# Examining the effects of disruption on travel behaviour in rural areas

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## ABSTRACT

Individuals living in rural areas are provided with little or no information regarding public transport disruptions. This can result in high levels of travel uncertainty with significant potential to affect travel behaviour. This paper, through 69 interviews, and 9 focus groups in rural areas in Scotland and England, explores the passenger experience, the behavioural responses, the coping strategies, and the variables that affect the decision making process during disruption. The analysis indicates that a wide range of behavioural responses are evident, extending well beyond the choice of route or mode of transport and in extreme cases includes life-changing activities (e.g. residential relocation). Further, we identify that the two most prevalent ways for mitigating the impacts of disruption are time buffering and kinship networks. In addition we identify as a contributing factor to the decision making process a set of variables that relate to the individual, the community and the transport network. The results provide a step towards understanding the interplay between disruption, travel, and the interaction of individuals with the transport system in rural areas.

Keywords: disruption, travel behavior, passenger adaptation, decision making, passenger experience, coping strategies.

## INTRODUCTION

There is a connection between travel and transport disruption and travel behaviour. Goodwin (2008, 2009) has illustrated that despite relative stability in aggregate behaviour patterns over time, there are very significant changes in behaviour at the micro and macro level. For that to occur there must be a 'tipping point', where a stimulus exceeds the sufficient level required for stability in travel behaviour. The 'tipping point' is usually reached by *a break in the travel routine of the individual* (Schlich 2003; Kitamura, 2006; Susilo, 2007). In this study we consider disruption as a chance for reflection and re-evaluation of travel, and aim through interviews and focus groups to explore the interplay between behaviour, decision-making and disruption. The contributions of this paper include an understanding of: (a) the rural passenger experience during disruption; (b) the behavioural responses to disruption; (c) the coping strategies to manage disruption and; (d) the variables that affect the decision making process of individuals living in rural areas.

# LITERATURE REVIEW

Travel and transport disruption in the literature is mainly conceptualised as disruption to the operation of the transport system. It may result from natural or man-made events, and activities, such as pre-planned road maintenance, and severe weather conditions. This conception is rather uni-dimensional and descriptive, as it does not consider the reciprocal impacts of disruption to the passenger. For this reason we define disruption as *any deviation from the passengers' normality*, where normality is the sense of order and continuity in regard to an individual's experiences that are produced and reproduced and are desired and sought after (Papangelis, 2013a). The definition of disruption aims to encapsulate various kinds of disruptions. Examples include: a mode of transport is not functioning as intended, natural or man-made disruptive events, an individual using an unfamiliar transport system .

Although there is a significant literature on different aspects of disruptions, almost no studies concentrate on travel behaviour, the coping strategies and the decision making process during disruption in rural areas.

Cairns et al. (2002) reviewed evidence from about 100 case studies of temporary or permanent transport network disruptions across the world and identified examples of alteration of traffic patterns and behavioural adjustments for 60 of these. The evidence from a survey of 150 transport professionals and disaster management experts indicated that public transport users change their attitudes towards travel and transport, and behaviour based on duration, significance, impact and effect of disruptions (Cairns et al., 2002). For example, a short term disruption (e.g., transport strike or a bridge closure) may lead to changing travel mode, choosing to visit alternative destinations, changing the journey frequency, consolidating trips for different purposes, altering the allocation of tasks within a household to enable more efficient trip-making, car-sharing, or avoiding possible journeys (e.g. by working from home occasionally). In the case of long-term disruptions (e.g. snowfall, long term closure of arterial road), passengers normally tend to make more permanent changes (e.g., job or home relocation; permanent mode change).

Zhu and Levinson (2010) also adopted a similar approach to Cairns et al (2002) and their analysis identified that changes that occur as a result of short-term disruptions (e.g., road closure) can become permanent. Furthermore, they identified *road network redundancy* as a factor in determining the significance of a disruption. The impact of disruption upon rural passengers compared to urban passengers is likely to be greater because passengers in rural areas usually have more limited transport connectivity, and fewer alternative routes for a given origin - destination. However, very little is known about the real impact of disruption on transport networks as the available data about traffic patterns are usually based on aggregate counts, and have not been assessed against predictive models of traffic behaviour (Watling et al., 2012).

Some studies have suggested that travel behaviour changes depend on the type and duration of disruption and whether the disruption is planned or unplanned (Fujii et al., 2001; Van der Waerden et al., 2003; Lo and Hill 2006; Van Exel and Rietveld, 2009). Van Exel and Rietveld (2001) examined the impact of 13 major public transport strikes in Europe and USA. They considered strikes as events that force passengers

to re-evaluate habits. They found that captive public transport users were most strongly impacted with 10% to 20% of their trips cancelled.

Several recent studies have used hypothetical or real-life scenarios to test the responsiveness and robustness of specific transport networks. De-Los-Santos et al. (2012) measured passenger robustness to disruptions and developed a robustness index for two different types of disruptions. They applied this index to two different scenarios with respect to the Madrid rail transit network: (1) providing alternative solutions (e.g., bus services) during disruption; and (2) not creating alternative solutions (meaning passengers have to wait for the failure to be repaired).He and Liu (2012) developed a traffic flow evolution model for transport disruptions which was evaluated following the collapse of the I-35W Mississippi River Bridge in Minneapolis, Minnesota. Jenelius and Mattsson (2012) proposed a grid-based approach to road network vulnerability analysis of area-covering disruptions (e.g., floods, heavy snowfall, storms and wildfires). Hounsell et al. (2012) discussed bus Automatic Vehicle Location (AVL) systems data management and applications; one of their applications is managing vehicle fleet during disruptions; however, their study mainly concentrates on urban areas.

In this paper, we utilise evidence gathered from interviews and focus groups with individuals living in rural areas to (a) discuss the rural passenger experience during disruption, (b) the behavioural adaptation to disruption, (c) the coping strategies and (d) the variables that affect the decision making process.Our findings enable an initial understanding of the complicated interplay between behaviour, adaptation, and disruption. This offers insight into the combination of policies and strategies, which can potentially support effective contingency planning and improved travel options for the user and the operator in rural areas during disruption.

# METHODOLOGY

To facilitate the present study a series of interviews and focus groups were undertaken with rural dwellers that utilise a variety of transport modes in various rural locations in Scotland and England. A summary of the research activities can be found in Table 1. The geographic location of the areas where the interviews, and focus groups where conducted is shown in Figure 1.

| No | Research Activity | Area | Date | Aim/Objective |
|---|---|---|---|---|
| 1 | 69 Interviews with rural bus users. | Scottish borders, UK | February, 2012 and November 2012 | • Discuss the effects disruptions in everyday life. |
| 2 | 4 focus groups[1] with rural bus, and car users and cyclists in various operational environments. | Leeds and Aberdeen, UK | March, 2012 | • Further investigate the effects of disruptions in everyday life.<br>• Explore the decision making process during disruption. |

[1]These focus groups were conducted as part of the EPSRC funded 'Disruption' project (funding reference number: EP/J00460X/1).

| | | | | |
|---|---|---|---|---|
| | | | | • Look into the behavioural adaptation during disruption |
| 3 | 5 focus groups with rural dwellers that use demand responsive transportation (DRT), ferries, airplanes, and cars. | Isle of Tiree, UK | September, 2012 | • Further explore the effects of disruption in the everyday life, the decision making process, and the behavioural adaptation during disruption. |

Table 1 – Details of interviews and focus groups.

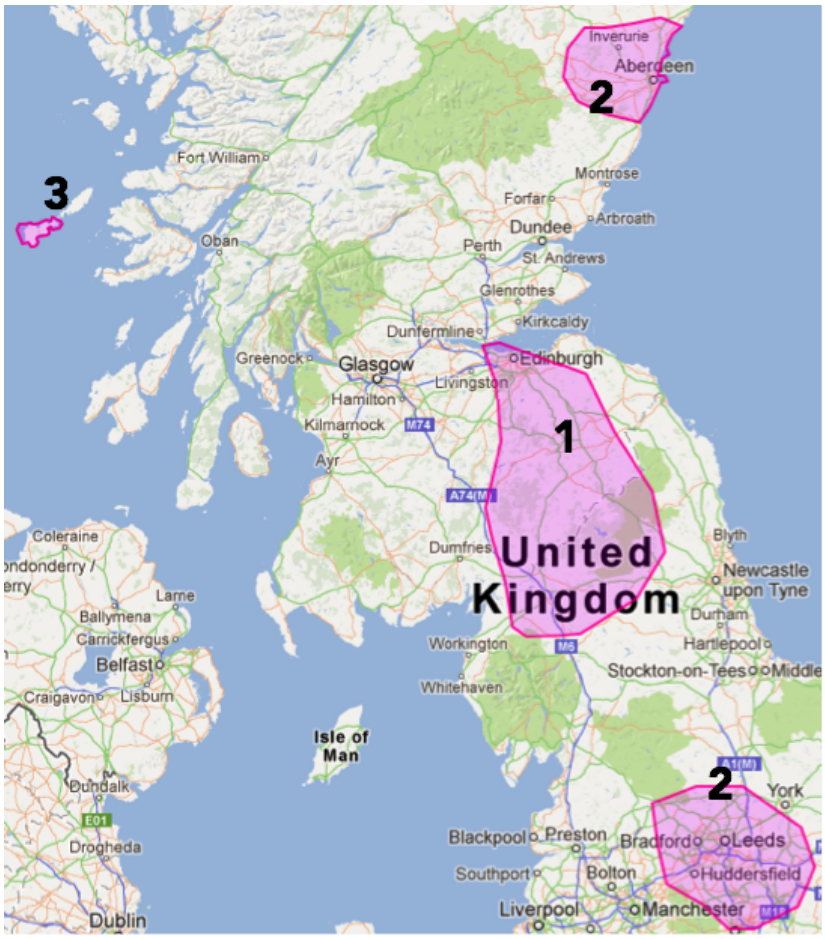


Figure 1 – Study area

## INTERVIEWS AND FOCUS GROUPS

The interviews were conducted in the Scottish borders area along the A7 corridor, which is mainly being served by the 95 / X95 bus service in February 2012 and November 2012. The service operates between Edinburgh and Carlisle via the town of Hawick, and covers a distance of approximately 100 miles, and passes through areas ranging from urban to remote rural. The 95/x95 mainly serves two types of passengers, (a) travellers that use the route from Carlisle to Edinburgh as a cheap alternative to the train service, and (b) locals that typically don't have access to a car and use the service for short trips for various purposes (commuting, shopping, entertainment etc).The interviews explored the common experiences, the shared

culture and the individual stories of a representative sample of these two groups with regard to bus service disruptions in order to elicit information regarding the effects of disruption in the everyday life of the participant. They took place on-board the bus while travelling, and involved 69 participants (45 male, 24 female) with a mean age of 32.7 years. Each interview lasted approximately 18 minutes. It should be noted that the participants were recruited based on a pre-screening interview regarding their frequency of bus usage, rather than randomly selected.

In addition, four focus groups were conducted at the Universities of Aberdeen and Leeds in the UK. The participants were a mix of urban and rural bus and car users, and cyclists from the Aberdeen and West Yorkshire County respectively. Each focus group was comprised of 8 to 11 participants with a mean age of 34 years, and lasted approximately 90 minutes. The participants were recruited through emails and flyers. The main discussion concentrated on the effects of disruption in everyday life, and the individuals' adaptation and decision-making processes during and after different types of transport disruptions.

Further, five focus groups were conducted on the island of Tiree, in the Inner Hebrides of Scotland. It has a population of 800 and the primary mode of transport within the island is demand responsive transportation (DRT) and cars; to the mainland there is a daily airplane to Glasgow, and a bi-weekly ferry to Oban. Due to its geographical location Tiree is very prone to disruptions and there are often food, fuel and medicine shortages. The focus groups involved 5 to 7 participants with a mean age of 37 years, and lasted approximately two hours. The participants were recruited through e-mails, flyers and announcements in the local noticeboards. The discussion mainly revolved around: (a) the dependency of the islanders on the ferry and the airplane service, and (b) the characteristics of in-island travel.

## DATA ANALYSIS PROCEDURES

The interviews and the focus groups were transcribed verbatim and the analysis involved two main processes: data reduction and inductive content analysis. These, with a combination of interpretational analysis allowed the elements, categories, patterns and relationships to emerge from the data in the form of themes.

The data reduction separated the data from the context by assigning a relevant theme to the study initial theme by noting the most salient statement of each participant.

The inductive content analysis was accomplished in two successive stages and aimed to amalgamate the aforementioned initial themes into meaningful integrated universal themes. In the first stage, each participant's very close or similar themes were linked under a general theme, while in the second stage; the themes that emerged from the linking were grouped into slightly more general themes. Such an approach enabled integrated universal themes to emerge from patterns without presupposing in advance what these higher-level themes would be.

# EXPERIENCING RURAL DISRUPTION

In all the areas we studied, disruption was frequent, expected, and seen as part of the transport system. This is vividly illustrated in the following quotations "*Whenever I'm going further than my daily commute, I think it's always a factor for me*", and "*I just kind of accept that if I'm going anywhere outside the Aberdeen area there's going to be a delay – there's going to be a disruption in my travel plans*". This expectation that a disruption might occur results in high levels of frustration. However, our data illustrate that this is not always the case as some disruptions are more acceptable than others. For example, man-made disruptions (e.g. strikes) are less tolerable than disruptions caused by nature (e.g. heavy rain or high winds). This is be described by the following assertion: "*I would say that public transportation disruption is man-made and the other we can influence. So that's the main problem, for me. I was very upset when I was stuck somewhere on the beach, it was freezing cold and I couldn't get the bus because they were striking and I didn't know they were*".

This quote also comes in line with our findings that each individual experiences disruption differently, as one individual's disruption can be another individual's opportunity or inconvenience. This may depend on various factors including personality and previous experience amongst others. The following two quotes illustrate this "*Some things, are just interruptions but It's when it affects what you've planned to do – you planned to have your breakfast on the train whilst doing your work because you are getting an early train, when you can't have your breakfast and you can't do your work then that's a disruption but if it's someone playing loud music then it's not really affecting your plans to sit on that train and get to a destination. For me, that would be the thing: whether it affects what my plans were for the journey*", and " *[…] for example weather things, in my home country it's not an issue at all, so this I don't feel as a disruption. It makes it difficult but I don't feel it as a disruption.*"

Along the same lines, some individuals living in rural areas don't consider a disruption problematic if they can find ways to work around it. This mainly depends on the type of disruption and on the purpose of travel. For example, individuals have been telling us that if they have to go to the doctor, and there is a bus or DRT instead of train, they do not consider it a disruption as long as they arrive on time.

Our findings also illustrate that individuals living in rural areas are more prepared to tackle disruptions than their urban counterparts, and preparedness is being seen as important. This is especially true for remote places. Individuals are more likely to be prepared for disruption in rural areas with higher chance of systemic disruption. For example, inhabitants of the island of Tiree, can experience high winds during winter that make the island inaccessible for up to two weeks, and so, they stock food and fuel for up to three weeks during the winter.

Further, live we have identified that certain groups of individuals are more vulnerable to disruptions than others. These can be summarised as:

- Family with young children
- Individuals without family or friends
- Those living in the outskirts of rural hubs or in hamlets
- Individuals dependent on public transportation

- Individuals that don't have immediate access to private transportation.
- Tourists or Individuals that they don't have knowledge of the locality

In spite of that, they mention that disruption is becoming easier to cope with. This is due to new technologies as they mention that they utilise a great variety of formal and informal information channels (e.g. social media, websites, blogs, forums, etc) to stay up to date, and exchange information (Papangelis et al, 2013). Figure 2 illustrates an individual living in a hamlet in the Scottish borders informing her twitter followers that the A7 roadworks are causing delays longer than expected.


Figure 2– Correcting and relaying official source information in twitter

Nonetheless, individuals have stated that disruption can also lead to positive outcomes. These can include: increased fitness by walking instead of taking the bus or driving, working from home, taking days off, and getting a break from the routine. The latter is illustrated through the following quotation: *"Maybe it's not a positive thing for our climate, but you know if you work in a large office like I was in that incident, when something like that happens, because it's a break from the routine and there's a prospect that they might need to send people home, regardless of the fact they might need to spend five hours getting there, people do look at that as quite a positive experience, it's like that kind of - You get a buzz."*

## BEHAVIOURAL RESPONSES TO DISRUPTION

Individuals living in rural areas have a wide array of behavioural responses to disruption ranging from minor adaptations to major adaptations. Our study indicates that minor adaptations are more prevalent in low impact disruptions, while major adaptations are more common in high impact disruptions.

| **Type of disruption** | | **Effects in journey** | **Examples of passenger adaptation** |
|---|---|---|---|
| Low impact disruption | Frequent | • Journey usually recovered.<br>• Adaptations are minor.<br>• No much time spent in planning and decision making process. | • Switching mode<br>• Catching an earlier bus.<br>• Staying overnight with friends. |
| | Infrequent | • Journey usually recovered.<br>• Adaptations range from minor to major.<br>• Decisions are well thought and planned. | • Keeping spare clothes at a friends house<br>• Leaving earlier or later<br>• Avoiding social arrangements on the day of travel |
| High impact disruption | Infrequent | • Journey recovery of abandonment depends on purpose of journey.<br>• Adaptations are major. | • Mode change<br>• Route change<br>• Relocation |
| | Frequent | | |

In low impact disruptions the journey is usually recovered and the change in travel behavior occurs to facilitate that particular journey. Not much time is spent in the planning and the decision making process. The individuals will usually base their actions on local knowledge, previous experience and momentary convenience. Examples of minor short term adaptations include: using local shops, staying overnight with friends, relying on family for lifts, switching mode, working from home, leaving early or late. However, if a low impact disruption becomes frequent it may lead to significant changes in the behaviour of an individual. During such disruptions the individuals spent more time in the planning and decision making process and base their actions on long-term convenience. Examples include: keeping spare clothes at a friends house, leaving earlier or later, avoiding social arrangements on the day of travel etc.

High impact disruptions lead to significant changes in the behaviour of the individual. The individual almost always plans a course of action, mainly based on previous experience and knowledge of the locality. A significant number of participants in both our interviews and focus groups mentioned that if a high impact disruption is infrequent they would only try to recover the journey if the purpose was important (e.g. commuting to work, visiting a doctor). The most common examples of behavioural adaptations to high impact infrequent disruptions are mode change, and route change. However, if a high impact disruption occurs often (even as often as once per month) may result in life changing events, such as buying a car or relocating. The following quotes demonstrate this "*I've moved – I use to live on Longtown but due to disruption I moved to Galashiels.*", and *"I used to commute with my bicycle every day. It's only about 8 miles but it's a really bad journey, and not in itself was a reason to buy a car, but I could not take it anymore!"*.

## COPING STRATEGIES

The most common coping strategy we have observed is 'time buffering'. Individuals usually make an assumption that they will be late, or that something will go wrong and "*build time on one end or the other"* of the journey in case that happens. The is exemplified in the following two quotes: *"By making that assumption I'm always building in time on one end or the other in which I can scramble for whatever I need. As far as my day to day commute is concerned I only rely on myself. So the only disruption is when I can't manage to do what I need to do.",* and*"I travel reasonably frequently down to West Wales and I travel at night because I know that the traffic disruption is going to be considerably less, it's just planning around it."*

Further, information is deemed extremely important for shielding against disruption. During our initial interviews when we asked the participants 'how could you minimise disruption in your journey' most of the interviews answered that cars, mopeds and motorcycles are the best way coupled with a technology that provides real time information about disruptions, and suggests ways around them (such as in-vehicle satellite-navigation systems). When we expanded this in the focus groups the participants mentioned that technologies and timely, accurate and personalised real-time information is probably the best way to insulate against disruption. In addition, when asked to rank the reliability of public transport and car in situations without real-time information, they ranked car higher as "*it is more flexible*". However, when presented with a mock-up of a technological solution that provides real-time information about all modes of public-transport they ranked the reliability of the public

transport and the car the same as: "*I will be more confident and when something goes wrong I will find a way around it.*"

Moreover, we have identified that kinship networks are also utilised as a way to protect against disruptions (Papangelis et al, 2013). Kinship networks are composed of weak ties and strong ties. The strong ties channels are individuals within the passenger kinship networks, which consist of family members, close friends, work colleagues, and school peers that are considered to be as close as familial links (Ebaugh and Curry, 2000). The weak ties are usually friends of people from their strong ties network, or other passengers, where they have a strong dependence on the connectivity to the individuals travel patterns. The information the passengers are seeking from these networks is usually to increase their situational awareness and information on how to mitigate the effects of disruptions. For example, during our passenger interviews, a participant mentioned that during the heavy snowfall in the Scottish Borders in 2010, she reached home safely not because of information that the operator provided, but from information that the passenger got from a friend of a friend about a local man going through her village with his snowplough. It was explained in our interview that the same individual, picked up other individuals that he did not know personally along the way only because they had shared common networks and ties. Figure 3 captures these information exchanges during times of disruption among strong ties, weak ties and formal information channels.

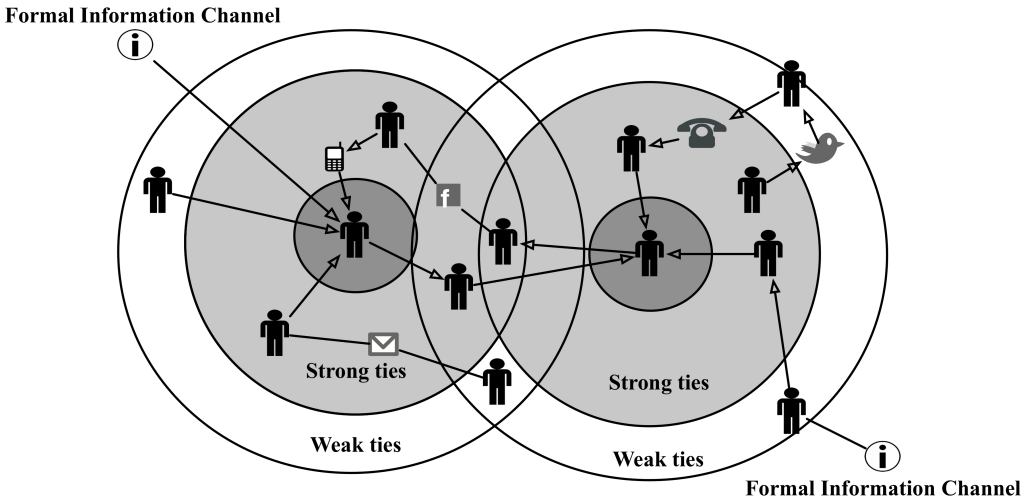


Figure 2 – Information exchange between individuals affected by disruption and their kinship network (Adapted from Papangelis, 2013).

## MAKING CHOISES DURING DISRUPTION

The behavioural adaptations discussed in the previous section are largely influenced and shaped by various variables. These have been identified as follows: (a) the information individuals have during disruption, (b) the frequency and purpose of the journey, (c) the available transport options, (d) the individuals social network, (e) the socio-economic characteristics of the individual, (f) the social norms, (g) the self-organisation/resilience of the locality, (h) the previous experience, (i) and various traits of the individual. It should be noted that these have only been identified as a

contributing factor in the present study, and that further research is required to understand the interplay between variables and individual's decision making.

*The information individuals have during disruption*

The information the individuals have during disruption may play the most important role in the decision making process of the individuals during disruption. We have expanded upon previous research that explores the passenger recovery process to disruption, and have identified that information is very important during the recovery phase, in which the individual looks for preventive measures to mitigate the effects of disruptions and recover the journey (Papangelis, 2013).

*The purpose of the journey*

The purpose of the journey play an important role in the decision making process on whether or not the individual will abandon or recover the journey. Many participant's stated that if they have an important journey to make they tend to choose modes of transport with low probability of disruption – such as car and DRT's. Further, they mention that if they experience disruption they tend to have an alternative arrangement.. This is illustrated in the following quote "*If I have to visit the doctor I will call a taxi […] and I will notify my relatives that I am taking a taxi in case there is any issues..*"

*The available transport options*

The transport options that the individual is aware of plays an important role in the decision making process during disruption. Most of the participants in interviews and focus groups that were relying on private motorised vehicles utilised them in case of disruption as they were not aware of the various options available to them. However, this was not true for the individuals who were utilising mainly public transport, as they were more aware of the other alternatives.

*The individual's social network*

The individual's social network is critical during rural disruptions as the individual usually exploits it to increase situational awareness and gather information on how to mitigate the effects of disruptions. Granovetter (1973) discussed how and when the individuals who comprise one's closest group do not possess the information or social resources that one needs in order to conduct their daily life, weak ties can be invaluable resources. Further, the activity of others (outside the individual's social network) who have a strong dependency or connectivity to the individual's travel pattern is important in case of disruption, as they might posses information that will help others to recover their journey.

*The social status*

The social status of an individual plays an important role mainly when choosing modes during disruption. A small percentage of participants in our focus groups mentioned that they would prefer taxi to bus, and if no taxi was available they would prefer to abandon the journey rather to use a bus. However, this was not the norm

amongst the participants of the focus groups as most agreed that the mode of transport does not matter as long as they arrive in their destination in a timely manner.

*The socio-economic characteristics of the individual*

Further, we have identified that the various socio-economic characteristics (car usage, family status, income, etc) play an important role in the decision making process and the recovery process of an individual. However, these have not been explored in the present study.

*The social norms*

The social norms of the locality affect the adaptation of the individual. Our studies indicate that individuals are less likely to use a new form of transport that is not common where they live. For example, in Longtown, in the Scottish Borders, car sharing is commonly employed when there is public transport disruption. However, they don't use other modes of transport, such as bicycles as they are not the norm. This is illustrated in the following quotation: *" I would not use a bike. It would be weird [...] nobody is using them around here except kids. I prefer to stay at home rather than seen riding a bicycle to college*".

*The self-organisation/resilience of the locality*

In resilience theory, communities are not resourceful, but rather have resources that can be developed, expanded or exhausted over time. The *capacity* to act is not enough to develop resilience; it is the action taken that is critical (Magis, 2010). The identification of resources by the passenger results in them accessing those resources to create new travel arrangements. Further, proactive individual and collective human agency is a key characteristic of resilience. Based on the preliminary data, individual action and collective action occur differently during short term and long-term disruption: in the short term, actions are marked with individualism, whereas in the long term, actions steadily become more collective and pro-social. This is particularly interesting, as it appears that the ability to develop collective resources and collective resilience does not occur unless the disruption is long-term, whereas individual resources are developed in the short term. This signifies that there is a temporal component to developing and enhancing different levels of resilience (Heesen et al, 2010).

*Previous experience.*

Past disruption experiences can impact future decision-making. Previous research has indicated that past decisions influence future decisions, because when something positive results from a decision, people are more likely to decide in a similar way, given a similar situation (Juliusson, Karlsson, & Garling, 2005). On the other hand, people tend to avoid repeating past mistakes (Sagi, & Friedland, 2007). The findings of our studies align with this literature, as over 80% of all the individuals involved in our studies mentioned that they base their decisions during disruption on

past successful actions. Further the participants mentioned that if a decision based on past experiences is not successful it will not be considered in the future.

*Various other traits of the individual*

In addition to the aforementioned, the individual's traits can influence decision making. Although not explored in detail in this study, it seems that the traits, personality, temperament and cognitive biases of an individual also play an important role in the decision making process. These seem to affect the collection and interpretation of information, and the individual's behavior during disruption (e.g. individualistic or pro-social behavior). However, further research is required in order to understand the interplay between those and decision-making and consequent travel behavior during disruption.

# DISCUSSION AND CONCLUSSION

In this paper we have conducted 69 interviews and 9 focus groups with rural dwellers in order to explore (a) the passenger experience during disruption, (b) the behavioural responses to disruption, (c) the coping strategies of the individuals,(d) and the variables that affect the decision making process.

Disruption in rural areas is seen as an inherent characteristic of the transport system. Even though it usually leads to frustration, it is often not seen as a problem if there is a way around it. Further, our findings illustrate that rural dwellers are more prepared to tackle disruption than their urban counterparts. However, this depends on the individual, as certain groups are more vulnerable than others. However, in the recent years information and new technologies is making these groups more resilient to disruption.

In addition we have identified that infrequent disruptions lead to more often micro adaptations in behaviour while frequent disruptions lead to major adaptations. The adaptation and the decision making process depends on several variables, namely, the information individuals have during disruption, the frequency and purpose of the journey, the available transport options, the individuals social network, the activity of others who have a strong dependency or connectivity to the individuals travel pattern, the socio-economic characteristics of the individual, the social norms, the self-organisation/resilience of the locality, the previous experience, and various traits of the individual.

These findings align with and expand previous studies by providing an initial insight into the rural dweller's behavioural adaptation during disruption, and can be utilised to inform which combination of policies and strategies can support effective contingency planning and improved travel options for the user and the operator in rural areas during disruption.

Future research should address the methodological implication of the present study, by, for example, employing ethnographic methods and observing the individual during disruption, rather than basing the results in recollections from recent past. Further, it should explore other rural groups (e.g. children, individuals with disabilities) and geographical areas, and further explore the interplay of the variables that affect the decision making process during disruption. In addition, it is suggested

that relevant future studies should take into account multiple theoretical and practical research elements from a range of related disciplines (such as psychology and anthropology) as this will enable new observation contexts and thus, provide multiple and diverse research perspectives.

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## References

Cairns, S., Atkins S., and P. G. Goodwin. Disappearing Traffic? The story so far, *Proceedings of the Institution of Civil Engineers: Municipal Engineer.* 2002. 151 (1), 13-22.

De-Los-Santos, A., G. Laporte, J. A. Mesa, and F. Perea. Evaluating passenger robustness in a rail transit network. *Transportation Research Part C.* 2012. 20, pp. 34–46.

Fujii, S., T. Gärling, and R. Kitamura. Changes in Drivers' Perceptions and Use of Public Transport During a Freeway Closure: Effects of Temporary Structural Change on Cooperation in a Real-Life Social Dilemma. *Environment and Behavior*. 2001. 33 (6), pp.796–808.

Goodwin, P. Enhancing the Effectiveness of Transport Policy by Better Understanding of Travel Choices. 2009. Centre for Transport and Society, UWE Bristol, July.

Goodwin, P. Policy Incentives to Change Behaviour in Passenger Transport. 2008. Paper prepared for the OECD/International Transport Forum, Leipzig 28-30 May 2008.

Granovetter, M. S. The strength of weak ties. *American Journal of Sociology* 78, 1973, pp. 1360–1380.

He, X., and H. X. Liu. Modeling the day-to-day traffic evolution process after an unexpected network disruption. *Transportation Research Part B,* 46, 2012, pp.50–71.

Heesen F.H., K. Papangelis, N.R. Velaga, and Farrington J.H. Pathways to passenger resilience during rural transport disruption: A conceptual model development. 2013. *Proc. 45th Annual University Transport Studies Group (UTSG) Conference*.

Hounsell, N. B., B. P. Shrestha, and A. Wong. Data management and applications in a world-leading bus fleet. *Transportation Research Part C,* 22, 2012, pp. 76–87.

Jenelius, E., and L. Mattsson. Road network vulnerability analysis of area-covering disruptions: A grid-based approach with case study. *Transportation Research Part A,* 46, 2012, pp.746–760.

Jullisson, E.A., Karlsson, N., Garling, T. Weighing the past and the future in decision making. *European Journal of Cognitive Psychology,* 2005. *17*(4), 561-575. DOI: 10.1080/09541440440000159.

Kitamura, R., T. Yamamoto, Y.O. Susilo, and K.W Axhausen, How Routine is a Routine? An Analysis of Day-to-Day Variability in Prism Vertex Location. 2006. Transportation Research Part A 40 (3), 259 – 279

Miles, M., and A. Huberman. *Qualitative data analysis* (2nd edition).Thousand Oakes, CA: SAGE. 1994.

Papangelis K., Velaga, N R, Sripada, S, Beecroft, M, Nelson, J.D, Anable, and Farrington, J H (2013). Supporting rural public transport users during disruptions: The role of real time information. *Proc. 92st TRB Annual Meeting*, Paper No 13-2964.

Sagi, A., & Friedland, N. (2007). The cost of richness: The effect of the size and diversity of decision sets on post-decision regret. *Journal of Personality and Social Psychology, 93*(4), 515-524. DOI: 10.1037/0022-3514.93.4.515.

Schlich, R. and K.W. Axhausen. Habitual travel behaviour: evidence from a six week travel diary. 2003. Transportation, 30 (1), pp13-36.

Susilo, Y. and K.W. Axhausen. Stability in individual daily activity-travel-location patterns: A study using the Herfindahl-Hirschman Index. 2007. Arbeitsberichte Verkehrs- und Raumplanung, 435, IVT, ETH Zürich, Zürich.

Van der Waerden, P., H. Timmermanns, and A. Borgers. The influence of key events and critical incidents on transport mode choice switching behaviour: A descriptive analyses. *10th International Conference on Travel Behaviour Research, Lucerne*. 2003.

Van Exel, N. J. A. and P. Rietveld. When strike comes to town: anticipated and actual behavioural reactions to a one-day, pre-announced, complete rail strike in the Netherlands. *Transportation Part A*, 43, 2009, pp. 526-535.

Zhu, S. and D. M. Levinson. A Review of Research on Planned and Unplanned Disruptions to Transportation Networks, *89th Annual Transportation Research Board Meeting*, Washington D.C. 2010.