

# **How Does On-Demand Ridesplitting Influence Vehicle Use and Ownership? A Case Study in Hangzhou, China**

## ***Extended Abstract***

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## 1. INTRODUCTION

Shared mobility refers to the shared use of a motor vehicle, bicycle, or other low-speed transportation mode, which has a huge influence on current traffic system. Among different types of shared mobility, ridesplitting is the most rapidly developing because of the develop of the transportation network companies, which means a form of ridesourcing where riders with similar origins and destinations are matched to the same ridesplitting driver and vehicle in real time, and the ride and costs are split among users (1).

One vehicle can service more than one commuter during a ridesplitting trip, so the magnitude of its impact on the number of road vehicles can be quite significant. However, people using ridesplitting services come from different travel modals, which may have diverse influences on the traffic operational performance. For example, ridesplitting can replace a part of taxis in the road network as well as some public transit (e.g., bus, and metro) in commuters' regular long-distance travels. Among them, the modal shift from public transit and non-motorized travels will increase the number of road vehicles and thus have a negative impact on traffic conditions. In the long term, individual commuters' travel habits may change, e.g., car and public transportation usage. Even people's willingness to purchase a private car will be influenced by the popularity of ridesplitting services.

There are some related works already conducted in this area. A report published by McKinsey (2) showed that for 37% of the consumers surveyed believed that owning a car seemed less important now that other forms of transportation were available, and significant numbers of consumers believed they could meet their needs by renting (40%), leasing (34 %), or co-owning cars (26 %) rather than purchasing their own. Shaheen (3) pointed out that sharing vehicles resulted in less traffic and fewer cars overall, by cutting down the number of vehicles needed by households and society as a whole.

The findings above have shown the great influence of ridesplitting. However, to the best knowledge of the researchers, how to quantify the on-demand ridesplitting services' impacts on the vehicle use and ownership using real-world ridesourcing data in a city scale is not fully understood, especially considering the multimodal shift that induces modal changes from public transportation and non-motorized travels after the emergence of ridesplitting services.

This paper focuses on quantifying on-demand ridesplitting's impacts on the vehicle use and ownership in terms of different stages. Using real-world ridesourcing order data provided by DiDi and questionnaire data collected from ridesourcing passengers, we aim to explore the short-term and intermediate-term impacts on the number of road vehicles for Hitch and Express ridesplitting, respectively, and long-term impact on the vehicle ownership. Providing quantified evidence of the ridesplitting's impacts, and helping government officials and legislators better understanding on ridesplitting, even making decisions to regular the shared mobility's market.

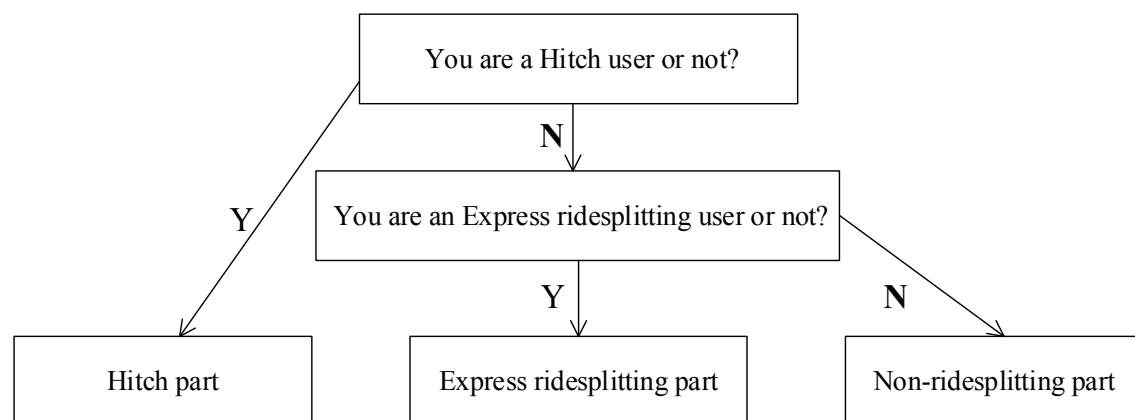
## 2. DATA AND METHODOLOGY

### 2.1 Ridesplitting Order Data

DiDi Chuxing is the largest on-demand ride service platform in China. The ridesplitting services provided by DiDi Chuxing include Express ridesplitting and Hitch. We collected two-week ridesourcing order data from DiDi Chuxing in Hangzhou, China. The sampling rate is 50%. Every individual ridesourcing order includes the pickup/drop-off locations and time stamps, trip ID, order ID, passenger ID, driver ID, ride beginning time, ride ending time, actual travel distance, planning travel distance, type of services, and whether ridesplitting is matched or not. In the ridesourcing dataset, passengers who share their trips by splitting ride and fare are marked. Based on the pickup locations and time stamps of a sequence of ridesplitting orders over the same shared trip, we can figure out the operational characteristics of the ridesplitting orders. In order to facilitate the presentation, we define one ridesplitting order of a specific commuter as one trip segment or simply an order, a shared journey from the first passenger getting aboard to the last passenger alighting from the car is called one shared trip.

### 2.2 Questionnaire Data

To collect data about ridesplitting users and trips, researchers conducted an online survey in Hangzhou, in June 30 and July 4, 2017. The survey was conducted by providing the users of the on-demand ride service platform (i.e., DiDi app) who had just finish a ridesplitting trip a private link to an online survey network by short message service. The questionnaire contains three categories for different respondents, namely the Hitch part, Express ridesplitting part, and non-ridesplitting part, the logic diagram is shown in Figure 1. Each part consists of nearly 30 questions. The survey data contain 744 useful and valid sample questionnaires, including 443 Hitch ones and 301 Express ridesplitting ones. Because the questionnaire is spread randomly during the whole two survey days among all ridesplitting commuters, it is convincing that the sampling method is representative and the sample can describe the whole of Hangzhou's ridesplitting commuters.



**FIGURE 1** Logic diagram for three categories of respondents.

## 3. FINDINGS

In the short term, considering the modal shift from public transportation and non-motorized travels in Hangzhou, Hitch decreases the number of road vehicle usage by 1,105 veh/day, and Express ridesplitting decreases the number of road vehicle usage by 1,946 veh/day. As a result,

ridesplitting can decrease the number of road vehicle usage by 3,051 vehicle veh/day.

In the intermediate term with the development of ridesplitting, more and more commuters will be attracted from using private cars or non-motorized travels, and their travel habits gradually form, so the total number of road vehicle usage for the intermediate term will decrease by 4,129 veh/day in Hangzhou (nearly 2‰ of vehicle ownership in Hangzhou), which causes a great improvement compared with the current situation. What causes the researchers' attention is one of the interesting results that Hitch's influence on vehicle usage in intermediate term is 866 veh/day which is not obvious as the influence in short term. The reason can be inferred as follows: flexible and highly customized makes ridesplitting popular, but this kind of characteristics will also lead to on-demand ride service platform cannot afford the increasing demand of ridesplitting service, especially for Hitch, which is usually unavailable due to commuting time and OD's limitation. Therefore, the modal shift from public transit will cause a serious impact on vehicle usage to a certain extent in the intermediate term. Good news is that Express ridesplitting, the majority of ridesplitting, is much easier to attach compared with Hitch. As a result, the whole impact of ridesplitting in intermediate term is still significant than it in short term.

#### 4. CONCLUSION

Ridesplitting will influence people's travel habits and reduce people's car purchase intention, and further ever affect the vehicle ownership. This paper provides evidence that ridesplitting can efficiently decrease the number of vehicles usage for different stages, and lower the vehicle ownership in the long term. An interesting phenomenon is that Hitch's influences on the vehicle usage in the intermediate term is not obvious as the influence in short term due to the modal shift from public transit. The results obtained represent a good starting point for a deeper and wider analysis of the ridesplitting's impacts on the traffic system. The future work will concentrate on more detailed commuter behavior influenced by ridesplitting, and the ridesplitting's impact on drivers.

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