PHONE CALL WHILE RIDING AMONG DELIVERY WORKERS: THE APPLICATION OF THE THEORY OF PLANNED BEHAVIOR

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With the rapid growth of online food delivery services, the population of delivery workers has reached 13 million in China. Most of them use electric bicycles (e-bikes) as their primary transportation tool. On the other hand, mobile phone call (MPC), as the primary and most effective communication method for delivery workers, induces distracted riding and threatens traffic safety. Although MPC has been extensively investigated in driving-related research, MPC among delivery workers has not yet been investigated. In this study, a questionnaire based on the theory of planned behavior has been designed to investigate social-psychological factors leading to MPC among delivery workers. 150 delivery workers participated in this study. The structural equation model method was adopted to analyze the data. The results show that injunctive norm is positively associated with MPC behaviors; but descriptive norm is negatively associated with MPC behaviors, potentially because of the selective perception phenomenon.

INTRODUCTION

Online food delivery, as a pivotal part of the fast-developing Online-to-Offline market in China, has had a tremendous and continuous expansion since 2011. Based on the report in 2022, the user population of online food delivery has reached 544 million in China (China Internet Network Information Center, 2022). Correspondingly, over 13 million online delivery workers in China enabled billions of delivery orders per year, which is still increasing (Sina Finance, 2022). In delivery tasks, delivery workers often travel through congested and narrow urban roads to carry ordered goods. The major online food delivery platforms, such as Meituan and Eleme, usually guarantee delivery within 30-60 minutes in urban areas. Thus, electric bicycles, or e-bikes, with two wheels and a rechargeable battery, are the best transportation tools for delivery workers considering their relatively high speed, high flexibility, and low cost (Wang et al., 2021).

At the same time, to shorten the waiting time for the merchants and customers, delivery workers may communicate with the corresponding agents in advance to confirm the delivery address and special needs. The merchants or customers may also contact delivery workers for special requirements, such as changing delivery addresses or asking to pick up missed items. Although there is no time limit for responding to these work-related calls, delivery workers are still motivated to make phone calls (MPC) while riding e-bikes to improve work efficiency. In addition, due to the long working hours (10 to 12 hours per day on average, Beijing Social Work Development Center for Facilitators, 2021), delivery workers may also need to handle non-working-related affairs during work and thus may call their family or friends while riding. Although we currently have no accurate statistics, MPC while riding has become widespread in big cities in China. In general, using electronic devices (e.g., music players and mobile phones) can impair the riding performance (e.g., peripheral vision detection) of motorcycle and bicycle riders (Ahlstrom et al., 2016; de Waard et al., 2011). MPC while riding among delivery workers, although not being studied specifically, is very likely to introduce distractions to delivery workers and hence may impair riding safety. What is worse, delivery workers have to ride through complex urban road networks, where there is no designated lane for e-bikes, and thus they may share the road with pedestrians. Hence, distracted riding may also threaten the safety of pedestrians.

At the same time, it should be noted that, although being work-related, MPC while riding among delivery workers is still a voluntary self-paced task – riders could stop riding without blocking traffic anytime to make phone calls. Considering no traffic laws forbidding MPC while riding in China, social-psychology factors may play a vital role in regulating such behaviors. Previous research on distracted driving may provide us with some insights into the motivations for distracted riding. For example, based on the theory of planned behavior (TPB), Merrikhpour et al. (2017) found that social-psychological factors are highly associated with MPC behaviors while driving. The TPB has been traditionally used to explain the motivations of specific behaviors, in which it assumes that "*attitudes toward the behavior, subjective norm, and perceived control*" can predict the "*intentions to perform behaviors*" with high accuracy (Ajzen, 1991). Chen et al. (2016) further expanded the TPB by separating subjective norm (also known as the social norm) into injunctive norm (IN, i.e., expectations from important others) and descriptive norm (DN, i.e., what important others always do) and found that both worked when explaining distracted driving behaviors.

It should also be noted that delivery workers may use hands-free devices (e.g., earphones) to make phone calls, which

can make it easier to answer a phone call while riding. However, according to driving-related research (Holland & Rathod, 2012; Backer-Grøndahl & Sagberg, 2011), both hand-held and hands-free phones can impair driving performance. Thus, in our study, we did not differentiate the mode of a phone call.

In summary, in a survey study, we applied the extended TPB model (Chen et al., 2016) to explore the social-phycological factors as well as other demographic and driving/riding-related factors leading to MPC while riding among delivery workers. A structural equation model (SEM) was built, and the contribution of each factor was quantified.

Based on the TPB framework, the following hypotheses were proposed in this study (Figure 1):

H1. ATT is positively associated with MPC behavior.

H2. IN is positively associated with MPC behavior.

H3. DN is positively associated with MPC behavior.

H4. PBC is positively associated with MPC behavior.

H5. Associations exist among attitude (ATT, i.e., positive or negative evaluation of the behavior), IN, DN, and perceived behavior control (PBC, i.e., perceived difficulty in performing the task).

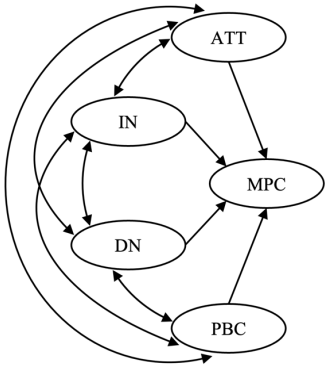

Figure 1. The proposed TPB model applied in this study.

METHOD

Data collection and description

To collect data, a questionnaire based on the TPB framework was designed and distributed to delivery workers in Guangzhou, China. We recruited 150 delivery workers (146 males and 4 females, mean age 27.25) who are officially registered in either Meituan or Eleme (two dominant online food delivery platforms) through a face-to-face approach. A cup of soft drink was provided to each participant in this study. This study has been approved by the Human and Artefacts Research Ethics Committee in HKUST (HREP-2022-0106).

Overall, the questionnaire consists of two parts:

Part 1: Demographics. As exogenous variables (non-social-psychological factors) may also be associated with measurement items and latent variables in SEM, in this part, we collected demographic information of the delivery workers, as summarized in Table 1.

Part 2: TPB-related Factors. We collected participants' responses to TPB-related factors regarding MPC engagement while riding e-bikes. Following Ajzen (1991), the ATT and PBC were collected. Further, following Chen et al. (2016), we separated social norm into IN and DN. In total, 15 MPC- related questions were asked, as listed in Table 2.

Table 1. Demographic information of participants

Variables	Descriptions	Percentage
Gender	Male	97.3%
	Female	2.7%
Age	1. 18-23	30%
	2. 24-29	34.7%
	3. 30-35	26.7%
	4. ≥36	8.7%
Educational background	1. Middle school or below	24%
	2. High school	54.7%
	3. Junior college / University or higher	21.3%
Household income (RMB)	1. <50,000	39.3%
	2. 50,000-100,000	36.7%
	3. 100,000-200,000	20%
	4. ≥200,000	4%
Working experience as delivery workers	1. <3 months	18%
	2. 3 months-1 year	28%
	3. 1-2 years	22.7%
	4. 2-3 years	16.7%
	5. >3 years	14.7%
Number of delivery orders per week	1. <200	22.7%
	2. 200-300	54%
	3. 300-400	15.3%
	4. ≥400	8%
Driving license & experience for vehicle	1. No driving license	33.3%
	2. <3 years	25.3%
	3. ≥4 years	41.3%
Crash & accident while working	1. 0	44.7%
	2. 1-2	32.7%
	3. ≥3	22.7%
Traffic violation with warning or penalty while working	1. 0	39.3%
	2. 1-2	40.7%
	3. ≥3	10%
Hands-free holder for cellphone on e-bike	1. Without	8.7%
	2. With but not always use it	22%
	3. With and always use it	69.3%
Earphone using while working	1. Never	35.3%
	2. Seldom	17.3%
	3. Sometimes	12%
	4. Usually	18%
	5. Always	17.3%

Analytical methods

An SEM was constructed to test the hypothesized relationships among the variables of interest. As a commonly used statistical method, SEM combines multiple regression analysis, factor analysis, and path analysis to build a covariance matrix (Jiang et al., 2019). We applied the two-step process suggested by Anderson & Gerbing (1988) for data analysis.

Firstly, Confirmatory Factor Analysis (CFA), including the reliability and validity analysis, was conducted by the measurement model to measure the accuracy and stability of the questionnaire results (Golafshani, 2003). The reliability was measured by Cronbach's α coefficient and composite reliability (CR). Then, the average variance extracted (AVE) was used to measure the convergent validity, which assesses whether the same construct has strongly correlated scores in the different measurements of indicators (Subhan et al., 2021). Finally, the path coefficients were calculated from the SEM to test our hypotheses. Besides, to account for the influence of demographical factors on the latent variables, all variables collected in Part 1 of the questionnaire were analyzed in the SEM model as exogenous variables.

Table 2. TPB-related questions

Constructs	Measure items	Response range
ATT	ATT1: For me, it is alright to answer phone call with cell phone in hand while riding.	1. Strongly disagree; 5. Strongly agree;
	ATT2: For me, it is alright to answer phone call with hand-free devices or earphone while riding.	
	ATT3: For me, it is alright to operate cell phone while riding.	
IN	IN1: People who are important to me think it alright to answer phone call with cell phone in hand while riding.	1. Strongly disagree; 5. Strongly agree;
	IN2: People who are important to me think it alright to answer phone call with hand-free devices or earphone while riding.	
	IN3: People who are important to me think it alright to operate cell phone while riding.	
DN	DN1: Most of my colleagues think it alright to answer phone call with cell phone in hand while riding.	1. Strongly disagree; 5. Strongly agree;
	DN2: Most of my colleagues think it alright to answer phone call with hand-free devices or earphone while riding.	
	DN3: Most of my colleagues think it alright to answer phone call with cell phone in hand while riding.	
PBC	PBC1: I believe I can ride safely while answering phone call with cell phone in hand.	1. Strongly disagree; 5. Strongly agree;
	PBC2: I believe I can ride safely while answering phone call with hand-free devices or earphone.	
	PBC3: I believe I can ride safely while operating cell phone.	
MPC	MPC1: How often do you answer phone call with customers while riding?	1. Never 5. Very often or always
	MPC2: How often do you answer phone call with merchants while riding?	
	MPC3: How often do you answer phone call with family members, friends, or others while riding?	

RESULTS

Measurement model

As shown in Table 3, the Cronbach'α coefficients range from 0.634 to 0.856, and the CR values range from 0.669 to 0.860, both exceeding the acceptable threshold of 0.6 (Griethuijsen et al., 2014; Ursachi et al., 2015). As for the AVE, generally, it should be over 0.5 (Hulland, 1999); but an AVE of 0.4 is also acceptable if the CR is higher than 0.6 (Fornell & Larcker, 1981). Thus, the AVE and CR in our study are acceptable. However, it should be noted that we have a relatively low factor loading (0.342) for PBC2. In general, we would expect a factor loading of over 0.4 (Stevens, 1992). Considering we have a relatively small sample size and a limited number of measurement items for each latent variable, we still decided to keep the PBC2 in the model. But the readers should be cautious when interpreting the results.

Table 3. Reliability and convergent validity of the research model

Constructs	Items	Factor loadings	Cronbach's α	CR	AVE
ATT	ATT1	0.661	0.634	0.681	0.430
	ATT2	0.432			
	ATT3	0.816			
IN	IN1	0.851	0.796	0.802	0.576
	IN1	0.671			
	IN3	0.745			
DN	DN1	0.865	0.856	0.860	0.762
	DN2	0.738			
	DN3	0.851			
PBC	PBC1	0.778	0.639	0.672	0.430
	PBC2	0.342			
	PBC3	0.753			
MPC	MPC1	0.630	0.670	0.669	0.405
	MPC2	0.711			
	MPC2	0.599			

Structural model

Following the measurement model, the structured model was constructed (Figure 2). We first examined the model fit. Table 4 provides the indices as well as their acceptable thresholds. The model fit indices we adopted include chi-square with degrees of freedom ($\chi 2/df$), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative fit index (CFI), incremental fit index (IFI), and Root Mean Square Error of Approximation (RMSEA). All the indices met the criteria, indicating good model fitness.

Table 4. Model fit of the SEM

Fit index	Standard value	Measured value
χ^2/df	<3	2.078
GFI	>.8	.871
AGFI	>.8	.804
CFI	>.9	.913
RMSEA	<.3	.085

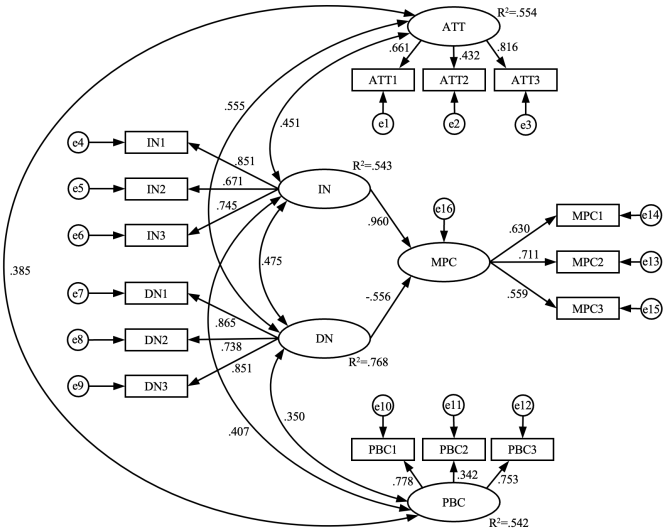

Figure 2. The results of SEM.

Then, in Table 5, we provide the statistics of the regression weights among latent variables, and Table 6 lists the correlations between exogenous variables and latent variables. It should be noted that due to the very unbalanced gender ratio of the delivery workers, we did not account for the effect of gender in the model.

Table 5. Regression weights of the constructs in the model

Path	Estimate	S.E.	CR	p-value	Hypothesis
H1: ATT → MPC	-	-	-	-	Not supported
H2: IN → MPC	.960	.226	4.312	***	Supported
H3: DN → MPC	-.556	.162	-2.922	.003	Supported
H4: PBC → MPC	-	-	-	-	Not supported
H5: ATT ↔ IN	.451	.075	6.005	***	Supported
ATT ↔ DN	.555	.088	6.311	***	
ATT ↔ PBC	.385	.074	5.182	***	
IN ↔ DN	.475	.082	5.767	***	
IN ↔ PBC	.407	.078	5.251	***.	
DN ↔ PBC	.350	.078	4.461	***	

Note: * p < 0.05. ** p < 0.01. *** p < 0.001.

Table 6. The correlations between exogenous and latent variables

Variables	IN	DN	ATT	PBC
Age	-.150	-.133	**-.233****	-.148
Educational background	-.168	-.170	-.177	-.149
Household income	-.060	.010	.068	.124
Working experience as delivery workers	-.032	-.059	-.094	-.027
Driving license & experience for vehicle	-.024	-.045	.149	-.113
Number of delivery orders per week	.062	-.057	.000	-.014
Crash & accident while working	.112	**.193***	.120	-.099
Traffic violation with warning or penalty while working	.137	.148	.124	.150
Hands-free holder for cellphone on e-bike	.262	**.138***	.189	.156
Earphone using while working	.038	**.040***	-.004	.100

Note: The bold represents significant effects (p < 0.05). * p < 0.05. ** p < 0.01. *** p < 0.001.

DISCUSSIONS

In the present research, we investigated the influence of TPB-related social-psychological factors on MPC engagement among delivery workers. The SEM model was constructed, and the relationships between latent variables and exogenous variables were also explored.

We found that DN and IN are directly associated with MPC behaviors. As expected, similar to what has been observed in previous studies (Lawrence, 2015; Nicolls et al., 2022), the increase in IN was associated with the increased self-reported MPC engagement, supporting the H2. The H5 was also supported as we observed the associations among all latent variables. However, H1 and H4 were not supported. It is possible that with the time pressure, the delivery workers have to engage in the MPC task, regardless of their attitudes towards (ATT) and the risk associated with (PBC) the behavior. Such a finding indicates that in future studies, we may need to seek working-related factors that may lead to MPC engagement.

It is interesting to notice that the increase in DN was found to be negatively associated with MPC engagement, which is contradictory to our original hypothesis (H3) and also different from what has been observed in previous driving-related studies (Nicolls et al., 2022). It is possible that the delivery workers who cared more about traffic safety were more likely to pay attention to MPC behaviors among their colleagues. Thus, they might be the ones who intentionally reduced the MPC engagement while riding. Such a finding has also been supported by the relationships between exogenous variables and DN. It was found that those who had higher DN were those who were more likely to use the hands-free holder and earphones during delivery – which can potentially reduce the risk of MPC-related distractions. Thus, we should be cautious when interpreting the influence of DN on behavior engagement. In scenarios such as taking a ride as passengers, the behaviors of other drivers are easy to be observed, and DN might be positively correlated with the behavior engagement – as the respondents may perceive the behaviors of others as "socially acceptable" (Brown et al., 2019; Geber et al., 2021). While in scenarios when the behaviors of others are easy to be ignored, those who noticed more behavior engagement of others might be the ones who care more about the behaviors (i.e., selective perception, Horn, 1965). In such a case, a negative correlation between DN and behavior engagement can be observed. Further research, however, is needed to validate this explanation.

Further, we observed some association between the exogenous variables and latent variables. For example, similar to what has been found in driving-related studies (Chen et al., 2016), we found that age was negatively associated with ATT, indicating that older drivers might be more cautious about e-bike riding safety. Further, the history of crash & accident while riding was positively associated with DN. Similar to the explanation of the relationship between DN and MPC, it is possible that those who experienced crashes or accidents cared more about riding safety and paid more attention to others' unsafety behaviors while riding.

Overall, based on the supported hypotheses (H2 and H3) in SEM, improving public awareness of riding safety and distracted riding may be a possible way to alleviate the distracted riding problem, given that it is difficult to change the work-related tasks of delivery workers and there are currently no clear traffic regulations to forbid distracted riding. At the same time, work-related factors may enhance the effects of public awareness enhancement, given that the rejection of H1 and H4 in our study might be attributed to delivery workers'

strong motivation to engage in MPC due to work-related pressure.

It should be noted that the sample size of the present research is relatively small (150 respondents), as we had to adopt a face-to-face approach to ensure data reliability. Thus, the readers should be cautious when interpreting our results. Nevertheless, we believe that our sample size has met the minimum requirement for SEM - generally, a minimal requirement of sample size for SEM analysis is usually 100 or 200 (Boomsma, 1982, 1985), and Bentler & Chou (1987) further revealed that 5 or 10 observations per estimated parameter are adequate for the minimal sample size. Future research, however, is still needed to increase the sample size to better understand the contributing factors of MPC among delivery workers, potentially taking both social-psychological and working-related factors into consideration.

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