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Exploring non-users’ intention to adopt ride-sharing services: Taking into account increased risks due to the COVID-19 pandemic among other factors

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\textbf{ABSTRACT}

The coronavirus disease 2019 (COVID-19) outbreak has a substantial negative effect on the global transportation industry. Ride-sharing is an innovative means of transportation that is also affected by the COVID-19. How and when individuals adopt ride-sharing services under the COVID-19 context should be explored to reduce the influence of the COVID-19 on ride-sharing and promote the development of ride-sharing services. This research investigates the effect of ambiguity tolerance and environmental concern on potential users’ intention toward adopting ride-sharing services and further examines how the COVID-19 affects their intention toward adopting ride-sharing services. Data from 964 potential users of ride-sharing services suggest that ambiguity tolerance and environmental concern directly and positively influence potential users’ intention toward adopting ride-sharing services. In addition, both indirectly affect consumers’ intention toward adopting ride-sharing services through perceived ease of use and perceived usefulness. Moreover, the perceived health threat negatively moderates the effect of ambiguity tolerance and environmental concern on consumers’ intention toward adopting ride-sharing services. This study enriches the research on how and when ambiguity tolerance and environmental concern influence consumers’ intention toward adopting ride-sharing services. Furthermore, this study highlights the moderating effect of perceived health threat under the COVID-19 context. Based on the empirical findings, practical implications are proposed for the providers and facilitators of ride-sharing services.

\section{Introduction}

In December 2019, the coronavirus disease (COVID-19) outbreak began in Wuhan City, Hubei Province and spread across China within weeks. Novel coronavirus-infected patients experience nasal congestion, runny nose, sore throat, diarrhea, and other symptoms. Patients with severe symptoms face a life-threatening situation. As the most populous country in the world, China is at risk of the epidemic spreading because the COVID-19 is highly contagious and spreads from person to person (Chan et al. 2020). Moreover, the COVID-19 has a substantial influence on economic development, and the transportation industry is greatly affected.

As one of the earliest and the most important applications of the sharing economy in the field of transportation, ride-sourcing has

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been becoming an extremely popular travel pattern (Zhu et al. 2017). Ride-sharing is a mode of transportation in which individuals with similar itinerary and schedule use the same car for work, school, trips, and long journeys and share the transportation costs, such as fuel cost, parking fee, and passing fee (Agatz et al. 2012, Lokhandwala and Cai 2018). In ride-sharing, passengers can directly make an online reservation (including publishing the information of the scheduled departure and destination) and share the ride with others through special mobile platforms, such as UberPool, DiDi Hitch, and BlaBlaCar. As an innovative transportation, ride-sharing is affected by the COVID-19. During ride-sharing, passengers may increase the possibility of acquiring the COVID-19 due to close contact with others in the same compartment space. This situation may also increase their health concerns. When the COVID-19 epidemic was relatively severe, various provinces and cities in China introduced restrictions on ride-sharing to strengthen the need for epidemic prevention and control. In March 2020, ride-sharing services were gradually allowed again in various regions after the epidemic situation improved in China. Although the COVID-19 epidemic situation in China has been largely contained, small-scale outbreaks continue to occur in Beijing, Dalian, and other places.

With the aggravation of serious environmental problems including global warming and air quality deterioration, environmental protection has become a key issue (Lindahl et al. 2014, Chen and Lu 2015). Specifically, transportation-related issues, such as traffic congestion, increased traffic energy consumption, environmental pollution caused by automobile exhaust, and other problems, are important causes of climate change. Thus, sustainable modes of transportation (e.g., walking, cycling, green vehicles, zero-emission vehicles, and clean energy vehicles) are gradually favored by people to reduce the effect of traffic on the environment. Ride sharing has potential in improving traffic conditions and protecting the environment. However, many passengers in China remain uninterested in ride-sharing services (Wang et al. 2019). Moreover, affected by the COVID-19, residents are highly cautious and hesitant about ride-sharing services. Hence, the factors that may influence consumers’ intention toward adopting ride-sharing services should be deeply explored. The objectives are to understand the influence of the COVID-19 on the willingness of consumers to adopt ride-sharing services, propose targeted solutions, and encourage additional consumers to choose ride-sharing services. In addition, the shift of consumers from non-users to users in ride-sharing services is gradual. Correct guidance, encouragement, and policy support from providers and facilitators exert an important influence on consumers without experience of ride-sharing to decide whether to adopt such a service in the future (Wang et al. 2018c). Moreover, in exploring the influence of the COVID-19 on residents’ willingness to adopt ride-sharing services from the perspective of non-users, factors, such as consumers’ previous experience, can be excluded. Therefore, this study investigates consumers’ willingness from a non-user perspective to promote the implementation strategy and further development of ride-sharing marketing.

Ride-sharing services can bring many benefits, such as help passengers with difficulty in taking a taxi during the peak travel period, and alleviate urban traffic congestion (Chan and Shaheen 2012, Wang et al. 2018c). Ride-sharing can also save transportation expenses given the co-payment among passengers (Stiglic et al. 2015). In addition, ride-sharing is a platform for passengers to meet other people, learn new knowledge of different industries or backgrounds, and form a pleasant feeling of interaction while traveling (Morency 2007, Chan and Shaheen 2012). Moreover, ride-sharing may mitigate greenhouse gas emissions and air pollution by improving the utilization of obtainable seat capacity (Teubner and Flath 2015, Wang et al. 2019). Data indicates that ride-sharing can improve 24% of vehicle utilization, where approximately 7.29 million tons of carbon emissions can be reduced annually (Li et al. 2018). However, ride-sharing is not entirely beneficial because it may reduce access and egress to transit by active transportation, may generate new travel, and may involve dead-heading and cruising travel. Alisoltani et al. (2021) found that when the travel density is medium, dynamic real-time ride-sharing does not necessarily alleviate congestion. Chen et al. (2022) indicated that ride-sharing services may cause a series of safety accidents. Hu et al. (2021) found that ride-sharing services can result in extra travel time for passengers as drivers detour to pick up other passengers. Yao et al. (2021) also indicated that in densely populated areas, it often takes a lot of time to locate and pick up passengers in ride-sharing services.

In exploring consumer studies on innovative products or services, different models are adopted to evaluate consumers’ acceptance (Chong et al. 2010). The technology acceptance model (TAM) (Davis 1989), theory of planned behavior (TPB) (Ajzen 1991), diffusion of innovation theory (Weigel and Hazen 1995), and unified theory of acceptance and use of technology (Venkatesh et al. 2003) are extensively used frameworks. Among many theoretical frameworks used to explain the adoption of technical products or services, the TAM is the most powerful tool for predicting consumers’ intention (Cheung and Vogel 2013, Teo and Zhou 2014, Hubert et al. 2017). Previous studies also demonstrate the rationality of the TAM in explaining consumers’ acceptance toward adopting ride-sharing services (Wang et al. 2018c). Considering the technical characteristics of ride-sharing, this study introduces the TAM as the theoretical support in exploring consumers’ intention toward adopting ride-sharing services.

Although the TAM is widely confirmed to be appropriate in explaining the acceptance of innovative technology, this method has limitations. The traditional TAM only analyzes consumers’ subjective cognition toward technical products or services and neglects to consider consumers’ characteristics (Wang et al. 2018c). Previous studies demonstrate that consumers’ personality has a certain influence on their acceptance toward new products or services when they have other choices (Girod et al. 2017, Wang et al. 2018b). Although ride-sharing can provide several benefits, risks in the consumer experience possibly exist. These risks may include personal property security, time costs, accident compensation, and other uncertain factors (Zhu et al. 2017). As a personality trait, ambiguity tolerance generally refers to the way individuals evaluate and react to ambiguous situations or information characterized by a series of complex, unfamiliar or inconsistent clues (Zhu et al. 2012, Xu and Tracey 2015). Consumers with a personality trait of ambiguity tolerance and those who are hesitant to do things are also uncertain when making purchasing decisions (Hazen et al. 2012). In

\[^1\] In China, passing fee refer to the fees that need to be paid for passing a certain road section. They are generally used in places such as national highway toll stations.
addition, research on the influence of ambiguity tolerance on consumers’ behavior in the existing literature is limited. The study of consumers’ intention toward adopting ride-sharing services should provide additional attention to ambiguity tolerance. Consumers’ personalities, such as environmental concern, may affect consumers’ acceptance as well (Zahan et al. 2020). These consumers may be unaware of the potential of ride-sharing in protecting the environment owing to their personality traits (Geissdoerfer et al. 2017). Thus, their environmental concern is another important consideration. The integration of personal characteristics, such as ambiguity tolerance and environmental concern, into TAM, can make the research of consumers’ acceptance toward adopting ride-sharing services highly comprehensive. Moreover, under the COVID-19 context in China, consumers’ perceived health threat may influence consumers’ decision making. The increased exposure to people in ride-sharing poses a potential risk of infection with the COVID-19. Consumers may perceive health threats of being infected with the COVID-19 before the COVID-19 epidemic completely ends and residents’ lives fully return to a normal state. Although the epidemic situation in China has been controlled, the psychological concerns of consumers may last for a long time. However, to the best of our knowledge, few studies explore the perceived health threat on consumers’ intention toward adopting ride-sharing services in the COVID-19 context. To fill this gap, the present study fully explores the influencing mechanism of perceived health threat on consumers’ intention toward adopting ride-sharing services.

The survey of potential users’ acceptance toward adopting ride-sharing services in China under the COVID-19 context is mainly based on the following considerations. First, China was one of the first countries in the world to experience COVID-19 outbreaks. Exploring Chinese consumers’ acceptance toward adopting ride-sharing services under this new situation is of practical significance. Second, China is the world’s most populous country, with a great potential pool of ride-sharing. Analyzing consumers’ acceptance toward ride-sharing services in China is conducive to the further expansion of the market. Third, China is the world’s largest carbon emitter and is one of the countries with the most serious environmental pollution problems. Hence, environmental pollution and traffic congestion in China must be urgently reduced. Ride-sharing may be an effective way to achieve these goals. Therefore, conducting this study in the Chinese context is feasible, and the empirical results can provide suggestions for providers and facilitators to expand the use of ride-sharing services.

This research integrates the variables of ambiguity tolerance, environmental concern, and perceived health threat into the TAM to further investigate Chinese potential consumers’ intention toward adopting ride-sharing services under the COVID-19 context. This study mainly contributes to the literature in the following aspects. First, the current study aims to investigate potential users’ intention toward adopting ride-sharing services, which enriches the literature in the field of ride-sharing services. Second, few studies investigate the influence of the COVID-19 and health factor on consumers’ intention toward adopting ride-sharing services. The current research innovatively considers the influence of perceived health threat on consumers’ acceptance toward adopting ride-sharing services under the COVID-19 context. Third, personal characteristics, such as ambiguity tolerance and environmental concern, are considered in the TAM, which can make up for the limited consideration of personality characteristics in the TAM and further improve the explanatory power of this model. Perceived health threat further increases the consideration of external and impeding factors in the TAM.

This paper is structured as follows. Section 2 introduces the literature review of the study and proposes the research hypotheses. Section 3 discusses the data collection and method used. Section 4 presents the data analysis and results based on structural equation modeling (SEM). Section 5 provides discussion and policy implications. Section 6 concludes this study and pinpoints the limitations.

2. Literature review and research hypotheses

Part of the literature on ride-sharing services explores the optimization of ride-sharing technology. Özkan (2020) studied the interplay between pricing and matching decisions of a ride-sharing firm. Li and Chung (2020) introduced a ride-sharing system that can support frequent updates of participants’ information. Huang et al. (2020) designed a ride-sharing route to benefit both customers and drivers. Enzi et al. (2021) tried to solve the multimodal ride-sharing problem. Manchella et al. (2021) proposed algorithm pools for ride-sharing improvement. Alisoltani et al. (2021) discussed whether the dynamic ride-sharing system can alleviate traffic congestion. Wang and Zhang (2021) explored how to improve the safety of ride-sharing services. Guo et al. (2021) established an effective real-time ride-sharing framework. Narman et al. (2021) designed an enhanced ride-sharing model to increase the usage of ride-sharing services.

Some literatures pay attention to the travel behavior of ride-sharing. Liu and Xu (2019) confirmed that the adoption of ride-sharing apps is influenced by income, access to technologies and peer adoption. Sharma (2019) suggested that consumers’ perceived value influences their intention to adopt ride-sharing services. Wang et al. (2019) also indicated that consumers’ perceived value and perceived risk are the main factors influencing consumers’ adoption intention toward ride-sharing services. Alonso-González et al. (2021) found that fare discount, additional travel time incurred, and (un)willingness to share the ride with other passengers are the three main factors influencing consumers’ adoption toward ride-sharing services. Shao et al. (2020) indicated that government support and platform reputation are the main factors that affect consumers’ intention to continue to use ride-sharing services. Wu and Neill (2021) verified that platforms affect consumers’ trust and then affect their intention to adopt ride-sharing services. Lee and Cha (2022) confirmed that anti-consumption affects the formation of consumers’ trust in the ride-sharing service. Nguyen et al. (2021) found that competitive price increases young consumers’ intention to adopt ride-sharing services. In addition, other similar shared travel behaviors have also been studied. Alemi et al. (2019) indicated that people who often use smartphone applications to manage other aspects of travel (such as selecting routes or checking traffic conditions) are more likely to use ridehailing services provided by Uber and Lyft in the American market. Alonso-González et al. (2021) indicated that whether consumers are willing to adopt shared ridesourcing services mainly depends on the trade-off of time cost. Hasan et al. (2021) found that performance expectancy, effort expectancy, hedonic motivation influence consumers’ intention to use Uber app. Jiang et al. (2021) indicated that consumers’ attitude positively
affects their participation continuance intention towards Sharing Economy. Malik et al. (2021) found that increased time and privacy concern affect consumers’ adoption intention towards shared ridehailing. Middleton et al. (2021) suggested that time and price have a relatively great impact on the choice between private and shared rides.

Despite the studies on the influencing factors of ride-sharing services, few consider the impact of health factors on consumers’ willingness to adopt ride-sharing services under the epidemic context.

This study employs the extended TAM to explore potential consumers’ adopt intention toward ride-sharing services under the COVID-19 context in China.

2.1. TAM

Davis (1989) originally proposed the TAM as one of the most popular models applied to explain consumers’ intention toward technological products or services. The TAM has attracted considerable attention and continued validation since its first publication (Venkatesh and Bala 2008). The TAM originally consists of four variables, namely, perceived ease of use, perceived usefulness, attitude, and intention to use. Perceived ease of use means the degree to the relative ease of using a new product or service. By contrast, perceived usefulness frequently refers to the degree to which an individual deems that innovative products or services can improve work performance (Davis 1989). Generally, perceived ease of use has a positive effect on perceived usefulness, whereas perceived ease of use and perceived usefulness jointly affect consumers’ behavior. Intention to use depends on perceived usefulness and attitude, and the actual behavior is influenced by consumers’ intention. Fig. 1 shows the TAM.

However, the existing literature discusses the necessity of the construct “attitude” as the mediator of such variables and intention to use (Natarajan et al. 2017). Studies (Teo 2009, Nistor and Heymann 2010, Wang et al. 2018c) confirm that no significant difference is observed between variances explained by the attitude and non-attitude models of the TAM. The literature indicates that the TAM, which omits the variable “attitude,” is highly predictive (Venkatesh 2000) owing to the weak mediating effect of attitude (Lee and Lehto 2013). In addition, existing studies that focus on the acceptance of innovative technologies omit “attitude” from the TAM framework (Wu et al. 2011, Park and Lee 2014). Therefore, the present study adopts a simplified TAM, which omits “attitude” to explore non-users’ acceptance toward adopting ride-sharing services. This study investigates potential consumers’ intention to adopt ride-sharing services, so actual behavior is excluded.

Previous studies confirm that perceived ease of use plays a positive role in perceived usefulness and behavioral intention and that perceived usefulness also positively affects behavioral intention (Park and Lee 2014, Wang et al. 2018c). For instance, Tan et al. (2014) suggested that if consumers perceive that using mobile learning is easy, then they have a high possibility to perceived usefulness. Chen et al. (2020) found that students’ perceived ease of use of Chatpot encourages students to perceive that Chatpot is useful in helping language learning and that they are likely to adopt Chatpot in learning Chinese. Brusch and Rappel (2020) verified that when consumers perceive the usefulness of instant shopping, they are receptive to instant shopping. Papa et al. (2020) also indicated that perceived ease of use is significantly and positively correlated with consumers’ perceived usefulness and intention toward smart healthcare.

Within the ride-sharing context, perceived ease of use is the extent of ease to which potential user deems the adoption of ride-sharing. By contrast, perceived usefulness means the degree to which potential user views the adoption of ride-sharing as useful for facilitating life, protecting the environment, and others (Shuhaiber and Mashal 2019). With the cited facts as basis, if consumers perceive that the method of reserving ride-sharing services is easy or signing a car ride-sharing agreement is not hard, they will have more energy and time to pay attention to other benefits of ride-sharing, rather than spend more labor and time to learn how to use ride-sharing services. When potential users recognize the usefulness of ride-sharing, their probabilities of adopting ride-sharing services are high. Thus, the following hypotheses are proposed:

H1. Perceived ease of use has a positive effect on perceived usefulness.

H2. Perceived ease of use has a positive effect on consumers’ intention toward adopting ride-sharing.

H3. Perceived usefulness has a positive effect on consumers’ intention toward adopting ride-sharing.

Fig. 1. TAM proposed by Davis.
2.2. Ambiguity tolerance

An ambiguous situation occurs when a person is unable to construct or organize an environment because of the lack of adequate criterion (Hammond et al. 2017). Ambiguity tolerance generally refers to the way individuals evaluate and react to ambiguous situations or information characterized by a series of complex, unfamiliar or inconsistent clues (Zhu et al. 2012, Xu and Tracey 2015). Generally, consumers with high ambiguity tolerance experience slight pressure from ambiguous information or situations because they can have a strong understanding of the information and the courage to face uncertainty. On the contrary, consumers with low ambiguity tolerance are less likely to accept ambiguous information or situations (Xu and Tracey 2015). Previous studies investigate the association of ambiguity tolerance with consumers’ attitudes and behavioral intention (Matsumoto et al. 2017). For instance, Lu and Gursoy (2015) demonstrated that ambiguity tolerance is positively associated with consumers’ intention toward adopting online tourism products. Jena and Sarmah (2015) found that ambiguity tolerance immediately affects consumers’ attitudes and intention to pay an additional charge for returning used products. Wang et al. (2018b) also verified the positive relationship between ambiguity tolerance and consumers’ attitude and intention toward remanufactured products.

Early research on ride-sharing finds that consumers are reluctant to abandon the convenience of private cars despite the potential of ride-sharing in environmental protection (Chan and Shaheen 2012). Considering the small space of ride-sharing and the close contact with strangers, individuals may hesitate to adopt ride-sharing services owing to the yearning for space and fear of social contact (Bonsall et al. 1984). In addition, ride-sharing routes need to consider the transportation needs of different passengers, which may prolong travel time. If consumers are tolerant of uncertainty, then they become tolerant and relaxed about ambiguous situations and inadequate information and become aware of the usefulness of ride-sharing. Similarly, consumers with high ambiguity tolerance are likely to accept and learn the new mode of travel, so they will find adopting ride-sharing services easy and will prefer to adopt ride-sharing services. Thus, the following assumptions are proposed:

H4. Ambiguity tolerance has a positive effect on consumers’ perceived ease of use toward adopting ride-sharing services.
H5. Ambiguity tolerance has a positive effect on consumers’ perceived usefulness toward adopting ride-sharing services.
H6. Ambiguity tolerance has a positive effect on consumers’ intention toward adopting ride-sharing services.

2.3. Environmental concern

Environmental concern is defined as awareness of environmental issues and attitude toward protecting the environment (Mas’od and Chin 2014, Yarimoglu and Binboga 2019), and it is regarded as one of the important factors in pro-environmental behavior decision making (Jain and Kaur 2004, Verma and Chandra 2016, Yadav and Pathak 2016). Previous studies confirm that if the awareness of consumers’ environmental concern is strong, then consumers’ intention toward protecting the environment is positive (Minton and Rose 1997, Hartmann and Apaolaza-Ibáñez 2012, Dienes 2015, Verma et al. 2019). For instance, Hansla et al. (2008) found that consumers’ environmental concern positively affects their intention of purchasing green electricity. Zhang et al. (2013) indicated that consumers’ environmental concern is positively associated with their intention toward adopting electric vehicles as an eco-friendly mode of transportation. Previous studies demonstrate that consumers’ positive environmental concern is positively related to their perceived behavioral control (Zhu et al. 2020). If consumers have a strong environmental concern, then they are likely to perceive that adopting ride-sharing services is easy. In addition, consumers with high environmental concern are inclined to form a positive attitude to hold that adopting ride-sharing services are useful because ride-sharing services have the potential in relieving traffic congestion and reducing air pollution. Costain et al. (2012) validated that people who adopt car-sharing services are more environmentally conscious and more willing to pay for carbon offsetting. Schaefers (2013) indicated that environmental motives promote consumers’ intention to adopt car-sharing services. Ciricella et al. (2018) also verified that car-sharing contributes to the reduction of greenhouse gas emissions as pro-environmental motives promote consumers’ adoption toward car-sharing services. Given the previous analysis, we propose the following hypotheses:

H7. Environmental concern has a positive effect on consumers’ perceived ease of use toward adopting ride-sharing services.
H8. Environmental concern has a positive effect on consumers’ perceived usefulness toward adopting ride-sharing services.
H9. Environmental concern has a positive effect on consumers’ intention toward adopting ride-sharing services.

2.4. Perceived health threat

The large-scale and prolonged COVID-19 outbreak continues to pose a potential threat to residents’ health, and people are highly cautious in choosing means of transportation. The perceived health threat is an important predictor of consumers’ intention to adopt or not adopt a particular product or service (Alaiad et al. 2019). Thus, perceived health threats must be considered in the exploration of consumers’ intention toward ride-sharing services under the COVID-19 context. The perceived health threat is derived from the health belief model, which describes an individual’s perception of the threat that their health may be experiencing or may experience in the future, including perceived susceptibility and severity (Becker 1974). The former refers to the perception of individuals’ susceptibility to their diseases or health problem (Witte and Kim 1996). In particular, under the ride-sharing context, perceived susceptibility means users’ subjective perception of the likelihood to be infected with the COVID-19 due to ride-sharing. By contrast, perceived severity is an individual’s perception of the serious consequences of a disease or health problem (Hadjistavropoulos et al. 2012). Perceived severity
also refers to consumers’ perception of the severity of the possible COVID-19 infection caused by ride-sharing.

Given that the COVID-19 is not completely over in China, consumers who adopt ride-sharing services with others may perceive potential health threats. Although a ride-sharing partner is safe, consumers may have psychological fear. Consumers who think that their health is at risk hold a negative attitude toward ride-sharing and less likely to adopt ride-sharing services. Few studies verify the negative effect of perceived health threat on consumers’ behavioral intention. Aaliiad et al. (2019) found that consumers’ perceived health threat has a significantly negative influence on their intention to adopt mobile health. The consideration of perceived health threat is greatly applied to the medical field. The following hypothesis is proposed to explore the influencing factors that affect consumers’ intention toward adopting ride-sharing services and based on the cited facts:

H10. Perceived health threat has a negative effect on consumers’ intention toward adopting ride-sharing services.

Although the applied individual’s characteristics in the TAM are effective, external factors are excluded, and obstructive factors are ignored (Chong et al. 2012). Although their personality traits, such as ambiguity tolerance and environmental concern, encourage consumers to adopt ride-sharing services, their choice of transportation mode is also affected by the external environment. The adverse factor may reduce the consumption desire of potential users. The health belief model indicates that if individuals perceive high health threats, then they are likely to take action to avoid the actual occurrence of health problems (Becker 1974). Specifically, under the COVID-19 context, consumers’ health is an important consideration in exploring their acceptance toward adopting ride-sharing services. If consumers perceive high health threat, then out of the health concern, they may be less likely to adopt the product or service. Although consumers have the same level of ambiguity tolerance and environmental concern, they are less likely to adopt ride-sharing services when their perceived health threat is high. Attention to perceived health threat may reduce the influence of individuals’ ambiguity tolerance and environmental concern and have a negative moderating effect on adopting ride-sharing services. Given the abovementioned argument, we propose the following hypotheses:

H11. Perceived health threat negatively moderates the effect of ambiguity tolerance on consumers’ intention toward adopting ride-sharing services.

H12. Perceived health threat negatively moderates the effect of environmental concern on consumers’ intention toward adopting ride-sharing services (see Fig. 2).

3. Data collection and methodology

3.1. Measurement scale

The questionnaire in two parts was introduced to collect survey data in this study. The first part was to collect the basic demographic information of the respondents, and the second one was to measure latent constructs. The constructs of the research were assessed by building on previous literature. The measurement of perceived ease of use was obtained from Lee and Lehto (2013) and Sheng and Zolfagharian (2014), whereas the assessment of perceived usefulness was derived from Schuitema et al. (2013) and Wang et al. (2018a). The measurement of ambiguity tolerance was based on Marks (2013) and Wang et al. (2018b), and the construct of environmental concern was assessed on the basis of Gadenne et al. (2011) and Wang et al. (2014). The measurement of perceived health threat was derived from Witte and Kim (1996) and Hadjistavropoulos et al. (2012), whereas the measurement of intention was obtained from Davis et al. (1989) and Gao et al. (2017). Detailed measurement scale items are presented in Appendix A.

The measurement items were assessed by a five-point Likert scale ranging from 1 (disagree) to 5 (agree). The questionnaire was initially reviewed and pro-surveyed by six experts, and several minor revisions were made to the written expression of the questionnaire items in accordance with their feedback. Afterward, a pilot survey was conducted to examine the reliability and validity of the questionnaire design. Fifty potential users of ride-sharing services were randomly selected in Huaihe Road Pedestrian Street, the most prosperous commercial street in Hefei during Sundays, to fill in the questionnaire. The selection of the time and place of the pre-survey was carefully considered to ensure the rationality of pre-survey samples. The results indicated satisfactory reliability and validity.

3.2. Participants and sample

Questionnaires were distributed on the Internet through a professional platform (Wenjuanxing, https://www.wjx.cn/), which is one of the largest platforms for collecting questionnaire data in China that focuses on providing professional data services for users. The respondents were from three major regions in China, namely, eastern China (Zhejiang province), central China (Anhui province) and western China (Shaanxi province). The economic levels of the eastern, central and western regions differ. The most developed is eastern China, followed by the central region, and the western region is relatively backward in economic level. Because of China’s large population, we chose regions in the east, middle, and west to reflect the willingness of Chinese population to adopt ride-sharing services. With the help of the professional questionnaire collection team, the respondents were invited to fill in the questionnaire from Wenjuanxing’s vast membership base. An email with a brief introduction of the purpose2 of the study and the electronic

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2 The purpose of this study is to investigate potential consumers’ intention toward adopting ride-sharing services under the COVID-19 context.
questionnaire were sent to the respondents. We sincerely invited potential interviewees to participate in our questionnaire and expressed our gratitude to them. There was no right or wrong answer to the questionnaire. Respondents were told to fill in the questionnaire according to their actual feelings.

The first question asked participants if they have experienced ride-sharing. Questionnaires with positive responses were excluded to select potential ride-sharing consumers. The survey purpose “for academic research purpose only” was visibly displayed at the front page of the questionnaire, and the “ride-sharing services” concept was clearly explained to the respondents. Participants were expected to read the options carefully and fill in the questionnaire truthfully. This questionnaire strictly protected the personal information of the respondents from public disclosure. After nearly four months of data collection, a total of 1,516 questionnaires were collected from 3000 invitations. We reviewed these questionnaires and eliminated those with missing answers and highly repetitive answers. Those who filled in the questionnaire in <3 min were also excluded. Finally, 552 questionnaires were filtered out as ineligible, and 964 questionnaires met the selection criteria. Each person who fills in the valid questionnaire was rewarded with 10 RMB.

4. Data analysis and results

Table 1 shows the demographic background information. Of the participants in the data survey, 493 (51.1%) are female and 471 (48.9%) are male. Most of the respondents are aged between 20 and 49 years old, with only 9.5% of the respondents under 20 years old and 14.6% over 50 years old. With regard to the education level, 69.9% of the respondents earned junior college or university degree, and 9.9% earned a master or Ph.D. degree, indicating that most respondents are well educated. In terms of the monthly income, 37.3% of respondents’ wages range from ¥5,000 to ¥10,000. With respect to geographical distribution, 331 (34.3%) respondents came from Eastern China.

Several actions were introduced to reduce the potential threats of social desirability and common method variance3 (CMV) on empirical results. First, in the prominent position of the questionnaire, consumers were informed that the questionnaire had no right or wrong answer and that the information was confidential. Respondents could answer the questionnaire completely according to how they actually feel. Second, we scrambled the order of variables and measurement items to avoid possible cues and causal relationships. Third, Harman’s single factor test was conducted to examine the potential threat of common method variance. The empirical results indicated that the measurement items are divided into six factors with eigenvalues higher than 1.0, which accounts for 69.36% of the variance. Furthermore, the variance of the first factor (27.45%) meets the standard of <30% (Gao et al. 2017), which implies that CMV is not an issue.

SPSS 22.0 and Smart-PLS 3.0 were used for data analysis. Confirmatory factor analysis (CFA) aimed to assess whether the collected data match the model. Then, reliability and validity tests were performed on variables with multiple measurement items. Finally, the regression method of partial least squares (PLS) was utilized to examine the hypotheses and further check the mediating effect of perceived ease of use and perceived usefulness and the moderating effect of perceived health threat. For complex hierarchical model structure, PLS-SEM is an appropriate method.

4.1. Reliability and validity analyses

CFA was carried out to evaluate the fitting degree of the model. Table 2 shows the goodness of fit index. The results showed that all

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3 Common method variance refers to the overlap in variance between two variables (Podsakoff et al. 2003).

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Fig. 2. Research model of this study.
the evaluation indexes of the model suitability meet the requirements. According to the empirical results, the model is in good agreement with the survey data.

Composite reliability and Cronbach’s alpha values are the main evaluation dimensions of variable reliability. Fornell and Larcker (1981) indicated that if the values of composite reliability and Cronbach’s alpha are higher than 0.7, then the reliability of the variable is sufficient. Validity was examined through convergent and discriminant validities. Chiu and Wang (2008) pointed out that convergent validity analysis concludes the factor loading and average variance extracted (AVE). The convergent is relatively good when the values of factor loading are >0.7 and the values of AVE meet the criterion of 0.5. Table 3 shows that the range of factor loading is between 0.871 and 0.913, and the minimum value of AVE is 0.770, thus verifying the convergent validity of the constructs. Regarding discriminant validity, the correlation among constructs should be lower than the square roots of the AVE values. Based on the empirical results, the discriminant validity is qualified (see Table 4).

4.2. Hypothesis testing analysis

The existing hypotheses were verified through SEM. Table 5 shows that perceived ease of use exerts a significant and positive effect on consumers’ perceived usefulness (β = 0.310, p < 0.001) toward ride-sharing services. Perceived ease of use (β = 0.259, p < 0.001) and perceived usefulness (β = 0.244, p < 0.001) significantly and positively affect consumers’ intention. Hence, H1, H2, and H3 are supported. Ambiguity tolerance also exerts a significant and positive effect on consumers’ perceived ease of use (β = 0.393, p < 0.001), perceived usefulness (β = 0.239, p < 0.001), and consumers’ intention (β = 0.189, p < 0.001) toward adopting ride-sharing services. Therefore, H4, H5, and H6 are supported. The results verified that environmental concern has a positive and significant influence on consumers’ perceived ease of use (β = 0.548, p < 0.001), perceived usefulness (β = 0.410, p < 0.001), and consumers’ intention (β = 0.272, p < 0.001) toward adopting ride sharing services, thereby supporting H7, H8, and H9. The empirical results indicated that consumers’ perceived health threat significantly and negatively affects their intention toward adopting ride-sharing services (β = −0.269, p < 0.001), which confirmed H10. Fig. 3 shows the results of the hypothesis.

Mediating effect analysis indicated by Hayes and Preacher (2010) was conducted to assess the mediating role of perceived ease of use and perceived usefulness. Table 6 shows that ambiguity tolerance significantly and positively affects consumers’ intention toward adopting ride-sharing services through perceived ease of use (β = 0.458, p < 0.001, CI: 0.409–0.508) and perceived usefulness (β = 0.450, p < 0.001, CI: 0.399–0.502). In addition, environmental concern significantly and positively influences consumers’ intention toward adopting ride-sharing services through perceived ease of use (β = 0.395, p < 0.001, CI: 0.344–0.448) and perceived usefulness (β = 0.388, p < 0.001, CI: 0.330–0.441). Most of the respondents in this paper are young people, aged between 20 and 49, and have a good educational background, they may have a higher tolerance for uncertainty and be more environmentally conscious. Younger and more educated consumers are more likely to learn how to adopt ride-sharing services. In addition, potential consumers with higher ambiguity tolerance and environmental concern are more likely to perceive the benefits of adopting ride-sharing services than the potential risks. Thus, ambiguity tolerance and environmental concern affects consumers’ intention by influencing perceived ease of use and perceived usefulness. Perceived ease of use and perceived usefulness mediate the relationships between ambiguity tolerance and environmental concern and consumers’ intention toward adopting ride-sharing services. Tables 5 and 6 show the empirical results, which indicate that ambiguity tolerance and environmental concern not only directly influence consumers’ intention toward adopting

### Table 1

| Demographic Indicator | Frequency | Percentage (%) |
|-----------------------|-----------|----------------|
| Gender                |           |                |
| 1. Female             | 493       | 51.1%          |
| 2. Male               | 471       | 48.9%          |
| Age                   |           |                |
| 1. Below 20           | 92        | 9.5%           |
| 2. 20–29              | 207       | 21.5%          |
| 3. 30–39              | 223       | 23.1%          |
| 4. 40–49              | 360       | 31.2%          |
| 5. 50 and over        | 141       | 14.6%          |
| Education Level       |           |                |
| 1. Senior high school or below | 195       | 20.2%          |
| 2. Junior college or university | 674     | 69.9%          |
| 3. Master degree or PhD | 95      | 9.9%           |
| Personal monthly Income |         |                |
| 1. Less than $2,000 ($283) | 168   | 17.4%          |
| 2. $2,000 – $5,000 ($283 – $707) | 287    | 29.8%          |
| 3. $5,001 – $10,000 ($707 – $1,414) | 360      | 37.3%          |
| 4. More than $10,000 ($1,414) | 149  | 15.5%          |
| Geographical distribution |         |                |
| 1. Eastern China      | 331       | 34.3%          |
| 2. Central China      | 326       | 33.8%          |
| 3. Western China      | 307       | 31.9%          |
| Total                 | 964       | 100%           |
Table 2
Results of CFA goodness-of-fit analysis.

| Index Criteria | Actual value | Judgement |
|----------------|--------------|-----------|
| $\chi^2$/df    | <3.00        | 2.52      | Yes       |
| GFI            | >0.90        | 0.93      | Yes       |
| NFI            | >0.90        | 0.92      | Yes       |
| IFI            | >0.90        | 0.91      | Yes       |
| TLI            | >0.90        | 0.91      | Yes       |
| CFI            | >0.90        | 0.92      | Yes       |
| RMSEA          | <0.08        | 0.03      | Yes       |

Table 3
Reliability and convergent validity analysis.

| Construct Item | Standard Loading | Cronbach’s Alpha value | Composite Reliability | AVE   |
|----------------|------------------|------------------------|-----------------------|-------|
| Ambiguity tolerance (AT) | AT1 0.895 | 0.877 | 0.924 | 0.803 |
| Environmental concern (EC) | AT2 0.905 | AT3 0.888 | AT4 0.881 | 0.909 | 0.936 | 0.786 |
| Perceived ease of use (PEU) | PEU1 0.898 | PEU2 0.907 | PEU3 0.913 | 0.891 | 0.932 | 0.821 |
| Perceived usefulness (PU) | PU1 0.903 | PU2 0.894 | PU3 0.901 | 0.882 | 0.927 | 0.809 |
| Perceived health threat (PHT) | PHT1 0.871 | PHT2 0.883 | PHT3 0.876 | PHT4 0.876 | PHT5 0.886 | PHT6 0.872 | 0.940 | 0.953 | 0.770 |
| Intention to adopt ride-sharing services (INT) | INT1 0.899 | INT2 0.897 | INT3 0.902 | 0.882 | 0.927 | 0.808 |

Table 4
Discriminant validity analysis.

| Construct | AT | EC | PEU | PU | PHT | INT |
|-----------|----|----|-----|----|-----|-----|
| AT        | 0.90 |    |     |    |     |     |
| EC        | 0.56 | 0.89 |     |    |     |     |
| PEU       | 0.49 | 0.51 | 0.91 |    |     |     |
| PU        | 0.52 | 0.48 | 0.43 | 0.90 |     |     |
| PHT       | −0.51 | −0.46 | −0.54 | −0.49 | 0.88 |     |
| INT       | 0.55 | 0.53 | 0.36 | 0.51 | −0.42 | 0.90 |

Table 5
Results of hypothesis testing.

| Hypothesis            | Coefficient | T-value | Result |
|-----------------------|-------------|---------|--------|
| H1: PEU → PU          | 0.310***    | 10.588  | Supported |
| H2: PEU → INT         | 0.259***    | 8.062   | Supported |
| H3: PU → INT          | 0.244***    | 7.249   | Supported |
| H4: AT → PEU          | 0.393***    | 13.739  | Supported |
| H5: AT → PU           | 0.239***    | 8.515   | Supported |
| H6: AT → INT          | 0.189***    | 6.082   | Supported |
| H7: EC → PEU          | 0.548***    | 19.548  | Supported |
| H8: EC → PU           | 0.410***    | 12.815  | Supported |
| H9: EC → INT          | 0.272***    | 7.678   | Supported |
| H10: PHT → INT        | −0.269***   | 6.326   | Supported |

Note: *p < 0.05; **p < 0.01; ***p < 0.001.
ride-sharing services but also significantly and indirectly influence consumers’ intention through perceived ease of use and perceived usefulness.

The moderating role of perceived health threat was examined by hierarchical regression analysis performed using SPSS 22.0. Model 1 examined the effects of control variables and independent variables (ambiguity tolerance, environmental concern) on intention to adopt ride-sharing services. Model 2 examined the effects of control variables, independent variables (ambiguity tolerance, environmental concern) and perceived health threat on intention to adopt ride-sharing services. Model 3 examined the effects of control variables, independent variables (ambiguity tolerance, environmental concern), perceived health threat and interaction terms on intention to adopt ride-sharing services. And perceived health threat both as a direct influence and as a moderator of the influence of ambiguity tolerance and environmental concern (through interactions with the latter variables). From models 1, 2 and 3, we can conclude that the influences of control variables on intention towards adopting ride-sharing services is not significant. Ambiguity tolerance and environmental concern positively and significantly influence consumers’ intention to adopt ride-sharing services. Perceived health threat negatively influences consumers’ intention to adopt ride-sharing services. Model 3 shows the empirical results of the moderating effect analysis. Data indicated that the interaction effect of ambiguity tolerance and perceived health threat on consumers’ intention toward adopting ride-sharing services is significant and negative (β = −0.086, p < 0.01). Perceived health threat

### Table 6
Mediation effect analysis.

| Path | Indirect effect | LBCI  | UBCI  | Significance |
|------|----------------|-------|-------|--------------|
| AT → PEU → INT | 0.458 | 0.409 | 0.508 | P < 0.001 |
| AT → PU → INT | 0.450 | 0.399 | 0.502 | P < 0.001 |
| EC → PEU → INT | 0.395 | 0.344 | 0.448 | P < 0.001 |
| EC → PU → INT | 0.388 | 0.330 | 0.441 | P < 0.001 |

Note: LBCI and UBCI = Lower bound and Upper bound of 95% confidence interval.

### Table 7
Moderating effect analysis.

| Ride-sharing intention | Model1 | Model2 | Model3 |
|------------------------|--------|--------|--------|
| Gender                 | 0.050  | 0.043  | 0.029  |
| Age                    | −0.028 | −0.024 | −0.019 |
| Education              | −0.017 | −0.027 | −0.018 |
| Income                 | −0.018 | −0.013 | −0.006 |
| Geographical distribution | −0.017 | −0.020 | −0.035 |
| AT                     | 0.380*** | 0.219*** | 0.146*** |
| EC                     | 0.555*** | 0.295*** | 0.202*** |
| PHT                    | 0.193*** | −0.435*** | −0.269*** |
| PHT*AT                 | −0.086** | −0.193*** | −0.193*** |
| Adjust R2              | 0.596  | 0.619  | 0.542  |
| F-value                | 11.892*** | 15.483*** | 13.699*** |

Note: *p < 0.05; **p < 0.01; ***p < 0.001.
sharing services is significant and negative (ride-sharing services than the potential risks, and their possibility of adopting ride-sharing services is higher. The findings are transportation. If they are receptive and tolerant to new technology and possible risks, then they may feel adopting ride-sharing services. Consumers need to learn how to subscribe to ride-sharing services and embrace this new way of sharing services. If potential consumers proactive in adopting ride-sharing services. The finding is consistent with that of previous studies, which prove that environmental concern directly and positively affects potential consumers’ intention toward adopting ride-sharing services. Ride-sharing may be beneficial to environmental goals, so potential consumers with high environmental concerns will be more proactive in adopting ride-sharing services. Environmental concern also indirectly affects potential consumers’ intention toward adopting ride-sharing services through perceived ease of use and perceived usefulness. The reason may be that if consumers have a high concern for the environment, then they are subjectively willing to learn how to adopt ride-sharing services. Consumers with high environmental concerns are well aware of the potential of protecting the environment by adopting ride-sharing services. Furthermore, environmental concern positively affects consumers’ intention toward adopting ride-sharing services. The results are in line with previous studies (Minton and Rose 1997, Hartmann and Apaolaza-Ibanez 2012, Dienes 2015, Verma et al. 2019).

Furthermore, ambiguity tolerance has an indirect effect on potential consumers’ intention toward adopting ride-sharing services via perceived ease of use and perceived usefulness. If potential consumers’ ambiguity tolerance is high, then they are likely to perceive the usefulness of ride-sharing services. The reason may be that consumers with high ambiguity tolerance are tolerant of the uncertainty risks brought by ride-sharing services. Consumers need to learn how to subscribe to ride-sharing services and embrace this new way of transportation. If they are receptive and tolerant to new technology and possible risks, then they may feel adopting ride-sharing services easily. Moreover, if consumers’ ambiguity tolerance is high, then they are more likely to perceive the benefits of adopting ride-sharing services than the potential risks, and their possibility of adopting ride-sharing services is higher. The findings are consistent with previous studies (Jena and Sarmah 2015, Matsumoto et al. 2017, Wang et al. 2018b). Environmental concern also indirectly affects potential consumers’ intention toward adopting ride-sharing services through perceived ease of use and perceived usefulness. The reason may be that if consumers have a high concern for the environment, then they are subjectively willing to learn how to adopt ride-sharing services. Consumers with high environmental concerns are well aware of the potential of protecting the environment by adopting ride-sharing services. Furthermore, environmental concern positively affects consumers’ intention toward adopting ride-sharing services. The results are in line with previous studies (Hansla et al. 2008, Hartmann and Apaolaza-Ibanez 2012, Verma et al. 2019).

The empirical results indicate how ambiguity tolerance and environmental concern affect potential consumers’ intention toward adopting ride-sharing services and reveal the potential mechanism. Under the COVID-19 context, this study investigates how perceived health threat affects ambiguity tolerance and how environmental concern affects consumers’ intention. To be specific, perceived health threat negatively moderates the influence of ambiguity tolerance on potential consumers’ intentions toward adopting ride-sharing services. At the same level of ambiguity tolerance, consumers with high perceived health threats are less likely to adopt ride-sharing services. Perceived health threat also moderates the effect of environmental concern on consumers’ acceptance toward ride-sharing services, which means at the same level of environmental concern, consumers with higher perceived health threats are less likely to adopt ride-sharing services. The moderating role of perceived health threat may be that the COVID-19 is infectious and poses a threat to human health. Although positive consumer personalities, such as ambiguity tolerance and environmental concern, promote consumers’ intention of adopting ride-sharing services, perceived health threat weakens consumers’ willingness to adopt ride-sharing services.

This study also provides several implications for promoting the further development of the ride-sharing services market. First, due to the fact that ambiguity tolerance plays an important role in consumers’ intention toward adopting ride-sharing services, consumers with low ambiguity tolerance may not adopt ride-sharing services. In order to improve consumers’ intention with low ambiguity tolerance to adopt ride-sharing services, the providers of ride-sharing services must provide a safe and convenient communication platform for ride-sharing services users to reduce their vague understanding of ride-sharing information and improve consumers’ intention to adopt ride-sharing services. These methods are the key to the success of this industry. Reliable service is conducive to the formation of a good ride-sharing reputation. Ride-sharing platforms should strengthen the constraints and management of the platform and strengthen the assessment and training of ride-sharing drivers, to provide reliable and satisfactory services for consumers. Moreover, the government can introduce policies and provide preferential treatment to encourage the development of ride-sharing. In addition, market supervision departments should strengthen the supervision and management of ride-sharing industry, which plays a guiding role in forming a good ride-sharing atmosphere.

Second, considering the evident influence of environmental concern on consumers’ intention toward ride-sharing services, the government should strengthen education on green consumption and guide consumers to improve their awareness of environmental protection. New media is also an important channel for people to acquire environmental information. The media should maximize television, radio, newspapers, and the Internet to make environmental documentaries, public service advertisements, environmental

Figs. 4 and 5 depict the slope analysis of the moderating effect of perceived health threat. Fig. 4 shows that consumers’ high perceived health threat weakens the influence of ambiguity tolerance on consumers’ intention to adopt ride-sharing services. At the same level of ambiguity tolerance, consumers are less likely to adopt ride-sharing services when their perceived health threat is high. Fig. 5 illustrates that consumers’ high perceived health threat weakens the influence of environmental concern on consumers’ intention to adopt ride-sharing services. At the same level of environmental concern, consumers are less likely to adopt ride-sharing services if their perceived health threat is high.

5. Discussion and policy implications

This study investigates potential consumers’ intention toward adopting ride-sharing services under the COVID-19 context through the expanded TAM. The empirical results verify that ambiguity tolerance significantly and positively affects consumers’ intention toward adopting ride-sharing services. Findings are consistent with those of previous studies, which verify the positive effect of ambiguity tolerance on consumers’ behavioral intention (Jena and Sarmah 2015, Matsumoto et al. 2017, Wang et al. 2018b). In addition, environmental concern directly and positively affects potential consumers’ intention toward adopting ride-sharing services. Environmental concern also positively affects potential consumers’ intention toward adopting ride-sharing services through perceived ease of use and perceived usefulness. The reason may be that if consumers have a high concern for the environment, then they are subjectively willing to learn how to adopt ride-sharing services. Consumers with high environmental concerns are well aware of the potential of protecting the environment by adopting ride-sharing services. Furthermore, environmental concern positively affects consumers’ intention toward adopting ride-sharing services. The results are in line with previous studies (Jena and Sarmah 2015, Matsumoto et al. 2017, Wang et al. 2018b). Environmental concern also indirectly affects potential consumers’ intention toward adopting ride-sharing services through perceived ease of use and perceived usefulness. The reason may be that if consumers have a high concern for the environment, then they are subjectively willing to learn how to adopt ride-sharing services. Consumers with high environmental concerns are well aware of the potential of protecting the environment by adopting ride-sharing services. Furthermore, environmental concern positively affects consumers’ intention toward adopting ride-sharing services. The results are in line with previous studies (Hansla et al. 2008, Hartmann and Apaolaza-Ibanez 2012, Verma et al. 2019).

The empirical results indicate how ambiguity tolerance and environmental concern affect potential consumers’ intention toward adopting ride-sharing services and reveal the potential mechanism. Under the COVID-19 context, this study investigates how perceived health threat affects ambiguity tolerance and how environmental concern affects consumers’ intention. To be specific, perceived health threat negatively moderates the influence of ambiguity tolerance on potential consumers’ intentions toward adopting ride-sharing services. At the same level of ambiguity tolerance, consumers with high perceived health threats are less likely to adopt ride-sharing services. Perceived health threat also moderates the effect of environmental concern on consumers’ acceptance toward ride-sharing services, which means at the same level of environmental concern, consumers with higher perceived health threats are less likely to adopt ride-sharing services. The moderating role of perceived health threat may be that the COVID-19 is infectious and poses a threat to human health. Although positive consumer personalities, such as ambiguity tolerance and environmental concern, promote consumers’ intention of adopting ride-sharing services, perceived health threat weakens consumers’ willingness to adopt ride-sharing services.

This study also provides several implications for promoting the further development of the ride-sharing services market. First, due to the fact that ambiguity tolerance plays an important role in consumers’ intention toward adopting ride-sharing services, consumers with low ambiguity tolerance may not adopt ride-sharing services. In order to improve consumers’ intention with low ambiguity tolerance to adopt ride-sharing services, the providers of ride-sharing services must provide a safe and convenient communication platform for ride-sharing services users to reduce their vague understanding of ride-sharing information and improve consumers’ intention to adopt ride-sharing services. These methods are the key to the success of this industry. Reliable service is conducive to the formation of a good ride-sharing reputation. Ride-sharing platforms should strengthen the constraints and management of the platform and strengthen the assessment and training of ride-sharing drivers, to provide reliable and satisfactory services for consumers. Moreover, the government can introduce policies and provide preferential treatment to encourage the development of ride-sharing. In addition, market supervision departments should strengthen the supervision and management of ride-sharing industry, which plays a guiding role in forming a good ride-sharing atmosphere.

Second, considering the evident influence of environmental concern on consumers’ intention toward ride-sharing services, the government should strengthen education on green consumption and guide consumers to improve their awareness of environmental protection. New media is also an important channel for people to acquire environmental information. The media should maximize television, radio, newspapers, and the Internet to make environmental documentaries, public service advertisements, environmental
Third, perceived ease of use and perceived usefulness significantly and positively affect consumers’ intention toward adopting ride-sharing services. The importance of perceived ease of use and perceived usefulness should be highly regarded. Drivers must enhance coordination among carpool passengers in the same batch to make the journey as pleasant as possible. Furthermore, government and ride-sharing platforms should strengthen the publicity of protecting the environment and alleviating traffic pressure.

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4 “Health code” is specific to COVID-19 in China, and only in terms of whether the possessor is likely to be infected with the disease. Based on the real travel data of the health code possessor, a personal QR code can generate in possessor’s WeChat or Alipay. The method is used for determining a person’s health status within the categories of ‘mandatory quarantine’ (red code), ‘self-isolation’ (yellow code) or ‘free movement’ (green code) (Yang et al., 2020).
6. Conclusions and limitations

Considering the potentially positive influence of ride-sharing services on easing traffic congestion and environmental pollution, this study investigated the antecedents of potential consumers’ acceptance toward adopting ride-sharing services. Moreover, the effect of the COVID-19 on consumers’ intention toward adopting ride-sharing services was identified. According to the extended TAM, this research explored the effect of personality traits, such as ambiguity tolerance and environmental concern, as motivations for the acceptance of consumers’ intention toward adopting ride-sharing services. The empirical results indicated that ambiguity tolerance exerts a direct and positive effect on consumers’ intention toward adopting ride-sharing services. Such an effect is moderated by perceived health threat, which weakens the effect of ambiguity tolerance. Consumers who perceive high health threats are less likely to accept ride-sharing services. Moreover, environmental concern indirectly influences consumers’ intention toward adopting ride-sharing services through perceived ease of use and perceived usefulness. Consumers with high ambiguity tolerance are likely to perceive that adopting ride-sharing services is not difficult and the usefulness of adopting ride-sharing services. They also have a high possibility to adopt such services.

Furthermore, this research verified that environmental concern directly and positively affects consumers’ intention toward adopting ride-sharing services, and the effect is also influenced by perceived health threats. When consumers feel that the health threat faced is high, they are less likely to adopt ride-sharing services. Moreover, environmental concern indirectly influences consumers’ intention toward adopting ride-sharing services through perceived ease of use and perceived usefulness. If consumers’ attitude toward protecting the environment is strong, then they are likely to form perceived ease of use and perceived usefulness toward adopting ride-sharing services and adopt ride-sharing services.

Although this study provided several contributions, four limitations need to be addressed. First, this study focused on consumers’ intention toward adopting ride-sharing services instead of the actual behaviors of ride-sharing. Although consumers’ intention is an important predictor of behavior, a gap may exist in intention and behavior, and research on consumers’ behavior toward adopting ride-sharing services should be further strengthened. Second, this study only considered the variables of ambiguity tolerance, environmental concern, and perceived health threat into TAM. Other factors, such as perceived value and convenience, may also exert influence on consumers’ intention toward adopting ride-sharing services. Third, the analysis data in this study were collected in China. If the survey is conducted in different countries, then the data will be of more academic value to compare consumers’ intention toward adopting ride-sharing services under different cultural backgrounds. Fourth, there are sampling biases in this study. The respondents mainly focused on well-educated young people and were rewarded to fill in the questionnaire. In addition, the respondents in this study were recruited through commercial vendor’s database, they may be more tech-savvy and internet-literate and more interested in the topic of ride-sharing than the population at large. Thus, the representativeness of the respondents needs to be further improved.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A

| Constructs and measurement items | Sources |
|----------------------------------|---------|
| **Ambiguity tolerance** | Marks (2013) and Wang et al. (2018b)Gadenne et al. (2011) and Wang et al. (2014) |
| AT1: I am tolerant of ambiguous situations. | |
| AT2: I enjoy tackling problems that are complex enough to be ambiguous. | |
| AT3: I prefer a situation with some ambiguity. | |
| **Environmental concern** | Lee and Lehto (2013) and Sheng and Zolfagharian (2014) |
| EC1: I think environmental problems are becoming increasingly serious in recent years. | |
| EC2: I think human beings should live in harmony with nature to achieve sustainable development. | |
| EC3: In my opinion, air pollution and shortage of water are the biggest environmental problems. | |
| **Perceived ease of use** | Schuitema et al. (2013) and Wang et al. (2018a) |
| PEU1: I know how to use the software to reserve ride-sharing services. | |
| PEU2: Signing a car-sharing agreement is difficult. | |
| PEU3: I consider the process of ride-sharing easy. | |
| **Perceived usefulness** | |
| PU1: I believe that adopting ride-sharing services is useful for reducing carbon emissions and alleviating energy shortage. | |

(continued on next page)
| Constructs and measurement items | Sources |
|----------------------------------|---------|
| PU2: I believe that adopting ride-sharing services help to ease traffic congestion and reduce travel costs. | Witt and Kim (1996) and Hadjistavropoulos et al. (2012) |
| PU3: I consider that adopting ride-sharing services will make the living environment better. | Davis et al. (1989) and Gao et al. (2017) |
| Perceived health threat | |
| PHT1: Being infected with the COVID-19 is not good. | |
| PHT2: Being infected with the COVID-19 can be very painful for me or my family. | |
| PHT3: If I or my family is infected with the COVID-19, it is extremely terrible. | |
| PHT4: I or my family may be infected with the COVID-19. | |
| PHT5: I or my family is at risk of contracting the COVID-19. | |
| PHT6: I or my family may be infected with the COVID-19 in the future. | |
| Intention to adopt ride-sharing services | |
| INT1: I am willing to adopt ride-sharing services in the near future. | |
| INT2: I plan to adopt ride-sharing services in the near future. | |
| INT3: I will make an effort to adopt ride-sharing services in the near future. | |

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