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# Factors influencing the acceptance and use of a bicycle sharing system: Applying an extended Unified Theory of Acceptance and Use of Technology (UTAUT)



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## ABSTRACT

This study explores which factors influence bicycle sharing systems acceptance as a new transportation technology by identifying and describing their relationships to intention and usage behaviour. Using the latest version of technology acceptance models (UTAUT2), this study examines the effect of *Performance Expectancy*, *Effort Expectancy*, *Facilitating Conditions*, *Social Influence*, *Price Value* and *Perceived Safety* on acceptance and usage of a newly introduced bicycle sharing system in Mashhad (MBSS), Iran. The mediating effect of intention to use MBSS on the relationship between these constructs and use behaviour was examined. A total of 600 questionnaires were distributed at 128 MBSS stations of which 271 users responded. The result of a regression analysis indicated that intention to use MBSS was predicted by all the studied constructs except for *Price Value*, while a path analysis showed that through the *Behavioural Intention*, *Facilitating Conditions* was the only significant construct to influence *Use Behaviour*. Findings did not support age, income, education, and experience as moderating the relationships between the constructs and *Behavioural Intention*. This study recommends tracking the barriers of acceptance of bicycle sharing system by those population groups who do not use the system or use it less than the others. Moreover, findings of this study suggest improvements to *Facilitating Conditions* such as integration of public transport and MBSS, relocation of the stations to improve their (equity of) accessibility and, introducing motivational promotion campaigns, improving cycling social status, and improved customer service of staff may make MBSS more interesting for citizens.

## 1. Introduction

Iran is among the highest in the world in CO<sub>2</sub> emissions (Mousavi et al., 2017). National CO<sub>2</sub> emissions have been steadily increasing resulting in a raised economic cost of emission (CO<sub>2</sub> and air pollutants) in Iran from almost seven billion USD in 2004, to around ten billion USD in 2010 (Gharagouzlou et al., 2012). With regards to the sectoral distribution of CO<sub>2</sub> emissions, the residential sector comes first, followed by transport and industry. Recently, the transport sector has played an important role in increasing CO<sub>2</sub> emissions in Iran. There has been a considerable rising trend of reliance on cars coupled with a very high rate of private car use which has resulted in congestion in the Iranian cities such as Tehran, Mashhad, Isfahan, and Tabriz (Soltani et al., 2018).

Mashhad city with a relatively dry climate located in the northeast

of Iran is the nation's second most populated city with over three million residents (Department of Studies and Planning, 2017). It has an area of about 351 km<sup>2</sup> and is 1050 m above sea level with an average slope of 0.6% (Akhlaghi et al., 2018; Pouresmaeili et al., 2018). The number of vehicle trips per day within the city has increased in recent decade from 4,035,560 to 6,576,268 with an increased rate of trips per person from 1.62 to two trips per 24 h (Department of Studies and Planning, 2007; Department of Studies and Planning, 2017). Reports on the air quality of the city of Mashhad have displayed 36 days of unhealthy air quality in autumn and winter of 2017. It has also indicated a rise in the concentration of air pollutants in two peak traffic hours of the day, meaning, early morning (7:00 a.m.) and afternoon (4:00p.m.). Therefore, vehicle activity plays an important role in air quality in Mashhad. Reducing traffic congestion will greatly contribute to the reduction of air pollution in the city (Pouresmaeili et al., 2018), at least

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on a per kilometre basis.

In recent years increasing bicycle use is considered as a solution for traffic issues. Commuting by bicycle can help to make the transport system more sustainable because demands little energy and other resources, and has a range of health, accessibility, environmental and socioeconomic advantages (Midgley, 2011; Bernatchez et al., 2015; Karki and Tao, 2016; Morton, 2018). Providing rental bicycles and bicycle sharing systems (BSSs) is one of the policies of governments for removing the obstacles of cycling in cities and encourage people to ride bicycles.

In 2012, the first BSS employing information technology for public use was launched in the city of Mashhad. This innovative program to tackle the growing traffic congestion and environmental concerns due to air pollutions was the first technological cycling program in Iran. Mashhad bicycle sharing system (MBSS) aims to promote the short distance use of bicycles, thus reducing private car use in the city. The MBSS allows members to access a shared fleet of bicycles. As of 2018, the system has provided over 2,300 bicycles in 128 operative stations placed across the city, offering ten hours of service per day for males above 15 years old. There is no registration fee for membership in the system, but 2,500,000 IRR<sup>1</sup> is received at the beginning of the registration process as a deposit in order to guarantee the bicycle return. Using the bicycles is free for the first 30 min, and costs 2000 IRR per hour for longer trips. MBSS membership is integrated with the Mashhad transit smart card that is useable for other public transportation modes including bus and Light Rail Transit (LRT).

As recently discussed by Jahanshahi et al. (2018) and Jahanshahi et al. (2019b), this new bicycle sharing technology has not been widely accepted nor used by residents of Mashhad despite its many advantages including positive impact on individual health, and the reduction of energy use and air pollution. Since its introduction to the city's transportation system, some unofficial reports indicate nearly 19,000 individuals registered in the system. This registration rate may not be indicative of the actual registered user base as this study suggests only approximately 500–700 (based on estimation described in Section 2.1) are regular users and there is a very low estimated trips per bicycle per day which is explained in the following.

The main challenge facing MBSS is the low rate of usage compared to other similar systems around the world. Almost one million males above 15 years of age in the city are allowed to use this system according to MBSS regulations, however just 500–700 are current users. Considering 2300 active bicycles in the system, there are 0.21–0.3 trips per bicycle per day which is very low in comparison with three to six trips per bicycle per day reported by the most other international bicycle sharing schemes (Fishman et al., 2015; Médard de Chardon et al., 2017). The low usage rates of the MBSS could stem from several factors. While socio-cultural, environmental, geographical, governmental policy, economic, system function and infrastructure each play a role (Fishman et al., 2014; Karki & Tao, 2016; Mateo-Babiano et al., 2016; Jahanshahi et al., 2018; Mattson and Godavarthy, 2017; Jahanshahi et al., 2019a; Jahanshahi et al., 2019b), intention to use is an especially significant factor that has been proposed to influence BSS use (Chen, 2016). To establish users' acceptance and uptake of the system, identifying how and why a user is motivated to use a technology that reshapes his /her mobility patterns is a challenge (Najm et al., 2006).

The intention and use of a BSS can be considered through the perspective of a new transportation technology (Chen, 2016). It is technology because it is not a simple extension to conventional bicycles, but a new mode of transport with distinct features such as range, operation, and practicality (Arkesteijn and Oerlemans, 2005; Rogers, 2003; Wolf and Seebauer, 2014). Considering MBSS as a technology, then raises the challenge of technology acceptance. In this regard, it is crucial to

review the literature of knowledge related to technology acceptance models and its intersection with the field of transportation, to further explore how BSSs' acceptance and usage can be investigated.

### 1.1. The literature of technology acceptance models and its application in transportation

The public's acceptance or rejection of ideas, systems and programme has important implications on the success of attempts to persuade behaviour modification. Different researchers have spent a long time studying theories and models that could anticipate and describe these behaviours (Venkatesh et al., 2003). Two of these theories, the motivational theory of Reasoned Action (TRA) and its farther developed theory of Planned Behaviour (TPB; Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980) have been used in studies regarding acceptance of different technologies (Liker and Sindi, 1997; Karahanna et al., 1999). According to TRA motivation is regarded as the most proximal determinant of actual behaviour. Further, motivation is explained by the attitude towards the behaviour and subjective norm. A third theory, Technology Acceptance Model (TAM) is a modified version of TRA and has become one of the most popular models for explaining the reasons for technology acceptance (Davis, 1989; Chen and Chao, 2011) including transport technologies (Meschtscheriakov et al., 2009; Chen and Chao, 2011; Hötl and Trommer, 2012; Roberts et al., 2012; Cheng and Huang, 2013; Park and Kim, 2014; Larue et al., 2015; Chen, 2016; Madigan et al., 2017). The model presents a motivational framework for the impact of *ease of use*, and *usefulness* on behavioural intention (Davis et al., 1989).

Building on these theories, Venkatesh et al. (2003); and Venkatesh et al. (2008) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT) comprising factors of *Performance Expectancy*, *Effort Expectancy*, *Social Influence* and *Facilitating Conditions* to explain both *Behavioural Intention* and *Use Behaviour*. This model is the most recent and comprehensive adaptation of these behavioural acceptance models, reflecting its' design as an integration of eight significant models in the field of technology acceptance (including TRA, TAM, and TPB as well as the Theory of diffusion of innovations, Social cognitive theory, Motivational model, Model of personal computer use, and Combined theory of planned behaviour/technology acceptance model).

While similar to the TAM model, UTAUT uses *Performance Expectancy* which relates to the usefulness of a system, and *Effort Expectancy* which relates to ease of using a system. With the addition of *Social Influence* and *Facilitating Conditions*, the UTAUT model considers both organizational and social variables in acceptance of technology which were not considered in previous models (Malhotra and Galletta, 1999; Legris et al., 2003). *Social Influence* relates to the influence of other people's opinions on an individual's acceptance or rejection of a technology (Venkatesh et al., 2003). *Facilitating Conditions* represents a level of infrastructure and environmental conditions that facilitate using a system (Venkatesh et al., 2003). *Facilitating Conditions* are perceived enablers or barriers in the environment that influence a person's perception of ease or difficulty of performing a task (Teo, 2010). In addition to these constructs, Venkatesh et al. (2012) reflected on consumer-oriented characteristics of technology acceptance and expanded the model to include *Price Value* (UTAUT2). *Price Value* is the degree to which users perceive the cost (be it monetary or otherwise) of using the system is reasonable. Madigan et al. (2017) suggested assessing the factor of *Price Value* for transportation studies, such as in the present review of BSSs.

Another addition that UTAUT has made in comparison to the previous acceptance model (TAM), is its' inclusion of moderators. It has been demonstrated that the variables of gender, age and experience can be considered as moderating variables that affect the relationships between the UTAUT variables of *Performance Expectancy*, *Effort Expectancy*, *Social Influence* and *Facilitating Conditions* and dependent variable of *Behavioural Intention* in acceptance of technologies

<sup>1</sup> 1 US \$ = 42,099 IRR and 1 Euro = 46,152 IRR (Date of exchange rate: 09/10/2019)

(Venkatesh et al., 2003; Brown et al., 2010; Venkatesh et al., 2012; Wolf and Seebauer, 2014).

While previous acceptance models were not powerful enough to explain the variance of intention to use, Venkatesh et al. (2003) were able to demonstrate that UTAUT2 explains approximately 70% of the variance of intentions to use and explains 50% of the variance of use behaviour of some studied technologies (Venkatesh et al., 2003). While UTAUT is a fairly new model, based on previous research it can be said that efficiency, validity, and reliability of this model have been proven in different fields (Anderson & Schwager, 2004; Lin et al., 2004). Also, studies by Venkatesh et al in 2003 have been deeply analysed and the efficiency of this model was established. Moreover, in a study by Oshlyansky et al. (2007), UTAUT model was studied in 11 different countries with different cultures. The results show that this model is a more rigorous model than other technology acceptance models (Venkatesh et al., 2012). As it was mentioned, this model presents a comprehensive approach toward technology acceptance, which fills the gaps of previous models.

So far, many researchers have used technology acceptance models in their studies, most of which have been about the acceptance of information technologies (Carlsson et al., 2006; Park et al., 2007, AlAwadhi and Morris, 2008; Im et al., 2011; Rahman et al., 2011; Alkhunaizan and Love, 2012; Hoque and Sorwar, 2017). In the field of transportation technologies, studies mainly focused on the fields such as automated public transport (Chen and Chao, 2011; Cheng and Huang, 2013; Madigan et al., 2017), car-sharing (Fleury et al., 2017) and advanced driver assistance systems (Rahman et al., 2017). Some of the aforementioned studies have used UTAUT model for indicating the factors that influence transport technology acceptance.

Fleury et al. (2017) evaluated car-sharing users' acceptance in France using UTAUT and added a new construct of "*Perceived environmental friendliness*". Results of this study show that *Effort Expectancy* had the strongest impact on *Behavioural Intentions* to use car-sharing. Also, the newly added construct (*Perceived environmental friendliness*) had a significant but small effect on *Behavioural Intentions*. Adapting the UTAUT2 model, Madigan et al. (2017) found factors such as *Performance Expectancy*, *Social Influence*, *Facilitating Conditions* and *Hedonic Motivation* in influencing users' intentions to accept automated road transport systems (ARTS) in the city of Trikala, Greece. The findings also illustrated no relationship between *Effort Expectancy* and *Behavioural Intentions* for ARTS. Rahman et al. (2017) attempted to investigate driver acceptance of Advanced Driver Assistance Systems (ADAS) as an advantageous system for improving transportation safety. They have used the Technology Acceptance Model (TAM), the Theory of Planned Behaviour (TPB), and UTAUT for modelling driver acceptance in terms of *Behavioural Intention* to use an ADAS, using both a simulator approach and an online survey. On the basis of their findings, all three models explained driver acceptance.

Technology acceptance models present an opportunity to explore the factors that drive user intention and behaviour across many sectors. In transportation, these can be applied to support a review of cycling technologies and what factors influence adoption, acceptance or rejection of these bicycles among the public.

There are a limited number of studies on acceptance of cycling technologies. Wolf and Seebauer (2014) developed a model combining UTAUT and addition factors influencing travel behaviour, to explore the factors influencing adoption and use of e-bikes by early adopters in Austria. Using structural equation modelling (SEM) the authors found that use of e-bikes is mostly influenced by perceived usefulness. The findings revealed that different trip purposes were influenced by various factors including supportive social environment, personal ecological norms, and attitudes towards physical activity. Furthermore, they found a moderating role of age for usage of e-bikes.

Hazen et al. (2015) attempt to understand the factors influencing the populations' intention to use a BSS in Beijing, China. They used a TAM model including the constructs of perceived quality, perceived

convenience, and perceived value (new added construct). They found positive direct relationships between all the constructs and intention. In addition, the results showed that value could play an important role for adoption of the system by potential users.

Applying a modified model of TAM and TPB, Chen (2016) explores the effects of perceived green value (the set of attributes associated with the environmental consciousness value of BSSs), perceived green usefulness (the extent to which an individual believes that BSSs will add to the environmental performance in some part of his/her life within an organizational context), perceived pleasure to use, subjective norms and perceived behavioural control on green loyalty (the degree of reuse intention due to a powerful environmental motive and sustainable commitment to BSSs) to a BSS. They added a new moderator to the model: general attitude toward protecting the natural environment. The results showed that perceived pleasure to use and subjective norms are the strongest predictors of loyalty to a BSS.

Chen and Lu (2016) investigated the factors influencing green intention (refers to the possibility that a consumer will use a BSS as a result of his or her specific wants or needs related to sustainability) to use a BSS. They developed a model including the constructs of perceived usefulness, perceived ease of use, and user attitude. Findings revealed that the highest mediation effect on green intentions was for user attitude. Perceived ease of use does not have a significant effect on intentions to use BSS.

Liu and Yang (2018) used an expanded TAM model to observe the factors affecting intention to use a BSS. They found that intention to use is predicted by perceived usefulness and perceived ease of use. In addition they found that gender was a moderator for subjective norms and imitating others.

As outlined above, some studies used technology acceptance models in the field of transportation and in particular BSS. However, the literature on technology acceptance and cycling did not consider perceived safety in the models. Also, since to the best of our knowledge the UTAUT2 model was not used in the literature on cycling, there is no study which considers the degree to which users perceive the cost of using the system to be reasonable for acceptance of a cycling 'technology' like a BSS (Price Value in UTAUT2 model). In addition, no study in this field was carried out in Middle Eastern countries with their specific context (cultural, economic, geographical, religious, etc.). For instance, women were not allowed to use a BSS in Iran, directly influencing the overall usage rates of the system. Next an indirect effect is likely: probably this influences the use of the system by men, since they sometimes want to use the system together with their family members, or they reject the system to show their disagreement with this forbidding regulation (Jahanshahi et al., 2018).

## 1.2. Research gaps and objectives of the study

The current study has both empirical and theoretical aims. The empirical aim of this study is to examine the factors influencing acceptance and usage among users of a BSS in Iran as a developing country which introduced such cycling technology for the first time in the country. From the theoretical perspective, it will be evaluated if perceived safety can predict intention to use a BSS or can influence users' *Use Behaviour* through *Behavioural Intention*. *Perceived Safety* construct were added to the original model for the first time, as evidence indicates that safety-related issues considerably affect cycling acceptance and adoption. Madigan et al. (2017) suggested *Perceived Safety* as one construct to be of particular relevance in the transport context, however the present study marks the first time this aspect is considered in the theoretical framework of UTAUT for BSSs. Two new moderators, income and educational levels were added to this study. These moderators were based on previous studies of BSSs which indicated the importance of these moderators for people's perception of using bicycles (Transport for London, 2010; Fishman et al., 2014; Bernatchez et al., 2015; Tran et al., 2015; Karki and Tao, 2016). In this

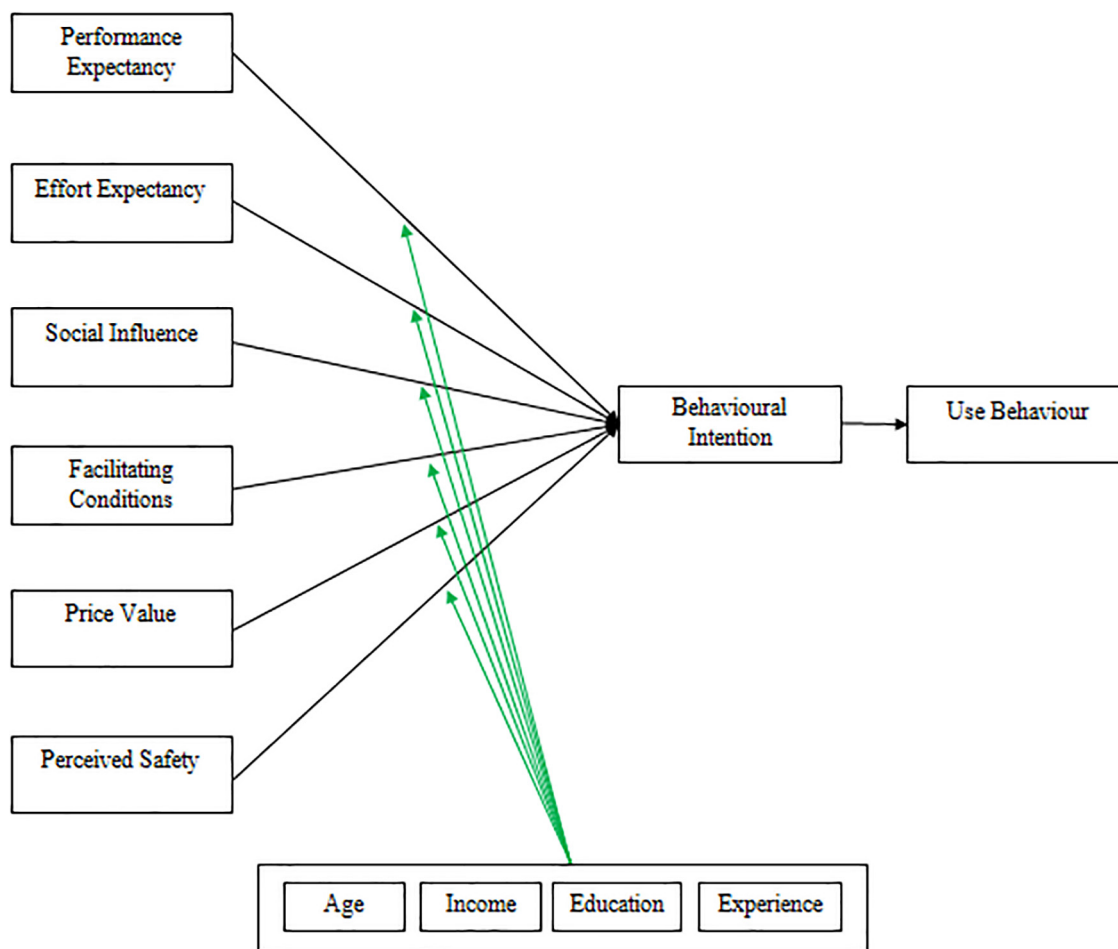


Fig. 1. Conceptual model of study based on UTAUT2 (Venkatesh et al., 2012).

study, gender was eliminated from the list of moderators due to MBSS regulations which allow only men above 15 years of age to use this system.

In this regard and based on this extended UTAUT2 model, more specifically, this study sought to: identify any relationships between the constructs including *Performance Expectancy*, *Effort Expectancy*, *Social Influence*, *Facilitating Conditions*, *Price Value* and *Perceived Safety* and depended variable of *Behavioural Intention* for BSS in Mashhad; determine if *Behavioural Intention* of MBSS users relates to *Use Behaviour*; determine if *Behavioural Intention* mediates the relationship between the six constructs and the *Use Behaviour*; and, determine if age, income, experience and educational levels of users moderates the relationships between the six constructs and *Behavioural Intention* (See Fig. 1).

Analysing and discussing acceptance of a BSS in a developing country can help to highlight the challenges of transport technologies in a wider range of contexts (geographical, cultural, economic, etc.). Moreover, this study will expand the theoretical horizon of UTAUT2 by adding new questions related to authorities, women, and social class to the model questionnaire. Addressing the objectives of this study will guide us in identifying which factors affect MBSS acceptance and usage. Understanding the weight of each studied construct could be vital knowledge for policy-makers and local government to track potential problems and barriers. With respect to the financial limitations of the context, it could be crucial to prioritize the more effective factors in driving cycling use behaviour.

## 2. Research methodology

### 2.1. Participants

Because of MBSS regulations that only allow men over the age of 15 to use the program, all participants of this study were male. Mashhad has a population of over 3.3 million with a gender ratio of 1.01 (more men than women). There are only about 1 million potential users (males over 15 years old). > 70% of Mashhad's inhabitants are younger than 40 years old. Around 30% of males over 15 years old have degrees more than Diploma and over 70% of them have Diploma and less than Diploma. The number of males over 15 years old who are employed is 720,811 (72%) (Statistic Centre of Iran, 2020), but there is no official information about income rates of the population in Mashhad city. In addition, data on car and bicycle ownership are not available.

Table 1 provides a profile of the 271 participants including their age, income, education, occupation, major usage purpose, car ownership, bicycle ownership, MBSS user type and period of use. The average age of participants was 32.93 with 11.88 SD. The age distribution indicates that most of the participants were < 35 years old (67.1%). In terms of occupation, about one-third of participants were students who are mostly presented in "without any income" category. Also, Table 1 shows that just under 70% of participants use MBSS only for commuting and not for personal recreational goals or fun. Regarding bicycle ownership, 74.2% of respondents did not have their own bicycle. Subsequently, data shows that nearly 40% used the system for less than six months.



**Table 1**  
Demographic characteristics.

Characteristics	Number	%	Characteristics	Number	%
<i>Age (in years)</i>			<i>Car ownership</i>		
< 20	31	11.4	Yes	125	46.1
20–24	59	21.8	No	146	53.9
25–34	92	33.9			
35–44	50	18.5	<i>Bicycle ownership</i>		
45–60	29	10.7	Yes	70	25.8
> 60	10	3.7	No	201	74.2
<i>Highest finished degree</i>			<i>Gender</i>		
Diploma and less than	59	21.8	Men	271	100
Diploma					
Associate degree	58	21.4	Women	0	0
Bachelor's degree	97	35.8			
Master's degree & PhD	57	21	<i>User type</i>		
			Regular	101	37.3
<i>Occupation</i>			Infrequent	170	62.7
Public sector	89	32.8			
Private sector	59	21.8	<i>Period of use</i>		
Student	78	28.8	< 6 months	104	38.4
Others	18	6.6	6–12 months	87	32.1
Without job	27	10	> 12 months	80	29.5
<i>Monthly income (million IRR)</i>			<i>Major usage purpose</i>		
Without income	83	30.6	Communting	165	60.9
< Labour law amount*	34	12.5	Recreational/Fun	37	13.6
Labour law amount-20	76	28	Both of them	69	25.5
> 20	78	28.8			

\* Labour law amount of income is the amount of money that government has established as a minimum range of salary for labouring in Iran.

## 2.2. Tools

Based on the UTAUT conceptual model, a 29-item paper-based questionnaire was designed in order to assess the acceptance technology. The questionnaire was developed based on studies of Venkatesh et al. (2003; 2012), Madigan et al. (2017), Chen, (2016) and Fleury et al. (2017) whose studies shaped the questions related to five constructs assessed in the current study: *Facilitating Conditions*; *Performance Expectancy*; *Effort Expectancy*; *Social Influence*; and, *Price Value*.

Another variable that is important for considering acceptance of BSSs is *Perceived Safety*, as it is one of the main concerns which may constitute a barrier to use of bicycles by consumers (Dill and McNeil, 2013; Chataway et al., 2014; Hezaveh et al., 2018). *Perceived Safety* is the degree to which individuals perceive that using a system is safe for them. A model that introduces perceived safety's role in acceptance would be useful for the evaluation of BSSs. Mashhad has provided approximately 100 km bicycle lanes. However, the cycling network is not integrated properly (Jahanshahi et al., 2019a). The bicycles in the BSS are of poor quality and do not have suitable and high quality equipment. Previous studies on BSS in Mashhad found that quality and quantity of bicycle lane strongly influence BSS usage in this city (Jahanshahi et al., 2018, 2019b). Therefore, *Perceived Safety* was added as a sixth (new) construct for the UTAUT model. The four questions related to *Perceived Safety* were designed based on Jahanshahi et al., (2018) which outlined previous literature about perceived safety and the findings of a qualitative study in Mashhad. This study found safety is of concern to potential bicycle users in Mashhad. The aforementioned constructs were measured by statements as illustrated in Table 3 on a five-point Likert scale from strongly disagree to strongly agree.

For assessing intention to use MBSS, three items as described and applied by Venkatesh et al. (2012) were used: "I intend to continue using MBSS in the future", "I will always try to use MBSS in my daily life" and "I plan to continue to use MBSS frequently". These statements were asked on a five-point scale with endpoints labelled strongly disagree and strongly agree. As for *Use Behaviour*, three questions regarding "usage frequency" were measured by five-point Likert scale

from very low to very high (very low for 1–5 trips per month and very high for > 20 trips per month) while "Km per trip" and "Time per trip" were based on three-point scales illustrated in Table 3.

## 2.3. Procedure and design

In preparing the questionnaire several transport experts were consulted and prior to fieldwork the face validity of the questionnaire was approved by a transport expert and a psychologist. The finalized questionnaire was translated from English to Persian ahead of a pilot study with 30 MBSS registered individuals to review the items in terms of clarity, comprehensibility, appropriateness, and fluency. Test-retest reliability is related to the temporal stability of a measuring instrument from one measurement time to another (Drost, 2011). To assess the reliability of the questionnaire a test–retest with 15 respondents with two weeks intervals was conducted. The analysis resulted in significant correlations coefficients as follows: *Facilitating Conditions* (0.99), *Performance Expectancy* (0.99), *Effort Expectancy* (0.89), *Social Influence* (0.97), *Price Value* (0.88), *Perceived Safety* (0.95), behavioural intention (0.98) and *Use Behaviour* (0.89). Also, Cronbach's alpha was analysed for reliability and confirmatory factor analysis (CFA) to assess the construct validity of the questionnaire which is reported in the following section.

Following these validation measures, the final 29 item paper-based questionnaire was distributed within the MBSS stations mainly in summer and fall in 2018. Those users which picked up/returned a bicycle to MBSS stations were asked to fill out the survey. Participants were those registered as MBSS members. In line with previous studies, it was assumed that those not registered as MBSS members do not have any experiences with MBSS and so could not answer the questions, (Karahanna et al., 1999; Madigan et al., 2017). Prior to issuing the survey, there was an estimated 500–700 users based on a field study. A total of 600 questionnaires were distributed to attempt to reach as many users as possible. 319 questionnaires were filled and returned to the researcher. After removing incomplete questionnaires, the responses of 271 participants remained for data analysis, implying a (net) response rate of 45%.

## 2.4. Reliability tests

Determining the reliability of a research instrument is a vital step for studies exploring factors that influence behaviour as it illustrates to what extent the study is replicable to achieve similar results at different times and places (and thus often by different participants) (Rosenthal and Rosnow, 1991; Drost, 2011). AMOS22 was used to compute confirmatory factor analysis (CFA) for verifying the factor structure of the observed variables. To confirm the convergent and discriminant validity of the items, it is crucial to conduct a CFA (Churchill, 1979; Byrne, 2012) to determine whether the hypothesized structure provides a good fit to the data (Diana, 2014) and to confirm the relationships between a set of observed variables and a set of common items (Muthen and Muthen, 2010). Items with loading factors < 0.5 were excluded (Hair et al., 2010). In addition, Cronbach's alpha values over 0.6 confirm the reliability of the model's constructs and illustrate acceptable internal consistency for each construct (Hair et al., 2010). The computed composite reliability (CR) shows if the model fitting is acceptable for constructs and indicates its acceptance for fitting the model if it was > 0.6 for each construct (Fornell and Larcker, 1981; Hair et al., 2010). Average Variance Extracted (AVE) computes the discriminant validity and appraises the amount of variance which produced by each construct according to its components (Bagozzi et al., 1991; Chen, 2016). AVE is acceptable if values are higher than 0.5 (Fornell and Larcker, 1981; Hair et al., 2010).

**Table 2**  
Descriptive statistics for indicators of model constructs.

Question	Median	Mean	Standard deviation	Strongly disagree	2	3	4	Strongly agree	disagree %	agree %
PE1: Useful mode of transport	4.00	3.84	0.746	0.4	5.9	17	62.7	14		
PE2: Achieve important things	3.00	3.30	0.782	17	0	38.7	41.3	3		
PE3: Reach destination more quickly	3.00	2.86	0.961	4.1	38	30.3	23.6	4.1		
EE1: Clear/understandable interaction	4.00	4.30	0.674	1.1	0.7	3.3	56.8	38		
EE2: Easy to use	4.00	3.93	1.007	1.8	9.2	15.5	41	32.5		
EE3: Easy to learn	5.00	4.43	0.808	2.2	1.5	2.6	38.7	55		
SI1: People important to me	3.00	2.73	0.992	9.2	37.6	25.5	26.6	1.1		
SI2: People who influence my behaviour	2.00	2.57	1.089	18.8	32.1	24	23.6	1.5		
SI3: People whose opinions I value	2.00	2.55	1.172	22.5	28.8	24	20.3	4.4		
SI4: Authorities	2.00	1.56	0.593	49.4	45.4	5.2	0	0		
SI5: Women banning	1.00	1.52	0.687	57.9	32.5	8.9	0.7	0		
FC1: Having the necessary resources	4.00	4.24	0.720	1.8	0.4	4.4	58.3	35.1		
FC2: Having the necessary knowledge	5.00	4.42	0.798	1.8	0.4	7.4	34.7	55.7		
FC3: Compatible with other transports	3.00	2.96	0.898	4.1	27.7	38.4	27.7	2.2		
FC4: Getting helps from others	3.00	2.93	1.044	8.1	31.4	22.9	35.1	2.6		
FC5: Compatible with social class	3.00	2.73	1.156	17	30.6	16.2	34.3	1.8		
PV1: Reasonably priced	4.00	4.44	0.598	0.7	0	1.1	51.3	46.9		
PV2: Good value for the money	4.00	4.24	0.843	3	0.4	7.4	48	41.3		
PV3: Providing a good value	4.00	4.33	0.856	3	0	7.7	39.9	49.4		
PS1: Bicycle equipment for safety	2.00	1.92	0.859	35.8	41.3	17.7	5.2	0		
PS2: Road safety for cycling	1.00	1.32	0.498	69	30.3	0.4	0.4	0		
PS3: System maintenance	1.00	1.61	0.722	51.3	38.7	8.5	1.1	0.4		
PS4: Bicycle quality/design	2.00	1.82	0.811	41	38	18.8	2.2	0		
BI1: Continue using MBSS in future	3.00	2.87	1.230	21	16.2	20.7	38.7	3.3		
BI2: Always try to use MBSS	2.00	2.65	1.316	25.5	25.1	17	24	8.5		
BI3: Continue to use MBSS frequently	2.00	2.14	1.098	36.2	28	24	8.9	3		
				Very low				Very high		
				1–5	5–10	10–15	15–20	> 20		
UB1: Usage frequency (trip per month)	2.00	2.27	1.124	35.8	18.8	29.5	14.8	1.1		
				< 15 min		15–30 min		> 30 min		
UB2: Km per use	3.00	2.28	0.707	49.1		37.6		13.3		
				< 3 Km		3–6 Km		> 6 Km		
UB3: Time per use	1.00	2.14	0.776	60.1		22.5		17.3		

\*PE: Performance Expectancy; EE: Effort Expectancy; SI: Social Influence; FC: Facilitating conditions; PV: Price Value; PS: Perceived Safety; BI: Behavioural Intention; UB: Use Behaviour.

### 2.5. Analysis of the model

In order to analyse the conceptual model of this study, firstly, prediction of *Behavioural Intention* by model constructs was assessed. In this regard, multiple linear regression models were estimated to predict *Behavioural Intention* based on all the studied constructs.

Secondly, the correlation coefficients between the constructs, *Behavioural Intention* and *Use Behaviour* were analysed, to determine if a relationship exists between each of the studied constructs.

In order to evaluate the mediating role of *Behavioural Intentions*, for the impact of the five constructs on *Use Behaviour* of the MBSS Structural equation modelling (SEM) and AMOS22 software were used. In this regard, the model fit was assessed the model's statistical validity. Using the Kolmogorov-Smirnov test and the Shapiro-Wilk test, it was assessed if the distribution of data is normal. After which, the CFA was performed to determine if the hypothesized statistical model fits the actual data set by using a number of 'goodness-of-fit' statistics (CFI > 0.95, GFI > 0.91, NFI > 0.91, RMSEA < 0.05, 1 < chi square ratio < 3) (Browne and Cudeck, 1993; Hair et al., 2010; Chen, 2016; Carmines and McIver, 1981; Marsh et al., 1988; Hu and Bentler, 1999; Little et al., 2002).

After confirming model fit, the conceptual model was estimated using AMOS22. In this stage significance and direction of effects between the constructs were analysed. Subsequently, effects of the moderators on the relationships between *Behavioural Intention* and the studied constructs were analysed.

## 3. Results

In this section, first, descriptive analysis of questionnaire items will

be presented. Next, the measurement reliability will be illustrated by reporting the results of Cronbach's alpha, AVE, CR, and CFA. Additionally, the results of correlations and linear regression will be presented to see how studied constructs affect each other and how they can predict *Behavioural Intention*. Subsequently, SEM will be explored using AMOS22 to examine the mediating role of *Behavioural Intentions* for the impact of the five constructs on *Use Behaviour* of the MBSS. As the final result of investigating the conceptual model of this paper, the path coefficients and significance between the constructs of the structural model are reported.

### 3.1. Descriptive analysis of questionnaire items

Table 2 presents median, mean, Standard Deviation (SD), and percentage of each response category for each of the items in the questionnaire. There are some important trends in the responses. For example, most of the respondents were strongly disagree with four statements related to *Perceived Safety* and in items SI4 and SI5 related to *Social Influence* of authorities and women, indicating fairly consistent attitudes towards these elements across respondents. Similarly, the highest mean scores apply to the items in the *Effort Expectancy* and *Price Value* construct, while the items in *Perceived Safety* and *Social Influence* had the lowest mean scores compared to the other constructs. The mean scores for *Behavioural Intention* have about average values (2.87, 2.65, 2.14). However, most of the respondents disagreed to continue to use MBSS frequently.

### 3.2. Reliability results

Table 3 illustrates the items within each construct used in the



**Table 3**  
UTAUT questionnaire items.

Constructs	Items
Performance Expectancy	PE1: I find the MBSS a useful mode of transport PE2: Using the MBSS to travel helps me to achieve things that are important to me PE3: Using the MBSS will help me reach my destination more quickly
Effort Expectancy	<b>EE1: My interaction with the MBSS is clear and understandable</b> <b>EE2: I find the MBSS easy to use</b> <b>EE3: Learning to use an MBSS is easy for me</b>
Social Influence	SI1: People who are important to me think that I should use MBSS SI2: People who influence my behaviour think that I should use MBSS SI3: People whose opinions I value would like me to use MBSS <b>SI4: In general the authorities would support the use of MBSS</b> <b>SI5: women are not allowed to use MBSS it doesn't affect my usage</b>
Facilitating conditions	<b>FC1: I have the resources necessary to use MBSS</b> <b>FC2: I have the knowledge necessary to use MBSS</b> FC3: The MBSS is compatible with other forms of transport I use FC4: I can get help from others (operators) when I have difficulties using MBSS FC5: Riding bicycle with shared bikes is compatible with my social class
Price Value	PV1: MBSS is reasonably priced PV2: MBSS is a good value for the money PV3: At the current price, MBSS provides a good value
Perceived Safety	PS1: The bicycle equipment are in such a way that I feel safe when using MBSS <b>PS2: Road safety for cycling in Mashhad is suitable that I feel safe when using MBSS</b> PS3: The system maintenance is in such a way that I feel safe when using MBSS <b>PS4: The bicycles brought for the system are in such a way that I feel safe when using MBSS</b>
Behavioural Intention	BI1: I intend to continue using MBSS in the future BI2: I will always try to use MBSS in my daily life BI3: I plan to continue to use MBSS frequently
Use Behaviour	UB1: usage frequency UB2: Km per use UB3: Time per use

Note: Bolded items were eliminated from the model analysis after reliability assessment.

questionnaire. Table 4 shows loading factors of each item; Cronbach's alpha coefficients, CR and AVEs for each construct. The table shows that FC1, FC2, SI4, SI5, and PS2 items each had loading factors < 0.5 (0.08, −0.13, 0.26, 0.23 and 0.41 respectively), so were eliminated. The convergent validity of constructs was assessed using the average variance extracted (AVE). All AVEs were acceptable with > 0.5 except for *Perceived Safety* construct having AVE 0.39. The authors decided to remove PS4 with the least loading factor of 0.506 from the construct. That produced a valid AVE of 0.68. Also, AVE was not reliable in the *Effort Expectancy* construct considering the whole items (0.40). A reliable outcome was not resulted in by removing each item in this construct. Thus, this entire construct was removed from the conceptual model of the current study. Also, the computed composite reliability (CR) was > 0.6 for each construct, indicating its acceptance for fitting the model. Finally, Cronbach's alpha coefficients of constructs were between 0.62 and 0.92, which are within the ranges of acceptable to

**Table 4**

Loading Factors, Cronbach's alpha coefficients of the constructs, CR and AVEs.

Constructs	Items	loading Factors	AVE	Cronbach's alpha	CR	Mean	Standard Deviation
Performance Expectancy			0.52	0.74	0.76	3.33	0.67
	PE1	0.69					
	PE2	0.79					
	PE3	0.67					
Social Influence			0.81	0.92	0.93	2.18	1.01
	SI1	0.88					
	SI2	0.92					
	SI3	0.90					
Facilitating conditions			0.55	0.78	0.78	3.45	0.86
	FC3	0.68					
	FC4	0.72					
	FC5	0.81					
Price Value			0.53	0.75	0.77	4.33	0.63
	PV1	0.59					
	PV2	0.85					
	PV3	0.71					
Perceived Safety			0.68	0.62	0.64	1.66	0.67
	PS1	0.81					
	PS3	0.55					
Behavioural Intention			0.79	0.91	0.84	2.55	1.12
	BI1	0.89					
	BI2	0.88					
	BI3	0.89					
Use Behaviour			0.64	0.84	0.92	1.84	1.20
	UB1	0.88					
	UB2	0.76					
	UB3	0.75					

very good reliability. On the basis of the reliability, 20 items within five constructs remained for analysing the conceptual model of the current study. Questions and constructs that have been eliminated are bolded in Table 3.

### 3.3. Analysis of constructs and items

#### 3.3.1. Relationships between the constructs

Multiple linear regression was calculated to predict *Behavioural Intention* based on *Performance Expectancy*, *Social Influence*, *Facilitating Conditions*, *Price Value* and *Perceived Safety*. The model was significant ( $R^2 = 0.72$ ;  $F(6, 2064) = 113.624$ ,  $p < 0.000$ ).

*Behavioural intention* was predicted by FC (0.845), PE (0.513), PS (0.383) and SI (0.322). *Price Value* was not significant (See Table 5).

The correlation coefficients between the constructs, behavioural intention and use behaviour provided in Table 6 show a significant and positive relationship among the constructs as well as between the constructs, and *Behavioural Intention* and *Use Behaviour*. The strongest correlation with *Behavioural Intention* and *Use Behaviour* is *Facilitating Conditions*, followed by *Performance Expectancy*, *Social Influence*,

**Table 5**

Multiple regression results.

Constructs	B	Sig	R <sup>2</sup>
Performance Expectancy	0.513	0.000	0.721
Social Influence	0.322	0.000	
Facilitating Conditions	0.845	0.000	
Price Value	0.103	0.138	
Perceived Safety	0.383	0.000	

**Table 6**  
Correlations of the constructs.

Constructs	A	B	C	D	E	F	G
A. Performance Expectancy	1						
B. Social Influence	0.407**	1					
C. Facilitating Conditions	0.662**	0.495**	1				
D. Price Value	0.207**	0.125*	0.298**	1			
E. Perceived Safety	0.462**	0.179**	0.507**	0.147*	1		
F. Behavioural Intention	0.706**	0.518**	0.836**	0.292**	0.515**	1	
G. Use Behaviour	0.611**	0.462**	0.724**	0.228**	0.452**	0.774**	1

\* Correlation is significant at the 0.05 level ( $p < 0.05$ ).

\*\* Correlation is significant at the 0.01 level ( $p < 0.01$ ).

*Perceived Safety*, and *Price Value*. Those having higher intention to use MBSS or who are using MBSS more frequently also indicated higher scores in *Facilitating Conditions*, *Performance Expectancy*, *Social Influence*, *Perceived Safety*, and *Price Value*.

### 3.3.2. Structural equation modelling

Using the Kolmogorov-Smirnov test and the Shapiro-Wilk test, it is found that the distribution of data is normal. As is shown in Fig. 2, constructs (latent variables) were presented in circles and items (observed indicators) were presented in rectangles. The structural model was identified by five constructs (*Performance Expectancy*, *Social*

**Table 7**  
The fit Statistics.

GFI	RMSEA	NFI	CFI	Chi Square ratio
0.914	0.049	0.930	0.971	1.641

**Table 8**  
Results of structural model.

Path	Effect direction	Coefficient	Result
Performance expectancy to BI	+	0.01	Not supported
Social influence to BI	+	0.015	Not supported
Facilitating conditions to BI	+	0.877**	Supported
Price value to BI	–	0.011	Not supported
Perceived safety to BI	–	0.011	Not supported
BI to Use behaviour	+	0.919**	Supported

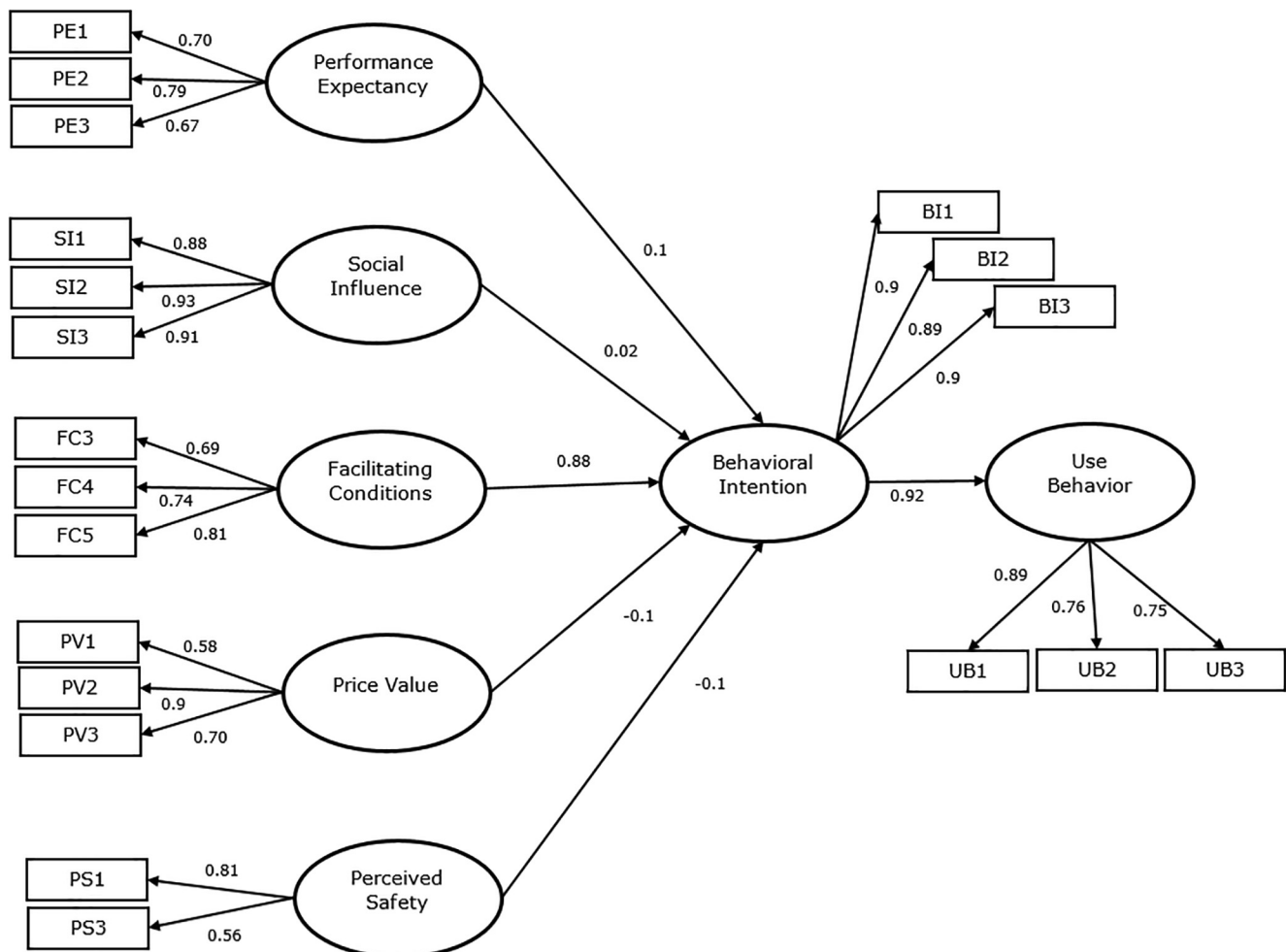
+ : a positive effect, – : a negative effect; BI: Behavioural intention; \* shows the significant influence.

\*  $p < 0.05$ .

\*\*  $p < 0.01$

*Influence*, *Facilitating Conditions*, *Price Value*, *Perceived Safety*). Loading factors were represented by the coefficients on the paths (See Fig. 2).

The results show that the fitness of the structure is acceptable based on the fit assessments of the UTAUT2 model presented in Table 7. As can be seen, the comparative fit index (CFI) is  $> 0.95$ , and the goodness of fit index (GFI) and Normed fit index (NFI) are both  $> 0.91$  indicating



**Fig. 2.** The conceptual model. Note: Number in the single-headed arrows between the constructs and items (observed indicators), between the constructs and Intention and between Intention and Use behaviour shows loading factors.

a good fit. The root means a square error of approximation (RMSEA) is  $< 0.05$  indicate a close fit. Finally, the chi square ratio is 1.641 which is in the recommended range of 1–3. The model fit statistics show that the model of the current study fits well and is approved.

Execution of the conceptual model through AMOS22 illustrate that the research conceptual model shows five constructs to have direct paths to *Behavioural Intention*. Also, one direct path is from *Behavioural Intention* to *Use Behaviour*. Table 8 reveals data about the significance and direction of effects between the constructs. The result shows that after examination of the model just two paths are supported. *Facilitating Conditions* has a positive strong direct effect on *Behavioural Intention* and *Behavioural Intention* has a positive strong direct effect on *Use Behaviour*. Fig. 2 shows a schematic view of examined the model. This result reveals that *Behavioural Intention* can mediate the impact of *Facilitating Conditions* on *Use Behaviour* of the MBSS. In other words, the actual usage of MBSS is influenced by the impact of *Facilitating Conditions* on *Behavioural Intention*, whereas as explained above (regression analysis), users' *Behavioural Intention* was influenced by all the constructs except for *Price Value*. The negative effect of coefficients of *Price Value* and *Perceived Safety* reveals the negative association between the constructs and *Behavioural Intention*. However, the importance of the coefficient is limited because they are not significant.

The moderators were included to examine their effects on the relationship between behavioural intention and *Performance Expectancy*, *Social Influence*, *Facilitating Conditions*, *Price Value*, and *Perceived Safety*. Results demonstrate that age, income, education, and experience does not have any meaningful effect on the relations existed in the study's conceptual model as  $\Delta R^2$  is 0.000 in all paths, Coefficients are meaningless and their significance is above 0.05.

#### 4. Discussion and conclusions

This study aimed to understand which factors affect people's technology acceptance regarding a BSS in Iran and which different factors affecting user's acceptance are relatively effective. The current study investigates factors influencing acceptance and usage of a BSS in Iran through the most recent acceptance model; UTAUT2. The particular aim of this study was to examine: whether *Performance Expectancy*, *Effort Expectancy*, *Social Influence*, *Facilitating Condition*, *Price Value*, and *Perceived Safety* can explain the intention of MBSS users to use MBSS; whether intention to use MBSS mediates the relationship between the constructs and the behavioural use of MBSS; and, whether age, experience, education and income moderates such relationships. This study expanded the theoretical horizon of UTAUT2 by considering *Perceived Safety* as a predictor of intention to use a BSS for the first time as well as adding new questions related to authorities, women, and social class to the model questionnaire based on previous literature and the case of study.

The sample of the current study shows that most people using MBSS are between the ages of 20 to 44 (74%). There are a lot of studies that similarly found younger people are more happy to use BSSs (Shaheen et al., 2011; Morency et al., 2011; Buck et al., 2013; Fishman et al., 2014; Bernatchez et al., 2015; Ricci, 2015; Raux et al., 2017). It is considerable to note that most of the users have an academic education or are pursuing a post-secondary education. This finding is also in line with previous studies (Tran et al., 2015; Castillo-Manzano and Sanchez-Braza, 2013; Bernatchez et al., 2015; Mattson and Godavarthy, 2017; Jahanshahi et al., 2019b). 46% of respondents own car and 76% of them did not own a bicycle. Indeed, this high percentage of users without private bicycles suggests that MBSS may be more attractive to people who have not previously had the opportunity to use a private bicycle for commuting and through MBSS have now found a way. The high percentage of utilitarian trips (as opposed to recreational trips) likely is due to the early 4:30 pm closing time of the system. The results reveal that just under 30% of the respondents used MBSS for more than one year, which may be an indicator of a low level of loyalty to MBSS

and could be result of low level of system service quality. Most of the users in our study have a low to medium income, in contrast to other previous studies on BSSs which showed higher rates of adoption among higher income residents (Transport for London, 2010; Ogilvie and Goodman, 2012; Fishman et al., 2014; Fishman et al., 2015; Ricci, 2015; Raux et al., 2017; Hosford et al., 2018). The differences between BSSs in developing and developed countries in terms of users' income was discussed recently by Jahanshahi et al. (2019b), where it seems using a BSS is more reasonable in developing countries and contexts which have higher costs associated with of transportation and cars. In addition, another potential barrier which could be related to the socio-cultural context, may be social status, where people with higher incomes avoid using BSSs because of a perceived potential decline in social status they use an inexpensive mode of transport. This factor was one of the cultural effective factors identified to have influenced the adoption of MBSS in a qualitative study by Jahanshahi et al. (2018).

As it is reported in the reliability analysis, confirmatory factor analysis led to the elimination of *Effort Expectancy* from the model. The items included in the EE construct were not a reliable construct for prediction among Iranian BSS users. Chen and Lu (2016) also highlighted that perceived ease of use (the same construct as EE) does not have a significant effect on intention to use a BSS. However, this finding is not in line with Liu and Yang (2018) who found this construct to be one of the predictors of the intention to use a BSS. The results of the correlation indicated a significant relationship between the remaining five constructs, intention to use MBSS and MBSS use behaviour. Regression showed that all constructs except *Price Value* could predict *Behavioural Intention* to use MBSS. Despite some evidence suggesting that, the cost and pricing structure may have a significant impact on consumers' technology use, for the current study it was not a significant. As explained above, there is no study on cycling technologies that considers the impact of price value on intention. However, the result is inconsistent with the study of Chan et al. (2008) indicating that the popularity of short messaging services (SMS) in China is due to the low pricing of SMS relative to other types of mobile Internet applications.

The results of regression analysis also illustrate that *Facilitating Conditions* was the strongest variable to predict intention. Previously Wolf and Seebauer (2014) found that this construct positively, but only to a small extent, influences the intention to adopt e-bikes. In addition, a study in 2013 found a strong positive relationship between *Facilitating Conditions* and drivers' intention to use car connectivity services (Park et al., 2013). Those with a high positive perception of compatibility of MBSS with their social status and other transportation modes they use, and those who think that staff members working in MBSS stations can facilitate their usage had a higher intention to use MBSS.

The next construct to predict intention to use MBSS was *Performance Expectancy*. Those who indicated using MBSS would help them achieve reach their goals or destination better had a higher intention to use MBSS. They think it is useful to use the bicycle in a sharing system. This is also consistent with Madigan et al. (2017) and Liu and Yang (2018). Also, Wolf and Seebauer (2014) showed that use of e-bikes is mostly influenced by this construct.

*Perceived Safety* and *Social Influence* came after, determining the importance of safety and social impacts on the intention to use MBSS. Individuals feeling safe in using a BSS had higher intentions to use it. The result supports Chataway et al. (2014) and Dill and McNeil (2013)'s view that safety may constitute a barrier to the use of this mode of transport. In Iran, safety is a concern for cyclists in particular which may discourage bicycling (Hezaveh et al., 2018). From the theoretical view, this study added *Perceived Safety* as a new construct to UTAUT2 regarding its importance in cycling and generally transportation. This construct predicted *Behavioural Intention* to use the BSS; future researchers can use this extended UTAUT2 model for transportation technologies, especially for cycling technologies. Users who perceived that others (for example, their family and friends) believe that they

should use MBSS had a relatively high behavioural intention to use MBSS. This is in line with the proposition that in travel behaviour *Social Influence* impact people's opinions on an individual's acceptance or rejection of a behaviour (Venkatesh et al., 2003; Yuan et al., 2005; Axhausen, 2008; Carrasco and Miller, 2009; Goetzke and Rave, 2010; Sherwin et al., 2014). As Sherwin et al. (2014) suggested, the effect of bicycling promotion programs can be improved in the city by controlling and harnessing social processes.

As reported in the result section, findings of structural equation modelling reveal that mediating role of *Behavioural Intentions* between the five constructs and *Use Behaviour* of the MBSS is significant. However, only *Facilitating Conditions* had a significant positive impact on *Use Behaviour* of MBSS through *Behavioural Intentions*. The results of the regression analysis and SEM both reveal the importance of *Facilitating Conditions* in acceptance and usage of MBSS. *Facilitating Conditions* had the strongest effect on intentions of users according to the regression analysis, and was the only construct which had an impact on the usage of MBSS according to SEM. As a conclusion, this results can show the importance of compatibility of MBSS with people's social status, compatibility and integration of MBSS with other transportation modes, and the quality of costumer services which users received from the system staffs, for the usage frequency, average time per case MBSS was use, and kilometres travelled per case MBSS was used. These factors positively influenced the acceptance of MBSS.

Wolf and Seebauer (2014) revealed the moderating role of age for usage of e-bikes in Austria. However, this study showed that the moderator variables, age, education, income and experience of using MBSS did not add to or detract from the mediating role of intention between the five constructs and acceptance of MBSS.

#### 4.1. Implications for policy

Findings of this study can help design better strategies and provide better insight for policy makers and local governments for improving the current systems or in launching new systems. The fact that students' and youths' taste is in line with using BSSs could be a good opportunity for policy makers to increase MBSS usage rates in Mashhad by providing more suitable BSS for these two groups, because they have a relatively high demand for bicycle usage. It is also vital for policy makers to take steps to explore how to provide a better situation for older people to increase their share of usage. Additionally, it would be a good idea to test expanded operating hours for MBSS to understand if it will encourage use for recreational purposes. Needless to say, the exclusion of women from MBSS eliminated approximately half of the potential users within the city and addressing this issue may be very helpful to increase cycling usage rate in the city. It would be recommended for policy-makers to focus more on bicycling equity in cities considering different socio-demographic characteristics such as age, gender, income level, education, and place of living.

As it is shown in this study, *Perceived Safety* as a new construct in bicycle sharing technology acceptance influences users' *Behavioural Intention* to use MBSS. Owing to the items related to this construct, improving equipment of bicycles and efficient bicycles maintenance in MBSS in order to increase cycling safety for the system users can influence their behavioural intention to use MBSS. Therefore it seems to be crucial for cycling policy-makers to consider cycling safety more in their planning and policies.

The findings illustrate that *Facilitating Conditions* is the most effective construct for intention to use MBSS. It is important to understand that in different contexts, bicycle sharing acceptance may be affected by different factors and it is not fair to provide adopt strategies solely through a blind imitation. While policy makers should consider a priority to focus on the factors related to *Facilitating Conditions* improving MBSS usage rates in Iran, other constructs may have a stronger influence elsewhere. However, some suggestions to improve the *Facilitating Conditions* for use which can increase people's acceptance to

use MBSS include:

- 1: Establishing regulations related to entering bicycles to public transportations such as buses and LRT or creating some portable bicycle storage for them;
- 2: Making some motivational promotions like rewarding users each time they use a bicycle via an integrated smart card giving them credits they can use to travel by bus or LRT;
- 3: Improving the training process for stations operators in terms of behavioural and customer service knowledge to make better conditions when users want help from them;
- 4: Relocating MBSS stations and increase the integration of stations with other modes of transportation throughout the city; and,
- 5: Improving cycling social status through some cultural events and effective advertisement, also by using MBSS by authorities and figures are important for people.

#### 4.2. Limitations

A first limitation of our study is that the sample size is relatively small. Secondly, the sample size is a bit homogeneous, at least with respect to gender: only men are allowed to use the MBSS system in Mashhad. This is problematic because gender influences user rates of BSSs (Fishman, 2019). This gender limitation of course also influences the sample size. The people in our sample were higher educated than the population: around 80% of the sample have degrees higher than diploma, whereas, this percentage for the population is only 30%. Moreover, the limited operating hours of the program, limits the transferability of our findings to systems with longer opening hours. Furthermore, the fact that non-users could not be included in this research limits the value of the study. Other limitations could be the risk of giving socially desirable answers by respondents, and self-selection. Self-selection at least occurs in the sense that the current users of the MBSS are early adopters, and early adopters do not need to be representative for the wider public, if that would use the system. Secondly there could be self-selection in the response rate: maybe people with less time pressure were more than inclined to respond, and we cannot exclude that time pressure correlates with variables included in our study. Next, some of the constructs and questions (e.g. PE3 and FC3) could be influenced by characteristics of the place of residence, work and other destination types. This study did not consider these aspects since it is limited to variables included in the UTAUT2 model.

All in all the results of this study cannot be easily generalized, but we expect them to at least apply to small sized BSSs in similar contexts (geographical, economic, socio-cultural, etc.).

#### 4.3. Recommendations for future research

Regarding the UTAUT model for BSSs, there are other factors such as hedonic motivation and habit whose impact can be further investigated for bicycle sharing technology acceptance. Future researchers can apply our extension of *Perceived Safety* as one of the predictors of intention to use transportation technologies, since the importance of safety in transportation modes is a growing trend and has been validated through this research. Regarding forbidding women from using MBSS, it is interesting to explore women's perceptions about using MBSS and exploring possible the scenarios where women could use this system. Perhaps introducing women to MBSS, may improve technology acceptance, introduce different barriers to adoption, or alter the priority of different constructs or aspects of the system. More importantly, important insights could be found by exploring how lifting the exclusion of women might impact men's usage of MBSS. Therefore, studies on the acceptance of BSSs (and maybe more studies on transport technology acceptance) could benefit from explicitly adding the compatibility of using a system (in this case a BSS) with people's social class. Next it is important to realize that, as explained above, we did not



include directly the characteristics of the residential area or other geographical characteristics, such as of the workplace. Further research is required to explore the impact of these characteristics on BSS systems.

Broadening our scope to acceptance of transport technologies in general it is important to study the acceptance of technologies in different contexts and situation, adopted in varying jurisdictions, especially in developing countries and cities, and provide some tailor made solutions when they are facing barriers to acceptance. It is very important to avoid blind imitation, as replication of what has worked in other contexts may not be successful. Further studies are required to evaluate technology acceptance issues in more developing countries and to study the acceptance of multiple technologies for different transportation modes to identify how the most effective acceptance factors differ between contexts.

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## CRediT authorship contribution statement

**Danial Jahanshahi:** Conceptualization, Data curation, Formal analysis, Investigation, Software, Writing - original draft. **Zahra Tabibi:** Conceptualization, Supervision, Methodology. **Bert van Wee:** Conceptualization, Supervision, Writing - review & editing.

## 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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