



# Assessing Consumers' Intentions Towards Green Alternatives of Disposable Packaging: A Case Study in Beijing and Shanghai

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**Abstract.** China's plastic pollution has gotten worse, especially during the COVID pandemic when the city's lockdowns boosted the food takeout business. Although the government has made efforts in curbing the use of conventional single-use plastic packaging, the problem is still looming up in the critical time of building ecological civilization. The key to resolve the overwhelming usage of disposable plastic packaging lies in reduction, along with using green alternatives: biodegradable packaging and returnable containers. The study investigated consumers' willingness to adopt new alternatives by applying the extended classical behavioral theory: the theory of planned behavior (TPB). The measurement scale, developed upon previous literature, gains validated reliability and validity after running confirmatory factor analysis (CFA) in SmartPLS. The study distributed 536 questionnaires online, targeting consumers from Beijing and Shanghai. 430 valid samples were collected and analyzed, with results showing that consumers' perceived behavior control has strong and positive effect on their willingness to pay more to using biodegradable packaging and willingness to participate in the returnable container programs. The environmental attitude, social norms and past green behavior show less direct relationships with people's adopting intentions. Their effects on the intentions are mediated by perceived behavior control disproportionately.

**Keywords:** Plastic pollution · Online food delivery · Behavioral intention

## 1 Introduction

Nowadays plastic is dispensable for people's ordinary living. With lightweight, water-resistant and portable properties, the low-cost material is widely used in packaging. For many reasons, the recycling of plastic waste is rather low. Data shows that the global production of plastics in 2018 reached 454 million metric tons, with an expected growth rate of 3.2% from 2020 to 2027. A latest research estimated that 11% of plastic waste generated globally, about 19–23 million metric tons, went into aquatic ecosystems in 2016 [1] and caused severe environmental pollution. China is regarded as the world's greatest plastic user, but is failing to manage its plastic waste in a sustainable manner. It is

estimated that most of the plastic waste is generated by packaging industry, with foods and beverage sector claiming the biggest share [2]. China's two online food delivery companies, Meituan and Ele.me, account for the biggest share of the market. The total amount of packaging waste from online food take-out business witnessed a skyrocket increase from 0.2 million metric tonnes in 2015 to 1.5 million metric tons in 2017, 75% of which is plastic containers [3]. Beijing and Shanghai are among the top 5 regarding online food demand. Worse still, COVID-19 facilitates the habit cultivation of ordering online due to city lockdowns.

Existing researches validated that reducing the total usage of single-use plastics is the key to address this plastic crisis [4]. The alternatives were developed in other countries to curb the usage of plastic packaging for online food delivery. In New York City, a third-party delivery service provider, DeliverZero, offers reusable containers for participating restaurants. Those containers will be returned and reused for other deliveries. Biodegradable packaging has been promoted as another green alternative. At macro-level, in order to curtail the use of disposable plastics, China has "New Normal" policy, comprised of "New plastic ban" and "waste sorting" campaigns, in major cities such as Beijing and Shanghai. In such context, studying the influential factors of individual consumption behavior towards traditional disposable plastic packaging and its green alternative becomes meaningful. The study thus proposes one research question: What factors influence consumers' adopting intention towards green alternatives of disposable packaging on food take-out against COVID-19 and "New Normal" policy paradigm?

## 2 Literature Review and Hypotheses Development

Consumption behaviors, derived human behaviors, gain a lot of attention in many fields as its correspondent theories can be applied to multiple disciplines such as business economics, social science, computer science and so on [5]. The most used behavioral theories in studying pro-environmental or sustainable behaviors are Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), Theory of Interpersonal Behavior (TIB), Nudge Theory (NT), Value-Belief-Norm Theory (VBN) and other cognitive and learning theories [6–9].

However, none of these theories are perfect. TRA was criticized for unable to predict behaviors because of insufficient constructs. It argues that behavioral intention is decided by two constructs, respectively attitude and subjective norms [10]. For this concern, TRA was extended into TPB by adding one more construct, perceived behavior control [11]. Numerous studies have validated the superiority of TPB over TRA [12–14]. Even so, there are still loopholes in this theory which are detected by some studies. For this reason, researchers started to incorporate new constructs into TPB to better predict behaviors. Some researchers combine TPB with other theories such as VBN, TIB, TRA and so on [15]. It is investigated that the most commonly used new constructs in this regard are situational, cultural factors and habits or past experience [16, 17]. Existing literature proves that by introducing new factors into TPB, the prediction of intentions and behaviors becomes more accurate [18].

## 2.1 The Extended Theory of Planned Behavior

Situational factors and past behaviors are the most widely-incorporated new constructs of TPB. Regulations, policies, media, facilities, weather, occasions, the surroundings, cultures, and product price and properties mentioned above are situational factors [19]. Some studies cluster it under social norms [20]. This research is conducted against “New Normal” policies in China. Against this backdrop, policies and regulations are situational factors that can be clustered under SN, which will exert effects on people’s routine intention and behaviors [21]. Past experience or behaviors are also being proven to be an influential factor of behavioral intention [22]. A study found that the past recycling behavior of college students has a significant impact on their future intention or attitude towards recycling [23].

## 2.2 Hypotheses Development

Most biodegradable plastics can only be degraded under certain industrial conditions, which means they need to be sorted and put separately. Returnable containers can be shared and reused for many times, which requires consumers to return the containers through collecting facilities. Biodegradable plastics are more expensive compared to conventional plastics and returnable container services. While returnable container programs are more inconvenient in terms of post-consumption disposal. Therefore, the adopting intention in this study is replaced by the willingness to pay more (WTP) for biodegradable plastic packaging and the willingness to participate (WTP) in returnable container programs.

In TPB, attitude is defined as the positive or negative evaluation of performing a specific behavior from individuals’ viewpoints [11]. Many studies have proven that pro-environmental attitudes can positively influence people’s pro-environmental intentions or behaviors [17, 24]. A study found that Hong Kong college students’ recycling behavioral intention is positively related to their environmental attitude [25]. In environmental studies, it is estimated that PBC serves as the mediator between attitudes and intentions in regard of responsible behavior towards marine protection [26].

Social norms can be defined as the pressure from the society which pushes individuals to conduct certain behaviors [12]. It is proven that social norms is an influential factor of people’s green behavioral intention [27]. As mentioned above, situational factors are counted as a part of social norms in some studies [20]. Policies, as a situational factor, play an important role in predicting people’s behavioral intention, which can drive people to change their behavioral intentions [28]. Perceived behavior control can mediate the effect of social norms on managers’ intention to take environmental measures [29].

Perceived behavioral control (PBC) refers to the ease or difficulty of an individual to perform a particular behavior [11]. It is dependent on control beliefs and perceived power. The former can be regarded as the driver or barrier that individuals perceive will influence they perform certain behaviors [11, 12]. While the later one is the evaluation of individuals towards the above behavior driving or impeding factors [12]. Empirical evidence proves that PBC can directly influences both on behavioral intention and actual behaviors [14].

Studies have validated that people who take a small step doing something are prone to doing more difficult things in this regard [30, 31]. For example, those who do a small thing in protecting the environment may move forward by adopting more complicated pro-environment behaviors [32]. In this sense, it is important for decision-makers to assist people in making small changes in their behavioral patterns so that leapfrog achievements can be realized one day. It is found that past behavior (experience) can be mediated by perceived behavior control in terms on online purchasing intentions [33].

Based the above argument, the research adopts extended TPB, comprised of attitude, social norms, perceived behavior control, past green behavior and intention, as the underlying theory. In this regard, the study proposes several hypotheses below. Figure 1 is the conceptual framework of the research, which reflects the relations between different constructs.

**Hypothesis 1a (H1a)** Environmental attitude and awareness positively affect people’s WTM for biodegradable packaging and WTP in returnable container program.

**Hypothesis 1b (H1b)** Environmental attitude and awareness is mediated by perceived behavior control when influencing WTP and WTP.

**Hypothesis 2a (H2a)** Social norms positively influence people’s WTM for biodegradable packaging and WTP in returnable container program.

**Hypothesis 2b (H2b)** Social norms is mediated by perceived behavior control when influencing WTP and WTP.

**Hypothesis 3 (H3)** Perceived behavior control positively affects people’s WTM for biodegradable packaging and WTP in returnable container program.

**Hypothesis 4a (H4a)** Past green behaviors positively influence people’s WTM for biodegradable packaging and WTP in returnable container program.

**Hypothesis 4b (H4b)** Past green behaviors is mediated by perceived behavior control when influencing WTP and WTP.

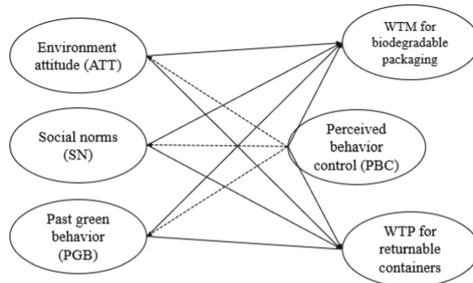


Fig. 1. Conceptual framework.

### 3 Methodology

#### 3.1 Measurement Scale

The measurement scales are adapted from previous literature, which is comprised of the measurements of biodegradable packaging and returnable containers. As shown in

Table 1, items with “a” and “b” are respectively established to measure the psychological constructs of choosing biodegradable packaging and returnable containers. Items without “a” or “b” are set to measure the constructs of two alternatives. 5 point-Likert scale is used to measure the items, ranging from “strongly disagree”, “disagree”, “neither agree nor disagree”, “agree” to “strongly agree”.

### 3.2 Data Collection

The research selected Beijing and Shanghai as the study areas since they have all officially implemented mandatory “waste sorting” regulations citywide respectively in 2019 and 2020. Anonymous questionnaires were distributed through both online platforms including a data collection website, credamo.com, and social media platform, WeChat, where respondents were paid for filling questionnaires. The questionnaire is comprised two scales which respectively estimate the psychological constructs of “biodegradable packaging” and “returnable containers”.

**Table 1.** Measurement scale

Latent variables	Items	Measurement scale	Source
Attitude and awareness	ATT1	It is very pressing to address “white pollution” problem	[34]
	ATT2	“White pollution” is majorly caused by the overuse of disposable plastics in food take-out	[35]
	ATT3	I am aware that disposable plastics take 100–450 years to degrade in the natural environment	[36]
Social norms	SN1	The waste sorting regulation encourages me to use the alternatives to replace conventional disposable packaging for food take-out	[36]
	SN2	The new plastic ban policy encourages me to use the alternatives to replace conventional disposable packaging for food take-out	
	SN3a/b	The media’s publicity makes me think about using biodegradable plastic packaging/returnable containers in the future	[37]
	SN4a/b	If my family or friends use biodegradable packaging/returnable containers for food take-out, I will try them	[38]

(continued)

**Table 1.** (continued)

Latent variables	Items	Measurement scale	Source
Perceived behavior control	PBC1a/b	Considering the disposal way, I am confident that if I want to, I can use and dispose biodegradable packaging in an appropriate way/rent and return returnable containers for food take-out	[12]
	PBC2a/b	It is easy for me to use and dispose biodegradable packaging/rent and return returnable containers	[34]
	PBC3a/b	I can pay a premium for biodegradable packaging/deposit enough money to rent containers	
	PBC4a/b	I am confident that I have enough time and resources to use and dispose biodegradable packaging/participate in the returnable container program	
Past green behaviors	PGB1	I sort food waste from packaging waste, whenever possible	[37]
	PGB2	I reuse non-contaminated plastic bags from food take-out packaging, whenever possible	
	PGB3	I recycle food take-out packaging whenever possible	
WTP for biodegradable packaging	WTM1	It is acceptable for me to pay more for biodegradable packaging for food take-out in the future	[39, 40]
	WTM2	The probability that I will pay more for biodegradable packaging for food take-out is very high	[34]
	WTM3	I am willing to consider spending more for biodegradable packaging	[41]
WTP for Returnable containers	WTP1	It is acceptable for me to pay a deposit for renting returnable containers for food take-out in the future	[39, 40]
	WTP2	I am willing to use returnable containers for food take-out in the future	[36]
	WTP3	The probability that I will participate in a returnable container program for food take-out is very high	[34]

## 4 Data Analysis

### 4.1 Descriptive Analysis

536 questionnaires were distributed in February 2021, which ends up with 430 valid samples for further analysis. More female (71.5%) was engaging in this survey. Half of the respondents come from Beijing and Shanghai respectively, mainly clustering in the age groups of 18–30 (69.2%). Most of them (90%) have accepted high education (bachelor or above) and work in private companies (25.7%) or still pursue their education (36.9%). The proportions of different monthly income groups, ranging from below 5,000RMB to above 20,000RMB, are around 10–25%.

**Table 2.** Socio-demographic characteristics of respondents (N = 430).

Variable	Item	Frequency	Percentage
Gender	Male	124	28.50%
	Female	306	71.50%
Location	Beijing	215	50.00%
	Shanghai	215	50%
Age group	below 18	4	1%
	18–30	297	69.20%
	31–45	121	28%
	46–65	8	1.80%
	above 65	0	0%
Education	Primary school and below	0	0%
	middle schools	14	3.27%
	professional schools	41	9.58%
	Bachelor or equivalent	248	57.71%
	Master and the above	127	29.44%
Occupation/company	Students	158	36.90%
	Civil servant	7	1.60%
	SOEs	67	15.70%
	Private company	111	25.70%
	Foreign company	26	6.10%
	Public organizations	43	10%
	Freelancers	11	2.34%
	Non-workers (retired or unemployed)	7	1.63%
Monthly income	below 5000RMB	55	12.85%
	5000-8000RMB	85	19.63%
	8000-12000RMB	106	25.75%

(continued)

**Table 2.** (continued)

Variable	Item	Frequency	Percentage
	12000-15000RMB	68	24.53%
	15000-20000RMB	48	11.21%
	above 20000RMB	68	15.89%

The questionnaire also investigates to what extent that the respondents are willing to pay more for biodegradable packaging and participate in returnable containers programs. Around 40% and 50% of the respondents are only willing to walk for less than 100 m and 100–500 m to return the containers. Less than 15% of the consumers would like to walk more than 500 m to return the containers. Approaching 75% of the respondents are willing to pay less than 30RMB of deposit, the rest would like to pay more than 30RMB of deposit. The willingness to pay more for the fee of using biodegradable packaging shows the same trend. As the fee increases, the respondents show lower willingness to pay.

**4.2 Measurement Model**

The study used Partial Least Squares Structural Equation Modelling (PLS-SEM), which can address a broad range of problems with less restrictive assumptions. The reliability and validity of the measurement model are tested using SmartPLS (v.3.2.9). Composite reliability (CR) shows higher superiority when it comes to assessing scale reliability [42]. If CR value is more than 0.7, it can be concluded that the internal consistency of the scale is reliable. As shown in Table 2, CR of the latent variables of both alternatives are higher than 0.7, showing adequate reliability. The AVE needs to be >0.5 to ensure sufficient convergent validity [43]. All the constructs’ measurements of biodegradable packaging have sufficient convergent validity as shown below. Most constructs of returnable containers are more than 0.5, meaning that the convergent validity is adequate in general. The discriminate validity is assessed based on Fornell-Larcker criterion, which requires that the square root of AVE is bigger than inter-correlations. Based on SmartPLS’s result, all the constructs’ scales of two models have adequate discriminant validity.

**4.3 Structural Model**

**4.3.1 Model Fit**

Fit indices of the estimated model are comprised of SRMR, d\_ULS, d\_G. The criterion of SRMR, d\_ULS and d\_G are respectively < 0.08, 0.95 and 0.95. The indices of both models, shown in Table 3, which are SRMR = 0.081 ( $\approx$  0.08), d\_ULS = 0.784 (<0.95), d\_G = 0.25 (<0.95) for biodegradable packaging, and SRMR = 0.066 (<0.08), d\_ULS = 0.585 (<0.95), d\_G = 0.212 (<0.95) for returnable container. It’s indicating reliable and adequate fit.



**Table 3.** Confirmatory factor analysis

Criterion	Biodegradable packaging		Returnable container		
	Estimated model	Result	Estimated model	Result	
<b>Internal consistency reliability</b> [43, 44]					
Composite reliability > 0.7	ATT	0.777	adequate	0.723	adequate
	PBC	0.879		0.889	
	PGB	0.795		0.794	
	SN	0.755		0.83	
	WTM	0.922		0.947	
<b>Convergent validity</b> [43, 44]					
AVE > 0.5	ATT	0.538	adequate	0.487	adequate
	PBC	0.708		0.671	
	PGB	0.565		0.569	
	SN	0.507		0.623	
	WTM	0.798		0.857	
<b>Discriminant validity</b> [43]					
Fornell-Larcker criterion	Inter-correlations < the square root of AVE	adequate	Inter-correlations < the square root of AVE	adequate	

### 4.3.2 Hypotheses Testing

A structural model was built via the bootstrapping procedure in SmartPLS, with a sub-sample size of 5,000. The endogenous variables'  $R^2$  values of estimated model of biodegradable packaging can explain 20.4% and 21.1% of PBC and WTM, and that of the estimated model of returnable containers can explain 16.8% and 55.5% of PBC and WTP. According to previous study [42],  $R^2$  reflects the model's predictive power. The predictive power of estimated constructs is acceptable.

For biodegradable packaging: Hypothesis 1a (path coefficient = 0.08, p-value = 0.199 > 0.1) and H2a (PC = 0.19, p-value = 0.19 > 0.1) are not supported. It suggests that environmental attitude and social norms have no direct positive effect on consumers' willingness to pay more for biodegradable packaging. H3 (PC = 0.455, p-value < 0.01) and H4a (PC = -0.014, p-value < 0.01) are supported, proving that perceived behavior control (PBC) and past green behavior (PGB) have positive influences on consumers' willingness to pay more (WTM). H1b (PC = 0.115, p-value < 0.05), 2b (PC = 0.19, p-value < 0.01) and 4b (PC = 0.310, p-value < 0.01) concern about the mediation effects between two constructs, which are all supported. It means that PBC can mediate the effect between ATT, SN, PGB and WTM. As H1a and H2a are not supported, which suggest that there exists a complete mediation effect of PBC on the path of ATT, SN and WTM.

For returnable containers: H1a (PC = 0.017, p-value = 0.670 > 0.1) and H4a (PC = 0.016, p-value = 0.695 > 0.1) are not supported. It suggests that environmental attitude and past green behavior have no direct positive effect on consumers' willingness to participate in returnable container's programs. H3 (PC = 0.666, p-value < 0.01) and H2a (PC = 0.016, p-value < 0.01) are supported, proving that perceived behavior control (PBC) and social norms (SN) have positive influences on consumers' willingness to participate (WTP). Hypothesis 1b (PC = 0.098, p-value < 0.05), 2b (PC = 0.340, p-value < 0.01) and 4b (PC = 0.091, p-value < 0.1) reflect the mediation effects between two constructs, which are all supported. It means that PBC can mediate the effect between ATT, SN, PGB and WTP. As in this model, H1a and H4a are not supported, which suggests that there exists a complete mediation effect of PBC on the path of ATT, PGB and WTP (Figs. 2 and 3, Table 4).

**Table 4.** Hypotheses test

Hypotheses	Path	Biodegradable packaging		
		Returnable containers		
		Path coefficient	p	Test result
hypothesis 1a	ATT-WTM/WTP	0.08	0.119	not supported
		0.017	0.67	not supported
hypothesis 1b	ATT-PBC	0.115	0.021	supported
		0.098	0.034	supported
hypothesis 2a	SN-WTM/WTP	-0.065	0.247	not supported
		0.151	0	supported
hypothesis 2b	SN-PBC	0.19	0	supported
		0.34	0	supported
hypothesis 3	PBC-WTM/WTP	0.455	0	supported
		0.666	0	supported
hypothesis 4a	PGB-WTM/WTP	-0.014	0	not supported
		0.016	0.695	not supported
hypothesis 4b	PGB-PBC	0.32	0	supported
		0.091	0.075	supported

$p < 0.01^{***}$ ;  $p < 0.05^{**}$ ;  $p < 0.1^*$ .

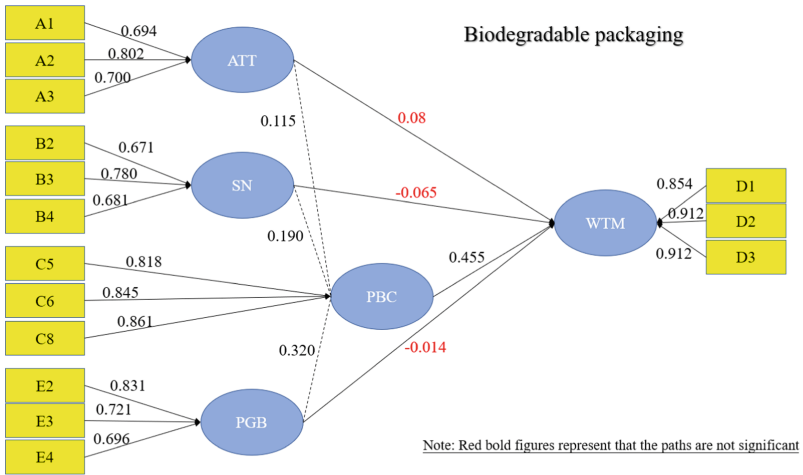


Fig. 2. Path analysis result of biodegradable packaging.

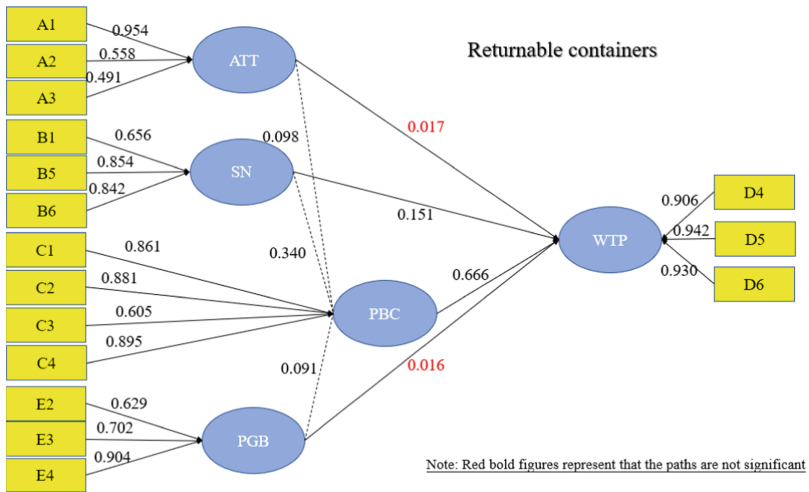


Fig. 3. Path analysis result of returnable containers.

## 5 Discussion

### 5.1 General Discussion

The study seeks to examine consumers' intention of replacing conventional plastic packaging with green alternatives. Applying the theory of planned behavior (TPB), the study examines the relationships between the environmental attitude (ATT), social norms (SN), perceived behavior control (PBC), past green behavior (PGB) and willingness to pay more (WTM) or willingness to participate (WTP). The result shows that ATT, SN and

PGB cannot directly affect consumers' adopting intentions towards biodegradable packaging and returnable containers. However, PBC can serve as the mediator between ATT, SN, PGB and WTM or WTP, which is consistent with previous research findings [26, 29, 33]. It is probably because that people are not familiar with new alternatives due to its limit of use. In this case, even though they are concerning about the environmental problems caused by single-use plastics and are positively influenced by their social networks when it comes to adopting new alternatives, they show hesitation for the lack of knowledge and experience of using biodegradable packaging and returnable containers (PBC). Nevertheless, in the case of biodegradable packaging, PBC and PGB show direct positive effects on consumers' WTM for new packaging choice. In regard of returnable containers, SN and PBC can directly and positively influence consumers' WTP in a returnable program.

## 5.2 Policy Implications

The findings generate some policy implications which provide suggestions for developing green alternatives to phase out conventional disposable packaging. To promote the use of green alternatives, the government should make efforts in improving consumers' perceived behavior control (PBC). The result demonstrates that PBC can not only exert direct effects on consumers' intentions of adopting alternatives (WTM and WTP) but also mediate the relationships between their environmental attitude (ATT), social norms (SN) and the adopting intentions (WTM and WTP). Regarding PBC, consumers' major concern lies in the accessibility, difficulty, time and resources of renting returnable containers and disposing biodegradable packaging [45–47]. The government should support the expansion of returnable containers programs by providing more policy or monetary incentives, in order to cut down the time, money and other resources that consumers spend on renting and using the containers [22]. Apart from it, cheaper and more durable biodegradable packaging should be provided to consumers to replace conventional ones. Placing more garbage bins to recycle used biodegradable packaging waste is also important [36].

## 5.3 Limitations

The study also has some limitations in regard to validating the explanation of complete mediation effect of PBC on ATT, SN, PGB and WTM/WTP. In the future research, it should be put into consideration. What's more, the research is conducted under a specific cultural and policy context, it is doubted that the result of the research can be directly applied to other cultures.

## 6 Conclusion

The research is conducted under the context of COVID-19 and China's "New Plastic Ban" policy, when people's online food ordering habit has been changed due to city lockdowns and the roll-out of new policy to restrict the use of disposable plastics in pilot cities (mainly Beijing and Shanghai). First, it fills the gap of TPB in the reality by

extending it with new constructs. Besides, although there exists studies proving that perceived behavior control can generating mediation effect between attitude, social norms and intentions [33, 48], to the best of my knowledge, there is no single study proves that the complete mediation of PBC existing between attitude, social norms and intentions. The study deducts that when people are not familiar with the new choices, they tend to consider more regarding the availability and accessibility (perceived behavior control) of adopting them. As a result, PBC shows strong relationship with their intentions and can even mediate the relationships of other constructs with intentions.

**Acknowledgement.** This research was funded by the Ratchadapisek Sompoch Endowment Fund (2020) under Microplastic and Plastic Pollution Cluster, Chulalongkorn University.

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