TRANSIT USER BEHAVIOUR IN RESPONSE TO SERVICE DISRUPTION: STATE OF KNOWLEDGE

Teddy Lin, University of Toronto
Amer Shalaby, University of Toronto
Eric Miller, University of Toronto

Introduction

Public transit service disruption is common across different transit modes at different times and days for all transit agencies. Due to much higher occupancy compared to personal vehicles and a smaller transit network compared to the road network, the impacts are significant for the transit agencies and users. Different passengers have different ways of coping with the service interruption. Passengers may respond differently to various types of incidents, depending on the cause and severity of disruption.

While any disruption usually affects network reliability adversely, the nature of the resulting reliability issues and their effect on user behaviour are distinct from those related to general reliability issues under normal transit services. Sikka and Hanley (2013) classified expected delays or travel time variability under "general reliability" and unexpected delays under "disruption". Similarly, Carrel, Halvorsen and Walker (2013) considered recurrent issues under "general reliability" and incident-related occurrences under "disruption". While there have been many studies on the effects of general reliability of both auto and transit on passenger behaviour and decision making, there is disproportionately much less attention dedicated to the subject area of transit user behaviour in response to service disruptions.

Disruptions to the road network have very different consequences from those occurring in the transit network, due to the much smaller size of the latter and its limited number of route alternatives, especially within the rapid transit network. Zhu and Levinson (2011) reviewed a wide range studies on transit and road network disruptions, such as transit strikes, bridge closures, special events and earthquakes, and they summarized the behavioural changes of both auto and transit users. However, information on unexpected road disruptions is usually more readily available to drivers, while the information seeking and choice behaviour as well as information availability for transit users are likely different. Compared to the auto mode, transit service disruption is not examined as extensively despite the potential of severe delays they could cause to overcrowded rapid transit systems.

Service recovery is a top priority for transport agencies in the event of a service disruption, and there are many studies done on the recovery of transit services, including a synthesis study by Pender, Currie, Delbosc, and Shiwatoki (2013). Nevertheless, most disruption management studies do not consider passenger behaviour explicitly and empirically. Transit user behaviour in the event of a disruption is not well understood, and as a result disruption management and recovery may not be optimal.

Of special significance are disruptions to rapid transit services which may have severe impacts on passengers' journeys and experiences. User behavioural responses can vary across different time periods such as an immediate decision-making, pre-planned intention or gradual adaptation. The immediate response happens when a disruption has just occurred and been communicated, which can be subdivided into pre-trip and en-route scenarios. A passenger encountering an en-route transit service disruption may decide to take the replacement shuttle buses (if applicable), walk to the destination, take a taxi, or wait until the disruption is over, while finding out about the disruption before starting the trip opens up other options such as a departure time change without route change. The pre-planned response refers to planned disruptions which are announced beforehand, allowing for alternate arrangements of travel. For example, a passenger informed of a planned disruption to a particular subway route may decide to utilize the subway system using a different route, change the destination or cancel the trip during the ongoing closure and return to the original choice after the disruption (no long-term change). The gradual response occurs after multiple encounters of disruptions, leading to behavioural changes in both the short and long terms. After the disrupted trip(s), the passenger may decide to change the departure time, switch to a different route or mode, or make no changes for the next trip. In the long run, the passenger may decide to permanently switch away from this route or mode, change the destination, cancel the trip, or simply make no changes. Table 1 outlines the options that are usually considered for different time periods.

Table 1: Most common alternatives at different stages

Immediate action	Pre-planned intention	Gradual adaptation
Pre-trip and En-route	Short-term and long-term	Short-term and long-term
Wait until service restored (no change) Departure time change only (pre-trip) Route change only Transit mode shift Mode shift Trip cancellation	No change (long-term) Route change only Transit mode shift Mode shift Destination change Trip cancellation	No change Route change only Transit mode shift Mode shift Destination change Trip cancellation

The passenger experience and behaviours can also differ based on the various causes of disruptions. For unplanned disruptions, passengers have to make a decision very quickly among a limited number of options at a different emotional state. For example, passengers are likely less understanding and angrier for disruptions where the transit agency is at fault or responsible; on the other hand, malicious attacks such as bombings can affect passenger behaviours beyond the incident occurrence. Passengers are likely going to behave differently for pre-planned disruptions such as maintenance or labour strike because they can find out about the severity and consider viable alternatives beforehand. Additionally, there are many service-oriented and user-oriented factors that affect passengers such as the availability and media of information, length of delay, weather, purpose of trip, comfort, and habit, to name a few. The complexity of decision making of transit user shows that empirical studies are needed to gain a better understanding.

Literature Review

Studies on passenger response to rapid transit disruptions can be classified into four types (with number of studies reviewed in parentheses): general (5), multi-type (0), single type (1), and single event (8). General transit disruption studies are not concerned with incident types and look into service interruptions or suspensions, which were all conducted for en-route situations only. The authors are not aware of any multi-type disruption studies that investigate how different types of incidents affect user behaviour in a controlled environment. Single-type disruption studies have recurring disruptions so they are potentially applicable to similar incidents in the future with a focus on long-term behaviour. Studies focused on a specific event or incident tend to have larger impacts immediately after the incident and possibly in the long term. Due to their specificity, the findings may only be applicable to a particular type of disruption at a geographical area, or possibly only the incident itself if it is very unique.

The following five studies looked into general disruptions and the immediate response of passengers. Tsuchiya, Sugiyama, ans Arisawa (2007) conducted a revealed preference (RP) survey that required extensive collection of reliable data during a month-long study period that saw 18 service disruptions of the regional rail systems in Japan. The study showed four possible route recommendations for users updated every minute: original route recommended, detour route recommended, no detour available (wait for service resumption), and not affected. The study, however, was focused on the traveller perception and accuracy of information provision without a thorough analysis of passengers' response behaviour. Fukasawa et al. (2012) conducted a stated preference (SP) survey of passenger behaviour in response to an en-route disruption in Japan to compare their departure time and level of service (local vs. express) choices between scenarios with and without information provision of the estimated travel time and crowding. The study found that there would be more instances of switching to other trains if information on alternative options was provided. Both studies in Japan found that passengers prefer having some information about the delays even if it is not always accurate. Bai and Kattan (2014) conducted an SP survey to study the effect of information provision on the passengers' en-route mode choice given LRT delays and found that a significant mode and transit mode shift would occur (over half) when information on the length of delay is not provided, compared to less than 25% with next rain arrival information given and not too long (10 minutes). Given a headway of 3 minutes, the additional wait time of 7 minutes might induce behaviours in response to service reliability as opposed to extended delays or disruptions. Teng and Liu (2015) used the responses from an RP survey to design the attribute levels for an SP survey for Shanghai Metro where service disruptions are rare and found that the majority of the respondents would consider the replacement shuttle bus while crowding is less important. The extensive metro system offers multiple competitive transit options such as alternative metro routes, shuttle and metro, and shuttle only (with the last option being taxi) that may not be applicable in smaller rapid transit systems. Bachok (2008) investigated disruptions due to train derailment but it appeared that the study was considering service suspension in general. The study considered different media of information and delay duration and found that those who have previously switched travel modes would not stay with rail (i.e. waiting) but encountered challenges with findings of insignificant travel time and cost.

Only one study investigated a single type of disruption without focusing on an event although there is little information on the transit user mode choice behaviour. The UK Department for Transport (2008) conducted a study on the experiences and perceptions of anti-social behaviour and crime. The study found that 3% of infrequent bus users or non-users did not use the bus more often due to concerns about crime and 2% of infrequent train users or non-users did not use the train more often due to the same reason. The study showed that security issues (most likely recurring) can change long-term behaviours due to psychological factors in addition to the impacts from disruptions.

The following four single-event studies reviewed pre-planned closures due to maintenance and upgrades as well as labour strikes. Mojica (2008) studied the station closure and service reduction (partial disruption) of Chicago's rail lines using smart card data and concluded that 79% of all riders continued to use rail with 8.4% for bus, 4% for non-transit and the rest unknown. There was no strong evidence of boarding time change, as a proxy for departure time change. The study found that long-term changes (post-disruption) are negligent with limited data collected 2 to 4 weeks after restoration of full service. Pnevmatikou & Karlaftis (2011) conducted an RP study on transit mode and route choice in response to a five-month pre-announced closure of an Athens Metro Line. The results showed that 58% of the respondents took the replacement bus service, 9% switched to modes involving auto and 13% chose to walk (only 15-20 minutes between closed stations). The results provided insights on travellers' behaviours for pre-planned and pre-announced closures and showed a low percentage of mode switch to auto in this study. The study, however, only recruited respondents who took the closed metro line after the re-opening and thus induced sampling bias by excluding those who no longer took the same line or transit mode. Pnevmatikou, Karlaftis, & Kepaptsoglou (2015) then extended the study with an SP questionnaire during a series of planned strikes and found that the joint RP-SP estimation with Nested Logit model performed better than the RP-only or SP-only model. The study found income, trip purpose and work schedule flexibility to be significant but only considered three options (auto, bus, and taxi) for investigating short-term and long-term behavioural changes. Van Exel and Rietveld conducted a synthesis study on traveller behaviour in the event of crew shortage due to a labour strike (2001) and also conducted a case study on the pre-planned and pre-announced one-day rail strike in the Netherlands in 2004 (2009). It was found that 62% of the people who intended to travel did not make the trip and 24%

chose to drive. The study also showed that almost half of those who intended to travel using auto mode also changed their behaviour in anticipation of major mode shifts due to the transit network disruption. The study did a before-and-after comparison among four available options (drive, other mode, travel on another day by train, cancel trip) and found that 86% of all respondents chose the same option as their intended choice beforehand; in addition, the number increased to 91% when the last two options (no travel on the day of) were combined.

The following four single-event studies reviewed unplanned disruptions due to weather, accident, and terrorist attacks. The New Zealand Ministry of Transport (2013) conducted a study following the storm that resulted in a 6-day partial closure of one commuter rail line and found substantial short-term changes in rail mode share for the area served by this rail line from 51% to 22% (the latter using rail and shuttle bus). More than half of the commuters in the affected area chose an earlier departure time over the closure period (short-term) despite the comparable travel times before and during peak periods. The study also showed that 11% of riders changed their departure time or mode in the long term (a month after the incident), but the agency drew the conclusion that long-term changes were not observed as a result of the storm. Murray-Tuite, Wernstedt, & Yin (2014) studied the behavioural changes due to a fatal rapid transit accident in Washington DC and observed that 17% of Metrorail users avoided the front or rear car of the train while 10% switched to a different transit mode or travel mode. The data collection started 5 months after the incident but it was unclear whether the observations referred to the short-term or long-term changes. The study noted the sampling bias due to the data collection method which omitted passengers who no longer took transit. Lopez-Rousseau (2005) analyzed the travel patterns after the March 2004 Madrid train bombing using aggregate data and found that both train and car trips decreased after the incident. In contrast to the 9-11 attack in the U.S., the study noted that psychological (scale of incident), cultural (car dependency), social, and political (preparedness) differences led to different behaviours, suggesting that there is a limitation in the transferability of findings. Rubin et al. (2007) examined the short to long term effects of the July 2005 London Underground bombing and found that 30% of passengers would travel less in an SP survey 2 weeks after the incident while only 19% confirmed their reduction of travel in an RP survey 7 months after. The study noted some limitations, namely that the RP respondents might not be representative of the SP respondents or the general population and that heightened perception of threats of terrorism could have led to behavioural changes prior to the incidents which could have been incorrectly captured in post-incident survey.

Shortcomings

Human behaviour and decision making is extremely complex. It is essential to have a good understanding of the factors that influence transit user behaviour and the considerations of possible options in the choice making process. These underlying factors and considered choices can change substantially in the event of service disruption. The factors that are traditionally considered include travel time and cost as well as socio-demographic variables such as age and income. Based on the literature, the following factors are also believed to have a potential effect on the mode choice of travellers in response to a disruption: cause of incident, stage of trip, purpose, anticipated delay information, uncertainty of delay duration, attitudes (desire to experiment, habit, grievance), subjective level-of-service attributes (comfort, cleanliness), flexibility, and weather. The extent to which the aforementioned variables are considered in the literature is discussed below. From a transit user's perspective, the following information needs were identified as important in a UK study: transparency of agency, length of delay, information provision for passengers before starting their journeys, information media, acknowledgement and announcement of short delays, information on alternative routes, information display at station, timetable display if altered, overview of service changes on website, and style of information (Passenger Focus, 2011). For customers faced with incidents en route, the three most important pieces of information are length of delay, route alternative and reason for delay while for customers informed of an incident before entering the transit system have the same set of priorities in a different order: length of delay, reason for delay, and route alternative.

Based on the literature review on different causes of disruption, it is clear that transit user behaviour varies by type of incident. To the authors' knowledge, there are no studies done on how different types of disruption causes, in a controlled experiment, affect the transit user choice making. In fact, many transit disruption studies are event driven, conducted due to an occurrence of a major disruption that provided an opportunity to study passenger behaviour in response to that particular disruption. While the findings can be informative, these studies have limited ability to draw more generalized conclusions.

When riders are faced with an unplanned transit service disruption, finding out about the incident before or during the trip can make a significant difference. Kattan, de Barros, & Saleemi (2013) considered pre-trip and en-route stages for the auto mode and found significant differences, especially with the option of mode switching at the pre-trip stage (22%). The authors are not aware of any studies on transit user mode choice when being informed of a service disruption before the start of the trip even though this information can be very useful for transit agencies for service recovery and passenger diversion. For pre-planned scenarios, most studies focused on short-term behaviours (defined as the duration of closure, regardless of how long the closure is). Only Mojica (2008) considered long-term (post-disruption) behaviours but the data were limited. The long-term behaviour can have more significant implications for the transit agencies than it appears because a 10% loss of ridership during a one-month closure results in a smaller reduction in total ridership count compared to a 1% loss for the year following the closure. For gradual adaptations, short-term and long-term periods are harder to distinguish and sometimes not explicitly stated in the studies. Generally, short-term is up to a few months after the incident(s) and long term is beyond a few months and sometimes related to recurrent major disruptions. Most studies focus on behavioural changes after a particular major disruption, providing a good opportunity to conduct such study. The impacts on recurring events are difficult to capture and the authors are not aware of any studies on transit user mode choice behaviour due to recurring major incidents.

The purpose of the trip has been considered in several studies in terms of its effect on the passengers' choice behaviour. Not surprisingly, business and commuting trips were more likely to be shifted to another mode than cancelled for pre-planned disruptions (Van Exel & Rietveld, 2009) and unreliable metro service during partial closure led to shifts to another transit mode for work trips (Pnevmatikou & Karlaftis, 2011). Two studies that investigated behaviours in en-route situations considered trip purpose (Bachok, 2008; Teng & Liu, 2015) but there was no strong evidence on the significance of trip purpose in the choice behaviour. More investigation is needed to reach a more meaningful conclusion.

Information regarding the disruption is important for passengers, and it is well understood that such information may not always be available to them. For the cause of disruption, the agency might not know it right away before a preliminary investigation or diagnosis; sometimes, the agency may not want to reveal the actual cause (e.g. suicide) for fear of triggering similar actions and instead opt for a generic and less transparent reference (e.g. medical emergency); when announced, it is unlikely that all riders are made fully aware of the incident. For the length of delay, the agency usually has a ballpark estimate of the duration but in most instances it does not share it to avoid frustration of customers if underestimated; even if shared through multiple communication channels, not all passengers would receive the information. Therefore, it is important to consider scenarios where the information is not available. Among the studies reviewed, Bai and Kattan (2014) designed scenarios between a 10-minute delay and no information while Bachok (2008) considered three different media of information (audio, visual, and text) and three different lengths of delay (30, 45, and 60 minutes). However, both studies modelled the scenarios separately so it does not reveal the individual effect of information availability and delay duration.

While it is known that uncertainty of the travel information provided (e.g. range of estimate for delay duration) can lead to a wide range of possible responses of the travellers, it has not been well studied other than the reliability aspects of travel, which are usually considered recurring and expected.

Unexpected service disruptions lead to delays where the duration is often unknown to the passengers and sometimes even to the agency. The authors could not find any studies that consider delay information at different levels of uncertainty.

There are other factors that are more subjective and hard to capture that may influence passenger choice-making behaviour. In addition to the commonly used variables such as travel time and cost as well as the factors mentioned above, Goodwin (2008) lists the following considerations for choosing among different modes such as a desire to experiment, habit, grievance, comfort, cleanliness, and flexibility. Desire to experiment and habit are hard to capture but may be inferred from previous experiences and choices. Murray-Tuite et al. (2014) confirmed the hypothesis that travel inertia and mode inertia would prevent transit users from switching mode after a fatal incident. Grievance can be explained by resentment and negative emotion towards the incidents as a reason for mode shifting, such as less frequent transit trips due to security issues (Department for Transport, 2008). Teng and Liu (2015) found that crowding is not important in disruption scenarios while Fukasawa et al. (2012) had similar findings for comfort relative to the importance of speed. Pnevmatikou et al. (2015) found that flexible work hours had a negative correlation with mode switch to auto. Depending on the length and duration of disruptions, it could be beneficial to consider departure time change if flexible work hours is considered. Most studies did not consider weather conditions with the exception of the consideration of temperature by Bai and Kattan (2014), which was found significant.

The choices available can depend on the transit agency operating the system and its response strategy. The auto option includes auto driving, auto passenger, carpooling, and taxi. Taxi is also used as a response strategy where Munich tram passengers are offered free rides for delays less than one hour (Zeng, Durach, & Fang, 2012). Bus bridging (providing replacement bus service for rail disruption) is the most common response for agencies (Pender et al., 2013). Re-routing within the transit network using other routes or transit modes is also an option that some transit agencies advertise to help passengers and divert some demand to other parts of the network. Waiting (until the disruption is over and following the same route to destination) is also an option for passengers, particularly for long-distance heavy rail services or incidents with short delays. Active transportation modes such as biking and walking are only feasible for shorter distances for subway disruptions. Destination change and trip cancellation are also possible, but are more likely for the pre-planned disruptions and gradual adaptations. It is important to recognize that the available and considered choices may change throughout the trip, for example, being close enough to walk to the destination or willing to take a taxi. It is important to provide all the possible choices to survey respondents if appropriate to obtain more accurate data.

Future direction

Although some studies considered passenger behaviours explicitly, those were modelled based on reasonable assumptions instead of empirical studies. These assumptions, while generally accepted to be logical, were not verified or compared with behavioural studies to confirm the validity and accuracy. Even though qualitative studies, aggregate data and individual passive data such as smart card data can reveal some information, usually at a cheaper cost, a better understanding of transit user mode choice in response to disruptions requires more detailed information that is only available through an unbiased travel survey. Advanced survey techniques have greatly improved the methodology of data collection. Individually customized data gives the opportunity to provide familiar and realistic scenarios to obtain more accurate data. The development of the SP method (Kroes & Sheldon, 1988) and joint RP-SP models (Ben-Akiva & Morikawa, 1990) in transportation have overcome the limitations in RP and SP data individually. Efficient design in SP experimental design can minimize standard errors and outperform orthogonal design (ChoiceMetrics, 2014). These advanced survey methods should be adopted to improve the quality of data and results.

Given the significant differences between different time periods of consideration for immediate, pre-planned and gradual behaviours, it would be preferable to investigate the transit user behaviours in separate studies. Studies for immediate actions in the literature lack consideration of some potentially important variables, especially the duration and uncertainty of delay as well as the availability of such information. In addition, delay may be experienced in other modes as well, including replacement shuttle bus and taxi which should also be considered. The type of incident may have an impact on passenger behaviour as well. Furthermore, choice alternatives need to be carefully selected and presented to include all considered choices without listing unfeasible ones. For pre-planned intentions, the biggest difference is that the preferred choice is no longer available until re-opening, possibly for an extended period of time (whereas scenarios for immediate decisions usually have a no change option to wait for service resumption). Behavioural changes are likely to include a combination of departure time choice and mode choice and, as a result, the model specification would be different for joint decisions. Destination changes and trip cancellations are also more likely to happen and should be considered appropriately. Behaviours after extended service closure come from a different choice set in a different time period and should also be compared against the pre-disruption behaviours. Gradual adaptations are harder to understand as there may be an ongoing motivation from recurrent incidents to perhaps try a different option while a major disruption or a series of frequent incidents may eventually trigger the permanent change. It is difficult to attribute the gradual adaptations to the underlying factors because analysis of experience and behaviour over a long time is required and other background situations may change over time. Also, it is more susceptible to sampling bias when travellers who have permanently switched to a different mode are not included or properly represented.

Conclusion

Transit user mode choice behaviour in response to service disruptions is more complex than the everyday commuting mode choice. Recent studies on this topic have been reviewed, categorized and summarized. There are three main categories and six sub-categories with regards to the timeline of transit user behaviour in response to disruptions: immediate (pre-trip and en-route), pre-planned (short-term and long-term), and gradual (short-term and long-term). The challenges and shortcomings of the studies are identified and recommendations on future studies are presented.

References

Bachok, S. (2008). Estimating, calibrating, and validating demand for feeder services during incident detections. *30th Conference of Australian Institutes of Transport Research.* Perth, Australia.

Bai, Y., & Kattan, L. (2014). Modeling Riders' Behavioral Responses to Real-Time Information at Light Rail Transit Stations. *Travel Behavior 2014, Journal of the Transportation Research Board, 1*, 82-92.

Ben-Akiva, M., & Morikawa, T. (1990, November). Estimation of Switching Models from Revealed Preferences and Stated Intentions. *Transportation Research Part A: General, 24A*(6), 485-495.

Carrel, A., Halvorsen, A., & Walker, J. L. (2013). Perception of and Behavioral Adaptation to Unreliability in Public Transportation. *Transit 2013, Journal of the Transportation Research Board, 2*, 153-162.

ChoiceMetrics. (2014, July 15). *Ngene 1.1.2 User Manual & Reference Guide.* ChoiceMetrics: https://dl.dropboxusercontent.com/u/9406880/NgeneManual112.pdf

Department for Transport. (2008). *Experiences and perceptions of anti-social behaviour and crime on public transport.* Department for Transport, Transport Statistics. The National Archives. http://library.college.police.uk/docs/dft/anti-social-crime-on-public-transport-2008.pdf

Fukasawa, N., Yamauchi, K., Murakoshi, A., Fujinami, K., & Tatsui, D. (2012, August 30). Provision of Forecast Train Information and Consequential Impact on Decision Making for Train-Choice. *Quarterly Report of Railway Technical Research Institute, 53*(3), 141-147.

Goodwin, P. (2008). *Policy Incentives to Change Behaviour in Passenger Transport.* University of the West of England, Bristol, The Centre for Transport & Society. International Transport Forum. http://www.internationaltransportforum.org/Topics/Workshops/WS2Goodwin.pdf

Kattan, L., de Barros, A. G., & Saleemi, H. (2013, November). Travel behavior changes and responses to advanced traveler information in prolonged and large-scale network disruptions: A case study of west LRT line construction in the city of Calgary. *Transportation Research Part F: Traffic Psychology and Behaviour, 21*, 90-102.

Kroes, E. P., & Sheldon, R. J. (1988, January). Stated Preference Methods. *Journal of Transport Economics and Policy, 22*(1), 11-25.

Lopez-Rousseau, A. (2005, June). Avoiding the Death Risk of Avoiding a Dread Risk. *Psychological Science, 16*(6), 426-428.

Mojica, C. H. (2008). *Examining changes in transit passenger travel behavior through a Smart Card activity analysis.* Massachusetts Institute of Technology. DSpace@MIT. https://dspace.mit.edu/handle/1721.1/44364

Murray-Tuite, P., Wernstedt, K., & Yin, W. (2014, May). Behavioral Shifts After a Fatal Rapid Transit Accident. *Transportation Research Part F: Traffic Psychology and Behaviour, 24*, 218-230.

New Zealand Ministry of Transport. (2013, November). *The Transport Impacts of the 20 June 2013 Storm.* New Zealand Ministry of Transport: http://www.transport.govt.nz/assets/Uploads/News/Documents/Transport-impacts-in-Wellington-storm-June-2013.pdf

Passenger Focus. (2011). *Information: Rail passengers' needs during unplanned disruption.* Passenger Focus. http://www.passengerfocus.org.uk/media/dca7e0b50f3ad90e6475953c74997ea3c4b0fa59/pf_unplanned_disruption_report__final.pdf

Pender, B., Currie, G., Delbosc, A., & Shiwatoki, N. (2013). Disruption Recovery in Passenger Railways International Survey. *Transit 2013, Journal of the Transportation Research Board, 4*, 22-32.

Pnevmatikou, A. M., Karlaftis, M. G., & Kepaptsoglou, K. (2015, September 28). Metro service disruptions: how do people choose to travel? *Transportation, 42*, 933-949.

Pnevmatikou, A., & Karlaftis, M. (2011). *Demand Changes From Metro Line Closures.* Association for European Transport: http://abstracts.aetransport.org/paper/download/id/3603

Rubin, G. J., Brewin, C. R., Greenberg, N., Hughes, J. H., Simpson, J., & Wessely, S. (2007, March). Enduring consequences of terrorism: 7-month follow-up survey of reactions to the bombings in London on 7 July 2005. *The British Journal of Psychiatry, 190*(4), 350-356.

Sikka, N., & Hanley, P. (2013, September). What Do Commuters Think Travel Time Reliability Is Worth? *Transportation, 40*(5), 903-919.

Teng, J., & Liu, W.-R. (2015, March). Development of a Behavior-Based Passenger Flow Assignment Model for Urban Rail Transit in Section Interruption Circumstance. *Urban Rail Transit, 1*(1), 35-46.

Tsuchiya, R., Sugiyama, Y., & Arisawa, R. (2007, December). A Route Choice Support System for Use During Disrupted Train Operation. *Japanese Railway Engineering, 47*(2).

Van Exel, N. J., & Rietveld, P. (2001, October). Public Transport Strikes and Traveller Behaviour. *Transport Policy, 8*(4), 237-246.

Van Exel, N., & Rietveld, P. (2009, June). When Strike Comes to Town … Anticipated and Actual Behavioural Reactions to a One-day, Pre-announced, Complete Rail Strike in the Netherlands. *Transportation Research Part A: Policy and Practice, 43*(5), 526-535.

Zeng, A. Z., Durach, C. F., & Fang, Y. (2012, May). Collaboration decisions on disruption recovery service in urban public tram systems. *Transportation Research Part E: Logistics and Transportation Review, 48*(3), 578-590.

Zhu, S., & Levinson, D. (2011, August 30). *Disruptions to Transportation Networks: A Review*. *Transportation Research, Economics and Policy*, 5-20.