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# Mobile Interactivity and Perceived Waiting Time: The Role of Cognitive Absorption and Perceived Procedural Justice

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## ABSTRACT

While the perceived waiting time can undermine user evaluation and cause application abandonment, there is little scientific research on waiting in mobile applications. This paper incorporates three mobile interactivity features (ubiquitous connectivity, active control, and responsiveness) into the model and examines the mediating role of cognitive absorption and the moderating role of perceived procedural justice between these features and perceived waiting time in a short-waiting application. The researchers empirically examine the model using data from 468 users of the ride-sharing mobile application. The results reveal that mobile interactivity can directly and indirectly (via cognitive absorption) lead to more tolerance in perceived waiting time. The findings elicit several implications for theories and practice.

## KEYWORDS

Cognitive Absorption, Mobile Application, Mobile Interactivity, Perceived Procedural Justice, Perceived Waiting Time

## 1. INTRODUCTION

Today, wait time reduction is a global challenge in ride-sharing mobile applications (Luo et al., 2015; Peng et al., 2020). However, there is little scientific research on understanding and managing mobile waiting. Ride-sharing applications are booming around the world. As of December 2018, China has 190 million ride-sharing users, and the market is still expanding (Peng et al., 2020). In Germany, “Mitfahrgelenheit”, one of the largest ridesharing websites, offers nearly 900 thousand ride-sharing options online in real time. In 2017, Moscow had one sharing car for every 5,000 residents, while Washington led with one sharing car for every 692 residents, and it is still spreading around the

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world. Thereby, reducing wait time for ride-sharing applications has become a global marketing and e-commerce problem.

Perceived waiting time is critical in short-waiting applications, such as ride-sharing applications. Public data show that the arrival time of their services is usually within an hour, and the majority of the application users wait less than 15 minutes (Ai De Chu Xing, 2018). Because of the short arrival time of the services, customers may constantly check the application's interface and keep an eye on the time of delivery (Kondrateva et al., 2020). For example, when customers use a ride-sharing application to take a taxi, from the time they click on the interface of the application to the beginning of the service, they may constantly check their mobile phones and keep an eye on when they purchased services will arrive. In this case, users keep watching the screen and it is easy to notice and record the passage of waiting time, the longer they wait the less satisfaction they feel and is more likely to lead user's application abandonment behavior (Voorhees et al., 2009; Khedhaouria et al., 2016). So, the management of waiting time in short-waiting applications is important. However, previous studies ignore this point.

Waiting is a ubiquitous and inseparable part of people's life and service experience, which negatively influences people's overall evaluations of products, services, and stores (Voorhees et al., 2009; Al-Otaibi et al., 2018). It has been confirmed that waiting can bring pressure and dissatisfaction to customers (Hamidi & Moradi, 2017; Li & Chen, 2019). The actual waiting time exists objectively in the transaction, while perceived waiting time is the subjective judgment of the customer. Previous studies mainly focus on how to reduce the actual waiting time of customers, such as opening more cash registers during peak hours, hiring more employees during peak season, and queuing to provide services (e.g., Dennis & Taylor, 2006; Li & Chen, 2019). In some cases, it is difficult to reduce the actual waiting time, such as during the peak of consumer spikes in consumption. Sometimes, the decrease in actual waiting time does not affect satisfaction, but the perception of waiting time does (Thompson et al., 1996).

Scholars have found that perceived waiting time may be more useful and more controllable. Perceived waiting time is more suitable in measuring the length of waiting time and has a greater impact on satisfaction than the actual waiting time (Rose, 2005). Thus, the previous researchers propose various solutions to reduce perceived waiting time, such as adding various fillers, text, music, animation, and games on the website's interactive interface, which have been proved to significantly reduce the perception of the wait (Lee et al., 2012; Oh & Sundar, 2015; Colleen, 2015). However, the current research on the influence of interactive interface on perceived waiting time focuses on websites (Mou et al., 2020), and there is a lack of research on mobile services.

Compare with the website interactive interface, the mobile interactive interface has distinctive attributes. First, it allows the user to contact the interactive interface anytime and anywhere through the mobile device. This is the first feature of mobile interactivity: ubiquitous connectivity. Second, when using a mobile application, a mobile device is convenient for the user to actively control the information search and acquisition in the application at any time. This is the second feature of mobile interactivity: active control. Finally, mobile applications' dialogue technology with people is becoming more and more humanized, and the response speed of the applications is getting faster and faster. This is the third feature of mobile interactivity: responsiveness. Therefore, the research results of waiting time in websites cannot be directly used in terms of mobile waiting. Although the role of web interactivity in reducing user-perceived waiting time has been confirmed by scholars, the impact of mobile interactivity on user-perceived waiting time is still to be verified.

Moreover, previous research focuses on the direct impact of technology and psychology on perceived waiting time. Few scholars study the interactivity as an environmental stimulus that affects the user's psychology. The Stimulus-Organism-Response model (Animesh & Pinsonneault, 2011) provides a complete framework for environmental stimuli to influence the user's psychological experience. As a stimulus in this framework, there is little relevant research on whether the three main features of mobile interactivity (Ubiquitous connectivity, active control, responsiveness) will affect

the users' psychological experience and thus affect users' evaluation of waiting time. In the previous studies, scholars have shown that perceived procedural justice can affect customers' cognitive state and psychological experience, and the effects of waiting time will be attenuated when waiting time procedures are perceived more equitable in the service recovery area (Voorhees and Baker, 2009). However, the important role of perceived procedural justice has not been fully studied in mobile waiting. Thus, to fill the research gaps above, this study answers the two questions:

- (1) Does mobile interactivity reduce the user's perception of waiting time? If so, what internal mechanism leads to a decrease in perceived waiting time?
- (2) Does perceived procedural justice play an important role in mobile waiting?

To address the research questions, the researchers develop a research model based on the Stimulus-Organism-Response framework and propose hypotheses by focusing on the flow theory and justice theory. The flow theory and justice theory will explain the psychological process of the effect of mobile interactivity on perceived waiting time. The researchers then collect samples from customers of ride-sharing applications to examine hypotheses. The results show that the three features of mobile interactivity have a significant negative effect on perceived waiting time, and cognitive absorption plays a mediating role. Further, perceived procedural justice positively moderates the relationship between cognitive absorption and perceived waiting time.

The contributions are as follows: (1) This paper fills the gap of mobile service waiting time research from the perspective of mobile application system designs. (2) The researchers extend the research field of the justice theory to the mobile service area and find the key factors that affect the function of flow theory in mobile services. (3) The researchers explore the influence of the internal mechanism of short-waiting application system designs on user-perceived waiting time.

## 2. THEORETICAL BACKGROUND

### 2.1. Stimulus-Organism-Response Model

Although the S-O-R model originates from environmental psychology, it was introduced into the retailing environment as early as 1994. Baker (1994) conceptualizes the stimuli as environmental cues in the retail environment, which include surrounding conditions, functional/esthetic design factors, and social factors. Researches of the S-O-R model in the retailing context show that the stimulus of the retailing environment affects the internal state of the customers, which in turn drives their behavior (Animesh et al., 2011). When used in the online commerce environment, the stimuli refer to the design features of the interface that the customers interact with (Eroglu & Machleit, 2010). The inner states represent the emotional and cognitive states of customers, containing their perceptions, experiences, and evaluations of the service (Jiang et al., 2010). The responses refer to customer attitude or behavior, such as purchase intention, product evaluation, service evaluation, and satisfaction (Sautter & Hyman, 2004).

The researchers use the S-O-R framework as the theoretical framework of our research for two reasons. (1) The S-O-R framework has been widely used as a theoretical framework in the online commerce environment to explain how website characteristics affect customer attitudes and behaviors (Animesh & Pinsonneault, 2011). (2) The previous research shows that the S-O-R framework provides a concise and clear framework to examine the effects of technological features as environmental stimuli on user intention and behavior (Luqman et al., 2017). In our research, ride-sharing mobile applications are artifacts with unique mobile interactive technological features, and these features surround customers and stimulate their intentions and behaviors. So the researchers apply the S-O-R framework to ride-sharing applications, to identify customer's psychological experience under the mobile interactive features and the consequence of such experience.

## 2.2. Mobile Interactivity Features as Environmental Stimuli (S)

A stimulus is something that provokes action (Bagozzi, 1986). Baker (1994) conceptualized the stimuli as environmental cues in the retail environment. According to Baker (1994), environmental cues include surrounding conditions, functional/esthetic design factors, and social factors. The customers' attitude toward the website and their behaviors can be predicted by studying the stimulating factors on them (Baker, 1994; Changchit, 2018; Hong, 2019). In our article, mobile interactivity is taken to represent the "stimuli" because it is one of the functions design factors, which will affect the customer's intention and behavior. Though there is no uniform definition of interactivity in academia, it is generally agreed that interactivity is the technical ability to create an interactive intermediary environment for people and machines based on communication technology, in which people and machines can communicate and exchange information (Kioussis, 2002).

Website interactivity mainly consists of three concepts: control, communication, and responsiveness. Control means the customer's degree of free control of the software platform, and it is related to the individual's contextual perception ability (Fortin, 2005). Communication refers to the individual's participation and the participatory process (Liu & Shrum, 2002). Responsiveness refers to the synchronicity and connectivity of the software platform (Deighton & Kornfeld, 2008).

The mobile application's significant feature of interactivity is mobility. Besides, there are four important features of mobile interactivity (Lee, 2005): connectedness, personalization, ubiquitous connectivity, and contextual offer. Connectedness emphasizes on providing consumers with unprecedented fluid interactivity. Personalization focuses mainly on creating customer profiles and developing interactivity relationships to meet individual needs. Ubiquitous connectivity is related to consumers, who get information or mobile services anytime and anywhere. The contextual offer focuses on the extent to which marketers provide customers with the best information or services related to their backgrounds based on their personal and time information (Yang & Lee, 2017).

Ubiquitous connectivity contains features of communication, synchronicity, connectivity, mobility, and contextual offer (Yang & Lee, 2017). It not only highlights the characteristics of mobile interactivity but also inherits and develops the interactivity features of websites. Whether it is mobile interactivity or website interactivity, users want to take the initiative to control, and this includes personalized features, which means that users will control the interface according to their personality and habits. Thus, the researchers argue that the second dimension of mobile interactivity is active control. After the active control, more attention is paid to the speed and efficiency of the interface response, so the researchers presume that mobile interactivity has three dimensions: ubiquitous connectivity, active control, and responsiveness.

The ride-sharing application is an artifact with unique mobile technological features, the customer interacts with the application system through the mobile interactive features and forms an assessment of these features. Ubiquitous connectivity, active control, and responsiveness are the three features of mobile interactivity, they capture various aspects of a customer's interactions with the mobile interactive interface that include customer and the technology factor. They do not only represent the mobile technology that supports interactions between customers and technology, but also the stimuli that can affect customers' intentions and behaviors.

## 2.2. Cognitive Absorption as Customers' Internal States (O)

The S-O-R model shows the impact of environmental stimuli on customer attitudes or behaviors, through the customer's experience of psychological feelings (Kamboj & Sarmah, 2018). In the online environment, the customer's experience of feelings is the process of psychological activities of customers after being stimulated by the technological features, which they interact with (Eroglu & Machleit, 2010).

The psychological activities refer to the individual's cognitive and emotional systems, containing an individual's perceptions, cognitive networks (Jiang et al., 2010). The customers' psychological process in an online environment similar to the flow theory (Jiang et al., 2010). Cognitive absorption

is developed from the theory of flow, and it describes a state of deep participation in software (Lin, 2009). Bozoglan and Demirer (2014) suggest that cognitive absorption is relevant to the intrinsic motivation of the user environment of information technology. It is a crucial cause of IT acceptance behavior and is often used to study virtual communities (Shoham & Brenčič, 2004). Hence, cognitive absorption is closely related to Internet use and can be used to explain the internal state of customers in the usage of mobile applications. Cognitive absorption has two dimensions: temporal dissociation and focused immersion.

- (1) Temporal dissociation is considered to be “the unable to record the passage of time when participating in the interaction (Tan et al., 2015. p747),” in mobile commerce, which refers to an individual’s inability to notice the passing of time while deeply involved in the mobile interactive interfaces (Agarwal & Karahanna, 2000).
- (2) Focused immersion is defined as the degree to which an individual participates in a task or object (Hess et al., 2006), referring to a fully engaging experience, in which other attentional needs are largely ignored (Agarwal & Karahanna, 2000). It is a highly engaging experience, in which people tend to ignore other disturbances at the time, indicating that an individual’s full attention resources are concentrated on a specific task, thereby reducing other cognitive burdens.

### **2.3. Perceived Waiting Time as a Response (R)**

In an online environment, customers expose to various technological features (Zha et al., 2014), which affect their intentions and behaviors. In our research, the perceived waiting time is the customers’ reaction after interacting with the mobile ride-sharing application, and it can be predicted by the technological features, such as ubiquitous connectivity, active control, and responsiveness.

Perceive waiting time refers to consumers’ subjective judgment of the elapsed time (Shchytko, 2018). The customers’ perception of the wait time changes with the external environment and individual demand factors (Krauser, 2015; Cao et al., 2019). Since personal factors are beyond the control of the business, it is only possible to control the situational factors to influence the perceived waiting time (Lee & Chen, 2019), and customers can reduce it by introducing environmental stimuli (Krauser, 2015). The more stimuli, the faster the perceived time pass. Under the background of mobile commerce, consumers judge and evaluate the perception of waiting time under the dual influence of mobile interactivity and personal reasons. In a short-waiting application, the length of the perceived waiting time is an important evaluation of customers after they are interacting with the interactive interface (Thompson et al., 1996), which is influenced by the interacting features. With the technological features customers are feeling less stressed about the waiting, thus perceive the time be shorter (Zakay, 1989; Shchytko, 2018). Hence, the researchers take the perceived waiting time as a response to the customer after interacting with mobile application interfaces.

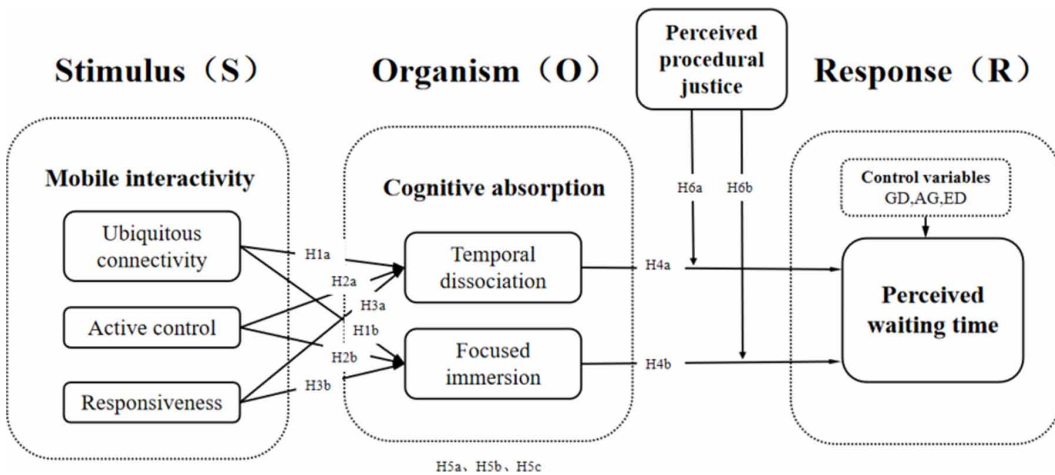
## **3. RESEARCH MODEL AND HYPOTHESES**

The research model is shown in Figure 1.

### **3.1. Mobile Interactivity (S) and Cognitive Absorption (O)**

In the short-waiting application context, consumers interact with mobile commerce platforms through the interactivity of the interface of mobile devices. These mobile interactive features may affect consumers’ psychological processes and lead to different attitudes and behaviors (Jiang et al., 2010). Therefore, the interactivity of the mobile application interface can be considered as environmental stimuli felt by consumers during the mobile commerce process (Liu & Shrum, 2009). Mobile interactivity allows users to mobilize their perception, movement, and cognitive abilities by interacting with the content provided by the interface (Alalwan, 2018), bringing a closer distance

Figure 1. Conceptual model



between the customer and the device. It provides a natural, real, and easy-to-operate interface that makes content more accessible to users when browsing (Oh & Sundar, 2015), and the user experience more heartwarming (Luo et al., 2016). Hence, mobile interactivity can create more positive attitudes and higher cognitive absorption (Oh & Sundar, 2015).

The ubiquitous connectivity is the convenience and pleasure that the device carrying the mobile application itself brings to the customer, which is the feeling that the computer can't bring. To a large extent, convenient, fast, and ubiquitous connectivity is the magic weapon that makes a mobile application stand out. Mobile applications move with mobile devices, and customers can use mobile applications no matter when and where they are. Therefore, the mobile device itself is an attraction, and combine with mobile applications that can work on any mobile device, it is convenient and fast, and naturally attracts the attention of customers. When customers use mobile applications, they can control and interact with the application interface anytime, anywhere. Ubiquitous connectivity will shift the user's attention from the waiting time to interacting with the mobile interface to create a sense of focused immersion (Oh & Sundar, 2015), creating a deeper customer involvement. When interacting with a mobile application, a customer may forget to pay attention to the time as they focus on the interactive interface, thus producing a sense of temporal dissociation, which is consistent with the competition for attention theory (Kahneman et al., 1973) and resource-allocation theory (Lee et al., 2017). One's energy is limited. When energy is occupied by one thing, it is difficult to concentrate on another thing. Therefore, the researchers hypothesize:

H1a: Perceived ubiquitous connectivity will positively affect temporal dissociation.

H1b: Perceived ubiquitous connectivity will positively affect focused immersion.

Active control involves the customer's perception of the degree of control over the mobile application interface. For example, the customer can choose the interface according to his or her preference, block the information that is not like, and the system will record the customer's choice, and push the information of interest to the customer when the interface is opened next time. The intrinsic motivation of the flow theory holds that individuals pursue what they do for their inner satisfaction. When customers perceive a high degree of control over the mobile application interface, they will feel a sense of satisfaction and feel integrate with the interactive interface, and this feeling will stimulate the customer's psychological experience and generate a kind of cognitive involvement, just like people who are immersed in mobile games. In this situation, customers are not interested in

other things at all. In such a state of self-satisfaction (Faiola, 2013), customers will feel empowered and controlled and in harmony with their surroundings (Tan & Lee, 2015). At this time, people will be immersed in the interactive interface, thus losing their sense of time (Csikszentmihalyi, 1988) and thereby creating a sense of temporal dissociation. Therefore, the researchers hypothesize:

H2a: Perceived active control will positively affect temporal dissociation.

H2b: Perceived active control will positively affect focused immersion.

As for the responsiveness, the response of the platform is related to whether it can attract customers' attention. When using the application, the customer has questions or needs to consult, can have a way to talk to the interface system, and the interface system can communicate with the customer in a timely and correct way. For example, the customer temporarily replaces the boarding address, and after the interface system inputs the information, the interface can respond to the customer and replace the address for the first time. When the customer triggers the alarm system, the interface system can respond and give the customer help for the first time. Customers may give a negative evaluation in the long process of waiting for the response of the platform and turn their attention elsewhere. However, when a platform responds to customers' instructions in a timely, synchronous, and with a quick manner, customers' attention will be attracted by the interactive interface, and they will be immersed in conversations with the interface, thus reducing their attention to the waiting time and creating a sense of temporal dissociation, which is consistent with competition for attention theory (Oh & Sundar, 2015). A customer's limited attention resources are assigned to non-time information processing and cognitive timers, reducing the ability of customers to track time. Therefore, the researchers hypothesize:

H3a: Perceived responsiveness will positively affect temporal dissociation.

H3b: Perceived responsiveness will positively affect focused immersion.

### **3.2. Cognitive Absorption (O) and Perceived Waiting Time (R)**

Temporal dissociation is the inability to notice the time. Researchers find that distractors will shift the customers' attention from the wait, inducing temporal dissociation, and thereby reducing the perceived waiting time (Shchytko, 2018). The greater it is caused by the distractors, the more it negatively affects customers' perception of waiting time in an online environment (Luo et al., 2015). It is consistent with the resource-allocation theory (Zakay et al., 2010). Since the customer's attention is limited, adding other non-temporal visual or auditory stimuli during the waiting can distract their attention and make customers unable to make a correct perception of the passage of time. In the context of short-waiting mobile applications, customer's attention is occupied by the interactive interface, and they may be unable to register the passage of time and perceive time goes by quickly, which will result in a reduction of the perceived waiting time (Lee et al., 2017). The direct negative effect of temporal dissociation on the perception of waiting time has been shown by Lee and Chen (2012). Therefore, the researchers hypothesize:

H4a: Temporal dissociation negatively affects perceived waiting time.

Focused immersion is a high involvement experience, in which people are usually unable to notice other disturbances at the interaction (Luo & Wang, 2015). Some teenagers' online gaming addictions are the typical example: with focus immersion they can forgets the time (Wan & Chiou, 2006). In online commerce environment, when customers are highly involved in interacting with the interface, they will forget themselves and lose their sense of time and themselves (Csikszentmihalyi, 1988). They get completely immersed in the interaction, thus ignoring other things around them,



including time, and thereby reducing the perceived waiting time. Lee et al. (2012) research the online waiting problem and conclude that focused immersion negatively affects the perception of the wait. The prior research revealed that there would be a main effect of immersion on the perception of time, and the customers' prospective duration judgment will decrease as the level of immersion increase (Ledbetter, 2016). Lee et al. (2017) use temporal information and distractor to distract customers' focused attention on waiting, proving the negative influence of focused immersion on the perception of waiting time once again. Therefore, the researchers hypothesize:

H4b: Focused immersion negatively affects perceived waiting time.

The mediating role of cognitive absorption. (1) Customers interact with the interactive interface, and their intention will be occupied by technological features, such as ubiquitous connectivity, active control, and responsiveness. Then fewer pulses pass through the cognitive counter, and they may be unable to record the passing of time and perceive a highly time distortion (Lee et al., 2017), that is, a sense of temporal dissociation. They may further perceive that time passed very quickly, thus reducing the perceived waiting time. (2) It is the same as the game users who experience higher levels of game immersion estimate perceive time to be lower (Wan & Chiou, 2006). When the customer interacts with a short-waiting application' interface, they will feel a highly interacting immersion. That is the feeling of focused immersion, which will make the perceived waiting time shorter (Li & Yuen, 2015). From what we have discussed above, the three interactive features will influence customers' cognitive absorption, and cognitive absorption will reduce the perceived waiting time. Therefore, the researchers hypothesize:

H5a: Ubiquitous connectivity indirectly affects perceived waiting time through the mediation of temporal dissociation and focused immersion.

H5b: Active control indirectly affects perceived waiting time through the mediation of temporal dissociation and focused immersion.

H5c: Responsiveness indirectly affects perceived waiting time through the mediation of temporal dissociation and focused immersion.

### **3.3. Perceived Procedural Justice as a Moderator**

Perceived procedural justice refers to the customer's sense of fairness on the rules and procedures used by the platform in dealing with the problem (Chou et al., 2016), as well as the evaluation of the procedures and systems that determine customer outcomes (Luo, 2007; Gohary et al., 2016). Previous studies show that procedural justice in online commerce is particularly significant when awakening cognitive reactions because service companies or sales representatives and customers typically do not have the chance to meet in reality (Voorhees et al., 2009). A customer's justice perception as a specific belief determines the psychological responses of customers' overall evaluation (Chih et al., 2017). Temporal dissociation and focused immersion are two kinds of cognitive states that customers display after interacting with a short-waiting application when wait. These cognitive states are affected by fair perception. When customers feel a highly fair procedure, they are more inclined to give a good evaluation (Choi et al., 2016). In this research, the overall evaluation is the perception of time.

Besides, social justice theory suggests that when a long wait is combined with an unfair procedure, customers' dissatisfaction increases, and then causing a multiplicative increase in negative evaluations of the wait (Voorhees et al., 2009). In this situation, even a short wait can make them feel long. But when customers feel that the procedures of wait are fair, they will feel waits are not so difficult to accept (Voorhees et al., 2009). This view is consistent with the appraisal theory. Appraisal theory holds that the customer consciously evaluates threats when they in a waiting situation if the waiting is evaluated as fair, they will not perceive much threat to them and will not negatively evaluate the

waiting (Lazarus, 1999; Voorhees et al., 2009). However, when customers perceive an unfair waiting procedure, the assessment of threats in the waiting will increase and the customer will distress and the perceived waiting time will increase accordingly. Customers believe they are treated more fairly when they perceive the provider follows a company formal procedure (Goodwin, 1990). In the context of waiting for a ride-sharing application when this wait properly complies with the ride-sharing application platform procedures, the customer will also consider themselves to be treated fairly. Here, the moderate function of perceived procedural justice plays a role. Therefore, the researchers hypothesize:

H6a: Perceived procedural justice acts as a moderator between temporal dissociation and perceived waiting time.

H6b: Perceived procedural justice acts as a moderator between focused immersion and perceived waiting time.

## 4. RESEARCH METHODS

### 4.1. Instrument

The Likert seven-point scale was used to compile the questionnaire and obtain samples through the questionnaire survey of users of mobile ride-sharing applications. The indicators used to measure mobile interactivity were adapted from Lee (2005), Yang and Lee (2017), Liu (2003), and Gao (2010). The indicators used to measure cognitive absorption were adapted based on Saadé and Bahli (2005) and Tan (2015), and the indicators used to evaluate perceived procedural justice were adapted based on del Rio-Lanza (2009). Finally, the indicators used to evaluate perceived waiting time were adapted based on Voorhees et al. (2009). Measurement items are seen in Table 3.

All scales used are mature scales, and two doctoral students with high English proficiency in the field were invited to translate the English scale into Chinese, then translate it from Chinese into English, repeat the operation, repeatedly correct the ambiguous words, modify the scale according to the practical characteristics and conditions of the ride-sharing application and revise it. According to the characteristics of users of the mobile ride-sharing application, gender, age, and education level were selected as control variables (Lee et al., 2017).

### 4.2. Data Collection

First, we selected users who had used ride-sharing applications. Second, we set up reverse questionnaires to test the effect of respondents' responses. Besides, we motivated the respondents with cash and small gifts to answer questions. Finally, although the questionnaires all adapted from mature scales, the researchers still pretested before the formal survey.

The researchers collected questionnaires offline in the pretest. 100 questionnaires were randomly distributed to ride-sharing application users, and 92 questionnaires were collected. Nine invalid questionnaires were eliminated for the reasons either that questionnaires are incomplete, or that respondents are not the users of ride-sharing applications. The reliability and validity of the 81 questionnaires were tested. In the pretest, the KMO value of mobile interactivity, cognitive absorption, perceived waiting time, and perceived procedural justice are 0.859, 0.746, 0.836, 0.822, respectively, all of which are larger than 0.5, and the probability of concomitant ball test is 0 (Nunnally, 1978), indicating that the results of this investigation are suitable for factor analysis. The factor load of each item of the variables is more than 0.5 (Chin, 1997), and there is no significant cross load problem. Therefore, the scale has a good validity structure. Then the researchers conducted a formal survey.

In the formal survey, 600 questionnaires were randomly sent out among ride-sharing application users online and offline. We motivated online respondents with cash and offline respondents with small gifts offline to answer the questions. Our ANOVA test showed no significant difference between

online and offline data. To mitigate the risk of homologous errors, the survey was conducted three times, two months apart, for a total of four months, and 569 were eventually recovered, with a response rate of 94.8%. Then, we eliminated the invalid questionnaires, including the questionnaires which are not filled by ride-sharing applications users, the questionnaires with missing data. Finally, 468 effective data were screened out. The users of ride-sharing applications are mainly young people under 35 years old, accounting for 98.5%. Among the respondents of the questionnaire, 86.7% were the users of the Didi and Uber taxi application, followed by the Quick taxi 8.93% and Shenzhou special car 2.68%. Demographics of the research samples are in Table 1.

**Table 1. Demographics of the research samples (N=468)**

Demographic profile	Categories	Frequency	Percent (%)
Gender	Male	170	36.3
	Female	298	63.7
Age	<25	173	36.9
	25-35	285	61.6
	35-45	8	1.1
	>45	2	0.4
Education	Junior college and below	88	18.75
	Undergraduate	125	26.79
	Master graduate student	242	51.79
	The doctor and above	13	2.68
Service application	Didi and Uber	406	86.7
	No.1 special car	0	0
	EasyGo	5	0.89
	Ttyongche	5	0.89
	A quick taxi	42	8.93
	Shenzhou special car	14	2.68

Finally, to avoid the threat of the common method bias, Harman’s single factor test was implemented to examine it. The most significant factor in the seven factors extracted from the data accounted for only 36.398%. So the common method bias is not a threat to this study.

## 5. ANALYSIS AND RESULTS

### 5.1. Measurement Model Test

In this research (see in Table 3), the Cronbach’s alpha values of the constructs are above 0.8, the composite reliability (CR) of the constructs is between 0.80 and 0.95, all above the recommended level of 0.7, thus indicating that our scale has good reliability. The validity of our scale shown in Table 3, all the standardized factor loadings were higher than 0.7 ( $p < 0.001$ ), and all the AVE values were higher than 0.6, implied a good convergent validity. Then the discriminant validity was evaluated by comparing the AVE and the correlation between a variable and other variables. Table 2 shows

Table 2. Results of correlation and discriminant validity testing

	UC	AC	RS	TD	FI	PJ	PW
UC	<b>0.806</b>						
AC	0.467**	<b>0.775</b>					
RS	0.419**	0.477**	<b>0.933</b>				
TD	0.395**	0.351**	0.328**	<b>0.794</b>			
FI	0.415**	0.472**	0.528**	0.384**	<b>0.825</b>		
PJ	0.096*	0.074	0.054	0.011	0.092*	<b>0.979</b>	
PW	-0.532**	-0.538**	-0.656**	-0.440**	-0.548**	-0.228**	<b>0.825</b>

Note: 1. \*\*\*p<0.001, \*\*p<0.01, \*p<0.05;  
 2. UC: Ubiquitous connectivity; AC: Active control; RS: Responsiveness; TD: Temporal dissociation; FI: Focused immersion; PJ: Perceived procedural justice; PW: Perceived waiting time.

that the square root of the AVE for each construct is larger than the correlations, thus indicating that discriminant validity is acceptable.

## 5.2. Hypothesis Testing

A structural model established in AMOS (23.0), the results as shown in Figure 2 and Table 4. The path coefficient between ubiquitous connectivity and temporal dissociation ( $\beta = 0.243$ ,  $p < 0.001$ ) supports H1a. The path coefficient between active control and temporal dissociation ( $\beta = 0.163$ ,  $p < 0.01$ ) and the path coefficient between responsiveness and temporal dissociation ( $\beta = 0.095$ ,  $p < 0.05$ ) support H2a and H3a. Next, the path coefficient between ubiquitous connectivity, active control, responsiveness, and focused immersion is ( $\beta = 0.161$ ,  $p < 0.01$ ), ( $\beta = 0.338$ ,  $p < 0.001$ ), ( $\beta = 0.354$ ,  $p < 0.001$ ), so H1b, H2b, and H3b are supported. Finally, the effect of temporal dissociation on perceived waiting time ( $\beta = -0.141$ ,  $p < 0.01$ ) and the focused immersion on perceived waiting time ( $\beta = -0.125$ ,  $p < 0.01$ ) were both found to have a significant negative effect, thus supporting H3a and H3b. The explained variances ( $R^2$ ) for perceived waiting time were 67%. The model fit indices, including  $\chi^2/df$  (2.733), RMSEA (0.061), CFI (0.955); TLI (0.945); AGFI (0.890); NFI (0.931), and IFI (0.955), implied good explanatory power (Lee, 2012).

Then, Table 5 shows that the direct effect of ubiquitous connectivity on perceived waiting time ( $\beta = -0.594$ ,  $T = 10.906$ ,  $p < 0.001$ ) is significant, but when the indirect effect of temporal dissociation and focused immersion are introduced ( $\beta = -0.314$ ,  $T = 5.657$ ,  $p < 0.001$ ), the direct effect is reduced, suggesting temporal dissociation ( $\beta = -0.190$ ,  $T = 3.84$ ,  $p < 0.001$ ) and focused immersion ( $\beta = -0.404$ ,  $T = 7.93$ ,  $p < 0.001$ ) having a mediated effect. Next, Sobel (1982) test is used to further test the mediated effect. The results indicate that temporal dissociation ( $Z = 7.59$ ,  $p < 0.001$ ) and focused immersion ( $Z = 7.58$ ,  $p < 0.001$ ) have a significant mediated effect. The bootstrap 95% confidence intervals for temporal dissociation (-0.206 to -0.078) and focused immersion (-0.277 to -0.131) do not contain zero, so the indirect effect exists. Thus, H5a is verified.

Next, Table 5 shows that the direct effect of active control on perceived waiting time ( $\beta = -0.623$ ,  $T = 10.806$ ,  $p < 0.001$ ) is significant, but as the indirect effect of temporal dissociation and focused immersion are introduced ( $\beta = -0.330$ ,  $T = 5.52$ ,  $p < 0.001$ ), the direct effect is reduced, which suggests that temporal dissociation ( $\beta = -0.219$ ,  $T = 4.56$ ,  $p < 0.001$ ) and focused immersion ( $\beta = -0.357$ ,  $T = 6.62$ ,  $p < 0.001$ ) have a mediated effect. The Sobel (1982) test was used to further examine the mediated effect. The outcomes indicate that temporal dissociation ( $Z = 6.86$ ,  $p < 0.001$ ) and focused immersion ( $Z = 5.26$ ,  $p < 0.001$ ) have a mediated effect. The bootstrap 95% confidence

Table 3. Measurement model evaluation result

Construct	Indicators	loading	AVE	CR	Alpha
Ubiquitous Connectivity	I can access this ride-sharing application anytime for the necessary information and service	0.767	0.65	0.84	0.878
	I can access this ride-sharing application anywhere for the necessary information and service	0.793			
	I can use this ride-sharing application “anywhere”, “anytime” at the point of need	0.802			
	This ride-sharing application enables me to order taxi services anywhere at any time	0.726			
Active control	I felt that I had a lot of control over my visiting experiences at this ride-sharing application	0.767	0.60	0.83	0.902
	While I was on the ride-sharing application, I could choose freely what I wanted to see	0.793			
	While using the ride-sharing application, I had no control over what I can do on the ride-sharing application platform	0.802			
	While using the ride-sharing application, my current actions will be determined by the kind of experiences I got in the past	0.726			
Responsiveness	This ride-sharing application could respond to my specific questions quickly	0.929	0.87	0.89	0.930
	This ride-sharing application could respond to my specific questions relevantly	0.936			
Temporal dissociation	Time appears to go by very quickly when I am using the ride-sharing application	0.748	0.63	0.80	0.834
	Time flies when I am using the ride-sharing application	0.839			
	Sometimes I lose track of time when I am using the ride-sharing application	0.787			
Focused immersion	When I am using the ride-sharing application I can block out most other distraction	0.855	0.68	0.81	0.865
	While using the ride-sharing application, I am absorbed in what I am doing	0.821			
	While using the ride-sharing application, I am immersed in the service I am performing	0.807			
Perceived procedural justice	I think my problem in the ride-sharing application was resolved in the right way	0.991	0.96	0.95	0.990
	I think this ride-sharing application has good policies and practices for dealing with problems	0.989			
	Despite the trouble caused by the problem, this ride-sharing application was able to adequately respond to me	0.973			
	This ride-sharing application proved flexible in solving the problem	0.968			
Perceived waiting time	Short 1 2 3 4 5 6 7 Long	0.812	0.68	0.88	0.894
	Unacceptable 1 2 3 4 5 6 7 Acceptable	0.876			
	Brief 1 2 3 4 5 6 7 Lengthy	0.814			
	Reasonable 1 2 3 4 5 6 7 Unreasonable	0.787			

Figure 2. Results of the research model tests Note:\*\*\*p < 0.001, \*\*p < 0.01, \*p < 0.05

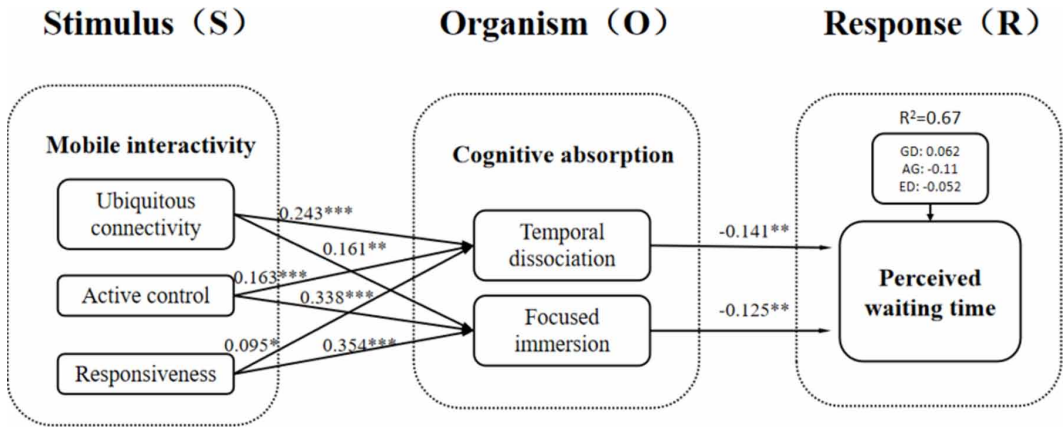


Table 4. Standardized parameter estimates

Structural path	Path analysis	T value	Result
H1a: Ubiquitous connectivity ---> Temporal dissociation	0.243***	5.192	Supported
H2a: Active control ---> Temporal dissociation	0.163***	2.617	Supported
H3a: Responsiveness ---> Temporal dissociation	0.095*	2.36	Supported
H1b: Ubiquitous connectivity ---> Focused immersion	0.161**	2.879	Supported
H2b: Active control ---> Focused immersion	0.338***	4.355	Supported
H3b: Responsiveness ---> Focused immersion	0.354***	7.000	Supported
H4a: Temporal dissociation ---> Perceived waiting time	-0.141**	2.847	Supported
H4b: Focused immersion ---> Perceived waiting time	-0.125**	3.065	Supported

Note:\*\*\*p < 0.001, \*\*p < 0.01, \*p < 0.05

Table 5. Results of mediation test

Constructs			Path coefficient				Mediation existence
Independent variable (X)	Mediator (M)	Dependent variable (Y)	X—Y	X—M	X+M—Y		
					X—Y	M—Y	
UC	TD	PW	-0.594***	0.485***	-0.314***	-0.190***	Partial
	FI			0.466***		-0.404***	
AC	TD	PW	-0.623***	0.433***	-0.330***	-0.219***	Partial
	FI			0.557***		-0.357***	
RS	TD	PW	-0.740***	0.384***	-0.526***	-0.205***	Partial
	FI			0.589***		-0.230***	

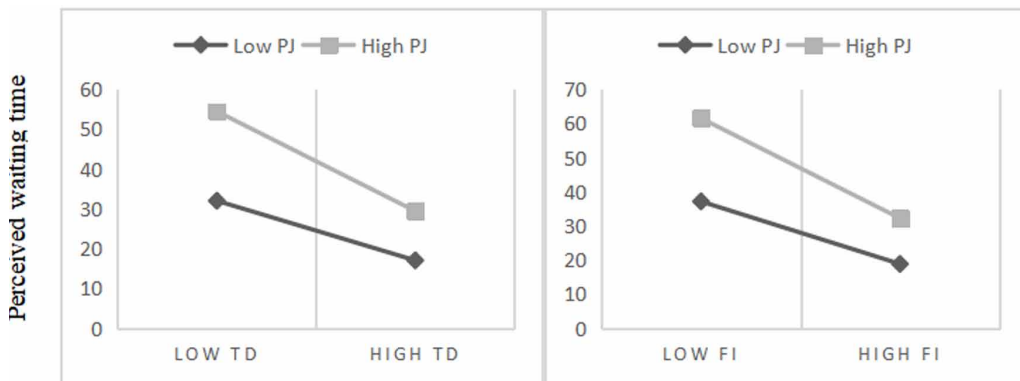
Note:(1) \*\*\*p < 0.001, \*\*p < 0.01, \*p < 0.05;  
(2) UC: Ubiquitous connectivity; AC: Active control; RS: Responsiveness; TD: Temporal dissociation; FI: Focused immersion; PW: Perceived waiting time.

intervals for temporal dissociation (-0.193 to -0.066) and focused immersion (-0.312 to -0.148) do not contain zero, so there is an indirect effect. Therefore, H5b is verified.

Furthermore, the direct effect of responsiveness on perceived waiting time ( $\beta = -0.740$ ,  $T = 15.28$ ,  $p < 0.001$ ) is significant, but when the indirect effect of temporal dissociation and focused immersion are introduced ( $\beta = -0.526$ ,  $T = 10.29$ ,  $p < 0.001$ ), the direct effect is reduced, suggesting that temporal dissociation ( $\beta = -0.205$ ,  $T = 4.64$ ,  $p < 0.001$ ) and focused immersion ( $\beta = -0.230$ ,  $T = 4.63$ ,  $p < 0.001$ ) have a mediated effect. The Sobel (1982) test is used to further examine the mediated effect. The results indicate that temporal dissociation ( $Z = 9.39$ ,  $p < 0.001$ ) and focused immersion ( $Z = 6.04$ ,  $p < 0.001$ ) have a mediated effect. The bootstrap 95% confidence intervals for temporal dissociation (-0.154 to -0.049) and focused immersion (-0.256 to -0.102) do not contain zero. Hence, H5c is also supported.

Finally, the moderate influence of procedural justice on the relationship between temporal dissociation and perceived waiting time is significant ( $\beta = 0.012$ ,  $p < 0.05$ ), showing that H6a is supported. The moderating effect is shown in Figure 3(left). The moderate influence of procedural justice on the relationship between focused immersion and perceived waiting time is also significant ( $\beta = 0.017$ ,  $p < 0.001$ ), wherein H6b is supported. The moderating effect is shown in Figure 3 (below).

Figure 3. The moderation effect Note: TD: Temporal dissociation; FI: Focused immersion; PJ: Perceived procedural justice.



## 6. DISCUSSION

Despite being an important part of online waiting, the existing literature rarely mentions the mobile waiting left a research gap in the information system literature and e-commerce. To fill the gap, the researchers using the flow theory and justice theory in the framework of the Stimulus-Organism-Response paradigm to investigate the influence of mobile interactivity on mobile waiting. The results provide initial evidence that mobile interactivity can directly and indirectly (via cognitive absorption) affects the customer's perceived waiting time and these effects are moderated by perceived procedural justice.

Specifically, the research first demonstrates that mobile interactivity can directly reduce the perceived waiting time. Ubiquitous connectivity, active control, and responsiveness do not only add value to customer's wait but also engage customers to the wait, and thereby reducing perceived waiting. Second, the researchers demonstrate how mobile interactivity influence perceived time through cognitive absorption. Specifically, the customers will experience a significant sense of temporal dissociation and focused immersion when interacting with the interactive interface and

reducing perceived waiting. Third, the results also confirm that perceived procedural justice is a crucial moderate factor in manage mobile waiting.

### 6.1. Theoretical Implications

The theoretical implications as follows:

First, the rapid development of global mobile information technology promotes the emergence of mobile commerce and mobile applications, and the research on the waiting problem of mobile applications not only fills the gap of wait management in mobile commerce but also makes a certain contribution to the further development of global mobile information technology and the prosperity of mobile commerce. (1) This paper contributes to the information system literature development by presenting a valuable tool - mobile interactive system designs, as a way to manage the customer's perceived waiting time in the mobile application. (2) This paper contributes to the m-commerce theoretical development by providing a strong theoretical explanation for the internal mechanism of the influence of mobile interactivity on perceived waiting time.

Second, by systematically examining online wait in a mobile commerce environment, the researchers extend the theoretical boundaries of online wait research from e-commerce to m-commerce. Although many scholars study waiting and make great contributions to e-commerce (Weinberg, 2000; Dennis & Taylor, 2006), it has not been fully studied in the m-commerce. The researchers develop and test a model to manage the perceived waiting time in the mobile application environment, and make significant progress in deepening the m-commerce wait time literature.

Third, this research introduces cognitive absorption, justice, and flow theory into the mobile commerce environment. It not only expands the application scenarios of these theories, enriches the theoretical literature, but also helps solve the waiting problem of ride-sharing applications and promote the prosperity development of mobile commerce. Specifically: (1) We expand the cognitive absorption research boundary from the website to mobile application and enrich the cognitive absorption theoretical advancement by confirming its new antecedents (ubiquitous connectivity, active control, and responsiveness). (2) This study extends the research boundary and enriches the literature of justice theory by introducing it into the mobile commerce environment. (3) This study deeply analyzes the key factors that affect the function of flow theory in waiting in mobile commerce is cognitive absorption, which mainly refers to temporal dissociation and focused immersion.

### 6.2. Practical Implications

The practical implications are as follows:

First, the results of this study on mobile ride-sharing applications are not only applicable to China, but also have the potentials to be applied to a range of countries because there is a waiting problem for ride-sharing application in many countries. Such as Yandex Taxi in Russia, Uber, Sidecar, Zipcar, and Lyft in the United States, Blablacar in France, and Ola in India. Waiting is also a problem in these ride-sharing applications, the results are also applicable to these ride-sharing applications. Therefore, the role of the interactive interface in reducing perceived waiting time is also applicable to the mobile commerce environment and information systems of other countries in the world.

Second, the results confirm that mobile interactive technological features can directly reduce the customers' perceived waiting time. Therefore, the researchers propose: (1) Developers of short-waiting application systems should pass the full range of equipment testing, ensure that customers can use the application unimpeded in different operating systems and different types of mobile devices, and ensure the connectivity of different interactivity interfaces. (2) Designers of application's interactive systems should fully consider the customer's active control, ensure that the information display of interactive interface is more comprehensive and the information classification is more accurate and specific, and enable customers to have better control of the information search and acquisition process, thereby increasing their attention on the interactive interface to reducing their perceived waiting time. (3) Managers of the mobile service platform should notice the responsiveness. The responsiveness



involves speed and correctness. Developers of mobile short-waiting applications should design a program that responds instantly and correctly to the user's instructions. Ensuring the synchronization of the user's input and the response received from the platform to divert customers' attention and reducing their perceived waiting time.

Third, this study finds that perceived procedural justice can positively moderate the relationship between cognitive absorption and perceived waiting time. This finding suggests to the practitioners and service managers of short-waiting applications, a fair procedure should be placed in the system in addition to interactive considerations. Specifically, service managers should explain the priorities of the wait for all the customers and make sure that all of the waiting is fair. The service managers can appropriately disclose the operating rules of the platform, such as appropriately disclosing the price, the order of the peak period, the authority of different levels of users, and more. Letting customers perceive procedural justice and reduce perceived waiting time.

## **7. LIMITATIONS, FUTURE RESEARCH, AND CONCLUSION**

Although this study provides some theoretical and practical implications, it has some limitations: this study collected data from ride-sharing application users, so they may not fully represent other short-waiting applications. Furthermore, the current research focuses on the characteristics of the interactivity features in short-waiting applications. Therefore, it may not be suitable for long-waiting applications.

The researchers also discuss future research directions: First, it is interesting to study mobile waiting based on the specific characteristics of different industries, such as takeout applications, daily fresh applications. Second, it is interesting to choose different research methods to study mobile waiting, such as case study, experimental study, and mixed-method approach with combining qualitative and quantitative researches. Third, researchers could study the impact of interactive interfaces on perceived waiting time before or after waiting. For example, does the influence of interactive interfaces on perceived waiting time change after customers exiting the interface?

In summary, the researchers reveal the significant influences of mobile interactivity on perceived waiting time, and also confirm the important role of cognitive absorption and perceived procedural justice. The researchers provide a basis for a theoretical model of mobile waits and are conducive to the extension of the waiting theory. This research also helps to the analysis of the system interactive placements design factors and the understanding of the user's psychological factors in waiting time.

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