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RESEARCH ON CONSUMERS' INTENDED USAGE OF COLD CHAIN LOGISTICS SERVICE THROUGH FRESH-FOOD APPS BASED ON THE STRUCTURAL EQUATIONS MODEL

Mengze ZHANG [ID][1], Michal FABUS [ID][2][✉], Yizhou ZHANG [ID][3]

[1]Department of Economics, Sejong University, Seoul, South Korea
[2]Department of Economics and Finance, Bratislava University of Economics and Management, Bratislava, Slovak Republic
[3]Department of Global Business, Anyang University, Anyang-si, Gyeonggi-do, South Korea

Abstract. By expanding the theory of planned behavior with Structural Equation Modeling, the objective of the study is to investigate consumer behaviors in the purchasing of fresh food through fresh-food apps and cold chain logistics services usage in Shanghai and Beijing, China. The results showed that the usefulness of the fresh-food apps has a positive impact on consumers' attitudes to enjoying apps' cold chain logistics services. However, the ease of use of apps has never had a positive impact on consumers' attitudes towards enjoying cold chain logistics services. Furthermore, consumers' attitudes, perceived behavioral control and subjective norm have a positive impact on their intention to use cold chain logistics services via fresh food apps. Findings confirmed that attitude plays a part of mediating role in usefulness and behavioral intention.

1. Introduction

Due to the recent economic development of in China, the income level of ordinary people has increased, resulting in the pursuit of lifestyles of a higher quality, including the consumption of high-quality fresh food. Fresh food here is defined as a primary food item prepared only with simple processing, division, preservation, and packaging; it is done without any cooking or other related processing. Specifically, it includes vegetables, fruits, aquatic products, meat, dried food, cooked food, and pastries.

Fresh food is an indispensable necessity for people's daily life, and it holds a significant share in the retail consumer market. According to the research of Analysis International and Nielsen, the fresh food market has a 2 trillion-yuan volume and maintains a continuous growth of more than 6% per annum. On average Chinese consumers buy fresh food 3 times a week; among them, fruits and vegetables account for 4.48 times and seafood averages 2.39 times (Dai & Chen, 2020). However, as an ordinary consumer, it is difficult to grasp the quality of fresh produce in traditional physical stores, and there are

considerable limitations in personal purchasing fresh produce at the place of origin. Generally speaking, fresh food planting areas do not have a good and complete tourism infrastructure, which makes it difficult to withstand a large number of visitors. It is also time-consuming and expensive for ordinary people to visit these fresh-food-growing areas. Although there are many gimmicks focusing on "picking fresh food personally", the real intent behind them is really sightseeing, rather than selling fresh food.

In addition, the acceptance and use of modern technology has become more and more important in their everyday lives. Mobile devices had imposed a deep impact on peoples' everyday life in the past 20 years (Islam et al., 2013; Narajan et al., 2018). The retail industry has recognized the potential energy of mobile technology and has begun to offer the new shopping mode via apps (Groß, 2015; Narajan et al., 2018).

In 2019, according to the relevant statistics, more than 5 billion people are using mobile devices in the world, and more than half of these devices are smart phones (Silver, 2019; Choi, 2020). As of December 2020, the percentage of Internet access using mobile phones has reached 99.7%

in China. And due to the outbreak of COVID-19, the social distancing policies have encouraged increased dependence on the Internet among individuals; and as a result, users' willingness and tendency to go online have accelerated. The netizens are acquiring the required information, online shopping and food delivery via Individual netizens use streaming media and social platforms to obtain information by internet media and use online shopping and online food delivery in their daily life (China Internet Network Information Center, 2021). Therefore, in order to meet ordinary consumers' demand for high-quality fresh food, to reduce the cost of transporting them, fresh-food apps came into being.

It is a common practice to use the modern technology in their daily lives, and people are becoming more and more interested in adopting these new technologies. There is a large potential market in retailing for the mobile technology, including the shopping app, the interaction between the sellers and the buyers, and so on (Groß, 2015; Natarajan et al., 2018). In China, the more well-known fresh-food apps include Hema, Dingdong Shopping, JD Daojia, and Daily Fresh. The functions of these fresh-food apps are similar. Consumers can simply register through the app to purchase fresh food according to their consumption preferences. After accepting the order, the vender will ship the goods through cold chain logistics and deliver them directly to the consumers.

Cold Chain Logistics (CCL) for Fresh Products is a food supply chain logistics (Mercier et al., 2017) which use the refrigeration technology to provide an appropriate temperature and humidity environment for perishable products such as fruits, vegetables, dairy products, meat, fish and so on (Ndraha et al., 2018; Han et al., 2021). A well-running cold chain system must be with the functions of maintaining perishable food in the environment with the appropriate temperature and humidity from the location of collection to the final consumption (Han et al., 2021).

It is obvious that if consumers have used fresh-food apps to purchase fresh food, they should have a good understanding of whether the cold chain logistics used by the vender is reliable and efficient. And these experiences will directly influence consumers' intent of continued usage of the fresh-food apps. In the existing literature, the focus has been on the factors that would influence the development of cold chain logistics.

With using the analytic hierarchy process (AHP), Qi et al. (2020) found that the three key factors of restricting the development of the cold chain logistics on the agricultural product in JILIN province are listed as follows: the cost of the cold chain logistics on the agriculture products, the application of the information technology, and the marketization degrees of the cold chain logistics. cost, information technology application, and cold chain logistics marketization degree are the development of agricultural product cold chain logistics in Jilin Province (Qi et al., 2020). Han et al. found out the key for meeting the requirements of the environmental concerns and

the changing markets is the future strategy of the CCL, because it is related to the low-carbon strategy and the smart innovation. The improvement of the new-coming information technology, including IoT, blockchain, artificial intelligence, etc.) has significantly accelerated the modernization of CCL (Han et al., 2021).

Li (2021) found that it can help maximize the freshness of the fruits and vegetables, reduce the transportation cost by using the predictive data transmission technology (PDTT) in cold chain logistics transportation. Besides, the automatic monitoring system is able to prolong the shelf life of the good (Li, 2021). Rong et al. (2019) revealed that consumers' household income, the education level, the government supervision of cold chain logistics and the subsidies for supporting this industry imposing the most significant influences. Wang et al. (2021) found that with the optimized distribution routes, parts of the costs are increased a little bit, such as the transportation cost and the energy cost, but the total costs are decreased greatly, and the customers' satisfaction and the vehicle loading rate are increased significantly. Chen (2020) found It is effective to optimize the transportation route by big data cloud computing analysis. Zhao et al. (2020) found that it is necessary to design the transportation route on the basis of analyzing the characteristics of electric vehicles, especially for the fresh products distribution. Dai et al. (2020) believed that service innovation help the cold chain LSPs to get the competitive advantages, important driving force for cold chain LSPs to gain competitive advantages. Cold chain logistics service providers in emerging markets tend to provide new value-added and differentiated services for specific customers, industries or regions.

It can be seen from these literatures that researchers are paying more attention to the following areas: the development and technological improvement of cold chain logistics providers; factors that affect the selection of cold chain logistics services in light of inherent characteristics of consumers; methods to improve customer satisfaction; and the application of big data and cloud computing to optimize the logistics distribution process. The impacts of consumers' buying tendency and consumption patterns have not been the main focus.

Chopdar and Sjvakumar (2019) claim that the individuals' cultural values always imposed significant impacts on the relationship between the various predictive factors and the preferences of using the apps. Narajan et al. revealed that personal innovation and perceived risk played a major role in the decision-making of using the mobile apps. The users with higher creative ability and willingness of using apps are less sensitive to the price by the Extended Technology Acceptance Model (TAM) and the Theory of Diffusion of Innovation (DOI) (Narajan et al., 2017). Bhullar and Gill (2019) pointed out that many factors had influences on the use of apps continuously, such as aesthetic graphics, gestalt, subtle animation, transitions, etc. Lim et al. (2020) found that consumers preferred the apps with the combination of information and entertainment, which had the positively effects on the using of mobile apps. Kim et al.

(2017) insisted that browsing behavior for non-shopping apps helped the users to understand the possession of shopping apps, because it reflects the users' preferences for acquiring more apps to some extent. In addition, digital experiences can help explain the purchasing decisions, such as online experience, mobile experience and browsing information from shopping apps.

It can also be seen from the above literature that, although the research on the shopping intentions using mobiles apps has a variety of research angles, such as culture, APP's page design, and consumers' habits of using them, they are relatively general and have not involved any fresh-food apps. As fresh-food app developers and/or operators, in addition to upgrading the cold chain logistics technology and management, they also need to pay attention to consumer behavior, because it is of vital importance to developing the company's business and improving the operation of cold chain logistics. Therefore, from the perspective of consumers, it is necessary to study the factors that influence consumers to purchase fresh food through fresh-food apps.

According to the theory of planned behavior, an individual's behavior is not only affected by behavioral intentions, but also restricted by the individual's ability to execute, opportunities, resources and other comprehensive background environments. Only when these conditions are fully met, can the behavior intention directly determine the behavior.

This study acknowledges that it is a new emerging paradigm for the use of cold chain logistics services for fresh food via mobile shopping apps, with large potential market in the business world.

Therefore, this study uses questionnaire surveys to investigate consumer behaviors in the purchasing of fresh food through fresh-food apps and cold chain logistics services usage, in China's two major developed cities of Shanghai and Beijing. Through the expansion of the theory of planned behavior, and the use of structural equations Model to study the factors influencing Chinese consumers' intention to use cold chain logistics services through fresh-food apps.

The remainder of the paper is composed of sections organized as follows. The second section contains the theoretical background of the Theory of Planned Behavior, and the underlying research assumptions of this study. The third section presents the data and the empirical approach used for this study. The fourth and the fifth sections describe the mediating effect of attitude and discusses the findings. The final section discusses the limitations of this study and possible future research directions.

2. Theory and research model development

2.1. Theoretical background and framework

The Theory of Planned Behavior (TPB) is an extension of the Theory of Reasoned Action (TRA), which captures the factors that influence an individual's behavior (Ajzen & Fishbein, 1980; Ajzen, 1985), and TRA focuses on the attitudes and subjective norms as motivations for behavioral intentions (Fishbein & Ajzen, 1975).

Planned behavior theory involves comprehensive factors on individual and social environment, and can explain the relationship between attitude and behavior more comprehensively. The theory believes that an individual's behavior is not only affected by behavioral intentions, but also restricted by the individual's ability to execute, opportunities, resources, and other comprehensive background environments. Only when these conditions are fully met, can behavioral intentions directly determine behavior. That is to say, individual will not completely control individual behavior. Individual behavior intention is mainly affected by three variables: behavior attitude, subjective norms, and perceived behavior control. Behavioral attitude refers to the individual's evaluation of a specific behavior, that is, the individual's preference attitude towards performing a specific behavior. Subjective norms refer to the social pressure that an individual perceives when deciding whether to perform a certain behavior; and it is more affected by the surrounding social environment and other factors. Perceived behavior control refers to whether an individual can successfully perform a certain behavior, and it is an individual's subjective judgment on the ability, resources, and opportunities needed to perform the behavior. Perceived behavior control not only involves internal control factors such as the knowledge, skills, and discipline of the individual when performing the behavior, but is also related to the external factors perceived by the individual, such as resources, time constraints, and the degree of cooperation of others. In a word, according to the theory of planned behavior, attitudes (ATT), subjective norms (SN) and perceived behavior control (PBC) are the main factors for affecting the individuals' behavioral intentions (BI), and to impose an influence on an individual's actual behavior (Chen et al., 2018).

TPB provided a powerful theoretical frame, explained the relationships tested in the academic area of the research (Weigel et al., 2014). Many literatures, which are referred to the study in product purchasing intention, have been showed that TPB is a useful theory (i.e. Khor & Hazen, 2017; Valencia-Arias et al., 2021). Therefore, we will take TPB as a theoretical basis for this study.

In addition, The TPB was established to explain a variety of behavioral intentions. Chen et al. (2018) explored the consumption behavior intention of the motorcycle express service by the Technology Accepted Model (TAM). They found perceived useful and perceived ease of use from TAM has a positive effect on the attitudes, and perceived usefulness mediates perceived ease to use and attitude, and attitude does not mediate the impact of perceived usefulness and perceived ease of use on behavior intention. Thus, we add the factors of perceived useful and perceived ease use into TAM as an extended model.

3. Hypotheses

3.1. Perceived usefulness (PU)

Davis et al. (1989) defined perceived useful the degree to which an individual believes that system will be useful in enhancing his or her performance. Chakraborty (2020) proposed that a high degree of control is useful for affecting the intention positively. Lee et al. (2017), Chen et al. (2018) claimed that perceived useful has significant positive impact on attitude. Haldar and Goel (2019) found that perceived useful has a significant positive effect on both attitude and intention to use apps. In the model of TAM, it assumes that PU predicts the attitude of using technology, and then predict the intention of using technolody (Haldar & Goel, 2019). When consumers find the fresh food apps useful, they will develop a positive attitude towards it, thereby creating a strong willingness to use it. Hence, this study postulates:

H1a: PU will positively influence the attitude to use fresh food apps.

H1b: PU will positively influence the intention to use fresh food apps.

3.2. Perceived ease of use (PEOU)

Perceived ease of use is another important variable in TAM. It is used to describe the effortlessness a person feels when using a new technology (Davis et al., 1989). Besides, the researchers proposed that PEOU refer to the degree to which an individual considers that a specific system would be easy to use; in other words, ease of use stands for the freedom of complexity and problems. Thus, the more easier of the apps for using, and more individuals are willing to use it. Therefore, the application is often easier to use and many people use it. Some others also mentioned that PEOU means how easy it is to use a new technology. The features can help facilitate the use of technology, while the use of the system and the ability of acquiring information can be used fairly (Chakraborty, 2020). In the literatures with regard to mobile apps, PEOU are tested to have a significant relationship with PU (Hur et al., 2017; Wai et al., 2018; Akdur et al., 2020). Therefore, there is an opinion that less time and energy consuming on shopping apps will lead to more positive attitudes towards purchasing fresh food via apps. Apart from this, it is believed that PEOU is also a driving factor for PU, Which means that when individual find it easy to use a new technology, they are more than enough to get familiar with it (Davis et al., 1989). Hence, the study hypothesizes:

H2a: PEOU will positively influence PU of the fresh food apps.

H2b: PEOU will positively influence the attitude towards the fresh food apps.

3.3. Attitude

Attitude has always been proven to be an important factor of predicting the intention in diiferent environments and behaviors (Weigel et al., 2014). According to Ajzen (1991), attitude refers to the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question. A positive attitude may encourage the behavior, while a negative attitude may hinder it (Greaves et al., 2013). Attitude also play an important role in influencing consumers' purchasing behaviors. Liang and Lim (2011) believed that attitude has positive impacts on behavioral intention. Hao and Hai-Tao (2020) suggested that a positive attitude toward SNS gifting has a positive effect on SNS gifting intention. Lee et al. (2017) claimed that attitude toward the use of mobile apps has positive effects on the intention of mobile apps. Chen et al. (2018) found that the attitude has no mediate effect on the impact of perceived usefulness on behaviour intention. Based on the above ideas, we propose that attitude has influences on the consumers' intention of purchasing fresh food via apps, and here are the hypotheses.

H3a: Attitudes toward purchasing fresh food on apps have positive influence on behavioral intention to use fresh food apps for enjoying cold chain logistics services.

H3b: Attitude mediates the impact of perceived usefulness on behavior intention toward using fresh food apps for enjoying cold chain logistics services.

3.4. Subjective norm

SN is a kind of social pressure which an individual should face, and it is always caused by the perceptions of the important clients and the constraint of the laws and regulations (Ajzen, 1991). In other words, the individual's view about specific behavior should be influenced by others, including the government, other institutions, families, friends and other peers in the community (Khor & Hazen, 2017). Higher degree of group identity will impose greater impact on the individual SN from the group environment stress, which means that the person with high identity tend to follow the group norms to make behavioral decision (Sparks & Shepherd, 1992). Few studies suggested that subjective norms have positive effect on behavioral intention (Liang & Lim, 2011; Khor & Hazen, 2017; Schmidt, 2019; Wang et al., 2021). However, Ghaderi et al. (2019) and Chakraborty (2020) found that there is no correlation between tourists' subjective norms and travel intention. In our research, SN refers to the social pressure from the reference group that the consumers face when using the fresh food apps, and we are aiming at revealing if the consumers' intention will also be influenced by the important individuals around them. In other words, when consumers find that the important people around them are using the apps, they would keen to follow their behaviors. Therefore, the following hypothesis can be established.

H4: Subjective norms have a positive influence on behavioral intention toward using fresh food apps for enjoying cold chain logistics services.

3.5. Perceived Behavior Control (PBC)

As the studies claimed in the early time, PBC is the level where they feel interested to start the behavior. it can be divided into 2 parts: how much unnecessary behaviors an individual can control, and how many people believe that it has the power to decide to execute a conduct or not. It depends on an individual's faith in his capability, not only internal and environmental variables, but also the encouragement of the social execution (Chakraborty, 2020). Ghaderi et al. (2019) thought that there is a positive relationship between PBC and local travel intention. Wang et al. (2021) found that PBC has a significant positive impact on young consumers' intention to recycle express packaging. However, Haldar and Goel (2019) found that there is no significant influence for PBC on the intention of using the carsharing apps. In this study, PBC refers to the ability to purchase fresh food via online shopping apps. PBC is an individual's impression of their ability to conduct specific behaviors, which are depending on their opinions of how easy or troublesome the conduct is (Chakraborty, 2020). We propose that PBC will impose an impact on the consumers' intention of purchasing fresh food by apps, and here is the hypothesis.

H5: PBC has a positive influence on behavioral intention toward using fresh food apps for enjoying cold chain logistics services.

4. Methods

The research model has been established after an in-depth review of the literature in cold chain logistics, mobile shopping applications, fresh food delivery service etc. From the perspective of PU, PEOU and TPB shown in Figure 1, This extended model is used to evaluate whether the ease of use and usefulness of the APP can affect consumers' attitudes toward using cold chain logistics services, as well as whether SN and PBC can affect consumers' planned behavior regarding the use cold chain logistics services. This part of the paper focuses on the method and instruments for collecting the data.

4.1. Data collection

The key point of this paper is designed to analyze the intention of using cold chain logistics service by fresh food apps from the respondents who have experiences in using these apps. According to other researchers, online questionnaires is competitive, because it is with lower costs, faster responces and a wider cover (Ilieva et al., 2002; Green et al., 2003; Narajan et al., 2017). In order to have enough sampling for the analysis, the survey was conducted through Credamo. Credamo is a well-known cloud-based survey platform in China, used for research based on consumers, monitoring results and fundamental statistical analysis. This questionnaire is only for the users with shopping via apps. So, the first question is if the interviewee has an experience in pur-

chasing products with apps, if no, the interviewee will be skipped to the last page of the survey. Considering China's vast geographical location and the imbalance of economic development between the east and the west regions, there may be differences in consumer behavior. Therefore, this study only focuses on consumers in the first-tier cities of Beijing and Shanghai. We have received 716 as a sampling group finally. However, we removed 19 respondents who did not use cold chain logistics services through fresh-food apps, excluded 107 invalid questionnaires and 80 samples that did not follow the normal distribution, leaving a total of 510 responses for the data analysis. The detailed information of the samples is showed in Table 1.

Table 1. Demographics of respondents

Characteristics	Number (N = 510)	Percentage
Gender		
Male	177	34.7%
Female	333	65.3%
Age		
14–25	130	25.5%
26–35	249	48.8%
36–45	109	21.4%
46–55	22	4.3%
Frequency of using shopping apps for fresh food one month		
1–5 times	269	52.7%
6–10 times	152	29.8%
11–15 times	59	11.6%
16–20 times	24	4.7%
More than 20 times	6	1.2%
Highest Educational Qualification		
High school	12	2.4%
college	54	10.6%
undergraduate	339	66.5%
Graduate and higher	105	20.6%
Income		
Less than 2000 Yuan	39	7.6%
2001–4000 Yuan	57	11.2%
4001–6000 Yuan	79	15.5%
6001–8000 Yuan	123	24.1%
More than 8000 Yuan	212	41.6%

From the data in Table 1, it can be seen that there are 333 female respondents and 177 male respondents. The age distribution of the respondents is as follows: the largest group is aged 26–35, with 249, this is followed by those aged 14–25 (130) and those aged 36–45 (109). In a survey on the frequency of using cold chain logistics services through the fresh-food app, 269 respondents used it 1–5 times a month, and 152 respondents used it 6–10 times a month. The number of respondents with higher education background is 339 who have a college degree. The highest level of income distribution is over 8,000 yuan, with 212 respondents earning that much.

4.2. Measures

The questionnaire was designed to collect the relevant date, it covers various dimensions, 27 questions in total. We take 7-point Likert scale as a measurement in this questionnaire, with values 1 for Strongly Disagree, 2 for Disagree, 3 for Somewhat Disagree, 4 for Neither Agree nor Disagree, 5 for Somewhat Agree, 6 for Agree and 7 for Strongly Agree. Comparing with 5-point Likert Scale, the 7-point Likert Scale is more competitive, such as the answers are not unnessararily skewed and more sensitive (Diefenbach et al., 1993; Collis & Hussey, 2013). In order to make the questionnaire more in line with the purpose of this research, the content of the questionnaire in the

preliminary study was changed to "The use of cold chain logistics services through fresh-food apps" while keeping the basic structure of the variables unchanged. Table 2 shows the source of each variable. A copy of the questionnaire is attached.

Structural equation modeling (SEM) is mainly used as a tool for estimating the multiple interrelated dependent relationship in the model (Hair et al., 1995). We always use AMOS 23.0 as statistical software tools. We will take reliability and validity test first, and get the results of Cronbach's alpha to assess the reliability. Then Confirmatory factor analysis (CFA), average variance extracted (AVE), composite reliability (CR) and average loadings (AL) were taken into consideration when we do the reliability and validity test.

5. Results and findings

5.1. Reliability and validity measurement

In order to evaluate the validity of the measurement model, CFA (confirmatory factor analysis) was performed on the multiple item constructs in the research model. According to CFA results, the loadings of AT2, PBC3, SN4, IN4, IN5, PEOU1, PU1, PU2 are much lower (below 0.5), so we remove these items with lower loading and remain the left 18 items in the SEM. The final results of CFA analysis are shown in "Table 3". The final measurement model of our study provides a better fit statistics ($\chi 2/df$ = 2.891; goodness of fit index

Table 2. Constructs and sources

Construct	Source
Perceived Usefulness (PU)	Patel (2016); Fu (2018)
Perceived Ease of Use (PEOU)	Chang and Tung (2008); Diop et al. (2020)
Attitude (AT)	Ajzen (2002); Tonglet et al. (2004); Wang et al. (2021)
Subjective Norms (SN)	Son et al. (2013); Khor and Hazen (2017)
Perceived Behavioral Control (PBC)	Chan and Lau (2002); Son et al. (2013); Khor and Hazen (2017)
Behavioral Intention (BI)	Shaharudin et al. (2010); Teng and Lu (2016)

Table 3. Validation of final measurement model – reliability and convergent validity

Variable		Estimates					Squared Multiple Correlations	Composite Reliability	Convergence Validity
		UNStd.	S.E.	t-value	P	CFA Loading	SMC	C.R.	AVE
Attitude	ATT1	1.000				.573	.328	.737	.486
	ATT3	1.801	.179	10.057	***	.765	.585		
	ATT4	1.541	.151	10.186	***	.739	.546		
PBControl	PBC1	1.000				.732	.536	.726	.472
	PBC2	.841	.084	10.020	***	.739	.546		
	PBC4	.783	.079	9.871	***	.579	.335		
SNorm	SN1	1.000				.798	.637	.857	.668
	SN2	1.031	.055	18.723	***	.890	.792		
	SN3	1.014	.058	17.525	***	.758	.575		
Intention	IN1	1.000				.908	.824	.813	.596
	IN2	.804	.060	13.472	***	.668	.446		
	IN3	.821	.058	14.093	***	.720	.518		
EasyUse	PEU2	1.000				.846	.716	.863	.678
	PEU3	1.007	.051	19.631	***	.846	.716		
	PEU4	.893	.048	18.529	***	.775	.601		
Useful	PU3	1.000				.631	.398	.741	.490
	PU4	.969	.090	10.769	***	.682	.465		
	PU5	1.186	.113	10.463	***	.780	.608		

Note: $\chi 2/df$ = 2.891; GFI = .932; AGFI = .903; CFI = .947 and RMSEA = .061.

(GFI) = .932; adjusted goodness of fit index (AGFI) = .903; comparative fit index (CFI) = .947; and root mean square error of approximation (RMSEA) = .061). The CFA results showed that all items have a significant relationship with their hypothesized factors (p < .001), which proves the convergent validity criterion. In addition, all standardized loadings are greater than 0.5 (Kline, 2015), and the squared multiple correlations (SMC) of each factor is greater than 0.33 (Hair et al., 1995).

Table 3 showed that the internal consistency of the structure is very good. For all variables, composite reliability (CR) is greater than 0.7 (Hair et al., 1997; Fornell & Larcker, 1981). The average variance extracted (AVE) is calculated for all factors, and according to Table 3, all AVE values are greater than 0.36, which meets the standard proposed by Fornell and Larcker (1981). Therefore, our measurement model meets the requirements for the reliability and convergent validity.

Table 4 showed the discriminative validity of the model. According to the correlation matrix, Although the correlation coefficient between AT and BI is much greater than 0.7, indicating there is a high degree of correlation. However, considering that the previous data regarding the appropriateness of the model did not violate the prior research, we will not modify the topics of these two variables. Therefore, except for the correlation value between AT and BI of 0.848, all correlation values are less than the square root of the corresponding average variance extracted (AVE) (Fornell & Larcker, 1981).

Table 4. Validation of measurement model – discriminant validity

	AT	PBC	SN	BI	PEOU	PU
AT	0.697					
PBC	0.557	0.687				
SN	0.653	0.521	0.817			
BI	0.848	0.666	0.609	0.772		
PEOU	0.347	0.449	0.350	0.510	0.823	
PU	0.504	0.665	0.495	0.652	0.788	0.700

Note: figures in bold denotes square root of the average variance extracted (AVE) and the elements below the diagonal denotes the correlation between each pair of constructs.

5.2. Structural equation modeling (SEM)

After the measurement model was tested by the validation, the collected data were analyzed by structural equation model (SEM). AMOS 23.0 is used as a software tool to perform analysis of the proposed model. The results and empirical estimation were good ($\chi2/df$ = 4.260; Goodness of fit index (GFI) = .897; Adjusted goodness of fit index (AGFI) = .860; Comparison fitting index (CFI) = .904; And approximate root mean square error (RMSEA) = .080). The modified index also does not show any signs of model mismatch, so there is no need to include any new paths between constructs.

The results of the SEM show that all our hypothesis except the positive relationship between the attitude and perceived ease of use are accepted with a minimum confidence level of 95%.

The results show that all of our hypotheses are accepted, with a minimum confidence level of 95%, except for the positive correlation between attitude and perceived ease of use. Table 5 shows a better measurement of the strengths of the relationships. Intention to use cold-chain logistics service with shopping applications for fresh food depends on the constructs – attitude (β = .772, p < .001), subjective norms (β = .091, p < .05), perceived behavioral control (β = .198, p < .001) and perceived usefulness (β = .203, p < .05). This is similar to the finds in previous literature from different perspectives like SNS gifting, kinds of apps such as carsharing apps, grocery shopping apps and mobile delivery apps, specialty food shoppers, remanufactured products, recyclable express packaging etc. (Hao & Hai-Tao, 2020; Haldar & Goel, 2019; Chakraborty, 2020; Liang & Lim, 2011; Khor & Hazen, 2017; Wang et al., 2021).

Attitude towards using shopping applications for fresh food depends on perceived usefulness (β = .516 p < .001). This is also similar with previous literature (Chen et al., 2018; Haldar & Goel, 2019). However, attitude towards purchasing fresh food with using shopping applications for fresh food does not depend on perceived ease of use (p > .1), which is different from previous literature like Chen et al. (2018). Perceived usefulness of shopping applications for fresh food depends on perceived ease of use (β = .659 p < .001). This is similar with previous literature of mobile applications (Hur et al., 2017; Wai et al., 2018; Akdur et al., 2020).

Table 5. Structural equation modeling results

No.	Hypothesis			std.	Ustd.	S.E.	t-value	P	Result
	PEOU	→	PU	.827	.659	.056	11.733	***	Supported
	PU	→	AT	.503	.516	.144	3.574	***	Supported
	PEOU	→	AT	−.005	−.004	.106	−.040	.968	Not Supported
	AT	→	BI	.623	.722	.073	9.874	***	Supported
	SN	→	BI	.113	.091	.038	2.435	.015	Supported
	PBC	→	BI	.260	.198	.042	4.681	***	Supported
	PU	→	BI	.171	.203	.067	3.035	.002	Supported

*Note: $\chi2/df$ = 4.260; GFI =.897; AGFI = .860; CFI = .904 and RMSEA = .080; *p < .05, ** p < .01, *** p < .001.*

5.3. Mediation analysis

In order to analyze the mediating effect of attitude between the usefulness and intention of buying fresh food using the fresh food shopping app app, the Sobel test (Sobel, 1982) was used. The mediating model is shown in Figure 1. First, check whether the impact of the non-standardized coefficient of PU for Attitude and the non-standardized coefficient of ATTITUDE for Intention are significant. If it is significant, it means that the mediating effect exists. Assuming the existence of mediating effect, we examine the impact of the non-standardized coefficient of Useful for Intention. If it is significant, it is a partial mediating effect, and if it is not significant, it is a complete mediating effect. Then, the above non-standardized coefficients are subjected to the Sobel test, and at the significance level of $\alpha = 0.05$, $z > |1.96|$ means that the mediating effect exists. Furthermore, in order to test whether the mediating effect conforms to the normal distribution, the bootstrap technology is used to estimate the standard error of the profile effect and the non-standardized coefficient, and calculate the significance level of the indirect effect, that is, the z value. AMOS 23.0 was used as a statistical software tool to conduct the analysis. And we can find out the results fo the mediation analysis from "Table 6", in which a confidence level of 95% was taken.
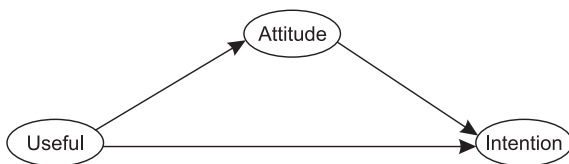

Figure 1. Mediation model

Table 6. Mediation analysis results

Hypothesis			UNStd.	S.E.	t-value	Std.	P
PU	→	AT	.462	.060	7.726	.518	***
AT	→	BI	.859	.081	10.561	.693	***
PU	→	BI	.337	.061	5.514	.305	***

As can be seen in Table 6, the non-standardized coefficient of PU for attitude is .462, p < .001, and the non-standardized coefficient of attitude for Intention is .859,

p < .001. These can explain the existence of attitude's mediating effect. Moreover, the non-standardized coefficient of Useful for Intention is .337, p < .001. In summary, it can be explained that attitude has partially mediating effects. Moreover, when the above non-standardized coefficients are subjected to the sobel test and the calculated z value is 6.231, which is larger than 1.96, further indicating that the mediating effect exists. That is, attitude has a mediating effect between Useful and Intention. Furthermore, as in Table 7, in order to test whether the mediating effect conforms to the normal distribution, the bootstrap technology is used to calculate the non-standardized coefficient and standard error of the indirect effect. That is, the non-standardized coefficient of the indirect effect of Useful on Intention is .397, its standard error is .073, the z value is 5.438, which is greater than the recommended value of 1.96, and in the bias-corrected 95% CI, the lower value is .291, the upper value is .555, which does not include 0. It means that indirect effects of Attitude exist. That is, Attitude plays a part of the mediating effect in PU and BI. This conclusion is inconsistent with the conclusion of previous research (Chen et al., 2018).

6. Discussion and conclusions

In this study, considering that consumers currently use fresh-food apps to enjoy cold chain logistics services, it is reasonable to put the ease of use and usefulness of the TAM model in the research model. Therefore, in this study, based on the TPB model, PU and PEOU are added to the TPB model, which not only studies the behavioral intentions of consumers using cold chain logistics services, but also considers the fresh-food apps themselves as a feature of technology products. In other words, it examines the usefulness and ease of use of fresh-food apps, and whether the usefulness of them can affect consumers' planned behaviors. The focus of the research is on the planned behavior of consumers in Beijing and Shanghai regarding the use of cold chain logistics services through fresh food apps. And take attitude as a mediating variable to study whether the variable of attitude plays a mediating effect in PU and BI.

From the collected data, it can be seen that although Shanghai and Beijing are first-tier developed cities in China, more than half of their residents purchase fresh food

Table 7. Bootsrap analysis results

Hypothesis	Coefficient	SE	Z	Bias – Corrected 95% CI		Percentile 95% CI	
				Lower	Upper	Lower	Upper
Total Effects							
PU → BI	0.734	0.067	10.955	0.6	0.872	0.601	0.873
Indirect Effects							
PU → BI	0.397	0.073	5.438	0.291	0.555	0.284	0.539
Direct Effects							
PU → BI	0.337	0.065	5.185	0.187	0.483	0.187	0.481

through fresh-food apps 1–5 times a month, that is, cold chain logistics services were used only 1–5 times a month. However, according to previous research, Chinese consumers buy fresh produce three times a week on average. In other words, the frequency of consumers in Shanghai and Beijing buying fresh food through fresh-food apps is less than 50% (including online and offline). Therefore, the conclusion that can be drawn is that, first, even in developed cities, consumers may rely more on offline stores to purchase fresh food than through fresh-food apps. Second, although the cold chain logistics in China is currently well developed, their services are still relatively unfamiliar to ordinary consumers, and hence they are more inclined to buy fresh food offline. Third, what should not be ignored is that 29.8% and 11.6% of the respondents in the survey used the fresh-food apps to buy fresh food within a month 6–10 times and 11–15 times respectively. That is, about 40% of the respondents may fully use the fresh-food apps to buy fresh food, and the willingness to directly use cold chain logistics services is relatively strong. In other words, although China's cold chain logistics services are still in their infancy, there is still a lot of room for development and a greater opportunity to seize more market share.

Through the analysis of the structural equation model, it is found that the usefulness of the fresh-food apps has a positive impact on consumers' attitudes towards enjoying cold chain logistics services through these apps. However, the ease of use of apps has never had a positive impact on consumers' attitudes towards enjoying cold chain logistics services. The reason why consumers think the fresh-food app is useful is that they can easily and quickly browse and select products and make settlements with a few taps on the screen (Haldar & Goel, 2019). Moreover, consumers can easily share their favorite products through social media apps (for example, WeChat, QQ, etc.). In often times, one can purchase fresh food on behalf of his friends, and even give it as a gift. Therefore, because the fresh-food apps have certain social attributes and break the geographical restrictions, the use of them can also easily meet the social needs of consumers, and it is also in line with the current consumer's life status (Hao & Hai-Tao, 2020). In summary, the usefulness of fresh-food apps will affect consumers' use of cold chain logistics services. However, with the rapid popularity of smart phones, the use of smart phones and their various APPs is similar. For consumers, using a new app does not require deliberate practice. Therefore, the ease of use of the fresh-food apps will not affect the attitude of using cold chain logistics services.

Consumers' attitudes towards fresh-food apps have a positive impact on their intention to use cold chain logistics services through fresh food apps. And from the analysis results, it can be seen that among attitudes, SN, and PBC, attitude has the highest influence. In other words, when consumers use cold chain logistics services through fresh-food apps, they will have a positive feeling, such as enjoyment, excitement, etc., and they will be more inclined to use the apps to enjoy cold chain logistics related services.

The same is true for fresh food carried by cold chain logistics. Consumers' SN for fresh-food apps have a positive impact on their intention to use cold chain logistics services. That is, consumers' intention to use will be influenced by their relatives and friends, and even colleagues' bosses. Moreover, the more relatives, friends, colleagues and other surrounding people use fresh-food apps, individuals will be more inclined to use cold chain logistics related services. This also implies that for Chinese consumers, the existence of a collective society will have an impact on the behavioral intentions of individuals.

Consumers' PBC for fresh-food apps will have a positive impact on their intention to use cold chain logistics services through fresh food apps.

Through the test of mediating effect, attitude plays a part of mediating role in usefulness and behavioral intention. That is, the usefulness of the fresh-food apps will affect the consumer's intention to use cold chain logistics through the consumer's attitude towards the use of them. Although the usefulness of fresh-food apps has a direct impact on consumers' planned behavior, the mediating variable of attitude can further improve the overall impact. That is to say, when the fresh-food app is useful, the attitude towards using it will affect the Chinese consumers' usage of the cold chain logistics services. This conclusion is inconsistent with the research conclusion of Chen et al. (2018). Therefore, for Chinese consumers, the emotional attitudes such as joy and excitement generated when using cold chain logistics services through fresh-food apps will deepen their positive impression, and become more willing to use cold chain logistics services via fresh-food apps.

Through the above analysis, we can conclude that Chinese consumers pay more attention to the usefulness of fresh-food apps. Therefore, for companies that develop them, they should pay attention to the practicality of the app when designing it. They need to be convenient for the purchase and payments, and it is also necessary for them to meet the social needs of consumers to quickly share products with friends. Second, when optimizing various functions of fresh-food apps, we should proceed from the perspective of consumers ensure that consumers can have a positive attitude towards the app when using the app. For example, beautify the page to ensure the smoothness of the app. Consumers do not need to frequently switch pages manually when browsing products, selecting products and making payments. In addition to the technical aspect, companies that develop fresh-food apps should also ensure the quality of their products and the quality of after-sales services. Consumers can easily contact after-sales customer service through the app, whether to address product-related issues, or to request return and exchange services. Moreover, since China's cold chain logistics services are still in their infancy, for companies that provide cold chain logistics services through fresh-food apps, it is not only necessary to provide consumers with a high-quality app to satisfy consumers' purchases, it also need to ensure the quality of the services. By providing high-quality cold chain logistics services, consumers will

be more willing to purchase fresh food through fresh-food apps, which can increase the profits of related companies and expand the market scale of related companies, thereby promoting the development of cold chain logistics services and forming a virtuous circle.

Limitation and further research

Based on TPB and two variables in TAM, ease of use and usefulness, this paper studies the willingness of consumers in Shanghai and Beijing to use cold chain logistics services through fresh-food apps. And found several important conclusions about the relationships among usefulness, ease of use, attitude, SN, PBC, and use intention. In the preliminary research, TPB is a very reliable and scientific model for studying consumers' willingness to use apps. Therefore, in this study, it is used to study consumers' willingness to use cold chain logistics services through fresh-food apps. Among them, usefulness has a positive and significant impact on attitudes, but ease of use does not. Moreover, usefulness, attitude, SN, and PBC all have a positive and significant impact on the use intention. Furthermore, attitude as a mediating variable will increase the overall effect of usefulness on attitude. The conclusions of this research can provide some valuable insights into the areas for improvement and future development directions for companies that currently develop fresh-food apps and provide cold chain logistics services.

However, this study has certain limitations. First, this study only investigated the situation of consumers in Beijing and Shanghai, and the results of the study do not represent the performance of Chinese consumers as a whole. Future researchers should use this model to study the situation of consumers in other regions of China. Second, this study did not analyze the reasons why the respondents used fresh-food apps to buy fresh food. In future research, it is possible to analyze the reasons and motivations for consumers to use cold chain logistics services through fresh-food apps. Third, variables such as SN and PBC may play a moderating role in the model. In future research, this part can also be taken into consideration.

However, this study has certain limitations that can potentially offer direction for further research. Firstly, as this study only investigated the situation of consumers in Beijing and Shanghai, the results of the study only represent the performance of consumers in China's developed cities. It might be important to research different cities in different economy development level in the future because economic level may influence consumers' lifestyle and purchase conception, which may affect their attitude and intention to use fresh-food apps. Secondly, the proposed conceptual model did not represent the motivations for consumers to use cold chain logistics services through fresh-food apps. But according to the McGuire's theory of psychological motivations, consumer motivations can be roughly divided into the following four types: Cognitive

motivation (focusing on the individual's need to adapt to the environment and gain understanding and meaning [of others or the surrounding environment]); Affective motivation (the need to achieve a satisfactory state of feeling and personal goals); Preservation-oriented motivation (which emphasizes balance); and Growth motivation (with emphasis on development). Furthermore, these broadly defined motivations are often subdivided into sixteen sub-categories. It seems worthwhile to analyze consumers' motivation for using fresh-food apps, perhaps it can provide marketers of fresh-food apps with a relevant theoretical basis for selecting appropriate marketing strategies and techniques. Thirdly, this study did not investigate and observe the actual usage behavior of consumers. In future research, understanding the actual use process of consumers can help us further understand, under the B2C setting of the e-commerce environment, the consumers' selection process of fresh-food apps, the decision-making process of buying them, and factors affecting the choices and final purchase decisions.

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Author contributions

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