Societal impacts of smart, digital platform mobility services—an empirical study and policy implications of passenger safety and security in ride-hailing

Ransford A. Acheampong
Department of Planning and Environmental Management. Manchester Urban Institute.
University of Manchester, UK
Email: Ransfordantwi.acheampong@manchester.ac.uk

Author accepted version of paper in Case Studies on Transport Policy | accepted Jan 13, 2021

Abstract
Smart, digital platform mobility solutions such as internet-based ride-hailing are becoming common in Global South cities. Empirical research on their wider societal impacts is however, limited. This study explores a critical dimension of societal impact, which is passenger safety and security. The paper uses a large sample qualitative survey data on the perceptions and experiences of users and non-users of internet-based ride-hailing services in Ghana. Through an inductive analysis, seven factors are identified that reflect heterogeneous safety and security perceptions and experiences in ride-hailing. Some individuals perceived a high sense of security and safety from ride-hailing platforms’ inbuilt features, including ‘driver and vehicle identification’ and real-time journey ‘trackability and traceability’. Additionally, they derived a sense of safety and security from the ‘privacy and lone travel’ in ride-hailing, as well as ride-hailing use in ‘emergency’ situations when other emergency services are not readily available. Others, however, expressed ‘distrust’ in the platforms’ inbuilt security features and believed that they enable exposure to ‘malicious and criminal activities’ that compromise their safety when using ride-hailing services. Moreover, safety risks were experienced through ‘driver behaviours’, such as reckless driving, distractions by smartphone usage while driving as well as fare pricing practices that are considered intransparent by passengers, leading to clashes between them and ride-hailing drivers. The implications of the findings are discussed in terms of their fundamental conceptual and empirical value to research on smart mobility, transport safety and travel-related well-being, as well as practical relevance for transport policy and governance in the age of smart mobility transitions.

Key words: smart mobility; smart cities; ride-hailing; passenger safety; security; platform mobility

1.1 Introduction
Ensuring safe transport remains one of the longstanding issues of transportation research and policy. Over the years, much of the research and interventions in road users’ safety, including vehicle passengers, have focused on the causes and prevention of traffic accidents, injuries and fatalities. This body of research has addressed the interlinkages between infrastructure-related factors that compromise the safety of different road users; personality; safety cultures; and behaviours, such as seatbelt wearing, mobile phone use while operating a vehicle, and alcohol and drug induced impairments that increase the risk of accident, injuries and fatalities (see e.g. Mokarami et al., 2019; Moradi et al., 2019; af Wåhlberg et al., 2017; Hao et al., 2016).
In recent years, the availability of new transport technologies and the associated smart, digital on-demand mobility solutions, are transforming urban mobility, with wider societal implications that include passenger safety and security (Rogers, 2015; Edelman and Geradin, 2015). Transportation Network Companies (TNCs), such as Uber, Lyft and Taxify/Bolt, are leveraging advances in Information and Communication Technology (ICT) and artificial intelligence, to provide new digital platform mobility solutions, such as ride-hailing, ride-sharing, car-sharing and bike-sharing in cities across the globe (see Acheampong et al., 2020; Stehlin et al., 2020; Acheampong and Siiba, 2019; Fishman, 2016; Shaheen and Cohen, 2013). These on-demand mobility solutions are part of the evolving Mobility-as-a-Service (MaaS) ecosystem (see e.g. Kamargianni and Matyas, 2017), albeit they tend to be restricted to requests by customers on single platforms provided by the individual TNCs, rather than being integrated bundles of mobility services across different modes and service providers. Currently, internet-based mobility solutions such as ride-hailing provided by TNCs enable consumers to access mobility services on-demand, in a manner that is more flexible and convenient than has ever been possible with existing conventional taxi and public transport services (Pham et al., 2017; Rayle et al., 2016).

Empirical evidence on the wider implications and impacts of new digital platform mobility solutions are still emerging. To date, research on the topic has focused on issues such as TNCs competition with and impact on the traditional taxi sector (see e.g. Akimova et al., 2020; Agyemang, 2020; Cramer and Krueger, 2016; Wahyuningtyas, 2016). Other studies have also focused on the factors driving adoption and diffusion of ride-hailing services, user characteristics, as well as their impact in terms of induced travel and mode substitution effects (see e.g. Acheampong et al., 2020; Dias et al., 2019; Grahn et al., 2019; Haddad et al., 2019; Henao and Marshall, 2019; Lavieri and Bhat, 2019; Tirachini and Rio, 2019; Giddy, 2018; Dias et al., 2018; Alemi et al., 2018; Dong and Zhang, 2018; Clewlow and Mishra, 2017; Rayle et al., 2016). The emerging evidence so far are mixed, suggesting that ride-hailing services replace car use and increase public transit ridership in some instances, but they also induce new trips and overall levels of vehicle miles travelled and motorization (Dias et al., 2019; Ward et al., 2019; Alemi et al., 2018; Circella and Alemi, 2018; Rayle et al., 2016).

Aside from the aforementioned impacts, these technology-driven mobility solutions are exerting wider societal impacts, including the safety and security of users. As a normative concept, safety reflect the state of being protected from conditions of physical, psychological or material harm (Maurice et al., 2001). Safety can be objectively or subjectively assessed (ibid). It can be objectively assessed by measuring some parameters of interest such as traffic-related deaths or injuries. Subjective or perceived safety on the other hand, reflect a feeling of being out of danger or harm. As a related concept, security then can be understood as the means of preventing or protecting from danger and harm. Safety and security are therefore closely related, mutually-dependent concepts, as the latter is a necessary condition for realising the former. For example, a secure system can improve the safety—objectively
measured or subjectively perceived—of those who use it by protecting them from danger or harm.

In the transportation literature, traffic safety has been a dominant theme in road transport research, with particular attention being given to the causes and preventions of accidents, injuries and fatalities. Some safety-related research has focused on perceived risk, such as the perception of specific hazards when driving a motor vehicle as well as perception of risk to the public in general in using different modes of transport (see e.g. Elvik and Bjørnskau, 2005; Alm and Lindberg, 2000). These studies have shown that perceived safety risks differ depending on the context in which a hazard is presented and the attributes that different events and technologies are judged to possess (see Alm and Lindberg, 2000).

1.2 Safety and security in ride-hailing—overview of emerging research

In recent years, the transition to smart cities and their accompanying smart mobility solutions, such as ride-hailing services, have exposed new safety and security concerns and challenges in transport and mobility that go beyond the traditional considerations of traffic safety. Smart mobility solutions depend on granular data generated and aggregated from multiple users. The ICT and data infrastructures of smart mobility solutions are vulnerable to cyber threats (Van Zoonen, 2016; Elmaghraby and Losavio, 2014). Cyber-attacks on smart city applications such as digital mobility platforms, in turn, pose significant threats to privacy of individuals and can expose them to malicious and criminal activities, thereby compromising their sense of safety and security (Braun et al., 2018; Zhang et al., 2017).

Moreover, by design, app-based ride-hailing services are inherently prone to security breaches. Indeed, in recent years, there have been several reports in the media on security breaches and safety experiences of passengers of ride-hailing services. These, in turn, have triggered some responses from the public-sector regulators of such services in some countries. For example, in November 2019, Uber lost its licence to operate in London (UK), following an initial probationary licence extension granted in September of the same year. Transport for London (TfL), the regulator, cited security lapses, including several breaches that compromised passengers’ safety as one of the main reasons for not renewing the ride-hailing company’s licence1.

Despite the growing concerns about passenger safety and security in ride-hailing services, a handful of research, both conceptual and empirical, has focused on these issues in the emerging literature (see e.g. Young and Farber, 2019; Su et al., 2019; Turoń et al., 2019; Guo et al., 2018). Young and Farber (2019) examined the barriers faced by different population groups in using ride-hailing, focusing partly on safety concerns. They show that senior citizens, parents, women, and other minority groups have several concerns regarding safety with ride-

---

1 See articles published in the Guardian newspaper for more information
https://www.theguardian.com/technology/2019/nov/25/uber-loses-licence-london-tfl
hailing. These concerns stem partly from perceptions that ride-hailing drivers may be unqualified and that some ride-hailing companies could be operating unlicensed or unregulated. Moreover, recognising the safety concerns of female riders and drivers of ride-hailing (Guo et al., 2018), investigate different operational systems of ride-hailing that could address these gender-based safety concerns. Ultimately, they propose a system that can allow females to be matched to female-only ride-hailing services in addition to a pooling system in which riders and drivers are matched without considering gender.

Moreover, some multivariable, quantitative user adoption studies do elicit the public’s safety and risk perceptions about ride-hailing (see e.g. Acheampong et al., 2020; Su et al., 2019; Ma et al., 2019), but they only go as far as presenting to respondents, predetermined statements to evaluate on the Likert Scale. Adopting this approach, Su et al., (2019), model the influence of factors including service quality and perceived safety on passengers used and loyalty to ride-hailing services in Vietnam. Their findings show that while perceived safety influence passengers’ utilization of ride-hailing services and mediate the influence on loyalty to these services. While these studies capture safety concerns as part of other latent variables influencing ride-hailing or car-sharing use, the resulting data can only reflect individuals’ subjective evaluations in a limited way, without offering in-depth insights about the different ways people perceive or experience safety and security in relation to this new form of mobility. A qualitative approach that builds on these initial empirical works could help provide in-depth understanding of issues of safety and security around ride-hailing and the associated policy implications.

This study addresses the aforementioned gap in the literature, by drawing on a large sample of exploratory survey data on individuals’ experiences and perceptions regarding ride-hailing services in the Global South—Ghana, West Africa. Through an inductive exploratory analysis of the data, the paper reveals the heterogeneity in individuals’ safety and security perceptions and experiences, that are reflected in themes including: ‘trackability’ and ‘traceability’; driver and vehicle identification; criminal activities; distrust in safety and security measures; and driver risk taking behaviours that compromise passenger safety. As we will demonstrate later in the discussion, these findings have theoretical value in helping to conceptualise and evaluate the different facets of passenger safety and security in digital platform mobility services. They also have practical policy relevance in informing wider transport and mobility governance and regulatory measures, as well as in designing and implementing technical fixes that could help ensure passenger safety and security in digital platform mobility services.

The rest of the paper is structured as follows. An overview of the case study context is provided in section 2 with a primary focus on situating ride-hailing as new form of mobility in the wider context of urban transport and mobility in Ghana. The research approach, covering the survey design, data collection and coding and thematic analysis of the datasets is presented in section 3. The results of the qualitative data coding are presented in section
In section five, a synthesis of the results is provided, followed by a discussion on the relevance and implications of the findings to both policy and future research in section 6. Reflections on limitations of the current research and possible future research directions are presented in the penultimate section, followed by conclusion in section 8.

2 Situating internet-based ride-hailing in Ghana’s urban public transport system

Historically, two main forms of public transport services have been available in major cities in Ghana. The most commonly used form of transport service in urban areas is the Trotro—10-19 seater minibuses used as public transport and operated by organized transport unions. While this form of transport provides affordable and flexible mobility for more than 80% of the population, it has a reputation for having lax safety standards and offering inferior service quality (Birago et al., 2017; Esson et al., 2016; Amoh-Gyimah and Aidoo, 2011). Alongside the Trotro, conventional taxi services are also used throughout urban Ghana. Conventional taxi services tend to be relatively expensive compared to Trotro and are therefore used mostly by individuals with relatively higher incomes who do not have cars, and less frequently for incidental trips by people in different socio-economic groups (Acheampong, 2020; Agyemang, 2017). Typically, the conventional taxi provides two types of services. The first is a relatively cheaper option whereby taxis tend to take up to four passengers who share a similar route or destination. Thus, for these traditional taxi services, passengers who often tend to be complete strangers share a ride, as is the case with the Trotro public transport services (Agyeman et al., 2019). The second type of service, known locally as ‘dropping’ is similar to a taxi hire in other countries. This relatively expensive service, typically involves lone travel or group booking for door-to-door travel purposes.

In the last few years, major Transportation Network Companies including Uber and Taxify/Bolt have been providing on-demand ride-hailing services in Accra and Kumasi, Ghana’s largest and second largest metropolitan areas, respectively. In addition to Uber and Bolt/Taxify, a number of relatively smaller TNCs have emerged in the last couple of years in Ghana’s major cities, including Yenko Ghana, Urughana, Accra Cab, and Poki Cab. Prior to the arrival of these internet-based ride-hailing services in the country in 2016 (Agyemang, 2020), Trotro or conventional taxis could be taken at designated stations or by hailing them from the street. Thus, in Ghana, the key difference between conventional taxi and the new internet-based mobility services is that the latter is ICT-mediated and provide transport services on-demand from any location within the cities where they operate.

In Ghana, TNCs currently provide ride-hailing as a single mobility service on their respective platforms. Thus, while their platforms contribute to the on-going global ‘servitization’ of mobility, they are not yet full-fledge Mobility-as-a-Service (MaaS) solutions that allow users to book mobility bundles across different modes on a single platform.
The context in which internet-based ride-hailing services operate in urban Ghana is unique. Firstly, to date, the existing public transport governance regimes have not evolved to deal with the presence of TNCs, despite major TNCs such as Uber entering the Ghanaian market since 2016. An initial study by Agyemang (2020), found that the existing regulatory regime, which was originally established to govern the operations of conventional taxis and Trotro, are inadequate to regulate TNCs and their ride-hailing services. Consequently, ride-hailing vehicles do not meet basic regulatory requirements, including being distinctly marked and belonging to a recognised unionised group, as required of conventional taxi operators in Ghana (Agyemang, 2020). This also means that public sector agencies have limited oversight over the activities of TNCs and those of the drivers who use their platform to offer ride-hailing services.

Within the setting of weak regulatory mechanisms and limited public sector oversight, safety and security measures are determined by the TNCs. For example, Uber outlines a four-stage process for any would-be driver to become registered on their platform and to operate ride-hailing services in Accra and Kumasi. This process involves registering online and providing a number of documentation, including, valid identification and driver’s licence, driver profile photo, as well as commercial insurance certificate and roadworthiness certificate covering the vehicle. While these measures are intended to contribute to safety and security, Uber does not make public how they verify the identity of applicants and the authenticity of any documentations provided at registration.

Moreover, similar to the rest of the world, the diffusion of smartphones and broadband internet has enabled the provision of internet-based ride-hailing services in Ghana’s two major cities. However, one major difference between the ride-hailing services offered in Ghana by TNCs and those offered elsewhere, is the mode of payment. Due to the undeveloped nature of online banking infrastructure in Ghana, digital forms of payment, such as the use of debit or credit cards are currently not possible. Instead, while users can request a ride using their smartphones, the majority of them pay for their travel in cash to the driver. The driver, in turn, makes agreed payments periodically to the TNCs they are registered with, based on the application’s record of journeys and their costs. In recent years, some of the ride-hailing platforms are enabling online payment either through direct debit or mobile-money transfers, albeit cash payment still dominate.

Unlike other contexts, such as Europe and North America, where similar ICT-enabled mobility services existed prior to the presence of major TNCs (e.g. Uber, Lyft and Bolt), in Ghana, the majority of urban residents using these new mobility services are doing so for the first time. Within a context where passengers have largely been used to public transit in both conventional taxis and Trotro, the presence of ride-hailing services that are mediated by ICT-

---

2 More information about Uber’s registration process in Ghana can found here: [https://www.uber.com/gh/en/drive/requirements/](https://www.uber.com/gh/en/drive/requirements/)
platforms, and typically involves lone travel with drivers who are considered ‘strangers’ (Acheampong et al., 2020), could have a number of implications for safety and security of passengers.

It is within the foregoing context that issues around passenger safety and security, as perceived and/or experienced by both users and non-users of internet-based ride-hailing services are explored in this paper. In the next section, the research approach and methodology are outlined.

3 Methods
3.1 Survey design
An exploratory survey design was adopted for this study. As an approach, exploratory research is useful in acquiring first-hand understanding of a topic or phenomenon, with the aim of producing inductively derived knowledge and generalisations (Stebbins, 2001). Internet-based ride-hailing services are quite new in urban transport and mobility, especially in Sub-Saharan Africa, and an understanding of their wider societal impacts globally is still evolving. On the specific subject of passenger safety and security in ride-hailing, in-depth empirical studies are lacking in the evolving literature, hence the need to use an exploratory design to inductively understand these issues.

Within this approach, an exploratory online survey was designed to understand the safety and security implications of this new form of transport from the perspectives of both users and non-users in Accra and Kumasi. These are the two largest urban areas in Ghana, where TNCs (i.e. Uber and Taxify/Bolt) have been providing internet-based ride-hailing services since 2016. Previous exploratory research in different disciplines have used online surveys in order to reach a larger population that would not be possible with traditional face-to-face personal interviews, without necessarily aiming to achieve a representative sample (see e.g. Elvik and Bjørnskau, 2005; Dibben and Williamson, 2007).

As argued at the onset of this paper, the use of single or few survey items formulated on Likert-scales to capture safety and security perceptions have dominated research on internet-based ride-hailing. This approach, however, does not allow eliciting detailed responses from study participants. To overcome this limitation, the survey for this study used an open-ended question to elicit public safety and security perceptions and experiences regarding internet-based ride-hailing. The following open-ended question was posed to the survey respondents:

“Overall, do you consider internet-based ride-hailing services such as Uber and Taxify/Bolt as being safe and secure? Please state your view or experience regarding this...you may also identify if your view or experience applies specifically to any of the ride-hailing service providers in your city/metropolis. Please provide as much information as you possibly can”

Before presenting the above question to the respondents, a brief description of internet-based ride-hailing was first provided in the questionnaire, explaining how this service is
different from the conventional taxi. This was necessary because the survey targeted both users and non-users of ride-hailing and it was anticipated that the latter group might not have heard or known much about this new form of mobility.

The above phrasing of the survey question was intended to allow the respondents to express their opinions in as much detail as possible about the safety and security implications of internet-based ride-hailing. Both users and non-users of internet-based ride-hailing services could answer this question. This allowed eliciting any experiences that respondents in the former group might have had in using the available services, as well as perceptions in both the former and latter groups, who may have formed opinions based on what they have heard in the media or about the experiences of others in relation to internet-based ride-hailing services.

Previous research suggests that single vehicle occupancy tend to typify internet-based ride-hailing trips in urban Ghana (Acheampong et al., 2020). By contrast, conventional taxi trips in urban Ghana often involve more passengers who share a similar destination or route occupying the vehicle. Given these differences between the old and the new taxi services, the survey also sought to explore the extent to which individuals thought they would feel safe having to travel in the same car with other strangers as they do when using conventional taxis.

In addition to the above safety and security questions, the survey participants provided data about their background socio-demographic characteristics (i.e. age, gender, education, income) and car ownership. They also indicated whether they have used any of the available ride-hailing services and provided information about the frequency of use in the last seven days prior to the survey.

### 3.2 Data collection

The survey was administered online between May and August 2019, targeting respondents, both users and non-users of internet-based ride-hailing, in Accra and Kumasi—the two urban areas where this new form of transport existed as of the time of the survey. Again, because of the ‘newness’ of this form of transport and the lack of any publicly available data on usage prior to conducting the survey, it was not possible to implement a probabilistic sampling approach. Instead, following the exploratory approach, the survey questionnaire was distributed via a number of online platforms, including direct emailing and via social media networks including Facebook, Twitter, LinkedIn and WhatsApp. To be eligible to participate in the survey, respondents had to be at least 18 years old and resident in either Accra or Kumasi. Initial screening questions were used to ensure that only those who met these criteria could complete the online survey. In order to reach a larger audience, the respondents were encouraged to share the survey link with other people in their network on the various social media platforms. In the end, the survey attracted 548 valid responses.
Conducting the data collection online, whereby the respondents self-completed the survey allowed to capture a relatively larger sample size, which would not have been possible with traditional qualitative surveys that involve personal interviews of relatively fewer individuals. The online administration of the survey also meant that the researchers had no direct influence on the responses given by the participants. The background socio-demographic characteristics of this sample are provided later in section 3.2.1.

3.3 Thematic coding and data analysis

The final qualitative responses were collated in excel spreadsheet for coding and analysis, making it possible to match the qualitative responses and emergent themes to other variables in the dataset, such as gender, city of residence and use experience of internet-based ride-hailing services. Transcription of the responses was not needed because the survey administered online meant that the participants typed their responses directly into the online forms.

Given the exploratory nature of the study, the coding of the survey responses followed an inductive approach. By this approach, themes ultimately emerged from the data, rather than the researcher coming to the data with some predetermined themes that would be expected, based, for example, on previous research or theory (see e.g. Sam et al., 2018; Thomas, 2006; Fereday and Muir-Cochrane, 2006). The data coding and thematic analysis followed a four-step process outlined as follows:

The texts of each of the responses were first read through in order to become familiar with the data. After this initial reading of the text, it emerged that individuals’ safety and security perceptions and/or experiences in relation to internet-based ride-hailing, fell under three broad coded categories. These were differentiated broadly as perceptions and experiences that reflected the view that (a) internet-based ride-hailing is safe and secure; (b) internet-based ride-hailing is somewhat safe and secure, implying that it is only safe/secure to some extent; and (c) internet-based ride-hailing is not safe and secure. A response was put under one of these three sub-groupings, if the view, perception or experience provided by the respondent distinctly reflected only one of them.

Next, the data was separated into the three distinct sub-groups identified above. The text of the responses was manually coded by systematically reading each of the responses and highlighting phrases and sentences that reflected the central and unique opinions, perceptions and experiences of the respondents. Initial labels were assigned to the codes for the identification and extraction of themes subsequently at the third stage of the analysis. Themes were ultimately identified by combining code labels that captured similar unique perceptions and/or experiences about safety and security in internet-based ride-hailing under each of the three sub-groupings.

The themes were also colour coded to allow for easy grouping and sorting. This also enabled basic descriptive analysis, such as counting the frequency of an emergent theme in the
dataset. Finally, the themes were labelled to reflect the various opinions, perceptions and experiences of the respondents in relation to safety and security in internet-based ride-hailing mobility services. While the researcher undertook the initial coding of the data, the codes were verified by another individual to ensure that they had been consistently identified and labelled. In the process, some initial themes were merged and some labels modified. Ultimately, the themes presented subsequently in the next section were maintained.

In the next section, the results of the coding and analysis of the data are presented. This begins with an overview of the sample characteristics. Following this, an overview of the themes that emerged from the data is provided using descriptive statistics. The themes and their corresponding sub-themes are then outlined and explained, producing verbatim quotes from some of the respondents to support and enrich the analysis.

4 Results
4.1 Background characteristics of respondents
Table 1 presents a descriptive summary of the background characteristics of the survey participants. As the survey was exploratory and therefore not intended to be representative of the populations of the two urban areas (i.e. Accra and Kumasi), the information presented in Table 1 is only intended to give some background and context to the individuals represented in the study. In addition, even though census information exists, disaggregate data on the variables captured in the survey is not available to allow for comparison with the survey data, as the census only makes aggregated data publicly available.

As summarised in Table 1, 57% and 43% of the respondents were residents of Accra and Kumasi metropolitan areas, respectively. Males constituted 54% of the sample. Most of the respondents (64%) were in the 25-39 age cohort (i.e. Millennials), which does not only reflect the relatively larger proportion of youthful population in Ghana, but also the fact that the majority of the population who have access to internet and are more likely to use internet-based ride-hailing services are in this age-group. Out of the total sample, 17% own a car while the remaining 83% rely mainly on public transport, including Trotro and taxi.

Regarding internet-based ride-hailing service use, 69% of the respondents, the majority of whom are younger, indicated that they had used at least one of the major ones available (i.e. Uber or Taxify/Bolt), while the remaining 31% had not yet used a ride-hailing service as of the time they completed the survey. Ride-hailing use involved work/school-related travels (48%) and other ‘special occasion’ trips (45%), such as church/mosque attendance, friends and family visits and social functions (e.g. weddings, parties and night outs). The purposes of the remaining seven percent of ride-hailing trips is unknown as the respondents indicated that they did not want to disclose the purpose of those trips. Most of the trips (90%) involved lone travel, while the remaining 10% involved ride-sharing, but with other individuals known to and travelling with the respondents on the reported journeys, such as friends and relatives. Ride-sharing options, such as those provided by Uber (i.e. UberPool) in other countries that
allow sharing a ride with other individuals, who could be strangers, were not available in Ghana as of the time of this study.

The aforementioned trip and user characteristics derived from our survey sample are broadly consistent with those of previous studies. Previous empirical work focusing on user characteristics and ride-hailing use patterns have shown that ride-hailing often involve lone travel for special occasion, social and recreational trips, and that users tend to be younger, highly educated with relatively higher earnings (see e.g. Acheampong et al., 2020; Dzisi et al., 2020; Grahn et al., 2019; Lavieri and Bhat, 2019; Rayle et al., 2016).

Furthermore, among those who had used a ride-hailing service, 20% owned a car while the remaining 80% did not. Individuals who had used a ride-hailing service also indicated their use frequency over the seven-day period prior to taking the survey. The results show that 69% had used a ride-hailing service between one (38%) and two (31%) times over the seven-day period. A further breakdown of ride-hailing use frequency is provided in Table 1. What these results mean is that ride-hailing constitutes one of the mobility options in the case study cities, and that individuals use this new form of mobility alongside the existing conventional public transport options (i.e. Trotro and conventional taxi).

| Table 1: Summary of characteristics of the survey respondents (n = 548, unless otherwise indicated) |
|-------------------------------------------------|--------|
| Locality                                        |        |
| Accra                                           | 57%    |
| Kumasi                                          | 43%    |
| Gender                                          |        |
| Male                                            | 54%    |
| Female                                          | 46%    |
| Age-groups                                      |        |
| 18-24                                           | 18%    |
| 25-39                                           | 64%    |
| 40-54                                           | 17%    |
| 55+                                             | 1%     |
| Education                                       |        |
| Basic school (Primary -JHS)                     | 9%     |
| Senior High School (SHS)                        | 8%     |
| Tertiary (undergraduate/Diploma)- currently enrolled | 14%  |
| Tertiary (undergraduate/Diploma)- completed     | 40%    |
| Postgraduate (Master's degree or higher)        | 30%    |
| Income (n =359)                                 |        |
| ≤GH¢1,050                                       | 57%    |
| GH¢1,051-2,000                                  | 25%    |
| GH¢2,001-3,000                                  | 13%    |
| GH¢3,001-4,000                                  | 5%     |
| Car-ownership                                   |        |
| Yes                                             | 17%    |
| No                                              | 83%    |
| Ride-hailing use                                |        |
| Yes, used ride-hailing                          | 69%    |
| No, never used ride-hailing                     | 31%    |
| Ride-hailing use frequency (seven)              |        |
| Once                                           | 38%    |
| Twice                                          | 31%    |
days prior to the
survey) | Three times | 13%  
| Four times | 5%  
| Five times | 5%  
| Six times  | 1%  
| Seven times| 8%  

4.2 Descriptive overview of the emergent themes on safety and security in ride-hailing services

Although the survey data is qualitative and analysed as such, it is useful to first provide a descriptive overview of the coded responses, showing the number of times each theme appeared in the data. As indicated previously in section 3.3, the data coding and thematic analysis regarding perceptions and/or experiences about passenger safety and security in internet-based ride-hailing, proceeded on the basis of an initial three distinct sub-grouping of responses being identified. The first sub-group of participants (n = 264), whose responses to the survey question reflected the distinct view that internet-based ride-hailing was safe and secure, comprised nearly half of the sample (i.e. 48%). The responses expressed by the remaining 25% (n = 137) and 24% (n = 132), reflected the distinct views that internet-based ride-hailing was not safe and secure, and internet-based ride-hailing being somewhat safe and secure, respectively. Among the former sub-group of respondents, there was an equal number of males and females. Among those who indicated that ride-hailing is safe and somewhat safe, 56% and 43% were females, respectively.
Fig 1: A descriptive summary of (a) safety and security opinions of rider-hailing user and non-user groups; and emergent themes among the (b) ‘yes ride-hailing is safe and secure’ sub-group (c) ‘ride-hailing is somewhat safe and secure’ sub-group (d) ‘no, ride-hailing is not safe and secure’ sub-groups.
Moreover, among those who had used internet-based ride-hailing (i.e. n = 378), more than half (54%) indicated that they felt safe using the service. The reverse was true among respondents who had not yet used a ride-hailing service (i.e. n= 170). Within this sub-group, 41% perceived this new form of mobility as not being safe and secure. An additional 14% perceived ride-hailing as only being safe to a certain extent, while 36% indicated that they would feel safe using the service (Fig 1a). The remaining 9% (n =15) indicated that they would not be able to comment on passenger safety and security because they had never used any of the available internet-based ride-hailing services.

4.3 Exploring the emergent themes from the qualitative responses

In this section, the themes and sub-themes that emerged from the coding of the qualitative survey responses are outlined. The results is organized around the three distinct sub-groups of respondents identified at the first stage of the data analysis (see section 3.3). For each sub-group, a descriptive overview, showing the number of times each theme emerged in the coding and analysis of the data, is first provided, followed by a discussion of the individual themes.

4.3.1 Sub-grouping #1 themes—Ride-hailing is safe and secure

A descriptive summary of the themes derived from the responses of individuals who considered ride-hailing to be safe and secure is presented in Fig1b. In 69% of the responses received, individuals expressed perceptions and/or experiences that was labelled ‘simply safe and secure’ (Fig1b). Typically, the responses by individuals in this sub-group to the interview question were in forms, such as ‘yes Uber is very safe...’ and ‘Uber/Taxify is definitely very safe for me...’. Thus, this sub-group of respondents could be considered as those who perceive or accept with a much stronger conviction that internet-based ride-hailing is safe and secure. In addition to the above, five themes emerged from the analysis of the detailed responses provided by the other respondents in the sub-group of the sample who consider ride-hailing as being safe and secure. These are labelled as ‘driver and vehicle identification’; ‘trackability and traceability’; ‘lone travel and privacy’; ‘speeding behaviour control’ and ‘emergencies’ (see Fig1b). The individual themes are explained as follows:

Theme #1.1: ‘Driver and vehicle identification’

Passenger safety and security of ride-hailing, expressed through the theme of ‘driver and vehicle identification’, relate to one of the main default security features deployed by TNCs on their platforms. Respondents indicated that they felt safe because the platform provides a basic profile about the driver, including a name and photo, as well as licence and registration plate of the requested ride. This initial idea of the driver, their responses suggest, enables them to form a level of trust that tends to attenuate their perception of safety and security risks, ahead of boarding the vehicle. As indicated in the background contextual information provided earlier in section 2, prior to internet-based ride-hailing services becoming available in the two urban areas in Ghana, there were no means by which individuals boarding conventional taxis, either at designated taxi stations or by hailing them on the street, could verify the identity of their would-be driver. Consequently, some of the respondents referred
to the fact that ‘*driver and vehicle identification*’ make ride-hailing safer than conventional taxi or public transport, as this verification feature is not available for those. These perceptions are reflected in the following selected verbatim responses to the survey question:

“Yes, it is safe and secure] because you have the profile of the driver, their picture and everything that can be easily verified before boarding the car...and you can share this information with people such as friend and family so that they know where you are in real-time” (Female respondent, 18-24 years old in Kumasi; has used a ride-hailing service); and

“...based on my experience, *Uber* is safer compared to other public transport services, such as ordinary taxi services because the drivers are aware that they can easily be identified” (Male respondent, 30-34 years old in Accra; has used a ride-hailing service).

A related sub-theme to the comparison drawn between *Uber/Taxify* and conventional taxis/public transport, is the respondents’ acknowledgement that ride-hailing services, being new, tend to dispatch vehicles that are of better condition and well-maintained. This contrasts with the poor vehicle conditions and lax safety standards that they find with the existing conventional taxi and public transport services. Thus, it is clear that, in addition to being able to identify the driver of a requested ride, when vehicles are perceived as new, clean or well-maintained, perceptions of safety risks are alleviated to a larger extent among some of the respondents.

**Theme #1.2: ‘Trackability and traceability’**

Like the first theme discussed above, ‘*trackability and traceability*’ as a second emergent theme from the analysis, derives from the technical features of digital platform mobility service providers. The respondents reflected internet-based ride-hailing’s safety and security through the Global Position System (GPS) technology that allows to track a given trip in real-time. From the point of view of the users of internet ride-hailing services, ‘*trackability*’ brings about safety and security benefits during the trip, by making it possible to share one’s travel with significant others, such as family and friends in real time. Another dimension of safety from ‘*trackability*’ derived from the responses, is the notion that users can alert any suspicious behaviour to significant others, and that being able to do so, made them feel safe and secure while using internet-based ride-hailing services. These views are reflected in two of the responses to the survey question below:

“*Uber* is safe because you get to share your trip details with family and friends and I think the system (app) also captures the trip information, so there will be no running away if the driver or passenger are assaulted or harmed by another” (Male respondent, 18-24 years old in Kumasi; has used a ride-hailing service); and

“I feel it [*Uber*] is safe because with the security features, you can alert friends when taking the ride... You can also quickly report any problem if you suspect one while on the journey” (Female respondent, 30-34 years old in Accra; has used a ride-hailing service).
A third sub-theme on ‘trackability’ from the survey responses relates to the experiences shared by some of the respondents who consider ride-hailing as being safe. Some of the respondents indicated that trackability gives them the additional capability of tracking the on-going trip on their own phones, so that any detours from expected routes by the driver could be detected and questioned. Their responses suggest that the ride-hailing app also becomes a navigation tool in its own right for the passengers, which means that they do not need to rely solely on the driver to take them to their destination. This suggests that ride-hailing platforms/apps distribute power of control over judgements and choices between the driver and the passenger during travel. The sense of control and navigation capabilities that the passengers derive, in turn, confers a sense of safety and security while using internet-based ride-hailing services. As one of the respondents noted:

“I consider it safe especially because you can share your travel with another person with the app on his/her phone... I once used that with a friend when I didn't know [exactly] where I was going, and my friend alerted me when the driver passed the place where I was supposed to alight... this was with Uber” (Male respondent, 25-29 years old in Kumasi; has used a ride-hailing service).

A closely related emergent sub-theme to ‘trackability’ is ‘traceability’, which relates to the ability to trace the driver or vehicle to recover personal belongings that could have been left in the vehicle. The responses that clustered into this theme suggest that ‘Traceability’ therefore, is seen, partly as an after-trip security benefit of using internet-based platforms to request a ride. This is reflected in two of the responses below:

“Being able to track your lost items is very advantageous with Uber or Bolt/Taxify compared to conventional taxis and other public transport drivers, who may not return them” (25-29, Female in Kumasi; has used a ride-hailing service).

and

“I left my belongings in a ride-hailing vehicle and traced my trips on their app...I got the driver’s details and got my belongings back” (Female respondent, Kumasi; has used a ride-hailing service).

Furthermore, ‘Trackability and traceability’ were also manifested through the notion of ‘surveillance’—the belief that the driver is being monitored by someone or that someone is watching over both the driver and passenger. As it became evident in the responses, some of the participants believed that the ‘surveillance’ reduces risk of harm during travel in the vehicle or allow any untoward action to be traced in the future, as captured in the response below:

“Uber is safe, as the details of the driver and car are known by the service providers. In the event of any bad deeds, investigations will be easier in order to bring the perpetrators to book” (Male respondent, 25-29 years old in Kumasi; has used a ride-hailing service).
Theme #1.3: ‘Lone travel and privacy’
The analysis further revealed that some individuals derived safety and security from the fact that ride-hailing allows them to travel alone, and offers privacy that is not possible with conventional public transport or taxi modes. As one of the respondents indicated:

“Uber is a safe mode and way of travelling because it gives me some privacy as compared to public transport” (Male respondent, 25-29 years old in Kumasi; has used a ride-hailing service).

Indeed, in the separate question about whether the study participants would feel safe travelling in the same car with other strangers, as is the case with ride-sharing that they are already used to in using conventional taxis, the majority of them (61%) agreed that they would not feel safe. Together with the sub-themes that bundled with the theme of ‘lone travel and privacy’, the results reflect a sense that travelling alone with a driver, whose identity is known through the trip booking app, and in a vehicle that is trackable in real-time, made some individuals feel safer while using internet-based ride-hailing services. Hence, these individuals concluded that internet-based ride-hailing is safe and secure.

Theme #1.4: ‘Speeding behaviour control’
A fourth emergent theme from the analysis is that individuals felt ride-hailing was safe because they could have some control over driver behaviour. For this theme, the main reference was to being able to monitor and control the speeding behaviour of drivers by directly feedbacking on their driving during travel. While being able to feedback directly to a driver is not particularly unique to internet-based ride-hailing, the survey responses for this suggested that the ability of passengers to rate drivers offers a feedback mechanism that has not been available with conventional taxis for example. In particular, individuals from whose responses this view emerged indicated drivers were aware that any reckless behaviour would reflect in poor passenger ratings. To them, this partly acted as a form of regulatory mechanism of reward and punishment that mitigated against the drivers taking risks that would compromise their safety. The following quotes from two of the respondents supports the aforementioned theme:

“I think Uber is safe because you can ‘control’ the driver if he or she is over speeding...and for security reason, Uber is the best since the driver you travel with is well known” (Male respondent, 25-29 years old in Kumasi; has used a ride-hailing service); and

“Uber drivers are very patient and listen to clients pertaining to their requests...with regards to obeying the speed limitations etc.” (Female respondent, 45-49 years old in Accra; has used a ride-hailing service).

Theme #1.5: ‘Emergencies’
The final theme that emerged from the analysis of opinions of individuals who find internet-based ride-hailing safe and secure, relates to the on-demand mobility service use in emergencies. As a respondent partly indicated,
Among the responses that reflected the theme of ‘emergencies’, some of the participants made reference to how internet-based ride-hailing has helped save lives in emergency situation, such as needing a vehicle to convey a sick person to the hospital. This association of safety and security with internet-based on-demand mobility services makes sense in a context where ambulance services are not readily available to respond to health emergencies in a timely manner. In fact, transporting patients to hospitals in taxis is an everyday experience in urban and rural Ghana. Thus, in such emergency situations, requesting a ride to the hospital via the ride-hailing app could be faster and more reliable than having to walk to the nearest taxi station or roadside to hail a conventional taxi.

4.3.2 Sub-grouping #2 themes—Ride-hailing is not safe and secure

An outline of themes and their frequencies among individuals who indicated that ride-hailing is not safe and secure are presented in Fig1c. Within this second sub-group of respondents, three main themes emerged from the analysis of the detailed responses they provided to the survey question. These are ‘distrust in safety and security measures’; ‘criminal activities’ and ‘driver’s safety compromising behaviour’. Each of these themes and their sub-themes are explained below.

Theme #2.1: ‘Distrust in safety and security measures’

The second sub-group of respondents, while acknowledging the security features built into ride-hailing platforms, did not simply trust in them to ensure their safety. This is in sharp contrast to the first sub-group of respondents who indicated that the in-built technical features of ride-hailing platforms gave them a high sense of safety and security when using the service. For some, these in-built security measures, including driver identification, trip ‘trackability and traceability’, are simply inadequate to ensure both passenger and driver safety and security while using the service, as exemplified in the response below to the survey question:

“Using Uber is not safe on the part of the driver or the client. Any criminal can order for Uber and use the service for his/her criminal activities. The telephone number alone is not a reliable means to track a client; people are becoming smarter [and sophisticated] these days... Criminals can also develop similar app or hack the Uber system to carry out malicious and criminal activities (Male respondent, 25-29 years old in Accra; has used a ride-hailing service).

Another related sub-theme on distrust in safety and security measures is what was identified largely from the responses, as a fear of what is not known about the driver. Most people expressing this view made reference to the driver being a complete stranger, which contrasts with the view of driver identification via the trip booking platform removing anonymity and the associated sense of having to sit in the car of a complete stranger. This view is reflected in the quote below in response to the survey question:
“No. It scares me a lot because the drivers of these Uber rides, we don’t know their identity, whether they are good people or kidnappers or armed robbers…. We sit in these rides and entrusting our lives in their hands [as] total strangers, hoping they take us to our destinations… I mean our safety is really something else” (Female respondent, 30-34 years old in Kumasi; has used a ride-hailing service).

Closely related to the above was the respondents fear and anxiety about impersonations, fake driver accounts on the booking platforms and instances of driver identity swapping, as captured in the experiences of some of the respondents while using the service:

“Some drivers drive with fake accounts, which is very unsafe to the passenger. Uber need to check how drivers are recruited” (Male respondent 30-34 years old in Accra; has used a ride-hailing service); and

“It’s not safe since sometimes the drivers are different from what the App shows you when you book the ride” (Female respondent, 30-34 years old, in Accra; has used a ride-hailing service).

Similar distrust in the platforms’ safety and security measures, especially around driver vetting and recruitment processes, were also raised by respondents who had never used a ride-hailing service. As one of such respondents answered in response to the survey question:

“No, I don’t (consider it safe and secure)...Their drivers are not properly vetted and their information is not shared with law enforcement to boost passenger confidence and ensure safety, especially for women passengers” (Male respondent 30-34 years old, in Accra; has never used a ride-hailing service).

In summary, the experiences and perceptions of the respondents under this theme suggest that, to them, technology does not necessarily bring about safety and security in ride-hailing services. Driver and vehicle identification in-built into the platforms do not essentially allow for easy verification and validation of such information. On the contrary, the mediating role of technology creates the very conditions that expose passengers to risks in using these digital platform mobility services.

**Theme #2.2: ‘Exposure to criminal activities’**

The perceived risk of exposure to criminal activities while using ride-hailing services was associated with three sub-themes, namely robbery, kidnapping and sexual harassment. The responses of the participants to the survey questions revealed that while most of them had not been victims of such criminal activities, their fears and concerns stemmed largely from news media reports on the subject of robbery and kidnaping around ride-hailing services, as captured in the answers of two of the respondents below:

“No it’s not safe. Some of the stories I have seen in the media and heard do not inspire confidence in safety... There is a story I read about an Uber driver attacking a passenger in an attempted...
robbery. In addition, I have been told stories by drivers about how people use fake licences to register multiple accounts with the service, especially when they are blacklisted. This makes me wonder about the extent of background checks done on the drivers” (Female respondent, 30-34 years old in Accra; has used a ride-hailing service); and

“I don’t consider it safe because of the stories and news items capturing how some of the drivers are kidnapping customers” (Female respondent, 30-34 years old in Accra; has used a ride-hailing service).

It is worth mentioning that, as reflected in the first of two quotes above, some of the respondents did acknowledge that not only passengers are exposed to the risks of criminal activity while using ride-hailing service, but that drivers were exposed to similar risks of armed robbery too. Moreover, for some other respondents who thought ride-hailing was not safe and that it enabled criminal activities such as kidnaping and robbery, their perceptions stemmed from the experiences of someone close to them. As one of the respondents recounted the experience of their friend while using a ride-hailing service:

“It’s not all that safe…. My friend nearly died, she did not know the driver was a ‘Sakawa’ guy… The driver intended to kill her.” (Female respondent, 18-24 years old in Kumasi; has used internet-based ride-hailing)

Aside fears of possible exposure to robbery and kidnaping, a third sub-theme that emerged from the analysis in relation to criminal activity around ride-hailing is sexual harassment. Some female respondents recounted their experiences of unrequested and sometimes incessant advances, such as proposals initiated by male drivers of ride-hailing vehicles they had travelled in. Some of the respondents had themselves not been victims of sexual harassment, but they recounted the experiences of others close to them or stories that they had heard via social media and on the news. As evidenced by the quote below, most of the respondents indicated that women were in particular at risk of sexual harassment and abduction while using internet-based ride-hailing services such as Uber and Taxify/Bolt:

“Well, I’m very concerned about issues to do with SAFETY/SECURITY using Uber. There is a strong sense among young women and girls in particular that these means of transport are not safe, although they could be convenient... There are real cases in Accra where safety has been an issue with Uber and Taxify. These businesses must think about novel ways that SAFETY and SECURITY can be strengthened...The firm that does this well will eventually be the market leader, I believe” (Female respondent, 50-54 years old in Accra; has used a ride-hailing service)

As a result of the above fears and anxieties around the dangers of robbery, kidnaping and sexual harassment, most of the respondents were of the view that they would not want to

---

3‘Sakawa’ is a local term for illegal practices which combine internet-based fraud with African traditionalist rituals. Those who dabble in these practices believe in offering various forms of sacrifices, hence its association with kidnappings that leverage internet-based ride-hailing platforms.
share a ride with complete strangers in a ride-hailing vehicle. As one male respondent indicated in relation to robbery and kidnaping, there is a genuine fear that ride-sharing, instead of lone travel in an Uber or Taxify, will increase one’s risk of exposure to these criminal activities and compromise safety:

“Personally, due to the emerging concerns of kidnapping and robbery [whereby the perpetrators] use ride-hailing vehicles as a medium of operation, I don't think I will like to travel in Uber, let alone do so with complete strangers” *(Male respondent, 25-29 years old in Kumasi; has never used a ride-hailing service).*

**Theme #2.3: ‘Driver’s safety compromising behaviour’**

The sub-group of respondents who consider using ride-hailing as potentially dangerous, made reference to some specific ride-hailing drivers’ behaviours which they thought exposed passengers to risks and compromised their safety and security. One of such behaviours is perceived dishonesty on the part of drivers. Respondents experienced this in different ways, including drivers taking detours that passengers considered suspicious, choosing longer routes in order to charge more for the trip, which often results in arguments, exchange of insults and even fights between passengers and drivers. The following quotes further illustrate these experiences of passengers of the service:

“Well, I don’t consider it as being safe. Because I have had an experience where I had to be smart when one driver did not to use his intended route... only to know that he meant harm. He ended up taking extra two Ghana Cedi (GHC2) from me, despite my charge was showing clearly what I had to pay... [I] stopped using Uber since then” *(Female respondent, 30-34 years old in Accra; has used a ride-hailing service).*

Finally, risk-taking behaviours and reckless driving, such as over-speeding and red-light jumping at traffic stops, were also mentioned by some of the respondents as examples of driver behaviours that compromise ride-hailing passengers’ safety.

**4.3.3 Sub-grouping #3 themes—Ride-hailing is somewhat safe and secure**

The last sub-group of responses to the survey questions, as outlined previously, reflected the view that ride-hailing services were somewhat safe and secure. As outlined in **Fig 1d**, this sub-group of respondents noted contradictions in ride-hailing platforms’ safety and security features. They noted, for example, that on the one hand ride-hailing platforms’ technical features, such as traceability, trackability and driver identification, are supposed to ensure passenger safety and security. Yet, these same technical solutions, if they fell in the hands of individuals with criminal intent, could pose serious risks and dangers to passengers. As one of the respondents indicated:

“...the fact that a map [i.e. ride-hailing app journey tracking] is involved alone does not guarantee total security and safety. Uber drivers can equally arrange with ‘saboteurs’ to cause
harm and risk the life of a genuine booked client” (*Male respondent, 18-24 years old in Kumasi, has never used a ride-hailing service*).

Reflected in some of the respondents’ statement was a deep-seated suspicion of ride-hailing platforms, even when they had never used any of the available service as of the time of the survey. Moreover, individuals in this sub-group also noted the contradictions of traceability on the one hand and the relative ease with which criminal activities could be perpetrated, using ride-hailing platforms and vehicles, as captured in the following response:

“Yes it’s the safest so far... I lost my phone in an Uber and called the driver the next day and I got it back...However, I heard some Uber drivers rob some passengers... after you alight they hint their colleague thieves about the passengers’ house; and if there is money, baam!! you are dead! (*Male respondent, 18-24 years old in Kumasi; has used a ride-hailing service*).

Moreover, for others, features such as trackability and traceability, while they could be useful for passengers overall trust, safety and security, do not always work. As one female respondent indicated in response to the main survey question:

“So far it has been safe for me... I always travel alone. Once I left my belongings in an Uber but it was difficult to find them and I never did. I also would not trust any of my children under 18 [years old] to take an Uber ride alone. I always try to ‘psycho-analyse’ the Uber driver to be sure I am safe” (*Female respondent, 40-44 years old in Accra; has used a ride-hailing service*).

Perhaps, the one response that sums up the views, experiences and perceptions across the different sub-groups of respondents presented in the analysis so far, is the extract below from the survey:

“I consider Uber as a safer option for passengers who are drunk and not in the right frame of mind. However, overall I do not trust enough safety mechanisms have been instituted by Uber to make the service safe... Personal experiences with drivers showed they had little regard for basic safety such as seat belt, noise distraction, fatigue driving etc... The fact that some drivers continue to fidget with phones whilst driving remains a huge concern to me. There have also been several reports of drivers assaulting passengers, especially female riders” (*Male respondent, 25-29 years old in Accra; has used internet-based ride-hailing service*).

5 Synthesis

In the previous sections, results of the exploratory survey on passenger safety and security in internet-based ride-hailing services have been outlined. This section presents a synthesis of the results from which implications for theory and policy are derived and discussed.

The results show that experiences and perceptions about safety and security are heterogeneous, manifesting along a continuum of internet-based ride-hailing services being safe, somewhat safe and not safe at all. Through the inductive analysis, seven factors affecting passenger safety and security experiences and perceptions have been identified and summarised in Fig 2. These factors are interrelated and reflect safety as a state of being
protected from harm, and security as the means of protecting or preventing individuals exposure to harm when using internet-based ride-hailing services. The seven factors are discussed as follows:

The first factor identified from the analysis is **identification** of driver and vehicle prior to boarding a ride-hailing vehicle. This factor can be considered to be related to both security and safety but at different levels. On one level, the identification measures are partly intended by TNCs to secure the integrity of the digital platforms on which users book their ride. On another level, users experience or perceive safety through the platforms’ in-built driver and vehicle identification features. That passengers were able to form an initial idea and perception of the driver of the requested ride via the app, as the analysis showed, appears to enable them to cultivate a certain amount of initial level of trust. For some users, it appears that this level of trust was enough to attenuate their perception of danger and risk when using a ride-hailing service, thereby leading them to conclude that this new form of mobility provides enough security which, in turn, ensures their safety.

Closely related to identification is the ability to track a trip in real-time by passengers themselves or being able to share the trip for tracking by their significant others, such as friends and relatives. Similar to identification, **trackability** functions on the digital platforms seemed to act to solidify some passengers’ trust that the system is secure and that their safety would not be compromised when using internet-based ride-hailing. Trackability function of ride-hailing applications, as an in-built security feature, also shapes users sense of safety through being able to question route choices of the driver as well as detect and interrogate unexpected detours that might be considered suspicious. Thus, the application’s inbuilt security feature provided a mechanism by which passengers derived and exercised some form of control when travelling in a ride-hailing vehicle.

---

**Fig 2:** Summary of factors affecting passenger safety and security in ride-hailing

---

Identification (driver and vehicle)

Trackability and traceability

Exposure to malicious and criminal activities

Privacy (lone travel)

(d)trust of app security features

Emergency use

Driver behaviour

Passenger safety and security in ride-hailing
Moreover, the ability to trace personal belongings that might be lost during a ride-hailing trip was also seen by some of the respondents as additional security benefits of using internet-based ride-hailing. Traceability in this context, is therefore, an after-trip possibility that is also aided by the possibility of being able to identify a driver and vehicle to recover personal belongings. The results of the survey also show that in relation to traceability, security is not perceived and/or experienced only in relation to the passengers themselves, but it also extended to their personal belongings.

Just as trust in inbuilt security features that allow for driver and vehicle identification and traceability, as well as journey sharing and trackability enhanced safety, so did distrust in these security features reduce perception of safety and security from the point of view of the users. On the one hand, some individuals derive their sense of safety and security from the mediating role of technology. On the other hand, others believed that these same platforms enable malicious and criminal activities that could compromise their safety in using digital platform mobility services, such as ride-hailing. By and large, the experiences and perceptions of some of the respondents suggest a distrust in the security mechanisms instituted by TNCs on their ride-hailing platforms.

As evidence from other countries and cities across the globe show, it is possible for individuals to breach the security measures of the TNCs ride-hailing applications and exploit them to the detriment of both users and drivers (Zhao et al., 2019; Khazbak et al., 2018). Consequently, as the results of this study has shown, there are genuine fears on the part of both current users and potential users of being victim of malicious and criminal activities such as robbery, kidnapping, unwarranted advances and sexual harassment while travelling in a ride-hailing vehicle.

The survey responses also revealed that some individuals seem to derive a sense of safety and security from the privacy and lone travel in ride-hailing. Even so, there were fears that lone travel and the privacy it affords could expose passengers to danger if they find themselves with a ride-hailing driver who has intentions of harming them. These fears seemed further heightened if the respondents imagined that they would be sharing a ride with up to four strangers, including the driver in the vehicle, as is the case with conventional taxis. As a result of this perceived risks, majority of respondents were unwilling to use ride-sharing options if they become available in their respective cities. To them, it is not possible to know if all or some of those with whom they are sharing a ride have criminal intents to harm them. As Pratt et al., (2019) found, some passengers are hesitant in using services such as Uberpool of Lyft Line because of safety concerns related to travelling with strangers. It is worth noting that in the context of this study, these fears and experiences have long existed even with using conventional taxis, but from the survey responses, it appears that some respondents associate the likelihood of exposure to harm from malicious and criminal activities more with internet-based ride-hailing services.

The foregoing analysis resonates with on-going debates about the wider security and public safety implications of the transition to smart cities in general and smart mobility solutions in particular. Smart cities and their mobility solutions have generated different impacts on urban mobility, and will continue to do so as new transport technologies emerge (Karvonen et al.,
In the context of digital platform mobility services, such as ride-hailing, some of these benefits have included providing convenient, flexible and reliable on-demand mobility solutions (Acheampong et al., 2020; Pham et al., 2017; Rayle et al., 2016). However, as the evidence provided in this study show, the digital platforms mediating smart mobility solutions could also provide the environment and conditions of anonymity that could be exploited to perpetrate malicious and criminal activities, resulting in possible negative outcomes for the general public. While TNCs allow passengers to know some information about their requested drivers, in safety and security terms, that information is only as good as it is verifiable. Some of the study participants were concerned that criminals could steal and assume the identity of genuinely registered ride-hailing drivers and there is no way they would be able to verify with confidence, the identification information presented to them before the trip. Thus, it became evident that the respondents’ fears and concerns stemmed partly from that which they cannot know about the driver via the online ride booking platforms, ahead of a given journey.

Moreover, driver behaviour was found to be one of the factors affecting passenger safety and security in ride-hailing mobility services. The perceptions and experiences of some of the respondents underscored some of the safety risks that have long existed before the era of digital platform mobility services, such as Uber, Lyft and Taxify. Reckless driving, risk-taking behaviours and distractions by smartphone usage while driving are long-standing issues in road safety research focusing on taxi drivers (see e.g. Cheng et al., 2016; Peltzer and Renner, 2005; Burns and Wilde, 1995). These issues were also highlighted by respondents in this study who were of the view that ride-hailing was somewhat safe or not safe at all. That said, some of the respondents believed that they asserted and ensured their safety through the instituted regulatory mechanism of reward and punishment, in the form of driver performance ratings. Indeed, driver ratings constitute one of the main mechanisms intended by TNCs to improve the quality of their mobility services and overall experience of ride-hailing users globally. It is therefore understandable why the respondents seem to believe in this mechanism. Negative ratings reflecting unacceptable driver behaviour are given after experiencing the service. However, it seems that some of the respondents see this as a useful feedback mechanism that could mitigate against risky and reckless driver behaviours and ultimately ensure the safety of all users.

Finally, it emerged from the analysis that some of the survey respondents also associated and experienced safety and security regarding internet-based ride-hailing in times of emergencies, such as ill-health. In such circumstances and in the context of Ghana in particular, where reliable ambulance services are hard to find, ride-hailing services provide public value by becoming a rapid response alternative, thereby contributing to saving lives. Thus, in the particular context of Ghana, the door-to-door, on-demand mobility solutions provided by internet-based ride-hailing, in certain situations, enables accessibility to essential services such as medical care in a manner that is flexible and quicker than using existing conventional taxis or public transport.
6 Relevance and policy implications of the findings
The inductively derived insights of this study could have fundamental conceptual and empirical value to scholarship on smart cities and smart mobility, transport safety, and travel satisfaction and mobility related well-being.

Conceptual and empirical work on the evolution, governance and impacts of smart mobility transitions continue to emerge (see e.g. Docherty et al., 2018; Marsden and Reardon, 2018). The evolving literature points to wide-ranging impacts, of which issues around user data generation, privacy concerns and data governance have received considerable attention in recent years (Braun et al., 2018; Paskaleva et al., 2017; Van Zoonen, 2016). Detailed empirical work on passenger safety and security in smart mobility solutions, as one of the important aspects of societal impact of smart mobility solutions is however, lacking. The current study therefore offers new insights to the evolving literature by identifying seven interrelated factors affecting safety and security in ride-hailing, as one form of smart mobility solutions (see Fig 2). These factors reflect different aspects of the topic and could help in further conceptualising and empirically assessing the wider impacts of smart mobility solutions in different contexts.

Moreover, as argued at the onset of this paper, transport safety research has traditionally focused mainly on road safety issues such as understanding and preventing accidents, injuries and fatality. As this study has shown, the emergence of new ICT-mediated transport technologies and services, raises new implications and frontiers for transport safety research to explore. To this end, the initial exploratory evidence provided in this study would be useful in two major ways. First, the insights from the current study could help broaden how we see and conceptualise transport safety and security, by considering new influential factors that have become relevant in the digital age and go beyond the traditional consideration of road traffic safety, such as those identified in this study (see Fig 2). Secondly, the safety and security factors identified in this study could serve as indicators for large sample quantitative empirical works seeking to understand these issues in different contexts.

Research around issues of travel satisfaction and mobility related well-being outcomes are increasingly becoming important in the quest for healthy, secure and safe urban futures (see e.g. Ye et al., 2020; Francois et al., 2017; Stone and Schneider, 2016; Susilo and Cats, 2014; Stradling et al., 2007). As new transport technologies and the associated digital platform mobility services diffuse rapidly, challenges around passenger safety and security, such as those evidenced in this paper, could become even more pronounced. Consequently, safety and security considerations from the perspective of commuters would become critical determinants of travel satisfaction and travel-related well-being. This therefore opens up new frontiers for fundamental policy-oriented research. To this end, the factors identified in this study as shaping passenger safety and security could inform the development and inclusion of additional indicators for assessing commuter satisfaction and well-being within digital mobility systems.

The current study has practical relevance for transport policy and governance in the age of digital platform mobility transitions. As previous studies in Ghana (see Agyemang, 2020) and elsewhere (see e.g. Thelen, 2018; Harris, 2017; Posen, 2015) have shown, major gaps in the
regulatory capacities of the public sector exists in relation to the governance of digital platform mobility solutions. In the particular context of Ghana, measures designed specifically to regulate TNCs and their digital platform mobility solutions are currently non-existent. The existing policy vacuum implies that TNCs such as Uber and Bolt/Taxify determine what level of security users might get, relying mainly on their platform’s inbuilt security features, such as driver and vehicle identification. However, as the findings of the study has shown, these inbuilt security features could be susceptible to breaches. In addition, some of the safety compromising factors, such as unacceptable driver behaviour and exposure to criminal activities in ride-hailing vehicles, go far beyond what the inbuilt security features offered by TNCs on their platforms can guarantee. As has been well documented internationally, it is unlikely that TNCs by themselves will address some of these safety and security lapses on their platforms without oversight and enforcement from the relevant public sector agencies. Thus, public sector regulatory measures are required to ensure that users of digital platform mobility services feel safe and protected. Based on the findings of this study, such regulatory measures should include setting safety and security performance benchmarks for TNCs to meet. TNCs should be required by law to act transparently by making any security lapses identified in their platforms that could compromise the safety of users, known to the regulatory agencies and the public. They should be required to provide the necessary technical fixes to guarantee public safety. Ultimately, these benchmarks should provide the basis to evaluate TNCs overall performance and to permit or revoke their operational licence.

Moreover, from practical policy perspective, this study underscores the links between digital platform mobility services, and security and local law enforcement. TNCs could collaborate with security agencies to relay information directly in real-time, thereby helping to improve passenger safety and security. It might also be useful for trip tracking in real-time to become possible offline, so that passengers can still access these inbuilt security capabilities even when they run out of broadband data and cannot access the internet while they travel. This might contribute to improving individuals’ safety and security experiences, and potentially deter criminal behaviour. The haggling over fares between drivers and passengers, due to the lack of online payment systems, while unique to the particular case of Ghana, might as well apply in other developing countries. Thus, in the long term, expanding direct online payment methods such as direct debit and mobile-money payments would be beneficial.

Finally, the findings of this study have implications for the implementation of different mobility models which have the potential to bring about wider sustainability benefits in the transport sector. As the findings show, people currently derive a sense of safety and security from lone travel in ride-hailing services. The majority of respondents are therefore unwilling to use ride-sharing options due to perceived risks of having to do so with more strangers. Meanwhile, ride-sharing constitutes one of the ways by which wider public value could be captured from technology-mediated mobility solutions. However, if safety and security concerns result in more lone-ridership instead of shared-ridership in ride-hailing, then new digital transport solutions would not contribute to realising critical objectives, such as reducing car use, energy consumption and air pollution and CO₂ emissions in the transportation sector. Thus, this study underscores the need for regulators and TNCs to
improve passenger safety and security, as a prerequisite to promoting the up-take of ride-sharing options, instead of lone travel in digital platform mobility services.

7 Limitations and directions for future research
The results and their interpretation need to be taken in the context of some limitations. TNCs and their mobility solutions are increasingly becoming a global phenomenon. Thus, while some of the findings resonate with safety and security issues that can be found in media reports in various countries, others are specific to the unique context of Ghana. Future research could build on the initial evidence provided in this exploratory study from Ghana to improve our understanding of how safety and security are being shaped in different contexts.

Secondly, the use of online platforms to generate data for this study enabled us to reach a relatively larger number of respondents that would not have been possible with traditional personal interviews. It is worth noting, however, that the resulting sample reflect the views and experiences of individuals who have access to the internet, who are also mostly young adults. This is not a weakness per se as we know from previous research that this demographics are more likely to use new ICT-mediated mobility services. However, it would be useful to understand the impacts of these new mobility services from the perspective of other individuals that could not be captured in this study both in Ghana and elsewhere. The current study also focused on passengers. However, it is possible that drivers of internet-based mobility services could also be exposed to some of the safety and security compromising issues that have been explored in this research. Thus, research focusing on this group could also be useful in understanding the wider societal impacts of these digital platform mobility services.

8 Conclusion
The emergence of new digital mobility solutions, as part of wider transitions to smart cities, raises new challenges for public safety and security that go beyond the traditional considerations of road safety. This study has provided rich empirical insights about passenger safety and security in internet-based ride-hailing services through the perceptions and experiences of users and non-users of these services in Ghana. From the inductive analysis of the data, seven main factors influencing passenger safety and security in ride-hailing have been identified (refer to Fig 2). It has been demonstrated that these findings have both conceptual and empirical value to research on the impacts of smart mobility solutions, transport safety, and travel and mobility-related well-being. From a practical policy perspective, the study does not only underscore the need for public sector regulatory measures to help protect public safety and security, but it also provide evidence and insights that could inform the development of safety and security benchmarks and performance evaluations of TNCs and their digital platform mobility solutions.
References


Stebbins, R. (2001). Exploratory research in the social sciences. SAGE.


