (78.5)***
Car Availability	Yes	82.6 (80.8)	79.8 (79.3)	73.1 (75.9)	80.5 (77.4)	95.3 (94.3)	86.2 (81.9)	***82.1 (81.1)***
Household with Children	Yes	20.6 (22.9)	25.1 (23.7)	21.8 (32.1)	32.0 (29.7)	16 .0 (20.0)	23.3 (22.3)	***23.0 (25.7)***
Disability	Yes	13.5 (12.8)	15.4 (12.4)	15.5 (16.0)	10.2 (10.9)	17.3 (17.0)	10.6 (9.8)	***13.9 (13.4)***

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