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RESILIENCE AND ADAPTATION: AN ACTIVITY SYSTEMS APPROACH

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ABSTRACT

Climate change will create new stresses for populations across the globe. Whatever mitigation pathways are adopted the question is about how much, not whether, climatic change will impact on society. In particular, we can expect more extreme rainfall events, flooding and variations in temperature which our infrastructures were not designed to cope with.

This paper poses fundamental questions about how societies should respond to this. In particular, through the use of existing frameworks of resilience and adaptive capacity the paper presents a comparative analysis of two potential response strategies. The first is a transport systems approach which focuses on the availability of infrastructures and transport services. The second is an activity systems approach which focuses on ability of society to conduct activities. The differences are explored conceptually and through a series of innovative data sets collected during periods of significant weather related disruption as part of the RCUK funded Disruption project.

The paper concludes that a transport systems approach sits comfortably within existing institutional structures and accountability processes. Each element of the system seeks to minimize the extent to which it is a source of failure under climatic events. This results in an ultimately flawed investment strategy underpinned by a paradigm of perceived stability. Such an approach also marginalizes user preferences for other strategies. The activity systems approach by contrast broadens the toolbox of responses beyond the transport system and integrates personal and group action and capacities. The activity systems approach incorporates the transport system but does not privilege it. Adopting such an approach could radically alter the transport planning paradigm and is not restricted to planning for extreme climate scenarios.

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1. INTRODUCTION

This paper is about how we conceptualise the task of planning for transport. It is often stated that transport is a derived demand; people travel because they typically wish to participate in an activity rather than for the sake of travel itself. The role of the transport system then becomes to provide sufficient opportunities for these activities to occur. The recognition of the importance of what happens where and when stops there (an exaggerated caricature perhaps but one worth exploring). Within the transport sector the organisation is highly siloed in most cases with responsibility for bus, rail and road divided between different agencies in the public and private sector. The very challenge of making the nuts and bolts of the transport system work and work together should not be under-estimated. It is where the locus of attention of transport agencies is. Ultimately, they are accountable to either the politicians (and their public) or their shareholders for the functioning of their part of the system.

There is however a rich tradition of research built around Hagerstrand's time-space geography which highlights the importance of both the networks which define separation, the activities that people seek to access and the meanings attached to those activities (Hagerstrand, 1970; Thrift, 2005). Shove (2012) also argues for far greater attention to be given to the meanings of what we do as well as the competencies and means which enable us to do those things.

This paper explores the limitations of thinking about the transport system as a system of transport systems organised by mode. It does so by exploring the logics in play around winter weather resilience and flooding where the transportation networks are impacted and unable to function as usual. Graham (2010: 3) suggests that we should recognise "disrupted flows as a powerful means of revealing the politics of the normal circulations of globalising urban life which tend to fall off the radar screen of contemporary political and social-scientific debates… 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". So, by looking at what happens when things do not function as they usually do, we might expose some of the assumptions which underpin the way we plan for transport. We contend that these insights require us to focus more on what people do and how they do it rather than on the level of service of the various networks they may (or may not) use. In summary, the paper suggests that we need to think about the system of activities that is at play and only then within that to consider when, and in what ways the transport networks matter most. To do so properly integrates changes to social practices, workplace norms and technological substitution into the feasible choice set for managing what we do. It would, we argue, change how we plan for phenomena like winter weather, but also more fundamentally how we plan for normality.

The paper begins with an introduction to some of the literature on resilience from which emerges some contentions about approaches to planning. A short review of the approach to managing some of our key transport networks is then presented, drawing on several studies seeking to learn lessons from bouts of extreme winter weather in 2010 and more recently.

Some findings are then presented from two studies conducted as part of the Disruption project. One is a large sample on-line questionnaire survey of a winter weather incident. The other is a qualitative investigation of the impacts of the York floods in autumn 2012. The discussion section compares and contrasts the existing approaches with the behavioural responses observed. This is where the case for an activity systems approach is made. We conclude with some reflections on implications of our findings and future directions.

2. RESILIENCE

Resilience is a 'malleable', contested (Shaw, 2012) and varied or 'fuzzy' (Pendall et al., 2009) concept within and between the disciplines involved in transport and mobilities research. It is important to consider the different framings, identifying the politics and values of each (Shaw, 2012), as the conceptualisation we choose guides our selection of research questions and methods (Prior and Hagmann, 2013). This in turn affects results, policy recommendations and ultimately political decisions. Three conceptualisations of resilience are described below. The first is engineering resilience the second ecological resilience. The third, evolutionary resilience may be useful in promoting consideration of the activity system in transport policy.

Engineering and economics are arguably the dominant disciplines in transport research and policy formation. Unsurprisingly the theoretical and conceptual perspectives of these disciplines form the basis of the concept of resilience applied in transport research and planning. Engineering resilience is the dominant form of resilience considered when applied to the "transport system". The emphasis is on ensuring reliability and recovery of the existing transport network to a defined level of service (e.g. Ben-Tal et al., 2011; Futurenet, 2009). Engineering resilience defined by (Holling, 1986) focuses on stability, the resistance to disturbance and speed of return to 'normal'- the equilibrium point. Ecological resilience, based on the work of (Holling, 1973), posits that systems can flip from one equilibrium to another given a large enough disturbance. The emphasis is on persistence, either resisting a stress and staying in one state or after a sudden shock adapting to the new conditions.

A high level criticism of engineering and ecological resilience when applied to systems with human actors is using the notion of equilibrium (Davoudi et al., 2012). Engineering resilience assumes a transport system has one regime of functioning to provide a level of service. If that level of service is disrupted or damaged it is repaired to return the system to its 'normal' equilibrium functioning. The current 'normal' is assumed to be desirable. This conservatism is deeply criticised for example by MacKinnon and Derickson, (2012). Though ecological resilience allows for the system to change to another state there is still a pre-occupation with equilibrium. Applications of equilibrium based concepts of resilience emphasise short term emergency responses in disaster studies. They only allow a reactive conceptualisation of resilience (Dovers and Handmer, 1992). This limits the range of policy approaches to resilience.

Whilst many in the critical social sciences would argue against any form of systematic approach (see for example Walker and Cooper, 2011). Davoudi et al., (2012) argue that the notion of resilience can be applied to systems involving human actors using a more appropriate conceptualisation resilience termed *evolutionary resilience*. Such an approach accommodates a variety of notions brought together and explained as the resilience thinking framework (Folke et al., 2010). These are; systems and system components resisting pressures, adaptation in reaction to pressures and transformation either forcibly as a result of pressures or by deliberate action in anticipation of some future pressure (Walker et al., 2004). The concept of *panarchy* (Gunderson and Holling, 2002) is used by the resilience thinking framework and emphasises interconnectedness: A system at a given spatial and temporal scale influences and is influenced by systems at other scales. This creates constant dynamics. Compared to panarchy, equilibrium is an over simplistic explanation of the state of systems (Folke et al., 2010). Despite this richer definition however Davoudi et al., (2012) argue that there are still four key caveats which need to be accounted for in applying the idea of resilience to planning policy and these appear to hold equally for transport planning in the context of activity systems.

Four caveats. [Paraphrased from Davoudi et al., (2012) with additions]

1. *Acknowledge the intentionality of human actions* (at all scales) – human actions are not determined – transformation is possible at any scale. There is a wariness of using a metaphor which has come in part from ecology to describe human systems to avoid environmental determinism. Gunderson and Holling, (2002) though explain that in human systems cycles and outcomes are tendencies rather than inevitabilities. There is also concern that the myth is propagated that human actions can only change individuals not higher level structures (Shove, 2010) and this links to points below.
2. *Self organisation can become translated into self reliance* of individuals without recognising that larger scale systems influence the ability of the individual to act. MacKinnon and Derickson, (2012) argue that resilience of individuals is greatly influenced by large scale political structures. This demonstrates that panarchy and interconnectedness must be emphasised.
3. *Resilience is normative* – The question of whether a transport system, the mobility system, economic efficiency, mobility justice or something else should be preserved is an essential question and as stated above is highly political. Equilibrium creates the erroneous belief that that the current 'normal' is always the natural desired state of things and that return to 'normal' is desired (Pendall et al., 2009). Returning to normal may also be interpreted as maintaining the resilience of those in power through a transport system designed to maximise their economic gain resulting in a very poor mobility system for many. Frerks et al., (2011) refer to this idea in terms of the politics of resilience. The idea is promoted for example through the securitization of transport that the high level system must remain unchanged but the people must undergo adaptation.
4. *Bounding the system risks exclusion*. Specified resilience is stating the resilience of what to what (Walker et al., 2004). Whilst this makes analysis tractable (a practical benefit) it risks privileging or excluding factors or actors (Folke et al., 2010). This system bounding and focus on specific scales is also normative and must be carefully considered (Pendall et al., 2009) For example, Sheller's (2012) emphasis of the importance of mobility justice in achieving sustainable mobility suggests we should consider resilience of the wider activity system rather than the more tightly bounded transport system (which is a subsystem of the mobility system).

In summary, evolutionary resilience applied to mobility systems give a richer understanding of issues, effects and responses to disruptions than the narrower traditional view of equilibrium based resilience of transport systems. Evolutionary resilience is a conceptual framing which allows us to argue that transformation of the transport system and its governance structures to build resilience of the mobility system is a valid objective.

3. RESILIENCE IN PRACTICE

To explore the mainstream conceptualisation of resilience in the UK transport sector, a review was conducted of a series of policy reports which resulted from a very severe winter weather event in 2009-2010 (Quarmby 2010a, 2010b, 2010c; Begg et al., 2011). The "coldest and most extended winter to hit the UK for 30 years" (Quarmby 2010a, p. 6) caused high profile system shutdown such as the closure of runways at Heathrow Airport leading to the cancellation of over 4000 flights between 17 and 23 December (Begg et al., 2011) with a range of negative knock-down implications in other airports; and the closure of motorways in Scotland which ultimately led to a ministerial resignation. Other documents which also provided insights into how resilience is conceptualised were examined as well (e.g. DfT, 2011; GLA, 2011; ICLEI, 2011; Defra, 2012; Smith, 2013).

A general conclusion to be drawn from this literature analysis is that the maintenance of normal mobility patterns disregarding the weather conditions is perceived as a priority even though, as recognised by David Quarmby (2010a, p. 7), "Market research carried out for the Local Government Association and made available to us suggests nevertheless that the public at large take a realistic view of how much it is worth investing to achieve resilience for winter conditions, given the relatively infrequency of severe winter weather". One can conclude from this that the aspiration to develop highly resilient transport is not necessarily driven by bottom-up pressure. A possible example of how the government has expressed the intention to maintain normal levels of service disregarding the circumstances is provided by the title of the web-based publication by the UK Transport Committee, "Keeping the UK moving" (UKTC, 2011).

Quite surprisingly, the threshold that was generally accepted for establishing adequate levels of preparedness was the one given by the exceptionally rigorous winter of 2009-2010. The Interim Report by Quarmby acknowledges that this was a particularly rare event, but under Recommendation 17 it is argued that "Given that the probability of next winter being severe continues to be relatively small but that severe winters are still possible despite the warming trend, we recommend that winter resilience planning […] should continue on the basis of dealing with winters of a severity similar to that of 2009-2010" (Quarmby, 2010a, p. 17). Being done, this obviously comes with a range of costs, for example the number of gritters and snow ploughs which are maintained. In any case, the recommendations proposed by Quarmby were well received and swiftly implemented by the British Government (see UKTC, 2011; Quarmby, 2010c). The reasons for accepting and promoting the notion that transport systems need to perform well even under any weather conditions are clearly of an economic nature. The Executive Summary of the DfT's report *Winter Resilience in Transport: An assessment of the case for additional investment* literally starts stating that the 'DfT estimates that the welfare cost of domestic transport disruption from severe winter weather is around £280m per day in England. The direct economic costs alone amount to £130m per day." (DfT, 2011, p. 6).

In reaction to these concerns with economic losses, the business cases for a range of winter resilience measures were analysed to determine the best course of action (DfT, 2011). The methodology adopted was to estimate the Benefit-Cost-Ratio (BCR) of different measures. Using this indicator the winning measures were improving salt storage arrangements, calibrating gritters (and training staff operating them), and third rail heating.

The only two options considered in the DfT report (2011) which were oriented towards changing activity systems (as we understand them in this paper) were 'low-cost' home working (meaning when the employee uses a private computer at home) and home working (which require the organisation to set up servers and office networking for remote stations). Home working did not perform well in terms of BCR due to the costs of implementing remote digital access systems across organisations. Note, however, that low cost home working was considered as a somewhat attractive option in terms of BCR. Interestingly, in the same document it is argued that a "distinction may be drawn between 'business continuity' and 'resilience'. The latter implies physical investment to make infrastructure robust to disruptive events, whereas the former is concerned with ensuring that business and other activities can continue to operate when infrastructure is disrupted. Aiming for business continuity may offer cost advantages over enhancements to physical infrastructure." (DfT, 2011, p. 29). The authors of this DfT report argue that the full range of benefits of business continuity measures such as home working and low cost home working were not counted though (e.g. those associated with improved quality of life). This is an obvious limitation of their approach with was focused on their definition of 'resilience'. These benefits are what make measures such as work from home to stand out from all the others. Indeed, the other measures were all aimed at maintaining people on the move under extreme weather. Laird et al., (2014) suggest that the use of traditional cost-benefit analysis may not be appropriate for significant disruptions.

In summary, a biased logic seems to exist in policy documents concerned with weather resilience for the British transport sector. Several reasons led us to draw this conclusion. Firstly, the key policy driver is maintaining normal levels of transport service disregarding weather conditions (even though there is evidence that the public is generally willing to accept that extreme weather naturally causes transport disruption). Secondly, to provide conditions for activity systems to adapt to disruptions in transport systems is only superficially addressed, or perhaps just quickly dismissed, or simply not taken into consideration at all in the vast majority of policy documents. This creates a flawed landscape of options to be considered by political decision makers. Finally, the tools and measures being considered also rarely take into consideration the nature of the activity systems that provide the reasons for people to travel in the first place. When these issues are factored in they are addressed sketchily and without clear intentions to convert them into policy making. Our key claim here is that to challenge this biased logic might provide potent opportunities to increase societal resilience to extreme weather. Quality of life might also be improved as travelling under extreme weather might be possible, but never stress- and risk-free. More focus should therefore be given to increasing the resilience of activity systems without exclusively relying on normality to be maintained in the transport sector disregarding weather conditions. The next section will use empirical data to further support this argument.

4. CASE STUDIES

From 18th January 2013, the UK experienced a fortnight of severe winter weather. The South West of England was initially affected although this spread further to the South of England and the east coast. More than 5000 schools were closed on 21st January. As part of the Disruption project a winter weather survey had been developed for deployment in such an instance. This was set up for delivery on 21st January through an on-line panel survey company which has 730,000 panellists in the UK. This was done in six of the most affected parts of the country (Hampshire; Kent; Surrey; Norfolk; South Wales and West Yorkshire). 2417 responses were received.

The second case study relates to a fluvial flooding event in the city of York during the Autumn of 2012. York and the surrounding area is at risk of flooding as it sits at the join of the rivers Ouse and Foss and also, slightly further south east, the river Wharfe. The river Ouse is also tidal up to the village of Naburn just to the south of York. Whilst York regularly experiences some flooding during the winter period, the Autumn 2012 floods were the second most severe on record, topped only by those in 2000. The flooding affected some businesses in the city centre, one of the main arterial routes into the city (the A19 at Fulford) and villages to the South of the city. Face to face interviews were conducted with seventy five households, in three locations (the villages of Naburn and Cawood and parts of Fulford) and thirteen businesses. The village of Naburn has a small primary school which was closed for two days which also affected the population of adjacent villages. The village of Cawood was affected by the closure of a bridge crossing of the Ouse which was closed for several weeks. Both villages are normally served by an approximately hourly bus service but this was cancelled for the duration that the bridge was shut.

An engineering systems resilience approach would require us to focus on the impact of infrastructure not being available to users with the usual level of service in terms of activities that would otherwise have been using that infrastructure that are not now possible. Engineering systems resilience would allow for mode shift and route changes as these could be seen as part of the system offering redundancy, even if often at lower levels of service than would typically have been available. Table 1 shows the results from the winter weather survey. This indicates that a whole range of journeys were not made during the winter weather period. The commute was particularly affected in terms of delaying start and end times and not travelling.

Table 1: General Responses – All Respondents & All Activities – n= 2417

Activity	**Delayed Start**	**Delayed Finish**	**Not Conducted**
Commute	30%	18%	29%
Biz Travel	6%	4%	17%
Return Home	12%	30%	4%
Health	3%	1%	9%
School/ Child Care	5%	2%	3%
Other Care	4%	3%	6%
Shopping	10%	5%	39%
Sport	1%	1%	12%
Leisure	2%	2%	22%
Family/ Friends	4%	3%	31%
Other	1%	0%	2%

Although based on qualitative interviews, the most common response given regarding the impacts of the flooding in York amongst car drivers was rerouting (40 responses) and the next most common response was not conducting the journey (18 responses). In addition, as the bridge was closed between Selby and York at Cawood, then the bus service running through Cawood and Naburn was cancelled which left people reliant on the bus to seek lifts or to remain within their local community.

Another way to present and interpret the data is through binary logistical regression models. These predict the probability of a person making a certain action, for example travelling or not travelling. Two models are now presented below which look at the probabilities of a respondent travelling (the dependent variable) when faced by a winter disruption. The probability to travel is influenced by the characteristics of their journey, for example the journey purpose, mode of travel etc. These are known as the independent variables and will have either positive or negative impacts on the probability to travel.

Model 1 (Annex A) is a general model which explains all trips being undertaken. The explanatory variables are a mix of categorical variable and dummy variables. The coefficients for each variable is reported along with the level of significance in brackets, with values equal of lower than 0.05 significant at the 95% level and 90% if equal or lower than 0.1. The key findings are:

- The distance * mode interaction category variables (e.g. commute_distance_cat) show that, when faced with a winter disruption, as distance increases the probability of continuing with the journey falls for commuting and school trips (signified by the negative sign on the coefficients). This is not the case for leisure journeys which appears to reflect that longer leisure journeys such as foreign holidays will have a greater probability of going ahead.

- The journey purpose dummy variables (e.g. Business_Purpose_Dum) suggest that winter disruptions will reduce the probability of all types of journeys (negative coefficients) compared with commuting but by differently levels. So for example, sports activities have the highest probability of not going ahead (-4.1) whereas journeys back home (-.04) have the least probability of being cancelled.

- Compared to car, walk and train journeys have a higher probability of taking place. Note that the other modes are not significant.

- Those aged 30+ years have a higher probability of not making their journey, particularly for those aged 30 to 49 years, which probably reflects the fact that they have children to care for.

- Compared with frequent journeys less frequent journeys have a higher probability of not taking place.

These findings all go to support the underlying basis of an engineering systems resilience approach. People make their decisions based on an expectation of "normal service" of the network and when it is not available they have to cancel or reroute or remode in large numbers. Framed this way, there is a very strong argument to focus efforts on engineering responses to the problem, but that would be to overlook some very important findings which only fully emerge if the framing of the problem allows it.

An initial point of important departure from the engineering systems thinking is the significant difference in impacts in journeys of different types (not just work and non-work as a simple binary). There are clearly strong social forces at play here. This is particularly borne out in the qualitative flooding analysis where social obligations play a significant role in the perceived importance of a journey:

"*So finally got out… I had to go to a golden wedding do yesterday in Middle Thorpe and I did manage yesterday morning*."

"*In fact today we've been to a christening so we had to get into the city centre...Traffic was an enormous problem [laughter] I would have preferred to have cycled in...but we had extra people with us so we had to have a car*."

The data also points to the importance of school closures on travel. This was also true in the flood in York where the school in Naburn was closed. School closures clearly have differential impacts also on different families depending on their structures and circumstances at the time. Single parent families reported much more significant difficulties than others, although dual income families had to engage in very complex schedule rearrangements. Interestingly, although different in nature (e.g. illness), the discussions around responses during the flooding showed this system of trading favours to be regularly exercised. By contrast, families with only one working parent were largely untouched by the school closure.

"*I left the office early, my office in town hall, to make sure I could get back to Stillingfleet to meet my son. And then I was worried about my mum, who comes to look after my son when I go out to work in the evenings because I'm a single parent, being able to reach my house from Selby. And then my travel back in to York to get to xxxxxxx School. So it was just all starting to become very unknown*"

"*I thought "Well, I'll put them with Andrea" ...I then phoned Barbera and asked her a big favour very quickly. So this was all in the space of about eight to ten minutes. I then got back to Sandra ...So it took probably about twenty-five minutes to get things roughly cobbled together. I was still going to take Ed up to nursery and that was good because that was unaffected, but about twenty-five minutes on the phone rushing around*"

This shows that the adaptations are occurring through the social system as well as the transport system. The fact that these types of arrangements are not unique suggests that adaptation occurs over time. Indeed, the winter weather survey showed that those people that experienced the weather event 7 or more times in the last 5 years were twice as likely to work from home (14%) as those that had never experienced such an event (7%). The attitude of the employer towards working from home also makes a difference as to whether this is selected as an option, with 32% of people with an accommodating employer working from home compared to 25% where the employer was not accommodating.

The final aspect that we draw on here is that of temporal redistribution. This is indicative of social adaptation and, whilst postponement is not of itself indicative of a major shift in transport needs, it is an important component to consider when determining what level of service is "critical" for our infrastructure. The data reveals very substantial adaptation over time. This is both in the short run (in relation to departure time) as shown in Table 1 and in terms of postponing journeys. In Table 1 activities that were cancelled and postponed were deliberately rolled together (as these are both absent from the networks on the days affected). This data is broken out in Table 2.

Table 2: General Responses – All Respondents & All Activities – n= 2417

Activity	Postponed	Cancel	New Destination	Conducted At Home
Commute	6%	23%	1%	8%
Biz Travel	7%	10%	1%	2%
Return Home	4%	6%	1%	1%
Health	9%	6%	0%	0%
School/ Child Care	3%	22%	0%	1%
Other Care	6%	6%	0%	1%
Shopping	39%	19%	5%	3%
Sport	12%	21%	0%	0%
Leisure	22%	29%	2%	1%
Family/ Friends	31%	28%	2%	1%
Other	2%	2%	0%	0%

The data shows that school trips are more likely to be cancelled than any other type of response (due to the school being closed). Sport and leisure activities are similarly affected and much of this will due to venue closure. After that, commuting is the only activity where there is more cancellation than rearrangement, selection of a new destination or conducting the activity remotely. Even with the commute, a substantial amount of journeys are replaced with home working (for those with jobs that can be conducted this way). In short, social adaptation is at least as important a response to these types of incidents as transport system adaptations. Again, this emerged in the flood surveys with reciprocity of child care, shopping locally or ‘making do’ and calling on other relatives or neighbours to conduct care visits etc. Guiver and Jain (2011) also observed a wide arrange of social ‘ripple effects’ in the aftermath of the Ash Cloud event which closed European airspace for several days in 2010.

These events are relatively shortlived but there are also examples of more long-term infrastructure disruptions such as the Workington floods (Guiver, 2011). Here, even more significant non-transport adaptation was observed as the town was severed for car based traffic for some weeks. Adaptations included organisations allowing people to change their usual place of work, adopting more flexible working practices and even setting up temporary surgeries and shops.

5. CONCLUSIONS

Reflecting back on our theoretical discussion, our data has indeed exposed some limitations in adopting an engineering systems approach to resilience. That is not to say such thinking is irrelevant, but it is limited. The findings clearly show an activity system which influences and is influenced by systems well beyond transport. Adaptation occurs as much through social adaptation and negotiation as it does through transport adaptation. The extent to which this is possible is determined also by factors which go well beyond those which the individual has control over (e.g. the attitude of employers; the availability of high quality broadband; the degree to which local alternative facilities exist; the flexibility to reschedule without penalty etc.).

The engineering systems approach also overlooks the distributional aspects of disruptive events. Although everyone will benefit from the networks being returned to their previous state, the focus on achieving this to maximum effect focuses efforts on main routes and key facilities. As the flooding example showed, those that are dependent on transport services that are lost or who have fewer support network options are most likely to suffer, and a different pathway to recovery would be plotted were the social system to be more central to thinking.

What are the implications of thinking about an activity system rather than a transport system? This would require far greater reach of the planning task, to engaging far more with the reasons for the demand we see on our networks, for understanding how to influence and engage with that – by means of working more closely with health, education, retail and work organisations. It also involves framing the decision set of travellers in quite a different way. One which includes social obligations, family networks and a broader temporal view of the activity sets we take part in. In short, this is a non-incremental change to our transport planning paradigm.

One of the challenges to such a transition in thinking is that this research could be seen to relate solely to high impact low frequency events and that relatively rare events don’t justify a change. This we would challenge through both the importance of the findings to even a core transport systems resilience approach (Laird et al., 2014) but also as a narrow interpretation of the findings. As Graham (2010) suggests, the disruptive events simply give us a greater insight into some of the processes that underpin everyday life. Ignoring this will, it is suggested, lead to a further divergence between the needs of the travelling public and the goals of the systems provided to support those needs.

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Annex A: Binary Logistical Explanatory Models

Independent Variables	Model 1 – All Trips	Model 2 – Commuting Trips
Constant	-.293 (.018)	-.323 (.041)
Distance	Na	-.005 (.115)
Commute_Distance_Cat	-.006 (.063)	Na
School_Distance_Cat	-.091 (.042)	Na
Leisure_Distance_Cat	.013 (.021)	Na
Business_Purpose_Dum	-.488 (.048)	Na
Return_Home_Purpose_Dum	-.041 (.879)	Na
Health_Purpose_Dum	-.951 (.005)	Na
School_Purpose_Dum	-.821 (.002)	Na
Other_Care_Purpose_Dum	-1.123 (.001)	Na
Shopping_Purpose_Dum	-1.862 (.000)	Na
Sport_Purpose_Dum	-4.132 (.000)	Na
Leisure_Purpose_Dum	-2.582 (.000)	Na
Meeting_Purpose_Dum	-1.792 (.000)	Na
Other_Purpose_Dum	-.620 (.017)	Na
Age30_49_Dum	-.459 (.001)	-.395 (.021)
Age50plus_Dum	-.277 (.044)	-.270 (.137)
Walk_Dum	.275 (.086)	.683 (.004)
Motorbike_Dum	-.075 (.917)	.112 (.890)
Bus_Dum	.069 (.673)	.010 (.965)
Train_Dum	.648 (.000)	.609 (.003)
Cycle_Dum	.097 (.799)	.325 (.442)
Plane_Dum	.383 (.600)	Na
Taxi_Dum	.506 (.343)	1.702 (.202)
Coach_Dum	.510 (.534)	Na
Othermode_Dum	-.032 (.940)	-.815 (.077)
ModerateJourneyFreq_Dum	-.523 (.021)	-.853 (.077)
LowJourneyFreq_Dum	-.260 (.291)	-1.880 (.077)
PhysicallyNotExpectedWork_Dum		-1.021 (.000)
NeutralAccommodEmply_Dum		.528 (.008)
UnaccommodatingEmply_Dum		.454 (.015)
N	2,417	974
% of Model Explained	77.3%	65.5%

- Note: Coefficients are reported in columns 2 and 3 with significance in brackets.