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Uncovering people's mask-saving intentions and behaviors in the post-COVID-19 period: Evidence from China

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ABSTRACT

The COVID-19 pandemic has caused a surge in the demand for medical masks over the past few months. Many countries and regions have experienced a shortage of masks and raw materials, as well as soaring prices. Understanding mask-saving behavior is an important way to help improve medical resource sustainability and respond to the outbreak. This study integrates the theory of planned behavior and normative activation to propose a new comprehensive theoretical framework, which aims to reveal people's mask-saving intentions (MSI) and behaviors in the post-pandemic period. Using the partial least squares structural equation modeling method, a total of 1057 questionnaires randomly collected from China were measured and empirically analyzed. Results indicate the following: (i) Reducing the frequency of going-out is the main approach to saving masks in China, and the majority of people reuse a mask from two to five times. (ii) Personal norms, subjective norms, attitudes and perceived behavioral control all have significant positive effects on MSI; awareness of consequences and ascription of responsibility also indirectly affect MSI through personal norms. (iii) As for extended factors, environmental concerns, perceived risk and information publicity positively affect MSI, but supply chain performance does not have a significant role. (iv) Excessive information publicity may weaken the impact of personal norms, subjective norms and perceived risk on MSI. Given the above findings, some insightful management implications are proposed.

1. Introduction

Over the past few months, the COVID-19 pandemic has caused severe disruption to the global economy and society and has significantly challenged the running of urban areas (Antony, Velraj, & Haghighat, 2020; Gössling, Scott, & Hall, 2020; Wang, 2021). As of November 8, 2020, 49,578,590 people worldwide had been infected with COVID-19; the death toll has now exceeded 1,245,700 (WHO, 2020). To control the spread of COVID-19, masks have become one of the most indispensable forms of protective equipment for the public (Feng et al., 2020; Wang et al., 2020). Given that the second wave of the COVID-19 pandemic has struck and become more severe (Jadoo, 2020), the global demand for masks will continue to increase.

Since we eat and drink every day, we have to take our masks off many times a day. Throwing a mask away every time one is used is extremely wasteful, especially for ordinary residents. One can imagine how many discarded masks are generated every day around the world. The sheer volume of discarded masks poses a serious challenge to the earth's environmental carrying capacity (Kalina & Tilley, 2020; Klemeš, Fan, Tan, & Jiang, 2020). Moreover, any surge in the amount of medical waste can easily cause secondary infections (Yang et al., 2020). Therefore, saving masks is vital for the sustainable development of cities and society.

According to the "Guidelines for the Public Scientific Wearing of Masks", issued by the National Health Commission of China, in low-risk areas or non-occupationally exposed groups, disposable and medical masks can be reused a limited number of times. However, the cumulative time spent wearing the mask cannot exceed eight hours (NHCRC (National Health Commission of the People's Republic of China) (2020)). Professor Nanshan Zhong, the leader of the senior expert group responsible for fighting COVID-19 in China, suggested that disposable masks without obvious deformation and dirt can be reused; the premise

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Table 1
Recent representative literature related to this article.

Literature	Topic	Specific behavior	Theory basis	Extended variables	Critical findings
Wang, Wang et al. (2018)	Energy saving	Habitual energy-saving behavior	NAM TPB	Save money	Residents' energy-saving behavior is driven by altruism. Social norms and policy environment are positively correlated with energy-saving behavior.
Wang, Guo et al. (2018)	Waste management	E-waste recycling intention	NAM TPB	Information publicity	IP does not directly affect recycling intention, but indirectly affects it through PN and ATT.
Asadi et al. (2019)	Sustainable consumption	Green IT adopting intention	NAM TPB	Competitive advantage Managerial interpretation	Attitude, managerial interpretation, cost saving, AR, AC and PN are significant factors that affect the willingness to adopt.
Wang, Wang et al. (2019)	Waste management	Waste separation behavior	NAM	Information publicity Information quality	IP has a significant direct impact on residents' behavioral intention toward waste separation, and information quality positively moderates this impact.
Lopes, Kalid, de, Rodríguez, and Filho (2019))	Energy saving	Workers' energy-saving behavior	NAM TPB	Performance shaping factors	The impact of SN and performance shaping factors on energy-saving behavior is not significant.
Li et al. (2020)	Sustainable mobility	Shared use of electric bicycle	TPB	Service quality Past behavior	Service quality has a positive impact on attitude and behavioral intention, but past behavior does not affect further behavior.
Si et al. (2020)	Sustainable mobility	Sustainable usage of bike sharing	TPB	Awareness of consequences Moral obligation	Perceived behavior control and moral obligation are the key drives of behavioral intention, while the effect of AC is not significant.
Xu et al. (2020)	Sustainable consumption	Purchase intention of green furniture	TPB	Past behavior Physical health concern	Perceived behavioral control, past behavior and physical health concern are positively correlated with purchase intention
Zhang et al. (2020)	Waste management	Smartphone recycling	TPB	Past behavior Risk perception Conscientiousness	Risk perception negatively regulates the relationship between conscientiousness and ATT, SN, PBC and past behavior.
The present study	Medical resource saving	Mask-saving intention	NAM TPB	Environmental concern Supply chain performance Perceived risk Information publicity	The present study aims to reveal the influencing factors and driving mechanisms of people's MSI.

is that the user should not touch the outside of the mask (Zhong, 2020). Kampf, Scheithauer, Lemmen, Saliou, and Suchomel (2020) argued that, in extreme cases where masks are in short supply, masks can be saved by extending the wearing time, and reusing, disinfecting or reprocessing the masks. Man et al. (2020) found that the sterilization of disposable masks using steam at 121 °C is economical and efficient and does not affect the safe reuse of masks. Rubio-Romero, Pardo-Ferreira, del, Torrecilla-García, and Calero-Castro (2020) pointed out that hydrogen peroxide vapor, ultraviolet radiation, damp heat, dry heat and ozone gas are all effective disinfection methods. Existing studies have made important contributions in explaining how to save masks. However, to date, research into people's mask-saving behaviors and intentions is lacking.

Clarifying what factors drive public mask-saving intentions (MSI) can effectively guide people's mask-saving behaviors, and help to formulate relevant policies that promote the economical use of masks and other medical resources. In the present research, mask-saving behavior is defined as an individual's action and intention to use masks sparingly by reusing masks, avoiding going out unnecessarily, distinguishing wearing occasions and other health approaches. Correspondingly, MSI refers to the subjective probability or possibility that an individual will engage in mask-saving behavior. Hence, the main purposes of this study are to reveal people's mask-saving intentions and behaviors in the post-COVID-19 period, and to provide useful implications for the government and health organizations in low-risk areas.

Specifically, this research attempts to construct a comprehensive theoretical framework, which is based on the normative activation model (NAM) and the theory of planned behavior (TPB). In light of the people's complex psychology after the COVID-19 pandemic, the MSI may be affected by some specific factors, such as the information publicity related to global infections and deaths, the supply status of medical supplies, personal concerns regarding the environment, and perceived risks regarding the pandemic. Therefore, the present study incorporates information publicity (IP), supply chain performance (SCP), environmental concern (EC) and perceived risk (PR) into the integration model of the NAM and TPB, in order to comprehensively reveal the drivers and influence mechanism of MSI.

2. Literature review

The NAM originated from scholars' studies of the factors that influence the helping of others. Schwartz (1977) claimed that the activation of personal moral obligation requires two important conditions. First, individuals must be aware that their potential behavior may affect the well-being of others. Second, individuals must be responsible for their behavior and consequences. Therefore, NAM is composed of three variables, namely, the awareness of consequences (AC), ascription of responsibility (AR), and personal norms (PN) (Schwartz & Howard, 1981). In practice, AC refers to an individual's consciousness of causing undesirable consequences for others by not performing altruistic behaviors; AR refers to an individual's sense of responsibility for adverse consequences. Finally, PN refers to the self-expectations and self-moral obligations of individuals to implement specific behaviors under specific circumstances.

According to the TPB, as a rational agent, individuals' behavioral decision-making is affected by three factors, namely, attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC) (Ajzen, 1991). In practice, ATT refers to the positive or negative evaluation of a certain behavior by individuals (Ajzen, 1985); SN refers to the social pressure individuals perceive from others regarding whether to carry out a certain behavior by others. Finally, PBC is the individuals' perception of the relative difficulty of performing a certain behavior, based on existing experience; PBC is also an assessment of internal and external objective factors. Generally, the stronger the SN that is perceived by the individual, the more positive their ATT toward a certain behavior is and the easier the perceptual behavior is controlled, the stronger the willingness to act will be.

The NAM and TPB are two classic theories used to explain and predict an individual's pro-environmental behavioral intentions (Si, Shi, Tang, Wu, & Lan, 2020). The NAM primarily explains behavioral intention from individual consciousness (Zhang, Liu, & Zhao, 2018), whereas the TPB considers the impact of psychological and social factors

(Ru, Qin, & Wang, 2019). Considering that NAM and TPB focus on different aspects of behavior interpretation (Wang, Wang, Guo, Zhang, & Wang, 2018), a growing number of researchers tend to integrate these two models (e.g., Asadi et al., 2019; Shi, Fan, & Zhao, 2017; Wang, Guo, Wang, Zhang, & Wang, 2018). Studies have also confirmed that the integrated model may have better interpretation effects when incorporating other variables (Han & Hyun, 2017; Kim, Woo, & Nam, 2018; Zhang, Geng, & Sun, 2017). As a result, NAM and TPB have been extensively applied in the study of individual pro-environmental behavior. Some recent representative literature related to this article is summarized in Table 1. For example, Wang, Wang et al. (2018) extended saving money to the integrated model of NAM and TPB, in order to investigate residents' energy-saving behavior. This study found that external factors (social environment) have a significant impact on residents' energy-saving behavior. Wang, Guo et al. (2018) added IP into a theoretical model integrating NAM and TPB, in order to examine residents' willingness to recycle e-waste. The study found that IP indirectly affects intention through PN and ATT. Similarly, Wang, Wang, Zhao, and Yang (2019) included IP and information quality in NAM, in an attempt to understand residents' waste separation behavior. Li et al. (2020) incorporated past behavior and service quality into the TPB model to explore the use behavior of shared electric bike users. The study found that service quality has a positive impact on ATT and behavioral intention, but past behavior does not affect future behavior in this case. Xu, Hua, Wang, and Xu (2020) added environmental consciousness, physical health concerns, and past experience to the TPB model, in order to explore the determinants of consumers' willingness to purchase green furniture. Zhang, Wu, and Rasheed (2020) incorporated risk perception into the TPB model and investigated the factors affecting the public's smartphone recycling behavior.

These existing studies have laid a solid theoretical and practical foundation for sustainable pro-environmental behaviors. However, no scholar to date has investigated people's saving intentions with regard to medical resources. In this critical period of a global epidemic, understanding the public's MSI and the driving mechanism is crucial to responding effectively to the pandemic. Thus, this study aims to fill this research gap through the integration and expansion of the NAM and TPB models. Unlike the extended factors of previous studies, in addition to environmental concerns and information publicity, the present study considers the impact of perceived epidemic risk and supply chain performance on saving intentions, as well as the moderating role played by information publicity.

3. Research hypothesis and integrated framework

3.1. The original predictors of NAM

According to the NAM, PN is a critical variable that drives individuals to develop pro-environmental behavior; PN is also affected and activated by individuals' AC and sense of responsibility (Schwartz & Howard, 1981). Schwartz stated that, when individuals are aware of the result of an action (AC) and assign responsibility for this result to themselves (AR), their sense of moral obligation will likely be activated. They will also experience a strong sense of moral obligation to engage in environmentally responsible behavior (Schwartz, 1977).

As far as the MSI is concerned, PN refers to a sense of moral responsibility when individuals carry out mask-saving behavior. Hence, AC refers to the undesirable consequences that may occurs, and that individuals are aware of, by wasting masks. In this context, AR refers to the responsibility that individuals should bear when they perceive adverse consequences. During the epidemic period, saving masks can improve the use efficiency of medical resources and reduce medical waste; thus, medical supplies can flow to countries and regions where they are more needed. When individuals realize that wasting (or not saving) masks may result in the waste of resources, environmental pollution and an uncontrolled epidemic, they will understand that they need to bear responsibility for this consequence. Thus, their sense of moral obligation to engage in saving behavior will be activated. This enhanced sense of moral obligation prompts individuals to have a strong saving intention (Gao, Wang, Li, & Li, 2017). Based on the above viewpoints, we postulate the following:

H1. *AC significantly and positively affects PN.*

H2. *AR significantly and positively affects PN.*

H3. *PN significantly and positively affects MSI.*

3.2. The original predictors of TPB

In light of Ajzen's explanation of TPB, individual decision making is influenced by three factors, namely, SN, ATT and PBC (Ajzen, 1991). Here, SN is divided into mandatory norms and exemplary norms. The former mainly come from leaders and government departments, who influence individual decision-making through authority and by playing a leading role. The latter mainly come from social resources such as family members, neighbors, friends, classmates, and colleagues, all of whom influence individual decision-making through reference and demonstration. In the prediction research of consumer behavior, ATT is generally regarded as the decisive factor (Gkargkavouzi, Halkos, & Matsiori, 2019). As a relatively stable psychological construction, the effect of ATT on behavioral intention has been confirmed in many previous studies (Si et al., 2019). While PBC reflects the influence of experience and future expectation on behavior (Ajzen, 1991). The more confident individuals are in their skills, or the more optimistic they are about their future expectations, the more willing they are to participate in a specific behavior. This view has been verified by some previous studies, such as battery pack recycling (Lizin, Dael, & Passel, 2017), waste separation behaviors (Ma, Hipel, Hanson, Cai, & Liu, 2018), and environmental behavior (Gkargkavouzi et al., 2019).

In this study, SN refers to the impacts of relatives, friends and other social networks on individuals' mask-saving intentions. Under the unique Chinese cultural background, collectivism is encouraged by society (Shi et al., 2017). As such, individuals are more likely to be influenced by leaders or groups (Ru, Wang, & Yan, 2018). Here, ATT refers to individuals' positive or negative evaluation of the economical use of masks. When individuals have a positive attitude toward mask saving, they will be willing to adopt saving behaviors (Liu et al., 2020). PBC refers to the ease or difficulty of saving masks as perceived by individuals. The more confident individuals are in their ability to save on masks and the smaller the expected obstacles they feel they may encounter, the stronger their MSI will be (Ma et al., 2018). Given the above discussion, we propose the following hypotheses:

H4. *SN significantly and positively affects MSI.*

H5. *ATT significantly and positively affects MSI.*

H6. *PBC significantly and positively affects MSI.*

3.3. Environmental concern (EC)

With the increasingly severe global environmental problems, the public's awareness of environmental protection has gradually increased. A growing number of studies have explored the impact of EC on individual behavior (Tang, Warkentin, & Wu, 2019; Wu, Liao, Wang, & Chen, 2019). EC is defined as an emotional attitude towards the seriousness of environmental issues (Landry, Gifford, Milfont, Weeks, & Arnocky, 2018). People who are more concerned about the environment are more willing to respond to environmental issues and then take actions that are beneficial to the environment. Research have indicated that individuals with a high degree of EC are more inclined to adopt pro-environmental behaviors, such as sorting garbage (Ma, Wang, & Kong, 2020), purchasing green products (Maichum, Parichatnon, & Peng, 2016), and using energy-saving appliances (Song, Zhao, & Zhang,

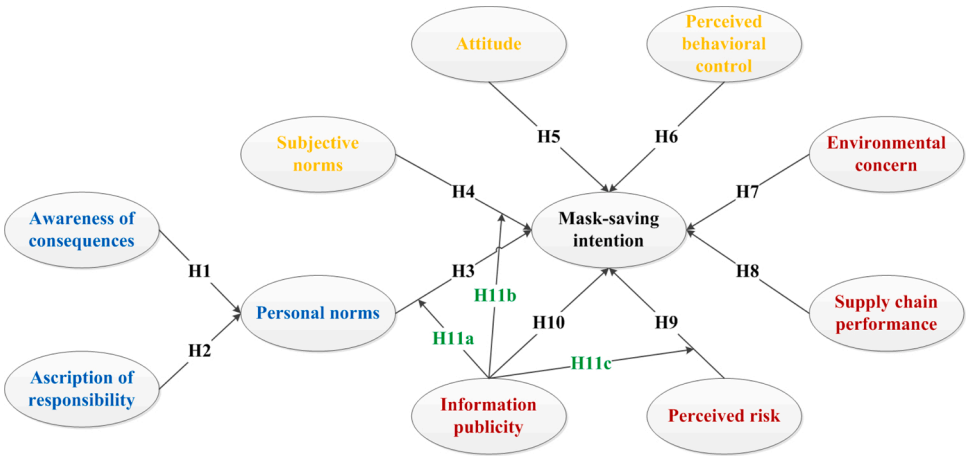

Fig. 1. Research framework of this research.
(The blue variables come from NAM, the yellow variables come from TPB, the red variables are the extend factors, and the green path represents the regulation effect).

2019). In other words, the more individuals pay attention to environmental issues, the more willing they are to make efforts to change their behavior to improve environmental conditions (Verma, Chandra, & Kumar, 2019). Mask saving is a typical pro-environmental behavior. Therefore, the higher individuals' EC, the stronger their MSI is. In the light of the preceding analysis, we propose the following hypothesis:

H7. *EC significantly and positively affects MSI.*

3.4. Supply chain performance (SCP)

In the current study, SCP refers to the performance of the production, supply and marketing of medical masks. This would include the supply condition of raw materials, product prices, and purchasing channels and convenience. Previous studies have found that market stimulus is an important cause of individual behavior (Xu, Ling, Lu, & Shen, 2017). Boey, Ekiz, and Kamarulzaman (2012) confirmed that price and service significantly affect passengers' decision-making when it comes to adopting low-cost airlines. Reasonable commodity prices make obtaining goods relatively easy for consumers; stable purchase channels and a reliable supply of goods also reduce the perceived difficulties for consumers (Pan & Truong, 2018). Generally speaking, when something is easy to obtain, the degree of being treasured will decrease. Similarly, when the SCP of the mask is gradually improved, the mask acquisition will be easier, and the cost will be reduced. Thus, individuals may not be as concerned about saving masks as before. As Chinese medical companies resume work, the supply of masks is gradually becoming sufficient. People can easily buy cheap and high-quality masks through online and offline channels. Therefore, we hypothesize the following:

H8. *SCP significantly and negatively affects MSI.*

3.5. Perceived risk (PR)

In practice, PR is the subjective evaluation of objective risks (Pennings & Smidts, 2003), as well as an individual's subjective prediction of the possibility, time, and degree of risk events (Mumpower, Liu, & Vedlitz, 2016). Tang, Geng, Schultz, Zhou, and Xiang (2017) found that the stronger the perception of environmental risks is, the more willing farmers will be to protect the environment by reducing the use of fertilizers and pesticides. In a study that analyzed farmers' willingness to use organic fertilizers safely, PR showed a significant positive impact on farmers' willingness to use such fertilizers (Savari & Gharechaee, 2020). In the present study, PR is defined as an individual's subjective assessment of the current and future severity of the epidemic and the supply risks associated with masks. For example, the COVID-19 pandemic may become more serious all around the world; the supply of masks may become insufficient in the near future. If the risk perceived by individuals is greater, their MSI may increase. Thus, we put forward the following hypothesis:

H9. *PR significantly and positively affects MSI.*

3.6. Information publicity (IP)

In practice, IP is generally considered to be the government or other specific organizations disclosing relevant information to the public via policies and media. In this research, IP refers to the government promptly publicizing information about the epidemic, including the number of confirmed cases, suspected cases and dead people (due to COVID-19) in different provinces of China, as well as the situation in various countries around the world. The effective self-protection and preventive measures for public are also components of IP. According to the information behavior model, a person's behavior is guided by the information they have been given (Pettigrew, Fidel, & Bruce, 2001); a lack of relevant information will become an obstacle to their behavior. For instance, non-familiarity with the standards of garbage classification, combined with a lack of relevant information, are both important reasons that hinder residents' garbage classification behavior (Mickaël, 2014). Similar to garbage sorting behavior, if people do not know whether disposable masks can be reused (or how to reuse them), their willingness to save masks may be weakened (Wang, Guo et al., 2018). In other words, propagandizing the economical use of masks and the current shortage of medical supplies will help increase individuals' MSI.

When the IP level is high, people with stronger PN will believe that they have a responsibility to use masks sparingly; they will likely be willing to save masks and appreciate their value (Song et al., 2019). From a cultural perspective, China advocates collectivism, and most people tend to subordinate the minority to the majority when making decisions (Shi et al., 2017). When the IP level is high, the influence of SN on the MSI at the social level may also be strengthened. Correspondingly, the higher the degree of IP there is, the greater the risk people will perceive, and concerns about the potential risk factors will increase people's MSI. Based on preceding reasons, we make the following hypotheses:

H10. *IP significantly and positively affects MSI.*

H11a. *IP positively moderates the impact of PN on MSI.*

H11b. *IP positively moderates the impact of SN on MSI.*

H11c. *IP positively moderates the impact of PR on MSI.*

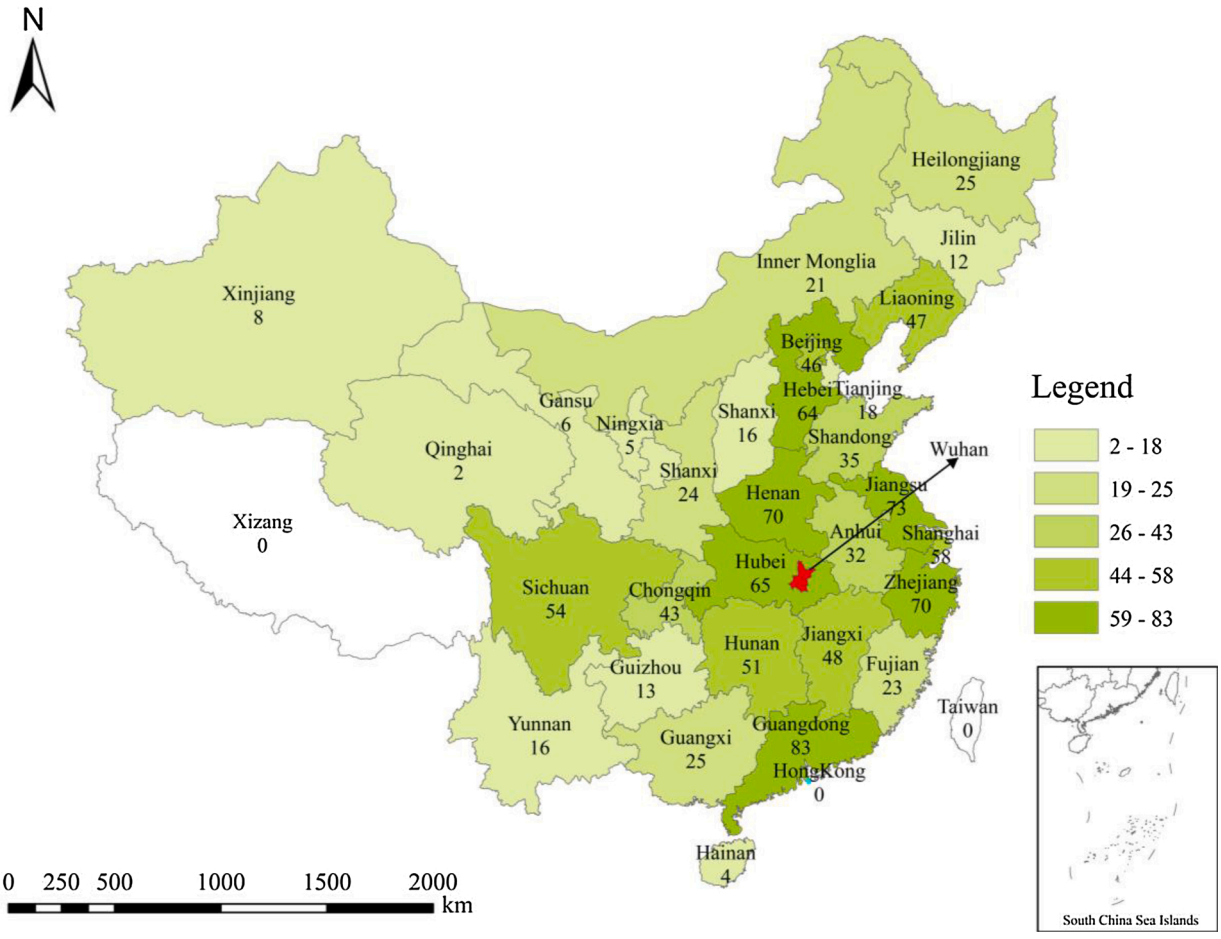

Fig. 2. Sample distribution.

In line with the preceding hypotheses, the comprehensive theoretical model of this study is shown in Fig. 1.

4. Methodology

4.1. Survey design

Considering the sensitivity and importance of COVID-19 research, the authors have reported this research to the school's ethics academic committee, conducted the research under the committee's supervision, and filed the final results for the record.

The first part of the questionnaire is a survey of socio-demographic characteristics and mask-saving behavior; the second part is the measurement items of the model's 11 latent variables. The measurement items were designed based on previous maturity scales and related research, combined with the practice of mask saving in China. To ensure that the questionnaire was easy to understand, two professors, two doctoral students, and five undergraduate students formed a focus group. Three online discussions were held, and the questionnaire items were appropriately adjusted. Then, to conduct the pre-test, 220 questionnaires were randomly distributed via a snowball sampling method. According to the test results and feedback from the interviewees, we deleted two questions that could easily be deemed to cause ambiguity. The descriptions of items were optimized again, and finally, 43 items were finally generated. Detailed survey items and reference sources are shown in Appendix A. Multi-level scales can provide respondents with more options, thereby increasing the credibility of the survey data (Finstad, 2010). Therefore, the variables in the questionnaire are measured using a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree).

4.2. Data collection and descriptive analysis

The data collection was done via the largest questionnaire survey website in China, Questionnaire Star (WJX, 2020b). Since 2006, more than 78.28 million users have collected 6.14 billion questionnaires. To ensure data quality, this study used the paid sample service of Questionnaire Star (WJX, 2020a). The database of the paid sample service contains 2.6 million random members with different demographic characteristics. On average, over one million respondents fill out the questionnaire every day. The paid sample service has a strict questionnaire screening mechanism, which ensures that the data are true and reliable. First, the sample service only issues questionnaires to people who meet the requirements. Secondly, after completing the questionnaire, the system eliminates invalid questionnaires based on the users' fill-in time, rules, and IP address. Finally, a customer service staff member conducts the final screening. As a result, those who have been screened and confirmed as having submitted valid questionnaires can be paid.

The questionnaire was completed from May 1st to 7th, 2020. Before completing the questionnaire, the interviewees were informed of its contents in advance. The purpose of this investigation is to understand relevant information after Wuhan was unblocked on April 8, that is, the mask-saving intentions and behaviors in the post-epidemic period. Ultimately, 1199 respondents answered the questionnaire; 142 invalid questionnaires were screened by the system (and manually), and 1057 valid questionnaires were obtained. Since all provinces in China have experienced the current epidemics (Ling, Joynt, Lipman, Constantin, &

Table 2
Socio-demographic statistics.

Characteristic	Demographic	Frequency	%
Gender	Male	491	46.5
	Female	566	53.5
Age (years)	Under 20	127	12.0
	21–30	527	49.9
	31–40	306	28.9
	41–50	73	6.9
	51 and above	24	2.3
Marital status	Married	509	48.2
	Unmarried	548	51.8
Place of residence	Rural area	149	14.1
	Town	363	34.3
	City	545	51.6
Occupation	Public servant	654	61.9
	Self-employed person	102	9.6
	Student	252	23.8
	Peasant	10	0.9
	Others	39	3.7
Education	Senior high school or below	111	10.5
	Junior college	166	15.7
	Bachelor's degree	700	66.2
	Master's degree or above	80	7.6
Annual income (RMB)	Less than 50,000	349	33.0
	50,001–100,000	384	36.3
	100,001–200,000	285	27.0
	More than 200,000	39	3.7

Joannes-Boyau, 2020), the survey was random and was not limited to a specific area. The specific sample distribution is shown in Fig. 2. Detailed socio-demographic statistics are presented in Table 2.

Figs. 3 and 4 show the main ways of saving masks and the number of times mask use is repeated in the post-epidemic period. In terms of the saving approach, 56.8 % of the respondents saved masks by reducing the number of times they go out; 24.4 % saved masks by disinfecting and sun-cure, and 14.5 % saved masks by distinguishing their wearing occasions and locations (i.e., reuse in low-risk places). With regard to the number of times the same mask is used, 61.5 % of the respondents said that their masks were reused two to three times; 23.9 % said that their masks were reused four to five times, and 7.6 % said that their masks were reused more than six times.

4.3. Research method

Partial least square structural equation modeling (PLS-SEM) and covariance based structural equation modeling (CB-SEM) are two typical and similar empirical analysis methods (Hair, Hollingsworth, Randolph, & Chong, 2017). Compared with CB-SEM, PLS-SEM does not require data to obey a normal distribution. Moreover, the latter is more suitable for predictive and exploratory research (Hair, Ringle, & Sarstedt, 2011), especially for a developmental theoretical framework. This study is an exploratory research that integrates two theories and four new variables. Besides, the filtered data may not conform to normal distribution. Thus,

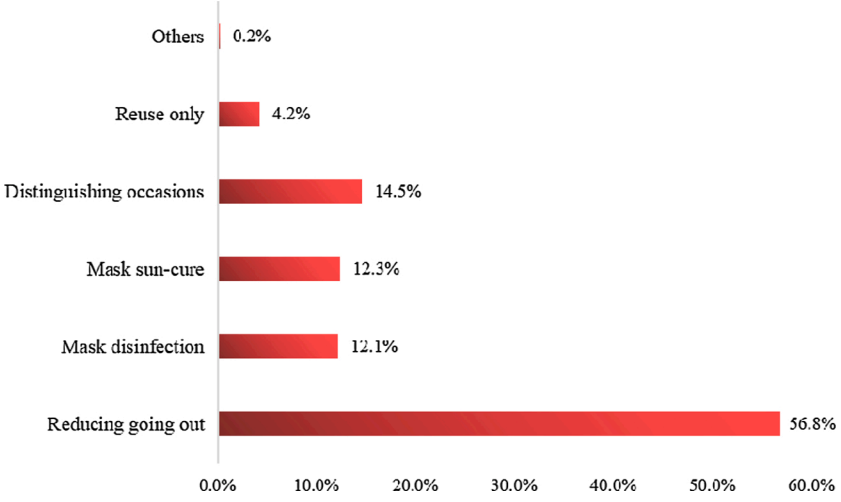

Fig. 3. People's mask-saving approach.

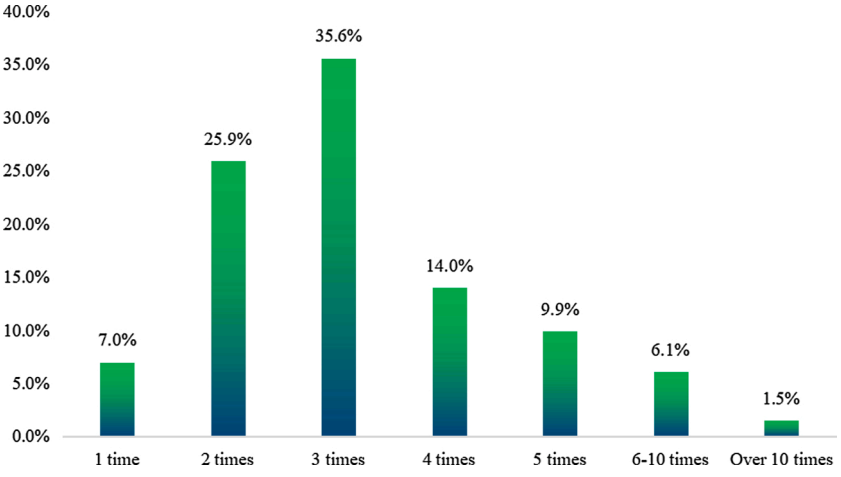

Fig. 4. People's repeated mask use frequency.

Table 3
Testing results of reliability and validity.

Construct	Cronbach's alpha	Composite reliability	AVE	Communality
AC	0.794	0.858	0.547	0.547
AR	0.819	0.874	0.581	0.581
PN	0.714	0.837	0.632	0.632
SN	0.861	0.906	0.707	0.707
ATT	0.895	0.927	0.760	0.760
PBC	0.798	0.881	0.713	0.713
EC	0.775	0.856	0.597	0.597
SCP	0.764	0.863	0.677	0.677
PR	0.763	0.861	0.674	0.674
IP	0.728	0.846	0.647	0.647
MSI	0.835	0.890	0.668	0.668

the PLS-SEM method is applied for empirical analysis.

5. Empirical analysis and results

5.1. Measurement model testing

Cronbach's alpha and composite reliability are typically employed for reliability testing. As shown in Table 3, the Cronbach's alpha values of all constructs are between 0.714 and 0.895, which are all higher than the 0.7 standard (Hair, Hult, Ringle, & Sarstedt, 2016). The composite reliability values of all constructs range from 0.846 to 0.927, which are also higher than the 0.7 standard (Hair et al., 2016). Consequently, the measurement model has good internal consistency and reliability.

The validity test of the measurement model mainly includes convergence validity, discriminative validity and construct validity.

Table 4
Square root of AVE and correlation coefficients.

Construct	AC	AR	PN	SN	ATT	PBC	EC	SCP	PR	IP	MSI
AC	**0.740**										
AR	0.619	**0.762**									
PN	0.523	0.667	**0.795**								
SN	0.547	0.571	0.509	**0.841**							
ATT	0.631	0.508	0.489	0.628	**0.872**						
PBC	0.521	0.399	0.360	0.480	0.482	**0.844**					
EC	0.382	0.325	0.220	0.252	0.232	0.276	**0.773**				
SCP	0.227	0.272	0.309	0.225	0.181	0.228	0.219	**0.823**			
PR	0.244	0.204	0.176	0.154	0.148	0.154	0.341	0.102	**0.821**		
IP	0.572	0.609	0.602	0.510	0.486	0.410	0.389	0.302	0.233	**0.804**	
MSI	0.635	0.627	0.555	0.563	0.525	0.486	0.458	0.297	0.303	0.663	**0.817**

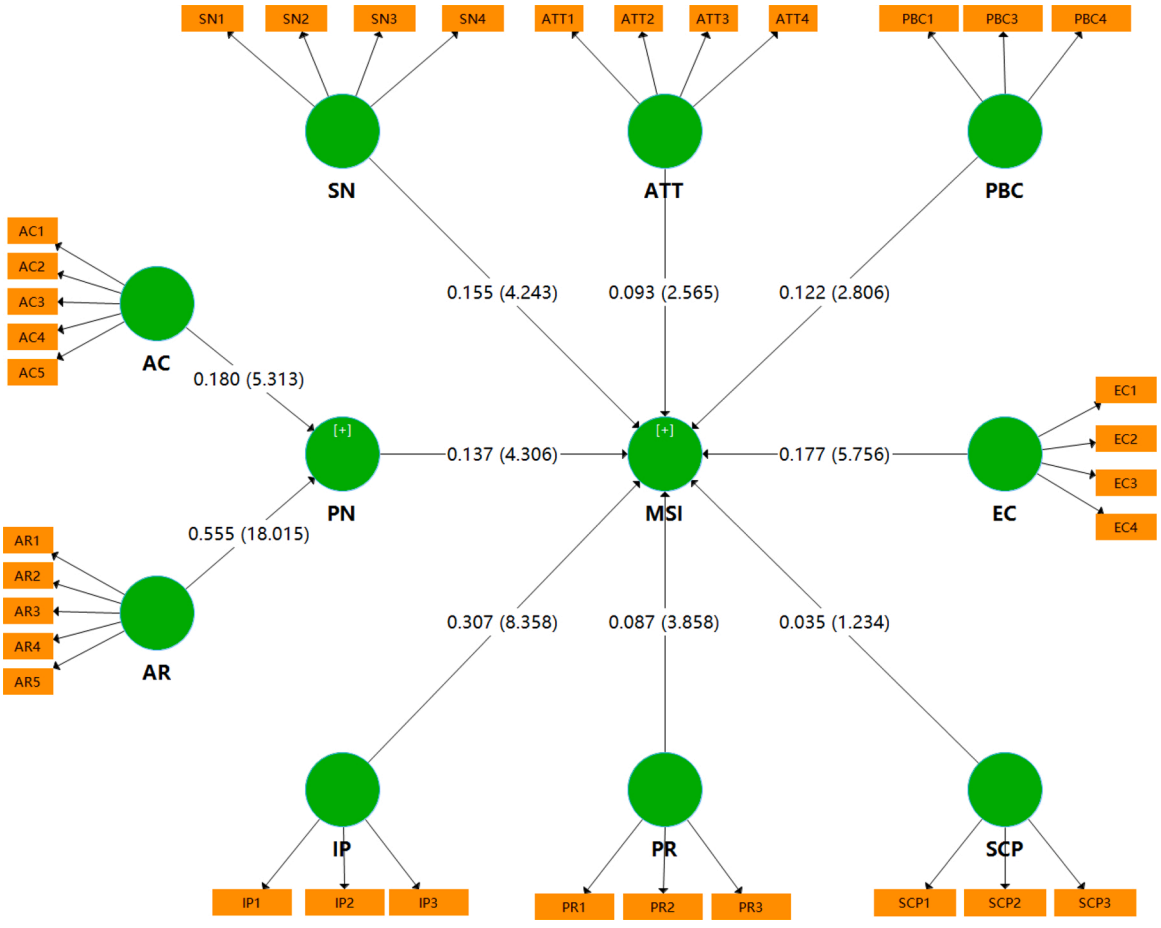

Fig. 5. Running results by Smart PLS 3.0.

Table 5
T-value, outer loading (bold font) and cross-loading.

	T-value	AC	AR	PN	SN	ATT	PBC	EC	SCP	PR	IP	MSI
AC1	33.032	**0.731**	0.405	0.367	0.394	0.516	0.411	0.364	0.140	0.222	0.374	0.478
AC2	32.414	**0.707**	0.438	0.346	0.379	0.466	0.360	0.314	0.145	0.206	0.406	0.442
AC3	25.396	**0.707**	0.377	0.329	0.376	0.440	0.405	0.338	0.195	0.261	0.368	0.458
AC4	45.814	**0.781**	0.505	0.413	0.448	0.476	0.383	0.207	0.147	0.114	0.453	0.494
AC5	46.889	**0.769**	0.536	0.458	0.419	0.446	0.378	0.226	0.210	0.134	0.494	0.478
AR1	42.432	0.614	**0.735**	0.530	0.540	0.544	0.427	0.318	0.176	0.214	0.529	0.621
AR2	48.792	0.559	**0.758**	0.529	0.513	0.484	0.366	0.337	0.220	0.165	0.541	0.597
AR3	60.391	0.420	**0.804**	0.506	0.425	0.348	0.272	0.162	0.224	0.120	0.445	0.411
AR4	49.877	0.395	**0.778**	0.480	0.355	0.284	0.235	0.234	0.197	0.162	0.389	0.386
AR5	41.582	0.350	**0.734**	0.490	0.324	0.253	0.204	0.175	0.219	0.112	0.403	0.349
PN1	66.133	0.536	0.576	**0.812**	0.476	0.497	0.377	0.259	0.245	0.193	0.545	0.556
PN2	43.769	0.343	0.501	**0.796**	0.380	0.337	0.211	0.135	0.226	0.107	0.440	0.374
PN3	40.959	0.331	0.501	**0.776**	0.335	0.297	0.243	0.103	0.267	0.104	0.430	0.357
SN1	50.452	0.409	0.420	0.404	**0.784**	0.461	0.343	0.177	0.248	0.158	0.373	0.421
SN2	80.927	0.497	0.490	0.394	**0.853**	0.558	0.446	0.260	0.153	0.145	0.443	0.503
SN3	83.891	0.475	0.515	0.463	**0.863**	0.545	0.414	0.198	0.181	0.104	0.457	0.485
SN4	84.511	0.452	0.488	0.452	**0.860**	0.539	0.405	0.210	0.186	0.115	0.435	0.481
ATT1	65.150	0.519	0.392	0.383	0.554	**0.865**	0.441	0.208	0.147	0.125	0.366	0.443
ATT2	95.864	0.530	0.442	0.398	0.557	**0.881**	0.426	0.187	0.154	0.127	0.416	0.451
ATT3	114.672	0.565	0.464	0.455	0.550	**0.886**	0.414	0.200	0.155	0.115	0.456	0.477
ATT4	82.341	0.586	0.473	0.466	0.528	**0.855**	0.400	0.214	0.175	0.151	0.455	0.459
PBC1	51.523	0.450	0.361	0.333	0.420	0.430	**0.830**	0.218	0.188	0.116	0.355	0.417
PBC3	51.831	0.434	0.319	0.272	0.377	0.395	**0.835**	0.251	0.169	0.140	0.316	0.392
PBC4	78.636	0.435	0.329	0.306	0.418	0.394	**0.867**	0.231	0.218	0.136	0.365	0.421
EC1	36.857	0.332	0.253	0.204	0.214	0.225	0.259	**0.766**	0.150	0.313	0.324	0.363
EC2	55.898	0.325	0.267	0.173	0.230	0.204	0.232	**0.819**	0.209	0.299	0.323	0.383
EC3	34.980	0.251	0.229	0.133	0.151	0.129	0.170	**0.749**	0.124	0.212	0.281	0.341
EC4	34.358	0.266	0.256	0.169	0.179	0.152	0.187	**0.755**	0.193	0.223	0.269	0.327
SCP1	41.995	0.184	0.194	0.226	0.157	0.141	0.181	0.165	**0.821**	0.064	0.214	0.219
SCP2	40.134	0.167	0.236	0.266	0.177	0.126	0.145	0.145	**0.822**	0.052	0.265	0.224
SCP3	36.639	0.204	0.237	0.266	0.214	0.173	0.227	0.220	**0.825**	0.126	0.262	0.281
PR1	25.887	0.153	0.141	0.136	0.106	0.098	0.086	0.233	0.037	**0.772**	0.127	0.181
PR2	40.875	0.214	0.170	0.157	0.125	0.126	0.132	0.282	0.105	**0.844**	0.190	0.268
PR3	45.382	0.222	0.185	0.141	0.143	0.135	0.150	0.314	0.095	**0.845**	0.239	0.279
IP1	67.395	0.486	0.503	0.510	0.429	0.445	0.345	0.331	0.257	0.195	**0.836**	0.557
IP2	64.217	0.472	0.485	0.471	0.419	0.393	0.356	0.389	0.259	0.223	**0.821**	0.567
IP3	38.577	0.419	0.485	0.474	0.380	0.329	0.283	0.202	0.208	0.138	**0.754**	0.469
MSI1	59.201	0.555	0.491	0.447	0.474	0.486	0.441	0.422	0.232	0.255	0.541	**0.823**
MSI2	75.006	0.554	0.529	0.447	0.469	0.471	0.400	0.379	0.237	0.294	0.569	**0.835**
MSI3	55.136	0.478	0.515	0.455	0.450	0.362	0.392	0.342	0.280	0.213	0.512	**0.800**
MSI4	52.322	0.486	0.515	0.467	0.448	0.390	0.355	0.351	0.225	0.227	0.544	**0.812**

Convergent validity is tested by the average variance extracted (AVE), which is equivalent to the communality (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014). The discriminative validity is tested by comparing the square root of the AVE value with the correlation coefficients between other variables. According to Fornell and Larcker (1981), the correlation coefficient between each pair of latent variables should not be greater than the square root of the AVE value of the latent variable. As shown in Table 3, the AVE and communality values of all constructs range from 0.547 to 0.760, which are clearly all higher than 0.5 (Hair et al., 2011). As presented in Table 4. The correlation coefficients between constructs are all smaller than the square root of AVE (bold font). These results confirm that the measurement model has good convergence and discriminative validity.

Construct validity is tested by outer factor loading and T-value. As shown in Fig. 5, after excluding those observed variables with an outer loading of less than 0.7 (i.e., PBC2 and PR4) (Hair, Sarstedt, Pieper, & Ringle, 2012), the outer loading of all items ranges from 0.707 to 0.886, which are all therefore greater than the cross-loading with other constructs. Moreover, the T-value for each item is over 25. These results indicate that the measurement model has good construct validity. (Table 5)

Furthermore, to test whether the model has multiple collinearity, the variance inflation factor (VIF) in each regression relationship is calculated. The VIF value of the measurement model is between 1.281 and 2.687, and the VIF value of the internal model is between 1.159 and 1.962. The VIF values of all constructs are between 1.151 and 2.687. All VIF values are lower than the critical value of 5 (Hair et al., 2011), indicating no collinearity exists between the model's latent variables of the model.

5.2. Structural model testing

The structural model is judged through R^2 and Q^2 (Hair et al., 2014). Here, R^2 means the explanation degree of the external dependent variable to the internal dependent variable, while Q^2 represents the predictive relevance of the structural model. A value of R^2 near 0.19 represents that the model has weak explanatory power, a value that is near 0.33 represents a medium explanatory power, and a value that is over 0.67 represents a strong explanatory power (Chin, 1998). Hair et al. (2012) argued that when R^2 exceeds 0.20, this represents a strong interpretation and prediction ability in consumer behavior research. As shown in Fig. 6, the R^2 of PN is 0.464, which means that AC and AR can explain 46.4 % of the variance of PN. The R^2 of MSI is 0.593, which means that all external dependent variables can explain 59.3 % of the variance of MSI. Therefore, the structural model of this study has strong explanatory power. Furthermore, the Q^2 indicator values are reported in Table 6. Both cross-validated communality and cross-validated redundancy values exceed the 0 standard proposed by Hair et al. (2014) and (2016), indicating that the structural model has good predictive power.

Employing 5000 resample bootstrap calculation of Smart PLS 3.0, the empirical results are shown in Table 7 and Fig. 5. Nine hypotheses are supported. Only H8 is not supported; that is, the positive impact of SCP on MSI is not significant.

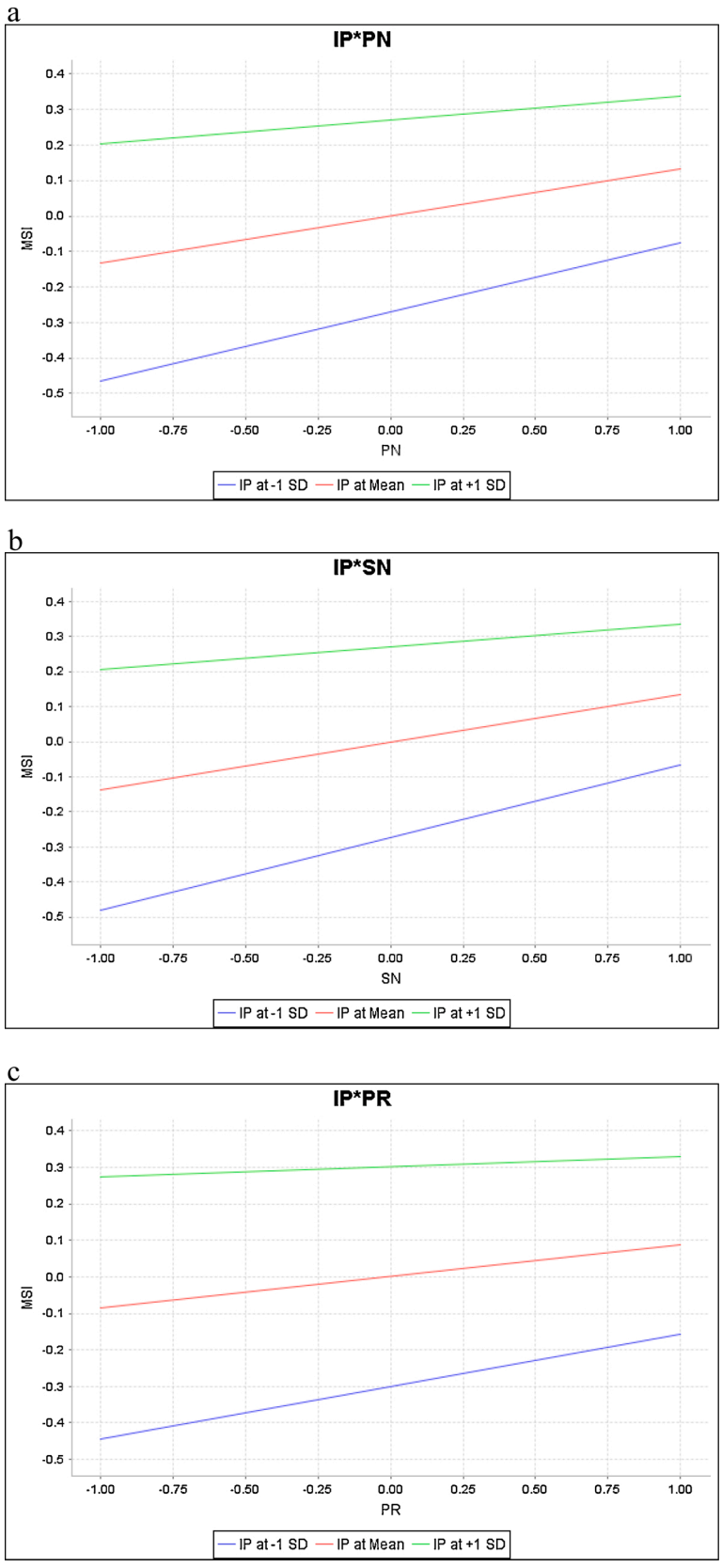

Fig. 6. a. Moderating effects of IP on the relationships between PN and MSI. b. Moderating effects of IP on the relationships between SN and MSI. c. Moderating effects of IP on the relationships between PR and MSI.

Table 6
Empirical results of the structural model.

Construct	R^2	Cross-validated communality	Cross-validated redundancy
AC		0.321	
AR		0.369	
PN	0.464	0.267	0.284
SN		0.503	
ATT		0.586	
PBC		0.413	
EC		0.329	
SCP		0.347	
PR		0.346	
IP		0.299	
MSI	0.593	0.441	0.389

5.3. Moderating effects of the IP

This research further examines the possible moderating effects of IP on the model. The testing results are shown in Table 8. Notably, IP has a significant negative impact on the relationship between PN and MSI ($\beta = -0.064$, $T = 2.793$, $P < 0.01$). Thus, H11a was negatively supported. Similarly, IP has a significant negative impact on the relationship between SN and MSI ($\beta = -0.071$, $T = 2.362$, $P < 0.05$) and on the relationship between PR and MSI ($\beta = -0.058$, $T = 2.545$, $P < 0.01$). Therefore, H11b and H11c are also negatively supported.

To present the moderating role of IP intuitively, according to Aiken and West (1991), a simple slope analysis is performed using SmartPLS 3.0. As shown in Fig. 6a, IP is divided into three levels, namely, high, medium, and low (i.e., IP at mean +1 standard deviation, IP at mean level, and IP at mean −1 standard deviation). When the IP level is high (green line), the influence of PN on MSI is less than when the IP level is low (blue line). In other words, an increase in the IP level weakens the impact of PN on MSI. Similarly, Fig. 6b and c, respectively, indicate that the influence of SN and PR on MSI also decreases in line with the increase of the IP level. Therefore, when the IP level is high, the positive effects of PN, SN and PR on MSI will be weakened.

6. Discussion

6.1. Research findings

In terms of the specific variables in NAM and TPB, AC and AR had a significant positive impact on PN, while PN was found to play a significant driving role on MSI. Also, SN, ATT and PBC were confirmed to have positive correlations with MSI. The above findings support the original assumptions of the NAM and TPB models (Ajzen, 1991; Schwartz, 1977), indicating that these two models can be used as a theoretical basis for forecasting the people's mask-saving intentions.

With regard to the extended variables, firstly, EC significantly positively affected MSI, which is consistent with previous studies (Liao, Zhao, & Zhang, 2018; Maichum et al., 2016). Saving masks not only improves the use efficiency of medical resources; this behavior but also reduces the amount of medical waste. Thus, people who pay more attention to the environment are more aware of the benefits of saving masks.

Secondly, PR had a significant positive effect on MSI. This finding is contrary to the results of Zhang et al. (2020), who investigated the influencing factors of smartphone recycling intentions. Unlike smartphone, however, masks are an indispensable form of protective equipment during the global pandemic (Wang et al., 2020), and one which is directly related to people's health and life. On the one hand, people worry that the COVID-19 pandemic will become severe and possibly even become out of control. On the other hand, limited productivity and resources may lead to an insufficient supply of masks.

Thirdly, SCP had no significant negative impact on MSI. In other words, when many Chinese enterprises returned to work and production, the supply of medical masks was sufficient, but people's MSI had not been significantly reduced. One possible explanation for this finding is that the COVID-19 outbreak has had an unprecedented impact on people's lives. The psychological panic and worry brought about by this impact will last for some time. The significant impact of PR on MSI also confirms this viewpoint. Additionally, according to the survey results pertaining to saving behavior (i.e., Figs. 3 and 4), people have formed the habit of reusing and saving masks in the past few months. Given that the epidemic in many countries around the world has not been effectively controlled, the Chinese people will probably not lose or change this saving habit in the short term. Therefore, the optimistic

Table 7
Verification of conventional hypotheses.

Hypothesis	Path	Standardized path coefficient	T-value	Confidence interval		Hypothesis supported
				2.5 %	97.5 %	
H1	AC —> PN	0.180***	5.313	0.114	0.237	Supported
H2	AR —> PN	0.555***	18.015	0.493	0.615	Supported
H3	PN —> MSI	0.137***	4.306	0.074	0.197	Supported
H4	SN —> MSI	0.155***	4.243	0.083	0.225	Supported
H5	ATT —> MSI	0.093**	2.565	0.023	0.166	Supported
H6	PBC —> MSI	0.122**	2.806	0.040	0.212	Supported
H7	EC —> MSI	0.177***	5.756	0.119	0.239	Supported
H8	SCP —> MSI	0.035	1.234	−0.019	0.095	Not supported
H9	PR —> MSI	0.087***	3.858	0.043	0.133	Supported
H10	IP —> MSI	0.307***	8.358	0.231	0.376	Supported

Annotation: *P < 0.05, **P < 0.01, ***P < 0.001.

Table 8
Verification of moderating hypotheses.

Hypothesis	Path	Standardized path coefficient	T-value	Confidence interval		Hypothesis supported
				2.5 %	97.5 %	
H11a	IP*PN —> MSI	−0.064**	2.793	−0.102	−0.016	Negatively supported
H11b	IP*SN —> MSI	−0.071*	2.362	−0.122	−0.006	Negatively supported
H11c	IP*PR —> MSI	−0.058*	2.545	−0.097	−0.010	Negatively supported

Annotation: *P < 0.05, **P < 0.01, ***P < 0.001.

performance of the mask market and supply chain has not significantly affected people's MSI.

Lastly, IP has had a significant positive impact on MSI; this conclusion supports the research finding of Bernstad (2014). Meanwhile, IP played a negative moderating role in the impact of PN, SN and PR on MSI. In other words, when the degree of IP related to mask saving was excessively high, the effects of PN, SN, and PR on MSI may have been weakened. This unexpected finding was contrary to the conclusion of Song et al. (2019), which emphasized that policy and propaganda positively moderate the impact of PN on energy-saving appliance purchase behavior. One possible reason for this result may be that excessive information propaganda may exaggerate the threat of the epidemic and aggravate people's panic. The emergence of panic emotion prompts individuals to take more measures to achieve self-protection, which in turn leads to higher mask usage frequency and consumption. To some extent, excessive information propaganda appears to weaken the influence of personal moral obligation and value norms on people's saving intentions. Similarly, the generation of panic affects individuals' subjective evaluation of the COVID-19 risk; thus, the impact of risk perception on saving intentions is also weakened.

6.2. Contributions, limitations and future directions

After the outbreak of COVID-19, many studies have discussed measures to control COVID-19 from different perspectives (Leng, Wang, & Liu, 2020; Megahed & Ghoneim, 2020; Rahman et al., 2020; Sun & Zhai, 2020). Taking medical masks as an example, the present study investigates people's intentions to save medical resources for the first time, effectively opening the black box of people's saving behavior and complex psychology after the COVID-19 pandemic. This study reveals the critical factors that drive people's MSI, and the conclusions and implications can help the government formulate specific policies to guide residents' mask-saving behavior. At the theoretical level, this study extends the application boundary of NAM and TPB, and proposes a new integrated theoretical model with strong explanatory power. As such, this research lays an important foundation for future research on other medical resource-saving behavior.

It should be acknowledged that this research has some limitations that could be improved. First, this study mainly examines Chinese residents' MSI; the conclusions and implications could provide insights to guide the saving behavior for groups in low-risk area or those with non-occupational exposure. Given the differences in the epidemic situation and cultural beliefs of different countries, the applicability of the present study toward other group types needs to be further explored. In follow-up research, the situation in high-risk areas or developed countries can be revealed, in order to perform a comparative study. Second, this study only investigates the antecedent variables of intention, but behavior is not investigated. Since there is a certain gap between intention and behavior (Hassan, Shiu, & Shaw, 2016), future research could attempt to reveal the behavior toward mask saving or the saving of other medical resources.

7. Conclusion and implications

In light of the severe situation of the current global epidemic, saving medical resources and reducing medical pollution are crucial. Combined with practice, EC, MS, PR, and IP are extended to the comprehensive theoretical model composed of NAM and TPB. The present study examines the driving factors of the people's mask-saving intentions in the post-epidemic phase, through a survey of 1057 respondents in China. The results reveal that AC and AR are important antecedents of PN; PN, SN, ATT, PBC, EC, PR, and IP also have significant positive correlations with MSI. Among them, IP has the greatest impact on MSI, followed by EC, SN, PN, and PBC. One unexpected finding is that SCP has no significant effect on MSI. Moreover, excessive IP may weaken the relationships between PN, SN, PR, and MSI. Finally, based on these

Table A1
Survey items and reference sources.

Construct	Items	References
Awareness of consequences	Saving masks can reduce resource consumption. Saving masks can reduce environment pollution. Saving masks can save money. Saving masks is conducive to epidemic prevention and control in China. Saving masks is conducive to epidemic prevention and control in the whole world.	Zhang et al. (2017) and Song et al. (2019)
Ascription of responsibility	I think I have a duty to save masks. I think it is everyone's responsibility to save masks. Everyone should be held responsible for resource consumption caused by not saving masks. Everyone should be held responsible for environmental pollution caused by not saving masks. Everyone should be held responsible for the spread of COVID-19 caused by not saving masks.	Zhang et al. (2017)
Personal norms	I would feel proud of saving masks. I would feel guilty about not saving masks. Not saving masks is against my principles of environmental protection.	Schwartz (1977) and Kim and Seock (2019)
Subjective norms	Most people who are important to me are in favor of me saving masks. Most people who are important to me will save masks. Most of the people who are important to me expect that I can save masks. Most of the people who are important to me encourage me to save masks.	Paul, Modi, and Patel (2016) and Si et al. (2020)
Attitude	I think saving masks is brilliant. I think saving masks is very intelligent. I think saving masks is very meaningful. I think saving masks is very responsible. As for me, saving masks is effortless.	Shi et al. (2017) And Verma and Chandra (2018)
Perceived behavioral control	Whether to save masks depends entirely on me. I can easily save masks as long as I want. I have relevant resources, time, and opportunity to save masks.	Wang, Guo et al. (2018) and Si et al. (2020)
Environment concern	I think environmental issues are related to the survival of human beings. I think everyone should contribute to environmental protection. Human beings must live in harmony with nature in order to survive.	Rajaie, Hosseini, and Malekmohammadi (2018), Wang, Wang, and Guo (2017)

(*continued on next page*)

Table A1 (*continued*)

Construct	Items	References
Supply chain performance	I think everyone is responsible to protect the environment. The current market supply of medical masks is stable. The current supply of raw materials for medical masks is stable. The current purchasing channels of medical masks have returned to normal.	Dissanayake and Cross (2018) and Bag, Wood, Xu, Dhamija, and Kayikci (2020)
Perceived risk	Sometimes, I worry about the comeback of COVID-19. Sometimes, I fear the global epidemic will spiral out of control. Sometimes, I fear there will be more asymptomatic infections cases. Sometimes, I worry about a shortage of masks in the future.	Zhang et al. (2020) and Bonnin (2020)
Information publicity	I think the relevant information publicized about saving masks is important. Information publicized about frugalness will motivate me to save masks. Information publicized about COVID-19 will motivate me to save masks.	Song et al. (2019), Wang, Wang et al. (2019) and Wang, Guo et al. (2018)
Mask-saving intention	I would like to save masks. I will make an effort to save masks. I will insist on saving masks. I will try my best to save masks.	Liu et al. (2020) and Ru et al. (2018)

research findings, the specific management implications and policy recommendations are proposed as follows, to promote residents' mask-saving intentions and behaviors.

Given that IP is the key driver of MSI, information disclosure and publicity in the post-epidemic period should be appropriately strengthened. Propaganda content makes the public more willing to save masks and also tells the public how to do so. Regarding the publicity approach, new social media could be fully utilized to expand the publicity scope. Nevertheless, excessive IP will weaken the promotion effect of PN, SN, and PR on MSI. Hence, the publicity for COVID-19 should be effective and appropriate, in order to avoid any unnecessary panic caused by excessive publicity. Moreover, AC and AR are important antecedents of PN, and PN and EC can considerably enhance MSI. Therefore, in future guidance measures, environmental issues can be taken as the breakthrough point; PN and MSI can also be improved by shaping the public's awareness of consequences and moral responsibility. Specifically, typical cases of medical waste threatening the environment can be made into short videos, which can be broadcast on TV and social media. Knowledge contests, essay seeking activities, and theme education on environmental protection can also be held. These are effective ways to appeal to the public to pay attention to the environment and to advocate the reduction of medical waste.

Considering the significant influence of ATT and SN on MSI, the government should pay full attention to the leading role of external social norms on individual behaviors and attitudes. Especially in the era of mobile internet, the role of online opinion leaders should be developed. Those leaders could effectively to appeal to their followers to save medical resources. Moreover, PBC has a significant positive impact on MSI. The initiative to save masks and the introduction of saving approaches can be printed on the outer packaging of masks or the garbage bins used to collect used masks. While popularizing conservation knowledge, the public should realize that saving masks is easy. The impact of PR on MSI is significant. In other words, the greater the risk people feel about the current or future epidemic, the stronger their MSI will be. Therefore, the actual situation of the epidemic and the shortage of medical resources in various countries around the world should also be promptly reported and made public. In this way, the public can be aware of the risks at the earliest possible stage and realize the importance of saving existing medical resources.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A

Table A1

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