Learning from Covid: How Can we Predict Mobility Behaviour in the Face of Disruptive Events? – How to Investigate the Mobility of the Future

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1 Introduction

With the beginning of the COVID-19 outbreak and the restrictions put in place to prevent an uncontrolled spread of the virus, the circumstances for daily activities changed. A remarkable shift in the modal split distribution was observed [Ank21]. Moreover, the changes in mobility during the COVID-19 pandemic had multiple impacts on road traffic [Yas21]. By now, several researchers have looked at the impact of COVID-19 as a disruptive event on mobility behaviour. This workshop within the 4th Symposium on Management of Future Motorway and Urban Traffic Systems aimed to discuss insights from these research projects and how they enable experts to transfer this newfound knowledge to future disruptive events such as climate change, rising energy costs and events related to a possible energy transition. Thus, the research question this workshop investigated reads as follows: What can we learn from the pandemic to be able to predict how different future disruptive events can shape the mobility of tomorrow?

2 Background

A disruptive event within the context of transportation systems is an event which has the potential to change the state of said transportation system significantly. These events include, but are not limited to, pandemics, extreme weather events related to climate change and local economic events due to structural change. Sustainable transportation systems allow the

basic access and development needs of individuals, companies and society to be met safely and consistently with human and ecosystem health and promote equity within and between successive generations [Ger15]. The resiliency of a transport system can be characterized by how a sustainability rating (e.g. a function dependent on sustainability indicators) changes throughout a disruptive event the transportation system is facing.

The COVID-19 pandemic was a prominent example of a disruptive event influencing mobility behaviour on a wide scale and thus impacting transportation systems. The pandemic allowed for extensive research on how transportation systems reacted to an influential event and how transportation systems should be designed in order to be resilient to disruptive events [Ank21]. These findings could help design methods to measure the impact of hypothetical future disruptive events. We designed two quantitative surveys with this aim and evaluated the designs in the workshop described here.

3 Methodology

In general, there are two ways of measuring self-reported mobility behaviour in the context of disruptive events: One option is to measure past behaviour during past disruptive events and abstract the results to possible future behaviour. We call this the explicit option. The second option is to describe hypothetical future disruptive events and ask participants how they would behave in the described situation. We call this the implicit option. Both concepts have advantages and disadvantages over the other. A significant advantage of the explicit option over the implicit option is avoiding problems measuring people's intentions rather than actual behaviour. The inconsistency between intention and behaviour has been described extensively in the context of travel behaviour [Gen17].

Consequently, measuring actual behaviour via the explicit option is expected to result in more valid data than measuring intention via the implicit option. However, one significant drawback to the explicit option is that focusing on past behaviour severely limits the ability to collect data on hypothetical future events.

Overall, the participants must abstract information in the explicit and implicit options. Using the explicit option, the participants must abstract their past behaviour and transfer it to future behaviour for future disruptive events. Usually, the past behaviour is limited to a few past disruptive events. Using the implicit option, the participants must abstract intentions regarding hypothetical disruptive events and transfer them to actual behaviour.

For this workshop, we developed one survey for the explicit option and one for the implicit option (see appendix). Participants were able to fill out both surveys and give feedback afterwards.

4 Results

Participants led an open discussion of the survey's results. Furthermore, the methodology was a focal point of the discussion. In the following, we summarize parts of the discussion

that elaborate on the disadvantages of the two survey methodologies and how they can be optimized.

Implicit option. The abstraction process in this option was seen as a significant problem not only because of the intention-behaviour gap [She16]. A second issue was the expectation that survey participants would react very differently to the presented future disruptive events depending on how elaborate they can imagine the hypothetical scenario. The workshop participants devised a possible solution: Specifying the scenario as much as possible. The survey could present a well-written story or an informative video with a specified narrative where the main character is confronted with a disruptive event. Participants then would be asked to specify how they would behave in this situation.

Explicit option. The proposed solution to the problem of transferring past behaviour to future events was asking participants about past behaviour openly (e.g. "Was there a time when you had to change your travel behaviour (including mode selection)?"). Subsequently, participants could be asked to specify the situation and how it affected their travel behaviour. This specification would enable researchers to categorize reported past situations afterwards and thus create clusters of situations likely to happen together during a hypothesized future disruptive event. An adequate sample size of participants is crucial for this method to result in meaningful insights. Categorizing past situations into clusters can only work if participants report sufficient situations they have faced.

5 Conclusion

Most workshop participants supported the explicit option as their preferred methodology because they felt the crucial issue of achieving a large sample size could be attained economically. In contrast, designing narrative stories or videos that guarantee a successful implicit option was assessed as having a questionable ratio of effort and return. Thus, the authors used findings from this workshop first to use the explicit option in their research and further develop and optimize this method of measuring future travel behaviour within the context of disruptive events.

The results of this workshop led to a specific design of the explicit method that will enable the authors to collect meaningful data on the impacts of several hypothetical future disruptive events and how they can impact mobility behaviour. The collected data will help the authors to analyze resilient traffic systems that allow sustainable mobility in the face of disruptive events.

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Appendix

A brief outlook on the two different concepts of surveys:

Part I: Measuring habitual travel behaviour

[..]

Part II: Recording changed transport behaviour due to disruptive events

The implicit concept

Define all relevant disruptive events with a sum of different consequences with different weightings.

1. How would your choice of means of transport change if route X with means of transport Y
   a) takes longer than usual (possibly specify how long)
   b) is more uncomfortable to use than usual (specify if necessary)
   c) is temporarily unavailable in the short term (specify “short term” if necessary)
   d) is no longer available at all in the long term (specify “long term” if necessary)
   e) ...
2. calculate different modal splits depending on different disruptive events by combining the answers of Part I and Part II

The explicit concept

1. Disruptive events include both expected risks such as storm damage in vulnerable regions or heat waves during the summer months, and unexpected risks such as global pandemics or fires.

   Which of the following disruptive events have you personally experienced in the last 3 years? (Multiple choice)
   a) Forest fire
   b) Heatwave
   c) Flooding
   d) Storm damage
   e) Drought
   f) Pandemic
   g) Involuntary/unforeseen job loss

h) Work-related relocation to new city

i) Loss of infrastructure (e.g. dismantling of rail infrastructure, closure of major bridges, etc.)

j) General deterioration in the quality of the residential environment (e.g. important supermarket in the town closes, reduced cultural offer in the town, etc.)

2. You stated in Part I that you mainly use means of transport Y for route X. In Part II, you stated that you had personally experienced scenario Z. How has the use of this mode of transport for route X changed since scenario Z occurred/when scenario Z occurred?

   a) Not at all

   b) Takes longer than normal

   c) Is more uncomfortable to use than normal

   d) Is temporarily unavailable for a short time

   e) Is no longer available at all in the long term

   f) Before scenario X occurred, I used another means of transport. (If selected: Which one?)

3. if answers b, c, d or e were selected in 2: Did these changes lead you to prefer a different mode of transport for route X than you normally would choose? (If yes: Which?)

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